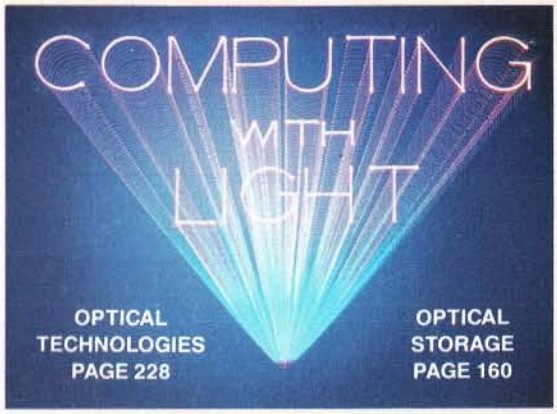
SETTING THE STANDARDS
15 YEARS

Special International-Only Editorial Section FOLLOWS PAGE 80

BYTE

OCTOBER 1989 A McGRAW-HILL PUBLICATION

Special Reports:



Apple's new portable

MAC *to go*

- Quattro 2
- Bill Gates on BASIC
- Parallel Processing with Macs
- Understanding Disk Caching
- Inside AppleTalk and NetBIOS
- 6 Short Takes

REVIEWS

- New IBM and Mitac SX Systems
- ColorQuick Mac Printer
- Two Portable Printers
- Logitech's MultiScope Debugger
- A new X Window System

£1.95 U.K./A $6.50 AUSTRALIA
Lit. 8,000 ITALY/$3.50 U.S.A.
0360-5280

THE DELL SYSTEM® 310
20 MHz 386.

The best combination of performance and value available in its class.

STANDARD FEATURES:

- Intel 80386 microprocessor running at 20 MHz.
- Choice of 1 MB, 2 MB, or 4 MB of RAM* expandable to 16 MB (using a dedicated high-speed 32-bit memory slot).
- Advanced Intel 82385 Cache Memory Controller with 32 KB of high speed static RAM cache.
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- Socket for 20 MHz Intel 80387 or 20 MHz WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard drive controller.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots (6 available).

***Lease for as low as $131/month.*
△ Extended Service Plan pricing starts at $251.

40 MB TTL Monochrome System	$3,599
40 MB VGA Color Plus System	$4,099
100 MB VGA Color Plus System	$4,699
100 MB Super VGA Color System (800x600)	$4,799

Prices listed reflect 1 MB of RAM. 150 and 322 MB hard drive configurations also available.

Performance Enhancements (Systems 325, 310, 316 and 220): within the first megabyte of memory, 384 KB of memory is reserved for use by the system to enhance performance. 4 MB configurations available on all systems. Call for pricing.

THE DELL SYSTEM® 316
16 MHz 386SX.™

Expandable, affordable access to 386 architecture.

STANDARD FEATURES:

- Intel 80386SX microprocessor running at 16 MHz.
- Choice of 1 MB, 2 MB, or 4 MB of RAM* expandable to 16 MB (8 MB on the system board).
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- LIM 4.0 support for memory over 1 MB.
- Socket for 16 MHz Intel 80387SX math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Integrated high performance hard disk drive interface and diskette controller on system board. (ESDI based systems include a hard disk controller.)
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots (7 available).

***Lease for as low as $98/month.*
△ Extended Service Plan pricing starts at $234.

40 MB TTL Monochrome System	$2,699
40 MB VGA Color Plus System	$3,199
100 MB VGA Color Plus System	$3,799
100 MB Super VGA Color System (800x600)	$3,899

Prices listed reflect 1 MB of RAM. 150 and 322 MB hard drive configurations also available.

THE DELL SYSTEM® 220
20 MHz 286.

It's faster than many 386 computers, and has a smaller footprint.

STANDARD FEATURES:

- 80286 microprocessor running at 20 MHz.
- Choice of 1 MB, 2 MB, or 4 MB of RAM* expandable to 16 MB (8 MB on system board).
- Page mode interleaved memory architecture.
- LIM 4.0 support for memory over 1 MB.
- Integrated diskette and VGA video controller on system board.
- Socket for Intel 80287 math coprocessor.
- One 3.5" 1.44 MB diskette drive.
- Integrated high performance hard disk interface on system board.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports (integrated on system board).
- 3 full-sized 16-bit AT expansion slots available.

***Lease for as low as $109/month.*
△ Extended Service Plan pricing starts at $264.

40 MB VGA Monochrome System	$2,999
40 MB VGA Color Plus System	$3,299
100 MB VGA Monochrome System	$3,599
100 MB VGA Color Plus System	$3,899

Prices listed reflect 1 MB of RAM. External 5.25" 1.2 MB diskette drive available.

THE NEW DELL SYSTEM® 210
12.5 MHz 286.

The price says this is an entry-level system. The performance says it's a lot more.

STANDARD FEATURES:

- Intel 80286 microprocessor running at 12.5 MHz.
- Choice of 512 KB, 640 KB††, 1 MB, or 2 MB of RAM expandable to 16 MB (6 MB on system board).
- Page mode interleaved memory architecture.
- LIM 4.0 support for memory over 1 MB.
- Integrated diskette and high performance 16-bit VGA video controller on system board.
- Socket for Intel 80287 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Integrated high performance hard disk interface on system board.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 3 full-sized 16-bit AT expansion slots available.

***Lease for as low as $64/month.*
△ Extended Service Plan pricing starts at $190.

20 MB VGA Monochrome System	$1,699
20 MB VGA Color Plus System	$1,999
40 MB VGA Monochrome System	$1,899
40 MB VGA Color Plus System	$2,199

Prices listed reflect 512 KB of RAM.
††640 KB versions of the above systems are available for an additional $80.
100 MB hard drive configurations also available.

All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typography or photography. **Payments based on a 36-month open-end lease. †Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices will vary. DELL SYSTEM is a registered trademark of Dell Computer Corporation. Microsoft, MS, MS-DOS and XENIX are registered trademarks owned by Microsoft Corp. Intel is a registered trademark; 386 and 386SX are trademarks of Intel Corporation. UNIX is a registered trademark of AT&T. Dell UNIX System V is based on INTERACTIVE Systems Corporation's 386/ix.™ *Signifies trademarks of entities other than Dell Computer Corporation. △Service provided by Xerox Corporation. Service in remote locations will incur additional travel charges. ©1989 Dell Computer Corporation. All rights reserved.

THE DELL SYSTEM® 325 25 MHz 386.

When you need a truly high-performance 386 computer, this is it.

STANDARD FEATURES:

- Intel 80386 microprocessor running at 25 MHz.
- Choice of 1 MB, 2 MB, or 4 MB of RAM* expandable to 16 MB (using a dedicated high-speed 32-bit memory slot).
- Advanced Intel 82385 Cache Memory Controller with 32 KB of high speed static RAM cache.
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- Socket for 25 MHz Intel 80387 or 25 MHz WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard drive controller.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots (6 available).

***Lease for as low as $196/month.*
△ Extended Service Plan pricing starts at $370.

40 MB VGA Monochrome System	$5,399
100 MB VGA Color Plus System	$6,299
100 MB Super VGA Color System (800x600)	$6,399
150 MB Super VGA Color System (800x600)	$6,899

Prices listed reflect 1 MB of RAM. 322 MB hard drive configurations also available.

All systems are photographed with optional extras.

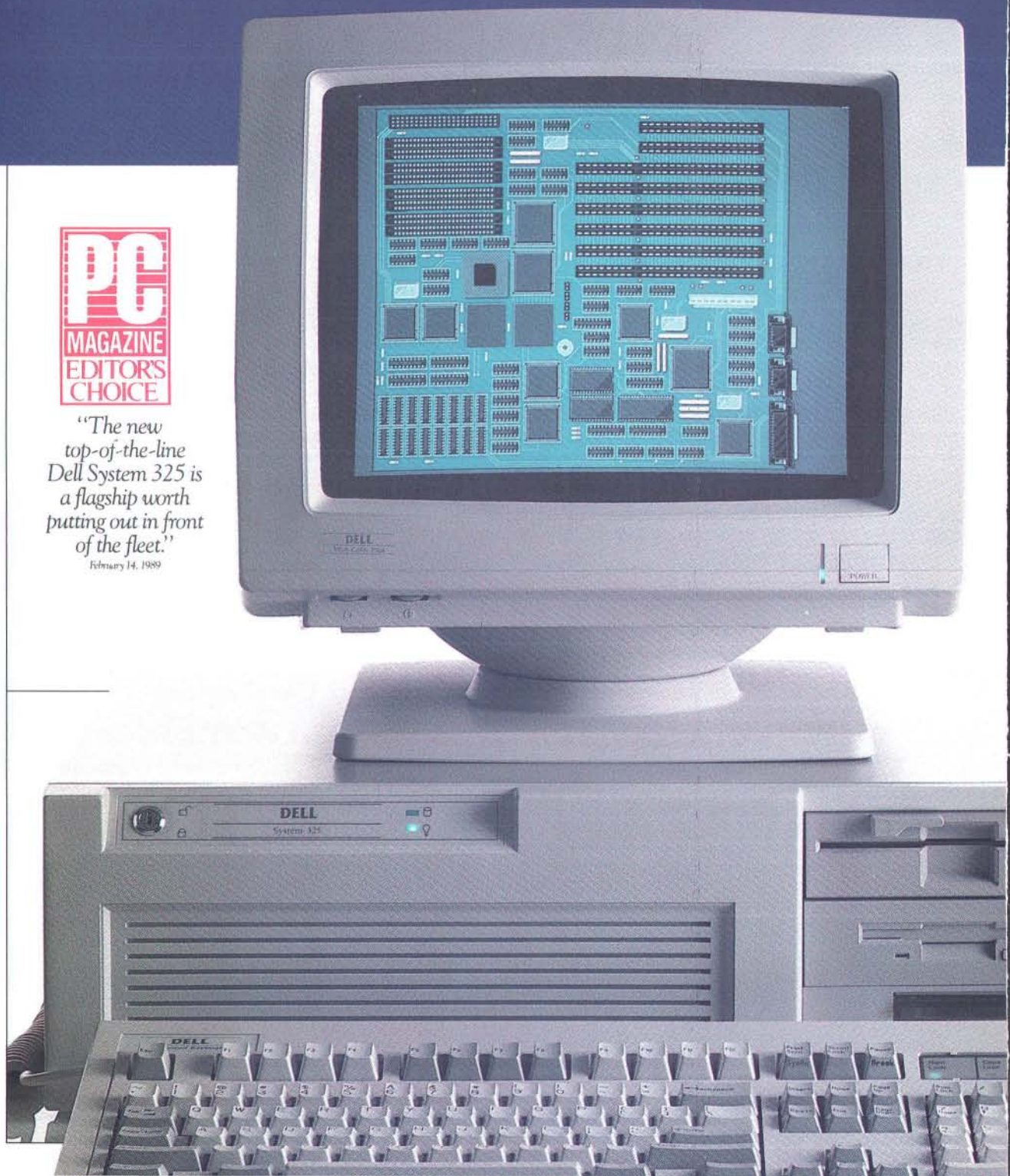
AD CODE NO. 11EK9

SO HOW COME YOU NEVER CALL?

PC MAGAZINE EDITOR'S CHOICE

"The new top-of-the-line Dell System 325 is a flagship worth putting out in front of the fleet."

February 14, 1989



THE DELL 386 SYSTEM 325 HAS A 25 MHz CLOCK RATE, CACHE MEMORY CONTROLLER, IDE OR ESDI HARD DISK DRIVE, PAGE MODE INTERLEAVED MEMORY, AND 100% COMPATIBILITY WITH MS-DOS, OS/2 AND UNIX SYSTEM V.

Technically speaking, the Dell System® 325 is one of the most advanced 386™ computers available. And, according to PC Magazine, it's one of the most advanced 386 computers they've ever tested.

In benchmark after benchmark, the 25 MHz Dell System 325 ran circles around a field of 386-based systems. A field that included the Compaq^ 386/25.

A show of prowess that earned the System 325 PC Magazine's Editor's Choice award.

It was a goal we set for ourselves from the very beginning. And an objective anyone with a penchant for power and performance can appreciate.

THE FIRST PERSONAL COMPUTER THAT'S REALLY PERSONAL.

Of the more than 150,000 personal computers we've sold to date, each one has been individually configured to fit the needs of its owner.

The System 325 takes that idea to its logical extreme.

For example, it runs either MS-DOS,® MS®OS/2, or our own Dell UNIX® System V. Which is compatible with AT&T's System V Interface Definition. And the world of XENIX® applications.

If speed is of the essence, we can include an optional Intel® 80387 or WEITEK 3167 math coprocessor. And since nothing about this system is lightweight, the standard mass storage is a 100 MB hard disk drive. Or we can configure it with a 40, 150 or 322 MB hard drive.

As you might expect, the output is just as intense. You can choose between VGA Monochrome with

paper-white screen, VGA Color Plus, or Super VGA for high resolution colors displayed on a larger screen.

Even though the 325 gives you all this performance, it still leaves you six open slots for whatever else you might want to add.

And once you've told us what you want, we'll make sure what you want works—by burning-in the entire system unit.

COMPUTER RETAILERS ARE NO KNOWS.

There are some good reasons computer retailers won't know much about the System 325.

First, with all the new and increasingly sophisticated systems they have to keep up with on a daily basis, you can hardly expect them to know everything.

Second, because Dell sells direct.

Which means you now have the unique opportunity to talk directly with the people who make them. And ask things like, "What is page mode interleaved memory?" or, "How much SIMM RAM should I add?"

In other words, the kinds of details that are important to people who make computers and people who use them.

So dealing direct not only can save you up to the 35% mark-up, but 100% of the frustration.

WE COME WHEN WE'RE CALLED.

One of the things that very clearly sets Dell systems apart from other computers is not just how they're sold but how they're supported.

Overkill was one description used in a recent PC Week article.

Perhaps.

But then, we think you'll agree, when something goes wrong, you want as much help as possible, right?

BEST OF ALL, YOU WON'T HAVE TO EXPLAIN TO A COMPUTER RETAILER WHAT ALL THAT MEANS.

Which is why every Dell system comes with a toll-free technical support line and self-diagnostic software. We're able to solve 90% of all problems right over the phone. The other 10% receive next-day, deskside service. Thanks to our new alliance with Xerox Corporation.

And you get all this help for a full year—whenever you need it—at no extra charge.△

As you've probably guessed, one of the things that drives us most is customer satisfaction.

So we'd like to give you the ultimate guarantee:

Try a System 325 in your office for a month. Run your toughest applications. Put it through its paces, at your pace. If you're not completely satisfied, send it back anytime within 30 days. And we'll refund your money.

No questions asked.

MAYBE YOU SHOULDN'T BUY ONE AFTER ALL.

No matter how many reasons we give you to buy a Dell system, sometimes it makes more sense to lease one instead.

Whether you need a single computer, or an entire office full, there is a leasing plan for your business that is just like 100% financing.

And just as we can custom configure your computers, we can see to it you get a custom designed lease plan to fit your exact business needs.† A fact that has not gone unnoticed. Especially by the Fortune 500. Over half of whom now own or lease Dell systems.

And just as we welcome their business, we welcome your business, too.

Just call us, toll-free. And don't be afraid to ask us the tough questions.

That's the part we like best.

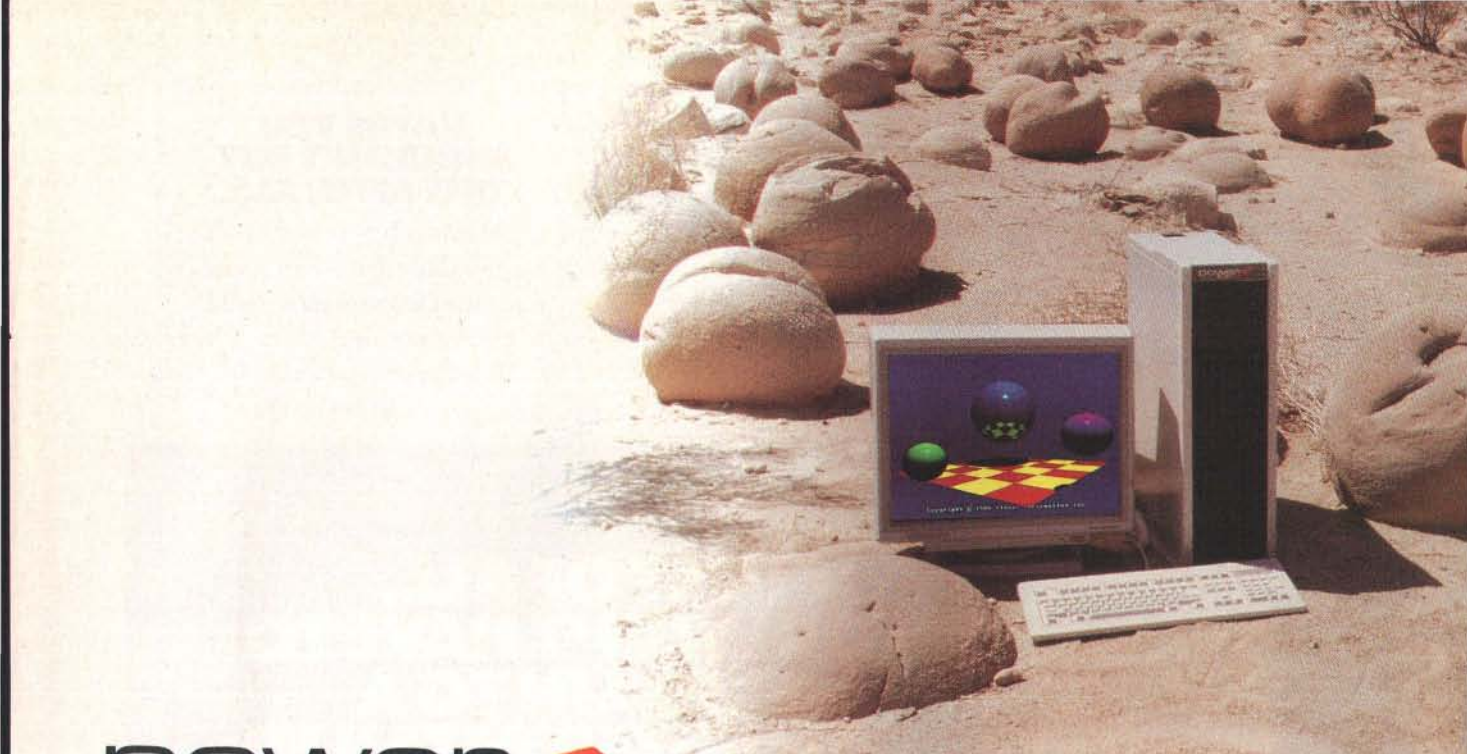
DELL COMPUTER CORPORATION

TO ORDER, CALL

800-426-5150

IN CANADA, CALL 800-387-5752
IN GERMANY, CALL 06103/701100
IN THE U.K., CALL 0800 414535

Circle 80 on Reader Service Card



power Cache 4 ...The most advanced
What else would you expect

PC MAGAZINE, *January 1989,*
"In a field of powerhouse machines there can only be one winner, and ALR's FlexCache is it."

INFO WORLD, *July 1989,*
"ALR Systems Unleash 486 Power. The PowerCache 4 shines in the CPU-specific portion of the InfoWorld Automated Benchmark Test, gaining a score of 16.3."

PC WEEK, *July 1989,*
"Based on a series of benchmarks run last week on Advanced Logic Research, Inc.'s prototype 486 desktop system, ALR will enter the 486 market with a bang."

At ALR, we will never rest on our laurels. We strive to be the best, as proven by our past achievements. Now with the introduction of the new ALR PowerCache 4™, we've designed a system that is far beyond comparison. Again, we have taken PC-microprocessing power a step further by designing a unique proprietary PowerCache 4 cache controller using ALR's custom ASIC chips which deliver the fastest processing speed ever.

More important, PowerCache 4 is the first PC to fully utilize 128-bit burst mode and a "read and write-back" 128KB cache design, providing a better than zero wait state performance as compared to the i386. Furthermore, the ALR PowerCache 4 is 100% IBM® PS/2™ Micro Channel™-compatible supporting bus mastering devices and giving

	ALR M130 Desktop	ALR M150, M350 M650 Floor-Standing	IBM M70-A21 Power Platform™
CPU	25 MHz i486	25 MHz i486	25 MHz i486
Bus	MCA	MCA	MCA
External Cache	128 KB cache Read and Write-Back	128 KB cache Read and Write-Back	None
Video Opt. on board	640x480 1024x768	640x480 1024x768	640x480 None
I/O Slots	6 expansion slots	6 expansion slots	3 expansion slots
Storage Expansion	4-3 1/2"	1-full height 2-1/2"-height 2-3 1/2" drives	3-3 1/2" drives
Disk Capacity	130 MB-260 MB	150 MB-650 MB	110 MB
Price	$9,990	Starting at $11,490	$12,990

California Anza-Borrego Desert State Park

(Cannonball-shaped sandstone, These concretions are formed of onion-skin layers of minerals resistant to erosion.)

i486™ system in the world. from the leader in 386™ technology.

you a more efficient system for a variety of multi-user and fileserver applications. Like most ALR computers, the PowerCache 4 is a truly balanced system. The fastest power is achieved by enhancing our PowerCache 4 design with the industry's fastest disk drives and interface. The PowerCache 4 systems come standard with a high-speed 15MHz ESDI and 32 KB hard disk cache on the disk controller. What more could you possibly need.

It's no wonder ALR remains ahead of the pack with our innovative design expertise. As far back as 1986, we've been recognized in the industry as a leader in performance. Recently, the highly acclaimed 386/220 won us "Best of 1987" from *PC Magazine*. 1988 brought us the honor of receiving the *PC Magazine* Award for Technical Excellence for designing the industry's most advanced cache architecture. As for 1989 we've already begun to excite the industry with the PowerCache 4.

Now, what else would you expect from a company who is so committed to innovation and high-performance technology that we take you a step beyond. At ALR, we are concerned with your processing needs. Our technical support staff is available to assist you by one simple phone call. All our systems are backed by a one year warranty. Call today for more information on the new PowerCache 4 and the name of an authorized reseller nearest you.

1-800-444-4ALR

PowerCache 4 is the first PC to fully utilize 128-bit burst mode and a "read and write-back" 128KB cache design, providing better than zero wait state performance as compared to the i386.

ALR California
Home of the World's First 386 PC
Advanced Logic Research Inc.

Advanced Logic Research, Inc.
9401 Jeronimo Irvine, CA 92718
(714) 581-6770 FAX: (714) 581-9240
For our Canadian office:
1-800-443-4CAN
For our UK office:
0 635-521 844 FAX: 0 635-521 844
For our Singapore:
(65) 258-1286 FAX: (65) 258-1285

ALR and Advanced Logic Research, Inc. are registered trademarks. PowerCache 4 is a registered trademark of Advanced Logic Research, Inc. IBM and PC, PS/2, Micro Channel are registered trademarks of International Business Machines Corporation. Intel, 386 and i486 are registered trademarks of Intel Corporation.

Circle 13 on Reader Service Card (DEALERS: 14)

BYTE

OCTOBER 1989 VOL. 14/NO. 10

COVER STORY

The Portable and the Powerful

by Tom Thompson and Frank Hayes

page 98

Apple's Portable Mac finally arrives, accompanied by the impressive Mac IIci.

PRODUCTS IN PERSPECTIVE

49 What's New

81 Short Takes

PageMaker for OS/2 Presentation Manager, *Aldus puts desktop publishing in the fast lane*
Think C 4.0, *a major upgrade from Symantec*
DeskWriter, *Hewlett-Packard's ink-jet printer for the Mac*
HyperAccess/5, *Hilgraeve adds many new features*
DOS Mounter, *a utility from Dayna to use with Apple's FDHD*
hyperStore-816 *and* **SmartCache PM3011**, *caching disk controllers from Perceptive Solutions and Distributed Processing Technology*

FIRST IMPRESSIONS

111 VROOMM Goes the Spreadsheet
by Rich Malloy
Borland's new Quattro combines the advantages of Excel with Lotus 1-2-3 compatibility.

REVIEWS

160 Product Focus: The Optical Option
by Steve Apiki and Howard Eglowstein
WORM and erasable optical disk systems offer practical, large-scale storage.

181 MCA Meets SX
by Mark L. Van Name and Bill Catchings
IBM's PS/2 Model 55 SX and American Mitac's MPS2386 combine MCA with the 80386SX.

187 Color Printer Quells Price-Tag Blues
by Tom Thompson
ColorQuick offers Mac users a slow but effective alternative to pricey thermal printers.

191 Speed Separates Two Portable Printers
by Wayne Rash Jr.
Kodak and Toshiba take different routes to design printers for the road.

EXPERT ADVICE

115 Computing at Chaos Manor: Disasters and Diversions
by Jerry Pournelle
Jerry tries to revive a damaged floppy disk and glories in using new CD-ROM products.

131 The Unix /bin: The Root to Happiness
by David Fiedler
Working with Unix has its privileges—literally.

143 OS/2 Notebook: A Compendium of OS/2 Applications
by Mark J. Minasi
A new OS/2 application guide lists hundreds of programs.

144E Macinations: Crimes of the Heart?
by Don Crabb
Don delineates his Macintosh wish list.

151 Down to Business: IBM's Vision for Your Office
by Wayne Rash Jr.
OfficeVision brings IBM's grand plan into view.

155 NetWorks: Breaking Down the Barriers
by Mark L. Van Name and Bill Catchings
A look at the issues you'll face if you try to integrate PCs and Macs on a LAN.

COVER PHOTOGRAPHY: GREG FULTON © 1989

INTERNATIONAL SECTION
begins after page 80

195 Four Debuggers in One
by Martin Heller
The MultiScope OS/2 debugger from Logitech challenges Microsoft's CodeView.

201 X Window System on the March
by Tom Yager
A look at 386/ix X11, a new 80386 X Window system from Interactive Systems.

211 Visually Map Your Data
by Stan Miastkowski
Mapping Information Systems' MapInfo puts your dBASE III data on the map—literally.

217 How Super Is SuperCard?
by Richard D. Lasky
Silicon Beach's improvement on HyperCard's features may have been costly in performance.

IN DEPTH

228 Introduction: Optical Technologies

231 Computing With Light
by H. John Caulfield
Optical computers combine the best of the electronic and optical worlds.

239 The Nitty Gritty Optical Band
Optical developments occur in the "nitty gritty" aspects of packaging, interconnections, ICs, and signaling:

240 Levels of Light
by Joseph W. Goodman
Optical interconnections are one route to high-speed computing.

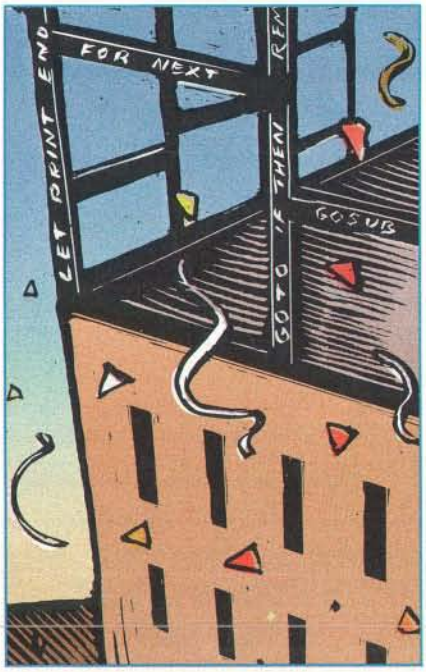
244 Joining Forces
by Donald J. Channin
Optoelectronics combines optics and electronics on a single chip.

249 Reflected Light
by Gary T. Forrest
Laser technology has an impact on everything from laser printers to optical disks.

259 Gigabytes On-Line
by James J. Burke and Bob Ryan
Erasable optical disk drives will change your notions of mass storage.

266 Read/Write Optical Subsystems
A guide to optical drive systems that let you store your own data.

FEATURES



268 The 25th Birthday of BASIC
by Bill Gates
Microsoft's chairman and coauthor of Microsoft BASIC tells where BASIC has been and where it's going.

279 Occam II
by Dick Pountain
The Occam II language is designed for parallel processing.

287 Hands-On Parallel Processing
by Geoffrey C. Fox, Alex W. Ho, Paul Messina, and Terry Cole
How to assemble a functional hypercube using Macs and AppleTalk.

HANDS ON

297 Under the Hood: Disk Caching
by L. Brett Glass
How to evaluate different disk-caching schemes.

303 Some Assembly Required: Two Tin Cans and Some String, Part 1
by Rick Grehan
The first of a two-part series comparing AppleTalk and NetBIOS.

DEPARTMENTS

8 Editorial: Hip-Deep and Rising
17 Microbytes
32 Letters and Ask BYTE
48C Chaos Manor Mail
351 Coming Up in BYTE
360 Print Queue
364 Stop Bit

READER SERVICE

350 Editorial Index by Company
352 Alphabetical Index to Advertisers
354 Index to Advertisers by Product Category
Inquiry Reply Cards: after **356**

PROGRAM LISTINGS

From BIX: See **358**
From BYTEnet: call (617) 861-9764
On disk: See card after **248**

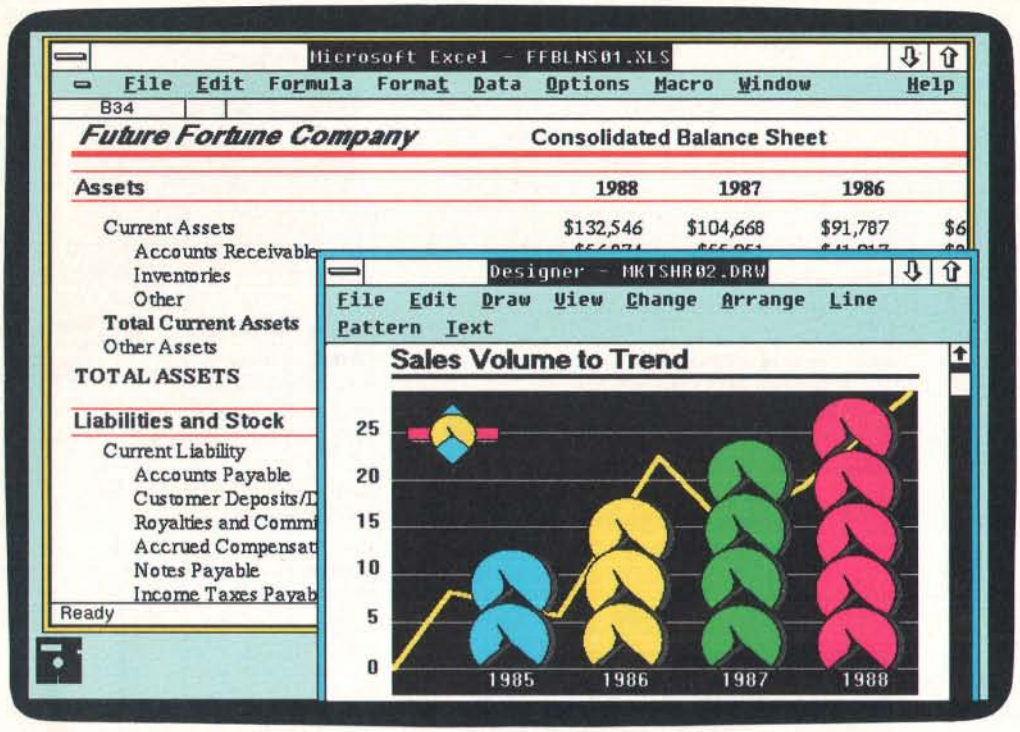
COVER LASER ANIMATION AND PHOTOGRAPHY: IMAGE ENGINEERING © 1989

BYTE (ISSN 0360-5280) is published monthly with an additional issue in October by McGraw-Hill, Inc. **Postmaster:** Send address changes, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520. Second-class postage paid at Peterborough, NH 03458, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Printed in the United States of America.

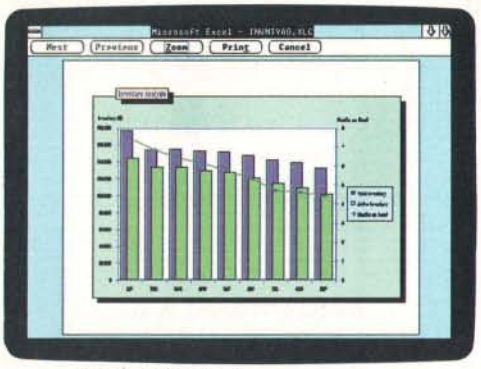
Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE.

Copyright © 1989 by McGraw-Hill, Inc. All rights reserved. Trademark registered in the United States Patent and Trademark Office.

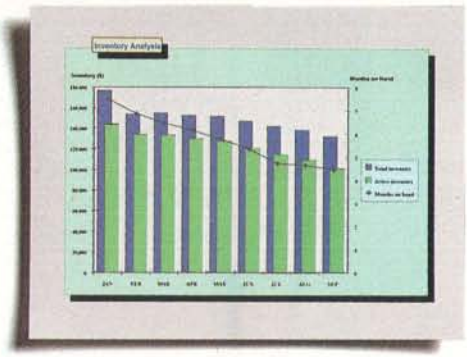
Subscription questions or problems should be addressed to: BYTE Subscriber Service, P.O. Box 551, Hightstown, NJ 08520.



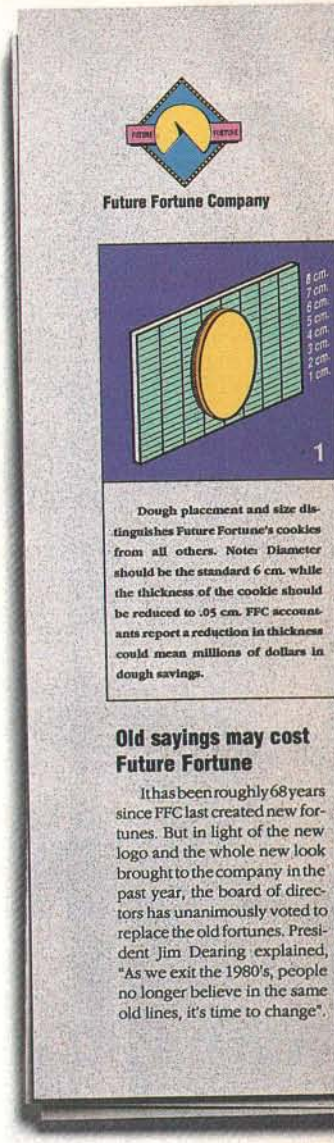
By no small coincidence, Microsoft Windows works the way you do: On more than one thing at a time.



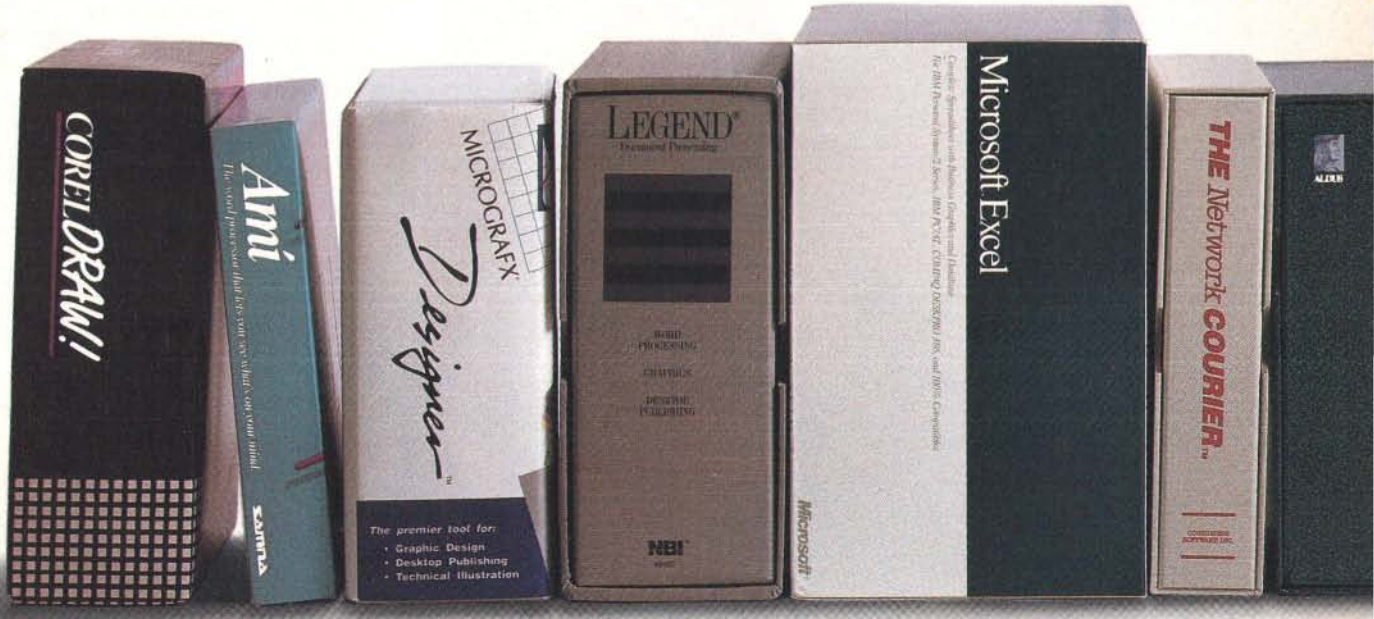
WYSIWYG. What you see on screen...



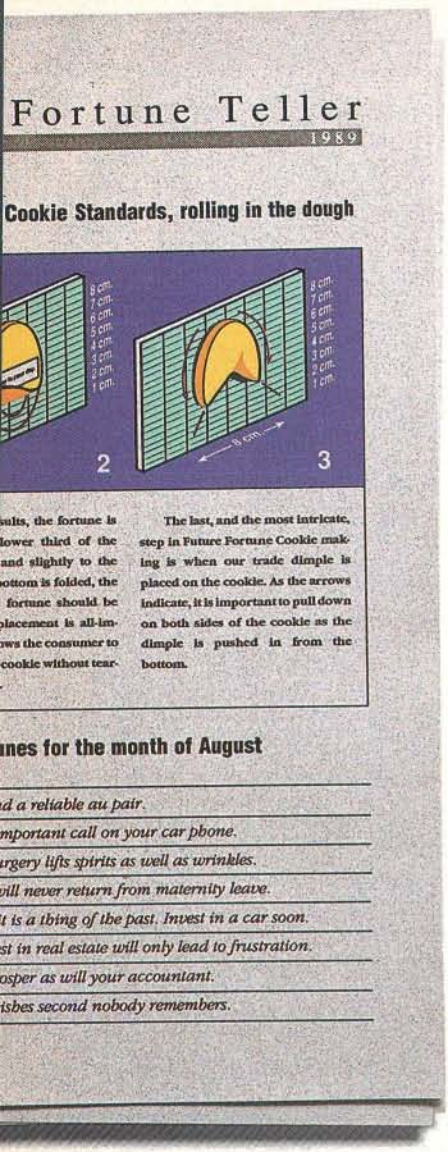
...is exactly what you get on paper.



An entire environment that



More good news: Hundreds of great Windows applications are available right now, as you read.

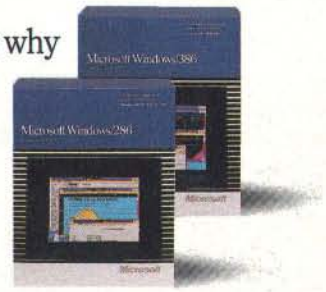


u do amazing things—like this—simply.

We'd like everyone who's using Windows applications on a part-time basis to please stop.

The trouble with using Windows™ applications every once in a while, is that you're only amazingly productive every once in a while.

This has got to stop. Which is why there's the Microsoft® Windows environment—the first and only *graphical* environment to let you work with multiple Windows or DOS applications without ever closing a single file, or quitting a single program.



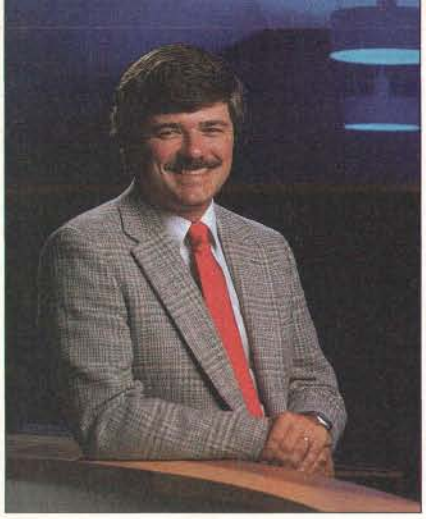
You may never see your C prompt again. Just give Microsoft Windows a 40-hour work week and you'll be pointing, clicking, cutting, pasting and flying through your work with the greatest of ease. Cut from a spreadsheet and paste onto a word processing document—without scissors and a copy machine. Exchange information, link files and programs, then watch your data get updated automatically, or if you prefer, at your command.

Call us at (800) 541-1261, Dept. J89 for more facts about how Windows can open up doors, and for our free Windows Shopping Catalog.

And see how the only way to get the most out of your Windows, is to look into ours.

Microsoft®
Making it all make sense®

Customers inside the 50 United States, call (800) 541-1261, Dept. J89. In Canada, call (416) 673-9811. Outside the U.S. and Canada, call (206) 882-8661. © 1989 Microsoft Corporation. All rights reserved. Microsoft and the Microsoft logo are registered trademarks and *Making it all make sense* and Windows are trademarks of Microsoft Corporation.



HIP-DEEP AND RISING

Smoke, mirrors, and misinformation can make your computing decisions needlessly complex

Some decisions are easy. Some are inherently difficult. And far too many are made unnecessarily difficult by smoke, bluster, and misinformation.

It's a problem that knows no boundaries of brand, operating system, or architecture, but for simplicity's sake, consider just the decisions involved when upgrading 80286- and 80386-based machines. I'll look at the 80386-based machines first.

If you bought a 16-MHz 80386-based machine a few years ago, you're probably now wondering about upgrading to 20, 25, or 33 MHz. If your current machine is working fine, it's merely a matter of checking out the specifications, benchmark results, and prices of the newer machines to see how many bucks the extra bang is going to cost you. Either the increase in speed (and, one assumes, productivity) is worth the expense, or it isn't. It's a relatively simple equation, with all factors known or knowable. Piece of cake.

Yes, certain complications can muddy the waters. For example, some early 80386 boxes accommodate only a relatively small amount of RAM on the motherboard and lack 32-bit memory-card slots. If you want to run memory-hungry software on such a machine, you'll have to use a regular AT-class memory card and suffer the delays imposed by the 16-bit bottleneck. This factor alone may justify an upgrade, even if there's nothing else "wrong" with your current setup.

A few unlucky souls face some really oddball complications. For example, some early 80386 chips were buggy. Once Intel knew there was a problem, it (laudably) instituted a liberal exchange policy to get the bad chips out of circulation. But despite Intel's efforts, there's little doubt that some manufacturers—especially the low-end cloners—shipped some systems with bad chips.

The total number of bad chips now in daily use is probably small, but for those who have those early chips, it could be bad news. One of the bugs, for instance, causes incorrect 32-bit multiplies, which may be no big deal under vanilla DOS but can be a real headache with 32-bit software.

Factoring this kind of problem into an upgrade decision involves a little spelunking: You'd need to physically examine or test a suspect chip. (Intel stamped two Greek sigmas on chips that were known to be good.) Also, there's public domain software that performs a quick-and-dirty 32-bit multiply and then checks the answer for accuracy. Such software is available on BIX in the IBM Exchange: Search for "bug" or "multiply" to find it.

So far, so good. Even with some oddball complications thrown in, you can find good answers to most upgrade questions. But artificial, unnecessary complications, like the spread of bad information, can make upgrade decisions very hard indeed.

Take the 80286 versus 80386SX question, for example. It shouldn't be at all difficult to sort out. BYTE readers got the full story last March, when our 80286 versus 80386SX cover story "Battle of the Chips" detailed the similarities and differences between the chips. Readers could fairly easily determine when it made sense to stay with fast 80286-based machines, when it made sense to opt for an 80386SX, and when it made the most sense to go with a "real" 80386 (without the SX's 32-bit-to-16-bit bottleneck).

But there's still a ton of confusion among users at large. Some people still think you need an 80386 to run OS/2. (You don't. An 80386-specific version of OS/2 won't be available until next year.) Some think that an 80386SX is inherently faster than an 80286. (It's not. At any given clock speed, an 80286 will generally keep up with an 80386SX; and in a number of important areas, like task switching, the 80286 is substantially faster than the SX.) Some think an 80386SX will save them money. (Not really. Most SX machines cost hundreds of dollars more than just-as-fast 80286 boxes. And some low-end 80386 clones, with full 32-bit memory buses, actually cost less than some name-brand SX machines, with their 16-bit buses.)

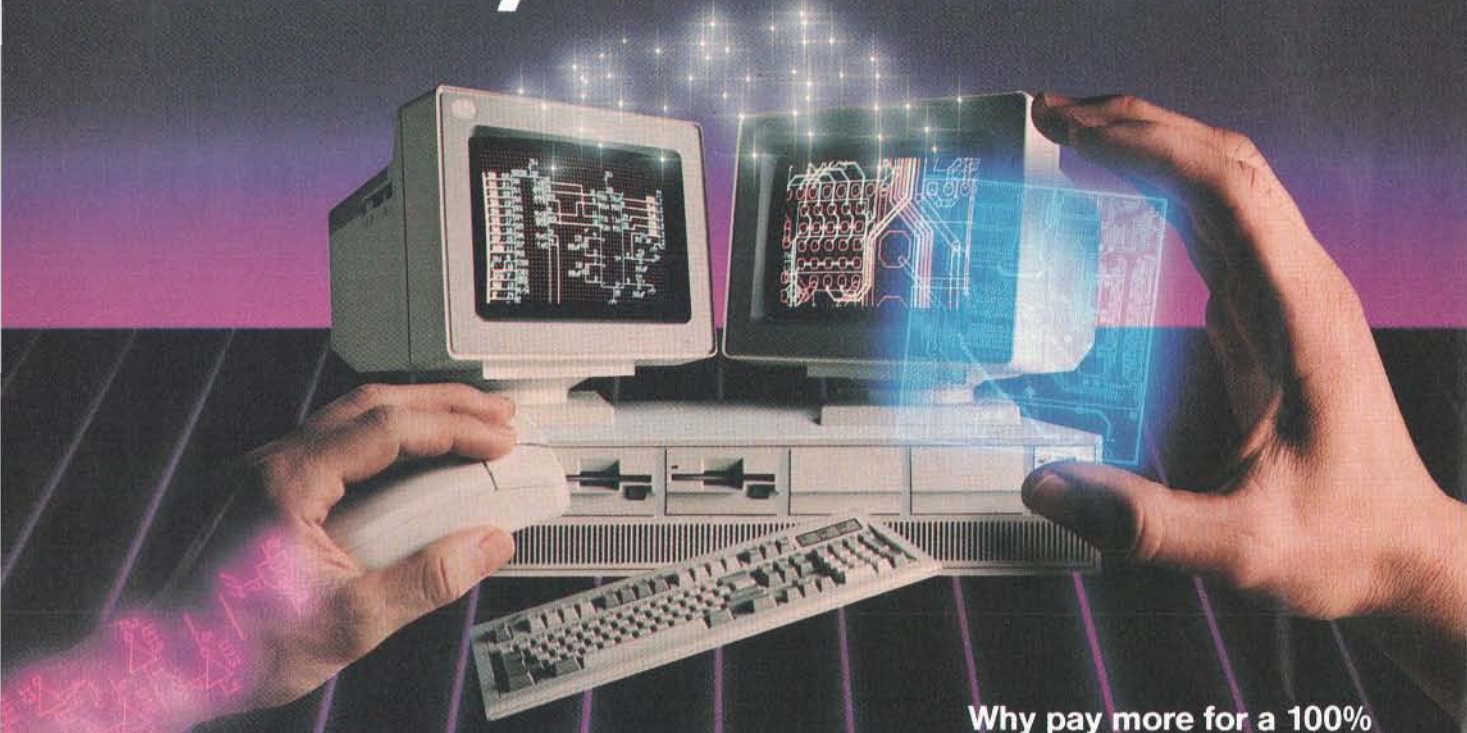
The problem here isn't the SX—there are cases where the SX is indeed the best choice. And as prices for the SX continue to drop, it will become more attractive and more competitive.

The problem is that this is just one of a growing number of instances where misinformation makes a computer decision needlessly complex. The sources of misinformation abound—some innocent, and some deliberate. Compare BYTE's SX story to a recent cover story in another major computer magazine, whose purpose seems not to be helping readers match the right tool for the job, but pushing them toward buying powerful and expensive gear, regardless of whether it's overkill. Misleading ads are bad enough, but when supposedly objective publications start acting as shills, it's downright scary.

As consumers, we need to be exceptionally alert to the hidden agendas of our information sources. Caveat emptor was never sounder advice. Upgrade decisions are hard enough without getting distracted by bad recommendations, bad information, or plain old hype.

—Fred Langa
Editor in Chief
(BIX name "flanga")

At last, an assistant that follows your directions



Wouldn't it be great to delegate your routing?

You can! We know your time is valuable. That's why Wintek pioneered comprehensive and affordable CAD packages for IBM personal computers. HiWIRE-Plus continued that tradition, integrating schematic-capture features and printed-circuit-artwork capabilities into one versatile package.

New autorouter.

The Autorouter for HiWIRE-Plus is powerful enough to handle the most demanding design problems, yet simple enough for a casual user. Just turn it loose on your design. It's hassle free because it works long hours, without supervision or errors.

100% autorouting.

The autorouter for HiWIRE-Plus rips-up, reroutes, and with appropriate design rules, racks up 100% completion.

- ☐ Forget gridded routers. This autorouter places vias and traces anywhere your design rules allow. With 1-mil resolution.
- ☐ Vary trace width and spacing for individual networks. Route 1, 2, 3, or more tracks between IC and connector pins.
- ☐ Set up boards from 1 to 250 layers, up to 60″ × 60″.
- ☐ Specify shape, size, and type of vias, layer-by-layer: through-hole, blind, buried, micro. Specify via types for individual networks.
- ☐ Use fewer vias and layers than comparably priced autorouters.
- ☐ For use on your IBM PC, XT, AT, PS/2, or compatible with 640K RAM.

Why pay more for a 100% autorouter?

Compare the features and performance to packages costing five times more. HiWIRE-Plus and the Autorouter for HiWIRE-Plus sell for $895 each. Both have a no-nonsense, 30-day money-back guarantee. With unlimited, toll-free, no-charge technical support.

Let HiWIRE convince you that it makes a great assistant. Call us toll-free at (800) 742-6809 today and put HiWIRE-Plus and the Autorouter for HiWIRE-Plus to work for you tomorrow.

WINTEK®

Wintek Corporation
1801 South Street
Lafayette, IN 47904-2993
Fax: (317) 448-4823
Phone: (317) 742-8428 or

(800) 742-6809

Europe: RIVA Ltd, England, Phone 0420 22666, FAX 0420 237000 / Brazil: Comicro, Phone (11) 289-7193 / Japan: BEST, Phone: (03) 374-1161, FAX (03) 374-9450

Circle 400 on Reader Service Card

OUT STANDING IN THEIR FIELD.

We've been recognized for being outstanding in our field because we're committed to our customers. We founded Gateway 2000 to provide *quality computers at agressive prices with uncompromising service after the sale.* We've done what we set out to do.

1988 BYTE AWARD OF DISTINCTION

Gateway computer systems are assembled by hand in our factory located just outside Sioux City, Iowa. The midwest work ethic is evident in every computer we produce. You'll also find the latest technology in all of our systems.

One look at our prices and you'll see we're aggressive. Most importantly, look at our *commitment to service.* We give you a full one-year warranty which includes *free on-site service* in most locations nationwide. Of course you also receive a 30-day money back guarantee and *lifetime* toll-free phone support.

If you're shopping for real value in a computer system, call Gateway 2000. *You have our personal pledge that you will be completely satisfied!*

Ted Waitt, President — *Norm W. Waitt, Vice President*

12 MHZ 286 LAPTOP

- Gas Plasma Display Screen
- 2.6 Megs RAM
- 1.44 Meg 3.5″ Floppy Drive
- External Port for 5¼″ Drive
- 40 Meg 28ms Hard Drive
- 1 Parallel & 1 Serial Port
- Expansion Slot (16 Bit)
- External EGA Monitor Port
- 84 Key Keyboard
- MS DOS 3.3 Installed

$2995.00

12 MHZ 286 VGA

- 80286-12 Processor
- 2 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 40 Meg 28ms Drive
- 16 Bit VGA Board
- 14" Multisynch Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$2195.00

16 MHZ 286 VGA

- 80286-16 Processor
- 2 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 40 Meg 28ms Drive
- 16 Bit VGA Board
- 14" Multisynch Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$2295.00

20 MHZ 286 VGA

- 80286-20 Processor
- 2 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 40 Meg 28ms Drive
- 16 Bit VGA Board
- 14" Multisynch Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$2395.00

20 MHZ 386 VGA

- 1 Meg RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 80 Meg 28ms Drive
- 16 Bit VGA Board
- 14" Multisynch Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$2995.00

Upgrade to 4 Megs $500
64K Cache Add $250

Monochrome Systems Deduct $500

25 MHZ 386 VGA

- 4 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 150 Meg 16.5ms ESDI Drive
- 16 Bit VGA Board
- 14" Multisynch Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$4245.00

64K Cache Add $500

33 MHZ 386 VGA

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 150 Meg 16.5ms ESDI Drive
- 16 Bit VGA Board
- 14" Multisynch Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$5495.00

GATEWAY 2000

GATEWAY 2000 • P.O. BOX 2000
SERGEANT BLUFF, IOWA 51054
IN IOWA 712-943-2000
TOLL FREE 800-523-2000

Due to the volatility in the DRAM market, all prices are subject to change.

BYTE

EDITOR IN CHIEF
Frederic S. Langa

PUBLISHER/GROUP VICE PRESIDENT
J. Burt Totaro

OPERATIONS
Glenn Hartwig *Associate Managing Editor*

REVIEWS (Hardware, Software, Product Focus)
Michael Nadeau *Associate Managing Editor*, Dennis Allen *Senior Technical Editor, Software*, Richard Grehan *Director, BYTE Lab*, Stephen Apiki *Testing Editor, BYTE Lab*, Stanford Diehl *Testing Editor, BYTE Lab*, Howard Eglowstein *Testing Editor, BYTE Lab*, Stanley Wszola *Testing Editor, BYTE Lab*

NEWS AND TECHNOLOGY (Microbytes, What's New, Short Takes)
Rich Malloy *Associate Managing Editor*, D. Barker *Senior Editor, News and Technology*, Anne Fischer Lent *Senior Editor, New Products*, Andrew Reinhardt *Associate News Editor*
Peterborough: Roger Adams *Associate News Editor*, David Andrews *Associate News Editor*, Martha Hicks *Associate News Editor*
West Coast: Gene Smarte *Bureau Chief*, Costa Mesa, Nicholas Baran *Senior Technical Editor*, Frank Hayes *News Editor*, Jeffrey Bertolucci *Associate News Editor*, San Francisco

SENIOR TECHNICAL EDITORS
Ken Sheldon *Features*, Jane Morrill Tazelaar *In Depth*, Tom Thompson *At Large*, Jon Udell *At Large*

TECHNICAL EDITORS
Janet J. Barron, Alan Joch, Robert Mitchell, Robert M. Ryan, Ben Smith

SENIOR CONTRIBUTING EDITOR
Jerry Pournelle

CONTRIBUTING EDITORS
Don Crabb, David Fiedler, L. Brett Glass, Hugh Kenner, Mark Minasi, Wayne Rash Jr.

CONSULTING EDITORS
Jonathan Amsterdam, Laurence H. Loeb, Trevor Marshall, Stan Miastkowski, Dick Pountain, Phillip Robinson, George A. Stewart, Mark L. Van Name, Peter Wayner

COPY EDITORS
Lauren Stickler *Chief*, Cathy Kingery *Copy Administrator*, Susan Colwell, Jeff Edmonds, Judy Grehan, Nancy Hayes, Margaret A. Richard, Warren Williamson

EDITORIAL ASSISTANTS
Peggy Dunham *Office Manager*, Linda C. Ryan, June N. Sheldon, Lynn Susan Valley

ART
Nancy Rice *Director*, Joseph A. Gallagher *Assistant Director*, Lisa Nardecchia *Assistant*, Jan Muller *Assistant*, Alan Easton *Technical Artist*

PRODUCTION
David R. Anderson *Director*, Virginia Reardon *Senior Editorial Production Coordinator*, Barbara Busenbark *Editorial Production Coordinator*, Denise Chartrand *Editorial Production Coordinator*, Michael J. Lonsky *Editorial Production Coordinator*

TYPOGRAPHY
Sherry Fiske *Systems Manager*, Donna Sweeney *Applications Manager*, Christa Patterson

ADVERTISING/PRODUCTION (603) 924-6448
Lisa Wozmak *Director of Advertising Services*, Linda Fluhr *Customer Service Supervisor*, Lyda Clark *Senior Account Coordinator*, Dale Christensen, Karen Cilley, Roxanne Hollenbeck, Rod Holden, Wai Chiu Li *Quality Control Manager*

ADMINISTRATION
Donna Nordlund *Publisher's Assistant*

MARKETING AND PLANNING
L. Bradley Browne *Director*
Pamela Petrakos-Wilson *Marketing Communications Manager*, Dawn Matthews *Public Relations Manager*, Lisa Jo Steiner *Assistant Promotion Manager*, Stephanie Warnesky *Marketing Art Director*, Sharon Price *Associate Art Director*, Julie Perron *Senior Market Research Analyst* Faith Kluntz *Copyrights Coordinator*, Cynthia Damato Sands *Reader Service Coordinator*, Carol Pitman *Marketing Assistant*

FINANCIAL SERVICES
Philip L. Penny *Director of Finance and Services*, Kenneth A. King *Business Manager*, Marilyn Parker, Diane Henry, JoAnn Walter, Jaime Huber, Agnes Perry

CIRCULATION
Dan McLaughlin *Director*
Vicki Weston *Assistant Manager*, Karen Desroches *Distribution Coordinator*, Louise Menegus *Back Issues*

PERSONNEL
Patricia Burke *Human Resources Administrator*, Beverly Goss *Receptionist*

BUILDING SERVICES
Tony Bennett *Manager*, Cliff Monkton, Mark Monkton, Gary Graham

BIX BYTE INFORMATION EXCHANGE

DIRECTOR
Stephen M. Laliberte

EXECUTIVE EDITOR
George Bond

MANAGING EDITOR
Tony Lockwood

MICROBYTES DAILY
D. Barker *Coordinator, Peterborough*, Rich Malloy *New York*, Gene Smarte *Costa Mesa*, Nicholas Baran *San Francisco*, Rick Cook *Phoenix*, Frank Hayes *San Francisco*, Martin Heller *Boston*. Jason Levitt *Austin, TX*, Laurence H. Loeb *Wallingford, CT*, Brock N. Meeks *San Francisco*, Stan Miastkowski *Peterborough*, Wayne Rash Jr. *Washington, DC*. Andrew Reinhardt *New York*. Sue Rosenberg *Washington, DC*, David Reed *Lexington, KY*

GROUP MODERATORS
David Allen *Applications*, Leroy Casterline *Other*, Marc Greenfield *Programming Languages*, Jim Howard *Graphics*, Gary Kendall *Operating Systems*, Steve Krenek *Computers*, Brock N. Meeks *Telecommunications*, Barry Nance *New Technology*, Donald Osgood *Computers*, Sue Rosenberg *Other*, Jon Swanson *Chips*

EXCHANGE EDITOR
Laurence H. Loeb *Macintosh Exchange Editor*

BUSINESS AND MARKETING
Patricia Bausum *Secretary*, Denise A. Greene *Customer Service*, Brian Warnock *Customer Service*, Tammy Burgess *Customer Credit and Billing*

TECHNOLOGY
Clayton Lisle *Director, Business Systems Technology, ISCo.*, John Spadafora *Programmer/Analyst*, Wayne Power *Senior Business Systems Analyst*

ADVERTISING SALES
Steven M. Vito *Associate Publisher, Vice President of Marketing*

Sara Lyon *Administrative Assistant*

Arthur H. Kossack *Eastern Regional Sales Manager*, **(312) 751-3700**
Jennifer L. Bartel *Western Regional Sales Manager*, **(214) 644-1111**
Susan Vernon *Sales Assistant*

NEW ENGLAND
ME, NH, VT, MA, RI, ONTARIO, CANADA & EASTERN CANADA
John C. Moon **(617) 262-1160**

ATLANTIC
NY, NYC, CT, NJ (NORTH)
Kim Norris **(212) 512-2645**

EAST
PA, KY, NJ (SOUTH), MD, W.VA, DE, DC
Thomas J. Brun **(215) 496-3833**

SOUTHEAST
NC, SC, GA, FL, AL, TN, VA, MS
Thomas H. Tolbert **(404) 252-0626**

MIDWEST
IL, MO, KS, IA, ND, SD, MN, WI, NE, IN, MI, OH
Kurt Kelley **(312) 751-3740**

SOUTHWEST, ROCKY MOUNTAIN
CO, WY, OK, TX, AR, LA
Karl Heinrich **(713) 462-0757**

SOUTH PACIFIC
SOUTHERN CA, AZ, NM, LAS VEGAS, UT
Ron Cordek **(714) 557-6292**
Tom Harvey **(213) 480-5243**

NORTH PACIFIC
HI, WA, OR, ID, MT, NORTHERN CA, NV (except LAS VEGAS), WESTERN CANADA
Bill McAfee **(408) 879-0371**
Christine Kopec **(415) 362-4600**

TELEMARKETING
Liz Coyman *Director*
Susan Boyd *Administrative Assistant*

NATIONAL SALES
Dan Harper **(603) 924-2598**
Elisa Lister **(603) 924-2598**

BYTE BITS (2x3)
Mark Stone **(603) 924-6830**

THE BUYER'S MART (1x2)
Brian Higgins **(603) 924-3754**

REGIONAL ADVERTISING SECTIONS
Scott Gagnon **(603) 924-4380**
Larry Levine **(603) 924-4379**
Barry Echavarria **(603) 924-2574**

BYTE POSTCARD DECK MAILINGS

BYTE DECK
Ed Ware **(603) 924-6166**

COMPUTING FOR DESIGN & CONSTRUCTION
COMPUTING FOR ENGINEERS
Mary Ann Goulding **(603) 924-9281**

INTERNATIONAL ADVERTISING SALES STAFF
See listing on page 353.

EDITORIAL AND BUSINESS OFFICE:
One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.
West Coast Branch Offices: 425 Battery St., San Francisco, CA 94111, (415) 954-9718; 3001 Red Hill Ave., Building #1, Suite 222, Costa Mesa, CA 92626, (714) 557-6292.
New York Branch Editorial Office: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.
BYTEnet: (617) 861-9764 (set modem at 8-1-N or 7-1-E; 300 or 1200 baud).
Editorial Fax: (603) 924-2550. **Advertising Fax:** (603) 924-7507.
SUBSCRIPTION CUSTOMER SERVICE: Outside U.S. (609) 426-7070; inside U.S. (800) 232-BYTE.
For a new subscription—(800) 257-9402 U.S. only, or write to BYTE Subscription Dept., P.O. Box 555, Hightstown, NJ 08520.

Officers of McGraw-Hill Information Services Company: President: Walter D. Serwatka. Executive Vice Presidents: Kenneth E. Gazzola, Aerospace and Defense; Ira Herenstein, Computers and Communications; Russell C. White, Construction; Robert P. McGraw, Healthcare; Brian H. Hall, Legal. Senior Vice Presidents–Publishers: Laurence Altman, Data Communications; David J. McGrath, Engineering News-Record. Senior Vice Presidents: John W. Fink, Finance; Michael J. Koeller, Human Resources. Group Vice Presidents: J. Burt Totaro, BYTE; Norbert Schumacher, Energy/Process Industries. Vice Presidents: George Elsinger, Circulation; Julia Lenard, Systems Planning and Technology; Elisabeth K. Allison, Planning and Development.
Officers of McGraw-Hill, Inc.: Joseph L. Dionne, Chairman, President, and Chief Executive Officer; Robert N. Landes, Executive Vice President, General Counsel, and Secretary; Robert J. Bahash, Executive Vice President and Chief Financial Officer; Frank D. Penglase, Senior Vice President, Treasury Operations.

Founder: James H. McGraw (1860–1948). Executive, editorial, circulation, and advertising offices: One Phoenix Mill Lane, Peterborough, NH 03458, phone (603) 924-9281. Office hours: Monday through Thursday 8:30 AM–4:30 PM, Friday 8:30 AM–1:00 PM, Eastern Time. Address subscriptions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520. Subscriptions are $29.95 for one year, $54.95 for two years, and $74.95 for three years in the U.S. and its possessions. In Canada and Mexico, $31.95 for one year, $59.95 for two years, $79.95 for three years. $50 for one-year air delivery to Europe. Y28,800 for one-year air delivery to Japan, Y14,400 for one-year surface delivery to Japan, $30 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is $3.50 in the U.S. and its possessions, $3.95 in Canada, $4.50 in Europe, and $5 elsewhere. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue. Address editorial correspondence to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Unacceptable manuscripts will be returned if accompanied by sufficient postage. Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any article herein for the flat fee of $1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 29 Congress St., Salem, MA 01970. Specify ISSN 0360-5280/83, $1.50. Copying done for other than personal or internal reference use without the permission of McGraw-Hill, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to the publisher. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London WC1R 4EJ, England.

BYTE and BYTE are registered trademarks of McGraw-Hill, Inc.

BORLAND'S TURBO C PROFESSIONAL 2.0

CORPORATE TOP RATED PC WEEK 1989 SATISFACTION POLL

PC WEEK POLL: C COMPILERS

	Overall Weighted Score	Overall Reliability	Complete of Command Descript.	Overall Perform.	Complete & Organiz. Document.	Document Clarity	Compiling Process Efficiency	Product Support Quality	Value Relative To Cost	Product Support Access.
Turbo C 2.0 (Borland International)	81	87	79	84	77	78	86	72	70	93
C Optimizing Compiler 5.1 (Microsoft Corp.)	76	83	80	81	78	74	76	68	67	70
C++ 1.07 (Zortech Inc.)	66	68	64	71	63	63	69	60	58	76

"Microsoft was No. 1, but they have been unseated by Borland." PC Week, *May 8, 1989*

PC WEEK POLL: SOFTWARE DEBUGGERS

	Overall Weighted Score	Overall Reliability	Effective. Programmer Interface	Document. Clarity	Complete. Command Descript.	Complete. & Organize. Document	Overall Perform.	Integration Within Programming Environment	C Compiler Compatibility	Product Support Quality	Product Support Access	Value Relative To Cost
Turbo Debugger 1.0 (Borland International)	84	89	90	81	81	81	89	88	81	73	72	93
Codeview 2.2 (Microsoft Corp.)	73	80	71	72	74	74	74	74	78	67	64	72

"Borland's Debugger outshines Microsoft's Codeview." PC Week, *May 15, 1989*

It's two winners in one.

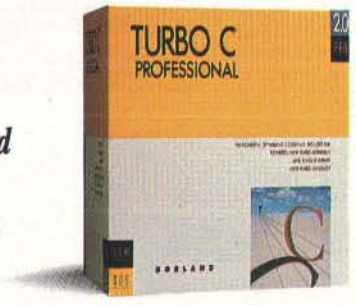
Turbo C,® the core of Turbo C Professional, was the outright winner in *PC Week*'s Poll of Corporate Satisfaction on C compilers. Overall, Borland won with 81. Microsoft® placed second.

Turbo Debugger,® also included in Turbo C Professional, was the outright winner in EVERY category in *PC Week*'s Poll Of Corporate Satisfaction on Debuggers. And, once again, we topped the score with 84, overall. Microsoft came in second-best, 11 points behind.

Get Borland's Turbo C Professional and get the best of both worlds: our top-rated C compiler and our top-rated Debugger.

Call **(800) 345-2888*** and we'll send you both *PC Week* polls and technical specifications on Turbo C and Turbo Debugger.

Turbo C Professional includes both Turbo C 2.0 and Turbo Assembler® & Debugger.



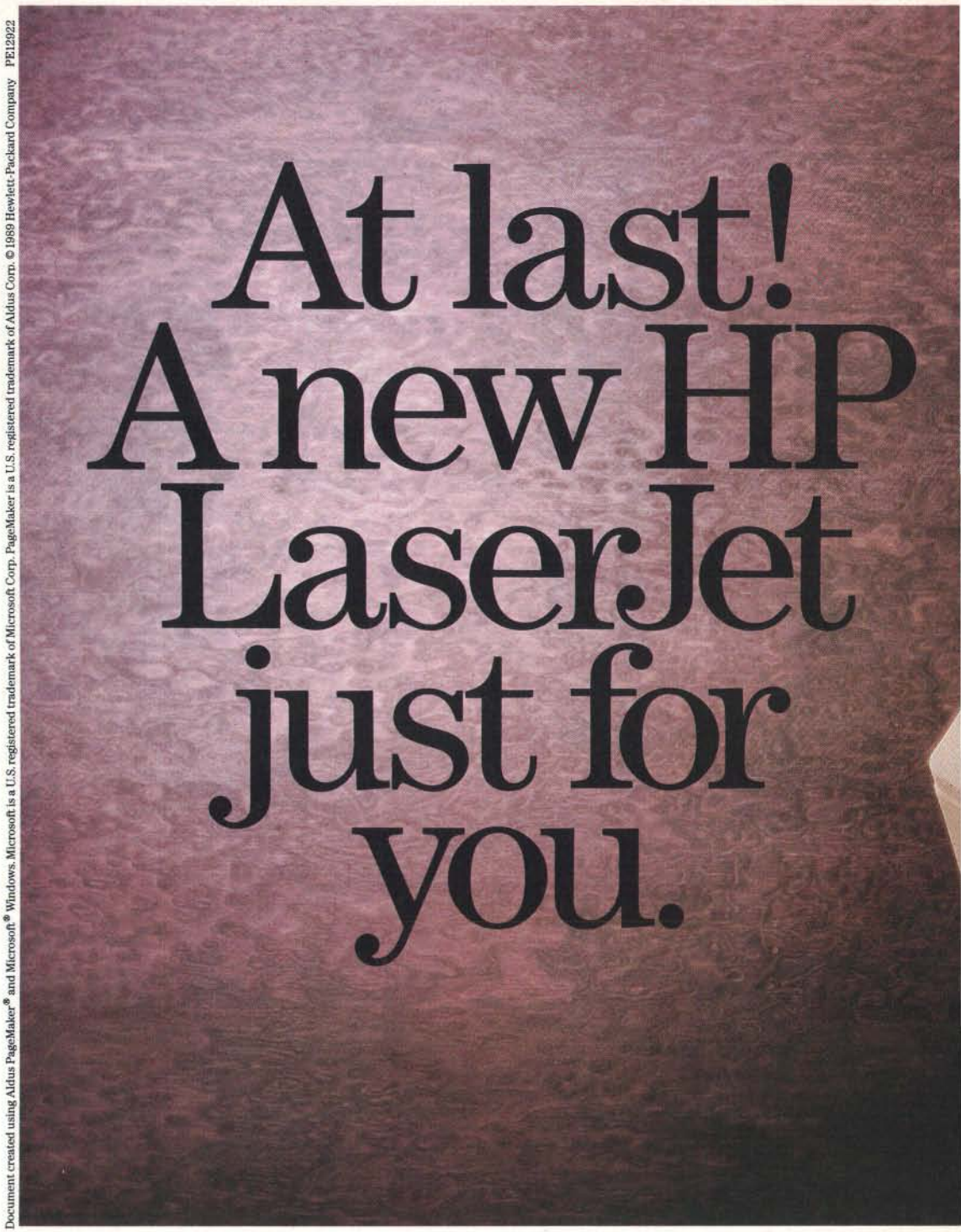
BORLAND

Code:MC35

From Canada, Call (408) 848-4391. Reprinted from PC Week, May 8, 1989; PC Week, May 15, 1989. Copyright ©1989 Ziff Communications Company. Turbo C, Turbo Debugger, and Turbo Assembler are registered trademarks of Borland International. Copyright ©1989 Borland International, Inc. All rights reserved. BI 1328

Circle 42 on Reader Service Card (DEALERS: 43)

Document created using Aldus PageMaker® and Microsoft® Windows. Microsoft is a U.S. registered trademark of Microsoft Corp. PageMaker is a U.S. registered trademark of Aldus Corp. © 1989 Hewlett-Packard Company PE12922



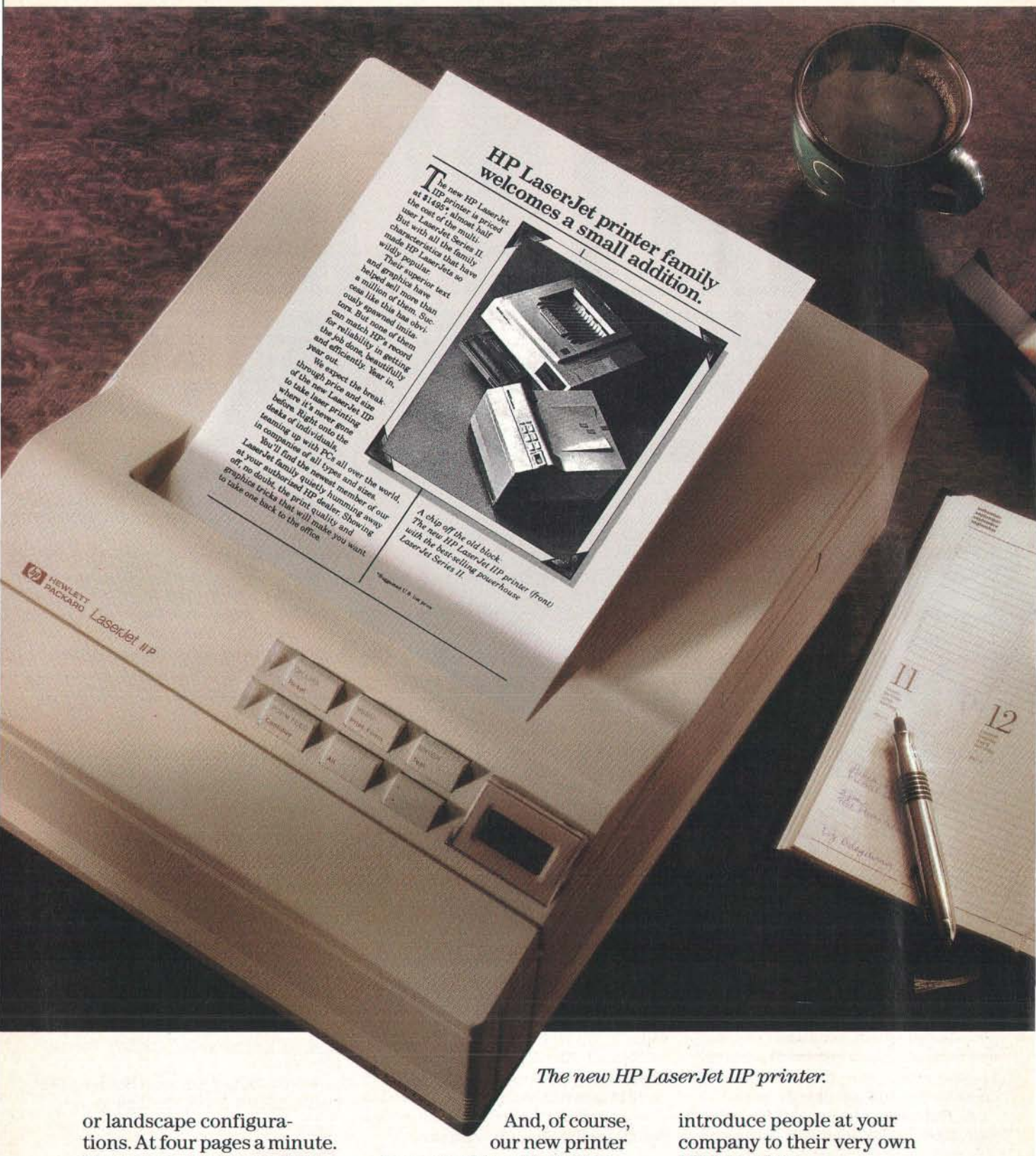
At only $1495*, it's got your name on it.

The HP LaserJet printer family has expanded—in a small way.

The new HP LaserJet IIP (as in Personal) fits right on your desk. And, with a price almost half of the multi-user LaserJet Series II,* into most budgets.

Its simple front panel gives you easy, push-button control over the menu, the 14 internal fonts, form feed and other functions. It handles four different paper sizes: letter, legal, executive and A4, as well as envelopes. In portrait

*Suggested U.S. list prices:
LaserJet IIP $1495;
LaserJet Series II $2695.
Dealer prices vary.



The new HP LaserJet IIP printer.

or landscape configurations. At four pages a minute. From one or two paper bins (the second is optional).

The 512K standard memory is upgradable to 4.5 Mbytes for more complex graphics and publishing programs.

And, of course, our new printer is compatible with the HP LaserJet Series II and virtually all popular PC software.

So call **1-800-752-0900, Ext. 277J** for your nearest authorized HP dealer. Then introduce people at your company to their very own HP LaserJets.

There is a better way.

HEWLETT PACKARD

Circle 116 on Reader Service Card

Creative License.

If you've ever tried to combine windows, menus, forms, and text entry to create an effective user interface, you know how challenging it can be.

Perhaps you've turned to a third-party library for help. Only to run into restrictions, limitations, and dead ends. So you had to compromise your design. Or modify the library source code. Or start over.

Which is precisely why we designed Vermont Views™, **the new generation of Windows for Data®**, the best-selling C library for user interfaces.

Vermont Views offers unbridled, unrestricted creative license.

The Human Interface Of Your Dreams

Vermont Views offers an unparalleled set of interface building blocks that you can combine in unlimited ways:

- Menus can be created in any style you choose, made scrollable vertically and horizontally, and nested to any level. Features include n-th character selection, checkmarks, and unavailable items.
- Data entry forms can be bigger than their display windows, have scrollable regions for the entry of variable lines of items, lists of choices for data entry, context sensitive help, and special decimal, date, time, and toggle fields.
- A mini word processor can be attached to a field window in a form or used as a pop-up note taker.

You're In Charge

Because you can write and attach functions to the beginning and end of menus, forms, fields, and to keys, you're always in control.

Use these control functions to call up subsidiary forms and menus, change field values and the active field, exit or abort a form, do almost any task you can imagine.

All interactive capabilities of Vermont Views use a unique system of accessible keytables, so you can easily change or disable key assignments – even add to the functions provided for menus, forms, text entry, and windows.

One For All

Vermont Views is available for DOS, OS/2, UNIX, XENIX, and VMS. Maintain the same user interface on all of these operating systems with the same source code.

Vermont Views provides international portability as well, with full support for IBM international characters, flexible date and time formats, and changeable decimal and thousands separators.

Novice Or Expert

Despite its depth and flexibility, Vermont Views is easy to learn and use. Each major facility is covered in a single, self-contained section of the manual, so you only need to learn capabilities as you use them.

To help you become an expert in no time, we include a free copy of the Norton Guides™ Engine and our own comprehensive Pop-Up Reference™. You'll have immediate, on-line access to function names, reference pages, structures and tables.

No-Time-Limit Guarantee

We've only touched on a fraction of what makes Vermont Views special. The only way to know it is to use it.

Try Vermont Views on your hardest problems.

For as long as you want. At no risk.

If not fully satisfied, return for a full refund. Anytime.

To Order Today Call 1-800-848-1248

Call to order Vermont Views today. And we'll send your "creative license" right away.

Prices: DOS $395; with Source $790. UNIX, XENIX, VMS, OS/2 please call.

Vermont Creative Software

Pinnacle Meadows, Richford, VT 05476

800-848-1248, 802-848-7731 Fax: 802-848-3502 Telex: 510-601-4160 VCSOFT

MICROBYTES

Staff-written highlights of developments in technology and the microcomputer industry, compiled from Microbytes Daily and BYTEweek *reports*

Is Classroom Computing Making the Grade?

Are computers in schools helping children learn? As school districts across the nation become more pressed for money, educators are having to ask themselves if computers are worth the expense. Many of the 2000 computer coordinators, administrators, and teachers at the National Educational Computing Conference in Boston recently said that they came looking for justification for using high-cost technology. But judging by papers delivered and comments made at the NECC, final grades aren't in yet on the benefits of computers and computer courses in the classroom.

After *The National Assessment of Educational Progress* was published by the Educational Commission of States, painting a grim picture of U.S. schools, some educators proposed programming courses as a means to improve weak thinking skills. But while the number of schools teaching programming courses continues to increase, so does the number of studies failing to document significant improvements in students' thinking skills as a result of these courses.

Mark L. Walker and Sharon Carver of the University of Rochester say that schools justify every subject in the curriculum on the grounds of two educational goals: "transmission of substantive subject-matter knowledge and the enhancement of general problem-solving skills."

Walker and Carver studied and tested the effectiveness of a curriculum to foster planning skills. The students started their 18 months of Logo programming in the fifth grade, doing tasks that involved list processing and essay writing. The team studied the think-aloud protocols used by the students. Their study concluded that programming effectively enhanced general problem-solving skills when students already had "the relevant prerequisite knowledge in each of the domains" in which they expected students to apply the general skills. The students who lacked the prerequisite knowledge did not benefit from learning to program a computer, the study said.

Another study, by Yuen-Kuang Liao and George W. Bright of the University of Houston, presented in a paper entitled "Computer Programming and Problem-Solving Abilities," suggested that "the outcomes of learning a computer language go beyond the content of that specific computer language." Students are able to obtain some cognitive skills, such as reasoning, planning, and general problem solving "through computer programming activities," they wrote. However, Liao and Bright said they need to clarify the "exact nature of the problem-solving abilities most likely to be developed through programming." They question whether computer programming is as efficient at developing these problem-solving abilities as other possible instructional approaches.

Pocket Memory Cards: Companies Seek Standards for Tiny Storage Devices

Memory cards are an essential component in the new wave of notebook-size computers. Without such tiny storage devices—they're about the same dimensions as a credit card—manufacturers such as NEC, Agilis, and Poqet wouldn't have been able to fit their full-fledged computers into packages more portable than a six-pack of beer. These cards, made by NEC, Fujitsu, Toshiba, Hitachi/Maxell, Epson, Mitsubishi, and others, range in storage capacity from as little as 16K bytes to as much as 16 megabytes. Because of their size and simplicity, they will become prevalent in featherweight computers.

But first the industry has to solve one critical issue: No standard physical, electrical, or logical formats exist for these cards. The dimensions

continued

NANOBYTES

The best **power source for portable computers** would be rechargeable lithium batteries, which would offer twice the voltage at half the weight of current batteries, says computer designer **George Morrow**. However, Morrow says, lithium is an extremely reactive metal, and the U.S. Environmental Protection Agency has refused to allow lithium batteries larger than AA size. The EPA is concerned with the possibility of larger lithium batteries, which explode more violently than conventional batteries, breaking open and releasing the metal into the environment.

Computer Professionals for Social Responsibility has issued a call for papers for its next symposium on Directions and Implications of Advanced Computing. The DIAC-90 conference will address "**ethical, social, and moral issues** in which computing plays a part." Papers should cover topics in general categories, such as direction and sources of research funding, defense applications, computers in a democratic society, and computers used for the public welfare. "Papers on ethics and values are especially desirable," a spokesperson said. Papers are due by March 1, 1990. The symposium is scheduled for July 1990 in Boston. Contact program chair Doug Schuler at (206) 865-3226.

IBM has brought its **4-megabit memory chips** to market on a board for upper-end PS/2 computers, making it the first PC product that uses the new, denser memory chips. The PS/2 Enhanced 80386 Memory Option, which works in Model 70s and 80s, comes in 2- and 4-megabyte versions, priced at $1795 and $3495, respectively. IBM says the 4-megabit chips, made at plants in Vermont, West Germany, and Japan, can access a bit of data in 80 ns.

NANOBYTES

Oki Electric (Tokyo) has joined the group of vendors working to develop a **multiprocessor version of Unix for Intel's 80386, 80486, and 80860** processors. Other members of the project are Intel, AT&T's Unix Software Operation, Olivetti, Unisys, and Prime. The software will conform to AT&T's System V Interface Definition. Intel said that the multiprocessor version will be ready for beta test sometime during the last quarter of this year and will be ready for commercial release next year.

Unix, Italian style: The Italian market for Unix-based systems will hit 1100 billion lira, or $750 million, this year, says the Italian research firm Mate. Last year, 30,000 Unix-based computers, worth 800 billion lira ($548 million), were shipped in Italy, a Mate report says. In 1987, 80286- and 80386-based systems running **Xenix** accounted for 71 percent of the units at Unix installations in Italy, but those machines have been gradually losing ground to engineering workstations, Mate's study shows.

OS/2 is such a good environment for developing code that **Jensen & Partners International** is now using it to develop all its products, said company president Neils Jensen during a demo of JPI's new C compiler. JPI is also using OS/2 to create MS-DOS versions of its compilers, said Jensen, who developed software at Borland International before starting his own company. OS/2 "could be very successful if IBM would push it as a developer's platform," Jensen said. JPI's latest developer's product is TopSpeed C.

Paul Mace, known for his eponymous company's line of software utilities, such as Mace Gold and Vaccine, will now be developing programs exclusively for **Fifth Generation Systems** (Baton Rouge, LA), which has taken over the ownership and marketing of Mace's commercial products. Fifth Generation is known for Fastback, Suitcase II, Pyro!, and other utility programs.

aren't standard, the electrical specifications (e.g., the voltage thresholds) aren't standard, and the logical format for storing and executing data and applications aren't standard.

In an effort to establish these standards, most of the memory-card manufacturers, some of the hand-held system vendors (e.g., Toshiba, NEC, and Poqet), and some major software companies (e.g., Lotus, Microsoft, WordPerfect, and WordStar USA) have set up a technical committee that will attempt to iron out a consensus. The committee is establishing technical and marketing groups to begin work on the standards as well as to promote memory cards as a competitive storage medium.

Competing technologies already in place will make it difficult to arrive at a single standard. NEC's UltraLite uses a 60-pin memory card that appears as an additional floppy disk drive on the computer; applications are loaded into system RAM and executed just as they would be from a floppy or hard disk drive.

The Poqet Computer memory card uses a 68-pin connector and executes the application directly from the ROM on the memory card. This configuration is supported by the Japanese Electronics Industry and Development Association (JEIDA), whose members include Fujitsu, Toshiba, Hitachi/Maxell, and Epson.

Agilis's hand-held workstation uses a proprietary format developed by Mitsubishi; it also formats the card like a floppy disk drive, but it is not compatible with the NEC approach. The memory cards in these various systems are not interchangeable.

These various formats and code-execution schemes mean that software developers have to write different versions of their software for each system. The easiest format, from a software developer's standpoint, is NEC's, which requires very minor modification of programs designed to run off floppy disk drives. The Poqet approach requires the software application to use a different memory scheme, which means that a developer has to make some code modifications to existing applications. However, the execution scheme supports LIM/EMS and will not require "a major rewrite if the code is written well," said Neal Chandra, vice president of business development at Poqet.

Software companies are eager to see a single standard. It would reduce R&D expenses and allow vendors to supply a single version of their software for all the different memory cards, said Jim Prelack, Lotus's manager of technical marketing for spreadsheets. And, of course, it would be nice if users could swap memory cards between different computers.

Despite the obstacles, there's optimism that a standard will emerge. Agilis marketing director Bert Keely said he thinks that the standard will be determined by which type of memory card has the most software installed on it. NEC marketing representative Jim Bartlett said he thinks there might be two standards: a standard for microcomputers based on NEC's design, and a "low-end" standard for calculators and other electronic devices, based on the JEIDA ROM-executable approach. Bartlett said that the JEIDA approach "is not applicable to this [the U.S.] market" because there is no installed base of machines supporting that standard in this country.

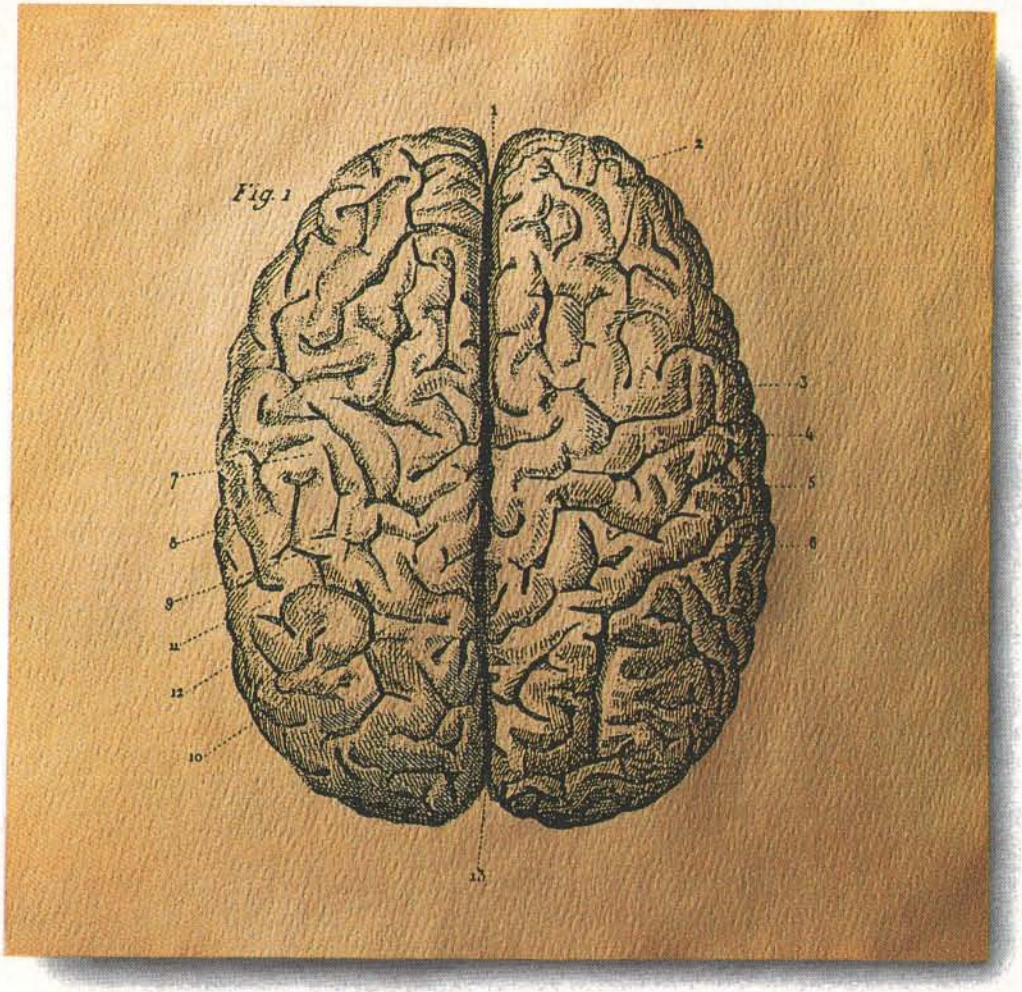
The standards can't come soon enough for product designers. As Fujitsu's John Reimer pointed out, "A whole generation of laptops and notebook computers are in the planning stages, and decisions are being made right now." Without standardization, memory cards will remain expensive, and software developers will be reluctant to tailor their software to them.

BIT Speeds Up SPARC with New Process

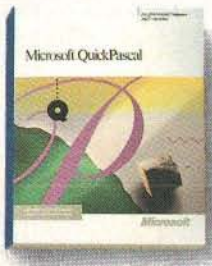
Bipolar Integrated Technology (Beaverton, OR) says it has produced the first emitter-coupled-logic (ECL) RISC microprocessor and claims that it's the fastest chip yet based on Sun Microsystems' Scalable Processor Architecture. The new 32-bit SPARC microprocessor runs at 80 MHz and executes 50 to 65 million instructions per second, the company says. The accompanying floating-point chip set can execute up to 40 million floating-point operations per second and offers a sustained processing rate of 14 MFLOPS, BIT says. That would make it comparable to Intel's new 80860 chip. Sun has said

continued

Now QuickPascal makes this software go even faster.



Even the quickest minds tend to brake suddenly when confronting new languages.



Enter new Microsoft® QuickPascal Compiler.

The first Pascal that is not only powerful but easy, intuitive and 100% headache-free.

For example, our new hypertext QuickPascal Advisor offers on-the-job training: by cutting and pasting sample code you can learn to program in Pascal from scratch. And if you do hit a snag, the Quick Advisor can straighten everything out right on the spot.

To accelerate your thought processes even more, all of our processes are seamlessly integrated; no other Pascal offers you easier access to your editor, debugger and compiler.

What's more, QuickPascal is the first PC Pascal to offer Object Oriented Programming, or OOP. With objects, you can easily assemble whole programs from modular building blocks of code and data. And once you know Pascal, OOP is a snap. Which means, you get maximum productivity with minimum effort.

Naturally, our Pascal is also fully source compatible with Turbo Pascal®.

So stop by your Microsoft dealer soon.

You'll find our software is on the same wavelength as yours.

Microsoft

Making it all make sense.™

Customers in the U.S. call (800) 426-9400. In Canada, call (416) 673-7638. Outside North America, call (206) 882-8661. © Copyright 1989 Microsoft Corporation. All rights reserved. Microsoft and the Microsoft logo are registered trademarks and *Making it all make sense* is a trademark of Microsoft Corporation. Turbo Pascal is a registered trademark of Borland International.

Epson EPL-6000. HP emulation. 300 x 300 DPI. 6 PPM. 512KB RAM, expandable to 4.5MB. 6 resident fonts. Two option font slots. Enhanced SelecType control panel. One year limited warranty.

UNTIL NOW, LASER PRINTING HAS BEEN OUT OF REACH FOR MANY PEOPLE IN BUSINESS.

HP LaserJet II is a registered trademark of Hewlett-Packard. Epson is a registered trademark of Seiko Epson Corporation. Epson America, Inc., 2780 Lomita Blvd., Torrance, CA 90505. **(800) 922-8911.**

With the new, affordable EPL-6000 from Epson, more businesses will be looking better on paper.

Opting for the quality of a laser printer has just become decidedly easier. Introducing the EPL-6000 laser printer from Epson.®

Coming from the company with the longest running success in the printer business, reliability is a given. What's more, the new EPL-6000 is compatible with application software written for HP LaserJet II.®

As for value, this new Epson combines solid, businesslike performance with a price that is as attractive as the printing. In fact, for quality, reliability and value in a laser printer, you could say Epson has the solution well in hand.

EPSON

WHEN YOU'VE GOT AN EPSON, YOU'VE GOT A LOT OF COMPANY.™

NANOBYTES

If you've ever had the **battery in your PC AT die**, you know how painful *that* can be. The lithium batteries in most ATs are good for a year or two, but once they croak, new ones are hard to find. **Rupp** Corp. (New York, NY) now has a nice means of insurance: a rechargeable backup battery for AT-type computers. Rupp's bATPac ($39.95) continually charges itself while your computer is on and will last for at least 10 years, the company says.

Data General's Aviion computers, based on Motorola's 88000 RISC processor, will be able to run **DOS applications**, thanks to a deal DG (Westborough, MA) signed with **Phoenix Technologies** (Norwood, MA). Phoenix will develop a version of its OpenPC software that will enable the DG systems to run DOS programs simultaneously with Unix programs.

NCR Corp. (Dayton, OH) and **IMC Networks** Corp. (Tustin, CA) are teaming up to develop a **32-bit Ethernet card** that will take advantage of the Micro Channel architecture's bus-mastering capabilities. The communications card will be built around NCR's 32-bit Ethernet controller chip, the 92C28. The forthcoming PCnic MCA bus card will comply with IEEE 802.3 Ethernet standards and will work with both thick and thin coaxial cable. The companies say the card will be out this quarter and will sell for $995.

Data Translation (Marlborough, MA) has **dropped prices** of its image processing and data acquisition products by as much as 25 percent. The DT2853-SQ PC AT Frame Grabber, for example, has gone down from $1895 to $1595, and the DT2817 PC Digital I/O Board has gone from $239 to $215.

AST Research (Irvine, CA) **lowered prices** on its computer systems with hard disk drives. The Premium 386/25 Model 95, for example, dwindled in price to $7195, a drop of $1100. AST also lowered the price of its hard disk drive upgrades.

that it has the BIT chips running now in its labs and plans to use them in future systems.

ECL designs have long offered higher speed than traditional TTL or CMOS chips, but they have suffered from higher power dissipation and lower gate densities. BIT claims to have solved these problems through a proprietary process called BIT111, which permits the company to make chips with the density of MOS chips and the speed of ECL chips.

The BIT111 process uses three metal layers and 1.2-micron lithography but employs conventional semiconductor manufacturing equipment, the company says. By reducing power consumption and reducing the size of transistors, BIT says it can squeeze as many as 250,000 transistors on a single chip.

The heart of the BIT chip set is the B5000, a 32-bit monolithic integer unit consisting of 125,000 transistors; it has been tested in the lab at up to 100 MHz, company officials say. The B5000 averages 1.2 cycles per instruction versus up to 1.6 cycles of instruction for previous SPARC implementations, according to information provided by BIT.

Portable with Color LCD First of More to Come

NEC has just started selling in Japan a portable computer with a supertwist color LCD. The 80286-based color computer has a list price of 748,000 yen, or about $5250. The 19-pound PC-9801LX5C, measuring 4.5 by 13.3 by14.9 inches, comes with two 3.5-inch floppy disk drives and a 40-megabyte hard disk drive. The display, which measures 9 inches diagonally, supports resolution of up to 640 by 400 pixels and up to eight colors. Although the company does not have plans at this time to offer the new system in the U.S., the computer will soon show up on these shores in one form or another, and it won't be the only color-LCD portable on the market.

Other companies are readying color laptops for the U.S. market, including Sharp, which showed its PC-8000 earlier this year at CeBIT and Spring Comdex. The 80386-based Sharp machine has a 14-inch color screen capable of showing 16 colors from a pallette of 512 at a resolution of up to 640 by 480 pixels. This portable is expected to be available early next year and to cost closer to $10,000, though the price has not been set yet. The backlit Sharp screen uses a series of tiny glass filters that "reflect" the basic red, green, and blue color components.

Hitachi has shown a prototype 6-inch active-matrix color screen installed in a computer but has not disclosed any product plans. The company is selling the display to other manufacturers, though, for about $2200 each. Hitachi's prototype screen manifested one of the problems that's still bugging active-matrix technology: It's hard to produce a perfect model. A careful observer could see that a few pixels were not working properly; active-matrix displays look great, but even one faulty transistor among several hundred thousand can result in a bad pixel.

Toshiba has made no product announcements but has shown prototypes of active-matrix color displays, one 11 inches wide and the other 14 inches. At last viewing, the display was crisp but fragile; company representatives at Spring Comdex would show the display for only 2 hours each day.

George Morrow Readying New Computer

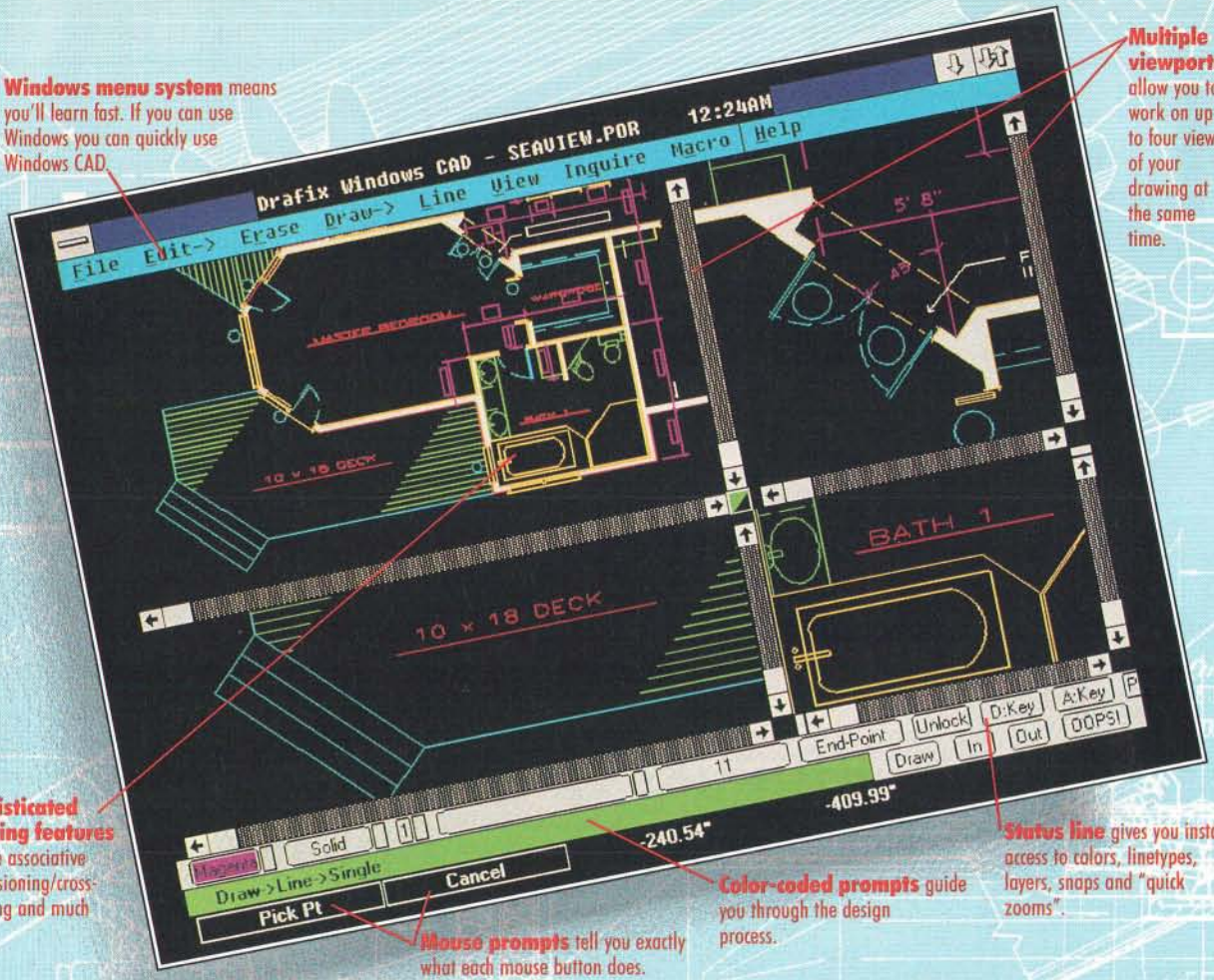
Four years ago, George Morrow was busy designing a portable computer called the Morrow Pivot, probably the first of the so-called lunchbox computers. Now the industry pioneer is working on another laptop, one that he promises will be ready for next month's Fall Comdex.

Morrow's new machine will be a conventional laptop, rather than a "pocketable" computer like those announced by Poqet and Atari, or a hand-held system like the NEC UltraLite, the Zenith MinisPort, and similar machines coming soon from the likes of Toshiba. The CPU will be an Intel 80386SX, a chip that Morrow

continued

Windows menu system means you'll learn fast. If you can use Windows you can quickly use Windows CAD.

Multiple viewports allow you to work on up to four views of your drawing at the same time.



Sophisticated drawing features include associative dimensioning/cross-hatching and much more.

Mouse prompts tell you exactly what each mouse button does.

Color-coded prompts guide you through the design process.

Status line gives you instant access to colors, linetypes, layers, snaps and "quick zooms".

FINALLY, CAD FOR WINDOWS. DRAFIX™ WINDOWS CAD.™

At last the power of true, high performance CAD is available for Windows. Drafix Windows CAD. With features that take you far beyond any Windows drawing package you currently use.

Powerful CAD. Windows CAD is the first and only Windows software to provide all of the designing and editing functions demanded by engineers, drafters, architects and other serious CAD users. It offers multiple interactive viewports, allowing you to work in four views simultaneously. Associative dimensioning, associative crosshatching and a powerful macro programming language are just a few of its features — and that's just the beginning.

Quick to learn, easy to use. Windows CAD lets you take full advantage of your Windows experience. If you already use Excel, Pagemaker, Micrografx Designer, or any Windows package, Windows CAD will have you doing precise, accurate CAD design in no time. And of course you can use all of the plotters, printers and video devices that work with Windows.

From a proven line of CAD products. Windows CAD is the latest in a full line of highly rated CAD software that includes Drafix CAD Ultra, Drafix CAD QwkStart and Drafix 3-D Modeler.

Order your copy of Drafix Windows CAD today! Now if you have Windows, you can have the full power of true CAD. Drafix Windows CAD. Only $695. For more information call us today at **1-800-231-8574.**

Drafix Windows CAD has features you usually find in packages costing 5 times as much!

Item Attributes ☐ 256 layers ☐ 8 colors ☐ 9 linetypes ☐ Up to 60 database attributes to any entity ☐ Multiple line widths

Drawing Features ☐ Lines: single, double, tangent, parallel, perpendicular, multiple width ☐ Arcs/Circles ☐ Curves/Splines ☐ Polygons and Polylines ☐ Ellipses ☐ Paintmarkers ☐ Freehand sketching

Input Methods ☐ Windows menu system ☐ Keyboard equivalents ☐ Ortho lock ☐ 10 item and grid snaps, including endpt, midpt, tangent and more ☐ Keyboard entry of coordinates ☐ OOPS (Undo) feature ☐ Dynamic Drag ☐ Quick zoom/pan ☐ Multiple viewports, all active

Powerful Editing Features ☐ Trim entities to each other ☐ Stretch ☐ Fillet (round) ☐ Chamfer (bevel) ☐ Erase ☐ Copy ☐ Move ☐ Mirror ☐ Rotate ☐ Arrays ☐ Select items by region, entity, attribute or combinations

Associative Dimensioning ☐ Linear, Radius, Diameter ☐ Single, Continuous, Baseline ☐ Ordinate, Elevation or Bearing format ☐ 23 terminator types ☐ Any alignment ☐ Tolerancing ☐ English and metric ☐ Fraction or Decimal

Associative Crosshatching and Solid Fill ☐ 15 crosshatch patterns, ANSI specs ☐ 64 solid fills

Text Editing ☐ Word processing window ☐ Multiple font styles

On-Line "Help" system

Macro Programming Language

System Requirements ☐ '286 or '386 processor ☐ Microsoft Windows 2.1 or later ☐ 1 Mb internal memory or greater ☐ Windows-supported mouse

File Compatibility ☐ Autocad DXF ☐ Drafix CAD ☐ HPGL ☐ CDF, SDF for database information

DRAFIX WINDOWS CAD

Foresight Resources Corp.
1-800-231-8574

Excel, Pagemaker and Micrografx Designer are trademarks of their respective companies.

Circle 100 on Reader Service Card (DEALERS: 101)

Smalltalk/V® PM. Think of it as a bold, "seat-of-the-pants" solution that cuts to the heart of the OS/2 Presentation Manager complexity challenge. Thus unlocking the potential of this powerful operating system.

Introducing Smalltalk/V PM. The to fulfill the promise of OS/2.

With the introduction of Smalltalk/V PM, object-oriented programming moves out of the realm of mystery and into a new era of breakthrough applications that promises to be of legendary proportions.

OS/2 PM is designed to push "user friendly" to a whole new level of sophistication. If you compare it to an orchestra, OS/2 has capabilities no ordinary assemblage of instruments has ever dreamed of possessing. Yet to tap its potential, OS/2 PM demands a conductor capable of true genius. That conductor is Smalltalk/V PM.

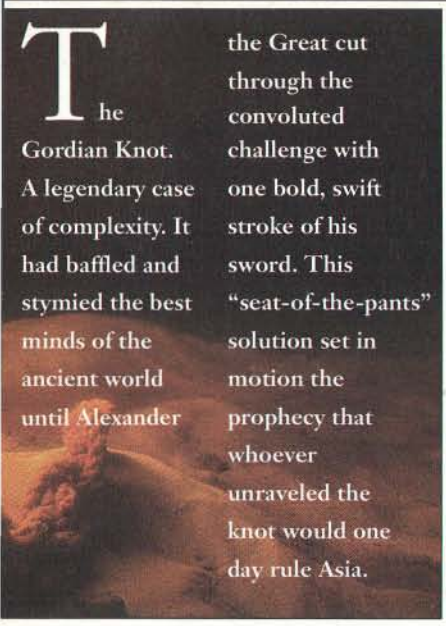
Is The Most Important Part Of Your Developer's Kit Missing?

OS/2 PM offers you a powerful, rich environment loaded with advantages like a Graphics Programming Interface (GPI), a LAN manager, multitasking, SQL, just for starters. And all of these components are accessible in a standard way using Smalltalk/V PM through Dynamic Link Libraries (DLLs). Combined with DDE (Dynamic Data Exchange), you can call and exchange data with other PM services or applications. Seamlessly. Now developers can write truly reusable components, which greatly increases their value. And you'll find Smalltalk/V PM the perfect "glue" between applications written in other languages.

You'll find Smalltalk/V PM a perfect language for representing and manipulating high-level information. Because you go from designing to prototyping to delivering a completed application in one seamless step, you cleanly avoid the old costly "crash and burn" delays so common with languages born in the age of mainframes.

UNLEASHING THE AWESOME POWER OF OS/2 PM

Smalltalk/V PM. It helps stop the natural drift toward vaporware so common in software development today. It lets you dive right in and get to the creative parts without the usual grunt work. For example, if you want to ignore the complexities of understanding OS/2 PM details you can immedi-

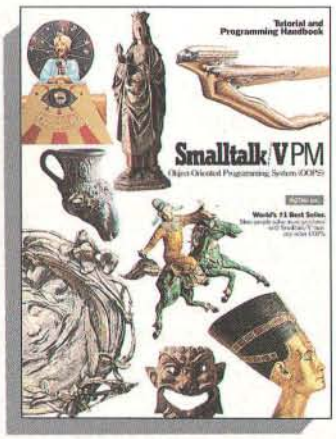


The Gordian Knot. A legendary case of complexity. It had baffled and stymied the best minds of the ancient world until Alexander the Great cut through the convoluted challenge with one bold, swift stroke of his sword. This "seat-of-the-pants" solution set in motion the prophecy that whoever unraveled the knot would one day rule Asia.

"THIS IS THE RIGHT WAY TO DEVELOP APPLICATIONS FOR OS/2 PM.
OS/2 PM is a tremendously rich environment, which makes it inherently complex. Smalltalk/V PM removes that complexity, and lets you concentrate on writing great programs. Smalltalk/V PM is the kind of powerful tool that will make OS/2 the successor to MS/DOS."

Bill Gates, Chairman
Microsoft Corp.

fast, seat-of-the-pants way



THE FIRST FULLY-COMPILED SMALLTALK.
Because Smalltalk/V PM is fully compiled it provides you with a more responsive environment than ever before. Now you'll be able to generate stand-alone applications (.EXE).

ately start creating without any limitations on your efficiency.

However, if you're the curious type, we have tools called browsers to help you fathom the masterpiece called OS/2 PM. You'll also find our incremental program development capability and push-button debugger simplifies application development and gives you instant response when you implement an idea. Our extensive user manuals and tutorials have earned us high praise.

SMALLTALK/V PM. THE TALKING HAS ALREADY STARTED.

"Digitalk's Smalltalk/V PM is a masterful implementation of a classical object-oriented programming language and a state of the art graphical user interface. Any programmer struggling with the complexities of Presentation Manager should take a close look at this product."

Charles Petzold, Contributing Editor, PC Magazine

"Digitalk's Smalltalk/V PM is dazzling! This product makes Presentation Manager pay off."

Jeff Duntemann, Contributing Editor, Dr. Dobbs Journal

"Smalltalk/V PM is an excellent tool for rapid delivery of prototypes which have all the functionality and user interface of a complete PM application."

Richard A. Landsman, System Architect, Lotus Development

"Smalltalk/V PM from Digitalk is the greatest! This is an incredible product."

J.D. Hildebrand Editor-in-Chief, Computer Language

THE BEST PM INVESTMENT YOU'LL EVER MAKE

Smalltalk/V PM $499.95

Prices and information on these and other Digitalk products are available on request:
Smalltalk/V, Smalltalk/V 286, Smalltalk/V Mac

Smalltalk/V

Smalltalk/V. A product of Digitalk Inc., 9841 Airport Blvd., Los Angeles, CA 90045. For information or to find a dealer near you call:

1-800-922-8255
1-213-645-1082
CompuServe 71361,1636
FAX 1-213-645-1306

Smalltalk/V is a registered trademark of Digitalk Inc. Prices subject to change without notice.
Other product names are trademarks or registered trademarks of their respective holders.

NANOBYTES

Texas Instruments (Houston) has officially released its **TI Graphics Architecture interface specification**, which is designed to optimize communications between TI's TMS340x0 graphics processor and the host processor that it's working with. TI is now offering several kits for software developers who want to make their applications compatible with TIGA. Meanwhile, TIGA continues to collect fans, with the latest major backer being **Hewlett-Packard**; HP said that TIGA will result in more applications supporting high-resolution graphics on personal computers.

After investing $100 million in Steve Jobs's **NeXT** Computer (thus buying one-sixth of the company), **Canon** has introduced the black cube to Japan. At the machine's official debut in Tokyo in July, about 3000 people showed up to see Jobs and his company's new system, a BIX user in Japan said. The event took place in a hall next to the site of Tokyo Disneyland, which somehow seems appropriate. In Japan, Canon will sell the basic NeXT computer for 1,980,000 yen, or about $14,000; with a 660-megabyte hard disk drive, for 3,980,000 yen, or about $28,000. A Japanese-language version is slated for next year. "Many people believe **Asia** will be the growth market for computers in the 1990s, and we believe that too," Jobs said.

Symbolics (Los Angeles) has moved its professional-grade **Animation and Paint System** from the high-end Symbolics 3600 workstations to the Mac II-based **MacIvory** system. The software is geared toward industrial design, scientific visualization, and engineering applications. The basic setup includes a Mac II with a MacIvory board, 5 megabytes of main memory, 16 megabytes of NuBus memory, a 320-megabyte SCSI hard disk drive, a 32-bit NuVista frame grabber/buffer, and a 16-inch monochrome monitor. Prices start at $49,500 and ascend to $75,900 for a system capable of three-dimensional painting, but these prices are about half of what the 3600-based models sell for.

said will become the standard in laptops in the next year.

VGA resolution (640 by 480 pixels) with at least eight shades of gray is the standard for laptop displays now, Morrow says; his machine will have at least 16 gray shades and perhaps as many as 32, using a new graphics controller from Cirrus Logic.

Although several color LCD screen prototypes have been seen at trade shows and NEC is now selling a portable with a color LCD, Morrow says he doesn't think they're practical yet for laptops. Aside from their high cost, the current color screens use tremendous amounts of battery power and tend to heat up. However, Morrow said that fiber-optic technology could make color screens practical sometime next year.

Like current laptops from Zenith and Compaq, the new Morrow machine will use power-management controller chips to push power requirements down; Morrow said he hopes that his system will offer 8 hours of use on a single battery charge. The key, he says, is replacing the typical nickel-cadmium batteries with nickel-hydride batteries, which weigh half as much for the juice they produce.

Will the new machine have a floppy disk drive? Maybe not. One possibility that Morrow is considering is to offer one of the new tiny 20- or 40-megabyte hard disk drives that weigh far less and use less power than a floppy disk drive. That, of course, would require some unconventional ways of getting programs and data into the laptop; Morrow says he's looking seriously at some exotic technologies, including infrared and radio-frequency modems.

Morrow says prices for the new system will start at $3995.

Government Agencies at Odds over Computer Sales to Soviets and Warsaw Pact Countries

The U.S. Commerce Department has lifted restrictions on the sale of most 80286-based desktop computers to Soviet-bloc countries, a move that pleased people in the computer industry but drew flak from other segments of the federal government.

U.S. companies can now sell to Soviet-bloc nations standard desktop personal computers with a Processing Data Rate of up to 68. The PDR is the Commerce Department's formula for computer power. A PDR of 68 would represent the equivalent of a system with an Intel 80286, up to 4 megabytes of RAM, and hard disk drive storage of up to 140 megabytes. The change represents a tenfold PDR increase; the previous level was 6.5.

The Commerce Department also lifted export restrictions for systems such as the Apple Macintosh Plus and SE and the IBM PS/2 Model 30. Restrictions are still in place for systems based on the 80386, the 68020, and the 68030, and for certain laptop computers.

"We are creating new opportunities for U.S. manufacturers to sell more widely abroad," said Commerce Secretary Robert Mosbacher. The Commerce Department says that some 6 million AT-compatible desktop computers were sold worldwide by U.S. companies in 1988; 2.7 million of them, worth more than a billion dollars, were sold outside of the U.S. Computer makers, including IBM, Apple, and Compaq, welcomed the change but expressed reservations about the size and profitability of the Soviet market.

The decision is not without detractors. Secretary of Defense Richard Cheney told reporters that he opposed the move, saying it will give the Soviet Union "significant capabilities" that it does not currently possess and will give the Soviets computers with "military applications." But Mosbacher said the Commerce Department had found that AT-type systems were already readily available in Eastern European and Soviet-bloc countries.

The U.S. Department of State agrees with the Department of Defense. The U.S. will continue to withhold high-technology exports from the Soviet Union and other Warsaw Pact countries, a State Department official said shortly after the Commerce Department announced its revised restriction list. The State Department will continue to "deny Moscow any such technology that could enhance its military capacity," the official told Microbytes Daily.

Exporting sophisticated computer

continued

NOW! Larger Data Sets. Upgrades Available

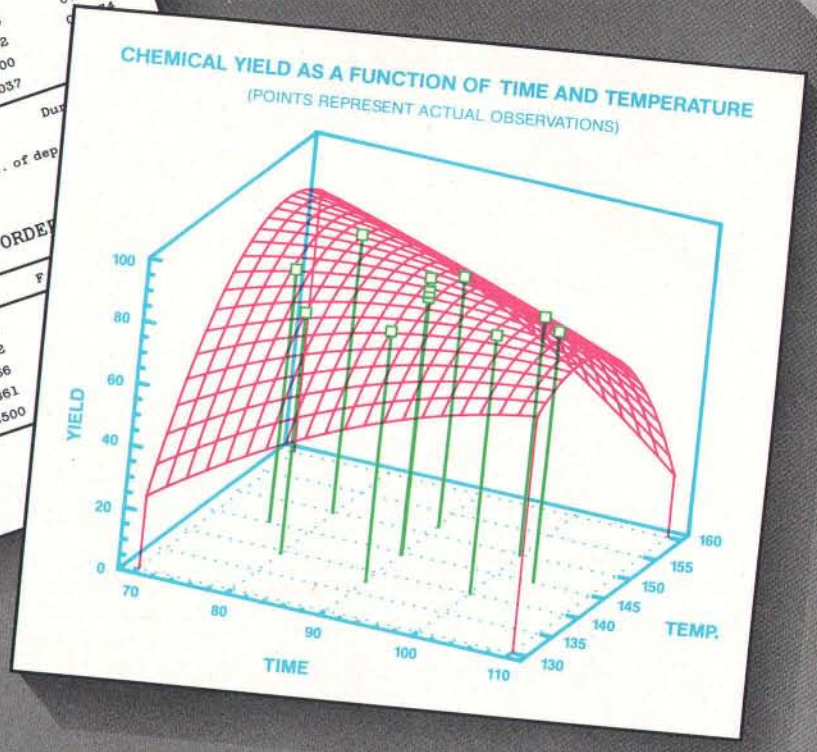
MODEL FITTING RESULTS FOR: YIELD

INDEPENDENT VARIABLE	COEFFICIENT	STD. ERROR	T-VALUE	SIG. LEVEL
CONSTANT	-3977.847583	747.932209	-5.3185	0.0018
time	17.862499	3.288094	5.4325	0.0016
time^2	-0.021469	0.008136	-2.6386	0.0386
temp	44.997502	9.614533	4.6802	
temp^2	-0.124651	0.032546	-3.8300	
time*temp	-0.0975	0.020297	-4.8037	

R-SQ. (ADJ.) = 0.7865 SE = 2.029674 MAE = 1.173868 Du
Previously: 0.0000 0.000000 0.000000
12 observations fitted, forecast(s) computed for 0 missing val. of dep

FURTHER ANOVA FOR VARIABLES IN THE ORDE

SOURCE	SUM OF SQUARES	DF	MEAN SQ.	F
time	15.3890909	1	15.389091	
time^2	15.6011921	1	15.601192	
temp	1.0765657	1	1.076566	
temp^2	60.4298606	1	60.429861	
time*temp	95.0625000	1	95.062500	
Model	187.559209	5		



BRAINS & BEAUTY

STATGRAPHICS® Sophisticated Data Analysis *and* Gorgeous Graphics — In An Easy-to-Use PC Statistics Package.

Get the best of both worlds with STATGRAPHICS — sophisticated data analysis *and* a dazzling array of graphics in an easy-to-use PC statistics package.

Powerful Statistics. Realize the full potential of your analytical skills. STATGRAPHICS gives you over 250 statistical procedures including ANOVA, regression analysis, quality control procedures, experimental design, multivariate techniques, nonparametric methods, exploratory data analysis, forecasting, time series analysis, and more.

Incredible Graphics. Turn the "Ho-Hum" into the "Ah-Ha!" STATGRAPHICS includes over 50 types of graphs that allow you to analyze your data visually and communicate your results brilliantly!

Easy To Learn and Use. Enter your data using our full-screen editor, or import data directly from your ASCII, dBASE®, Lotus®, or DIF files. STATGRAPHICS is completely menu-driven and includes online HELP, a self-paced tutorial, handy reference cards, and a user's guide complete with examples and sample data sets. No wonder *InfoWorld* said STATGRAPHICS "makes interactive data analysis and knock-your-socks-off graphics easy."

Why compromise? Get the power of sophisticated data analysis *and* gorgeous graphics with STATGRAPHICS — all for only $895.* For more details or to order today, call:

(800) 592-0050 ext. 400

In Maryland, (301) 984-5123;
Outside the U.S., (301) 984-5412 for the name of the dealer nearest you.

Ask about our money-back guarantee!

PC MAGAZINE EDITORS' CHOICE March 14, 1989

STSC STSC, Inc.
2115 East Jefferson Street
Rockville, MD 20852

Circle 263 on Reader Service Card

*Suggested retail price in U.S. and Canada. International prices vary. STATGRAPHICS, dBASE, and Lotus are registered trademarks of Statistical Graphics Corp., Ashton-Tate, and Lotus Development Corp., respectively.

Spreadsheet Rivalry Heats Up

products are not enough if software ... puter stores.

'Things are getting down and dirty,' a computer analyst observes.

Dealers who have seen what will be ... new promo-

RACE ... VS. PC

ust when ... tablishe ...

We Interrupt T... War For This Im...

To all those unlucky enough to be stuck smack in the middle of the current spreadsheet confusion, take heart.

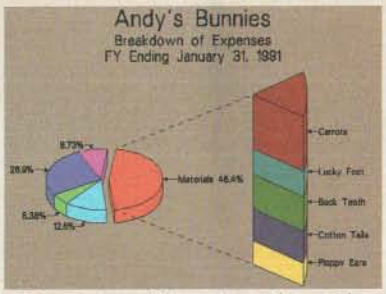
There is, at last, a viable alternative to war: revolution.

One that delivers even more performance than you have (ahem) been waiting for, but without demanding expensive new hardware or extensive retraining. And without abruptly cutting you off from any user in your company, even those on mainframes.

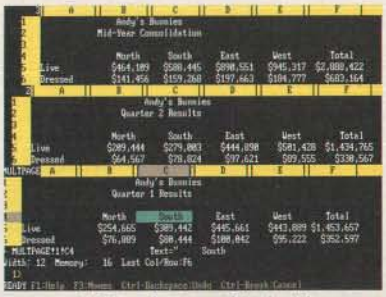
The name of the spreadsheet is SuperCalc®5.

And what it can do for you is, frankly, quite revolutionary.

Let's begin at the end. Stand-alone quality graphic capabilities have been built in. Offering hundreds of presentation treatments from word charts to three-dimensional bar, pie, scatter, and polar graphs.



Present a state-of-the-art picture of your work.



Link just about everything in sight.

And with SuperCalc5, you select fonts, lines, boxes, grids and shading. All of which can be used to produce the highest quality customized reports.

Plus, SuperCalc5 actually makes productivity easier. An integrated Undo feature simply reverses unwanted commands. And a truly comprehensive system of debugging highlights costly errors and analyzes macro logic.

Perhaps even more impressive is the way SuperCalc5 can link spreadsheets. Up to 255

Catch bugs before they come back to bite you.

© 1989 Computer Associates International, Inc. 1240 McKay Dr., San Jose, CA 95131. Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation. Excel is a registered trademark of

he Spreadsheet portant Update.

to be precise. Linking either in memory or on disk, either pages of the same spreadsheet or independent, either SuperCalc5's files or Lotus® 1-2-3®'s.

Which brings us to the "L" word. SuperCalc5 not only reads and writes Lotus® 1-2-3® files, it totally coexists with Lotus.

Andy's Bunnies

Income Statement

FY Ending January 31, 1991
Unaudited

	This Year	Last Year
Revenue:		
Sales		
Live	$5,778,453	$4,981,872
Dressed	$1,444,775	$677,313
Sales Discounts	($434,993)	($475,150)
Rent-a-Rabbit Fees	$679,991	$324,183
	$7,468,229	$4,613,218
Cost of Sales:		
Opening Inventory	$9,662,351	$5,676,715
Purchases	$109,814	$4,224,144
Freight in	$56,727	$43,345
	$9,828,892	$9,943,318
Ending Inventory	$7,334,110	$9,662,351
Cost of materials	$2,494,782	$280,967
Direct labor	$1,467,951	$1,477,260
Employee benefits	$289,390	$335,619
Ranch supplies	$679,444	$627,892
Total Cost of Sales	$4,931,767	$2,929,951
Gross Profit	$2,536,462	$1,707,917
Less selling, general and admin expenses	$469,687	$495,771
Earnings (loss) from operations	$2,066,375	$1,211,540
Other income and expense		
Interest income	$11,309	$9,760
Other income	$17,899	$15,040
Gain (loss) on sale of fixed assets	($375)	$0
	$28,829	$24,431
Provision for income taxes:		
Current income taxes	$1,050,207	$605,772
Deferred income taxes	$0	$0
	$1,045,207	$605,772
Net earnings (loss) for period	$1,045,207	$605,772

Produce annual-report quality output everyday.

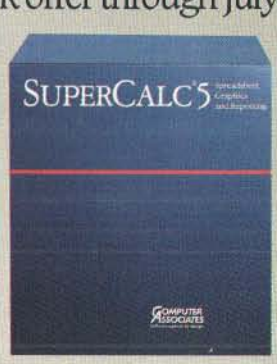
Letting you easily move 1-2-3 macros into SuperCalc5 and back again. Even toggling between menus is a snap for SuperCalc5.

But not for Excel®.

Which now brings us to the "E" word. Unlike Excel, SuperCalc5 runs on all IBM® and compatible computers but also takes full advantage of 286 and 386 machines when *you* decide to make that transition.

And if all that isn't enough to make you run out today and join the revolution, there's even more incentive.

Like our free demo disk offer through July 31, 1989. And our $100 upgrade offer for just about any spreadsheet you're using. Call 1-800-531-5236. In Canada call 1-800-663-6904.



Which finally brings us to our admittedly biased outlook for the much touted spreadsheet war.

With SuperCalc5, peace is at hand.

COMPUTER® ASSOCIATES
Software superior by design.

Microsoft. IBM is a registered trademark of International Business Machines.

Circle 60 on Reader Service Card

NANOBYTES

NCUBE (Beaverton, OR) has started shipping what it claims is the **fastest supercomputer in the world**. The massively parallel NCUBE 2 can be outfitted with as many as **8192 processors**; with that many of the 64-bit processors working together, the system can execute 60 billion instructions per second and 27 billion scalar-point operations per second, the designers say. NCUBE plans to have a version of Unix running on the supercomputer. **Oracle** has already said that it will port its database management software to the parallel system. The NCUBE 2 starts at $495,000.

Remember **CEBus** and the **Smart Home**? CEBus is a set of specifications for encoding and transmitting information over AC power lines. Home-electronics makers hope to design 'smart' appliances that talk to each other. But there's been 'embarrassingly little change' since CEBus made its debut in January, said Bob Garry of Diablo Research, one company working on the CEBus technology. Problems involving the networking of appliances over AC lines have yet to be ironed out, he said.

Vapor chasers: An **Ashton-Tate** attorney recently sent a letter to **WordTech** demanding that WordTech cease and desist marketing a product called dBASE/SQL. "Please be advised that your use of the 'dBASE' mark consitutes a violation of Ashton-Tate's federally registered trademark," wrote the ever-vigilant A-T attorney on the case. The letter demanded that WordTech, which makes products that integrate its dBASE-compatible DBXL with SQL, change the name of dBASE/SQL and destroy any materials that refer to dBASE/SQL. Fulfilling the A-T mandate will be tough: WordTech says it doesn't make a product called dBASE/SQL. Company president David Miller referred to "dBASE/SQL" as "**the ultimate vaporware**, since it's unannounced, undesigned, undeveloped, unknown, has no marketing plan, sales plan, packaging plan, nor any release date or pricing."

technology could "provide the Soviets with sufficient advancements in military design, which in turn would make it even more expensive for the U.S. to maintain a military advantage," said one member of the State Department.

The State Department's clarification of its stance coincided with meetings being held by the Coordinating Committee for Multilateral Export Controls in Paris. COCOM is the organization of NATO countries that oversees technology trade with the Eastern Bloc. Most COCOM representatives have favored loosening export restrictions to the USSR, if for no other reason than because they don't think the restrictions are working. Prohibiting export of AT-style machines had "become almost impossible to enforce because they are available through so many sources," said Frank Deliberti of the Department of Commerce's Office of Export Enforcement.

Intel Delivers EISA Chips to System Makers But Says Bus Won't Drive Users' Choices

Ten months after nine computer makers said they didn't need IBM's Micro Channel architecture (MCA) and announced their own 32-bit bus standard, Intel officially introduced the chips that will make the Extended Industry Standard Architecture a hardware reality. Computer makers adopting the EISA bus said that they'd have EISA-compatible systems ready by Comdex next month.

The new Intel EISA 82350 package consists of four chips. The 82357 incorporates enhanced direct-memory-access control, a timer/counter, interrupt control, bus arbitration, and DRAM refresh functions on a single chip. Intel says the chip offers a maximum DMA transfer rate of 33 megabytes per second, which is more than eight times faster than the transfer rate of the AT bus. By comparison, the MCA bus has a maximum data transfer rate of 20 megabytes per second, according to Intel. The 82357 also handles bus arbitration.

The 82358 EISA bus controller interfaces with the 8-/16-bit AT bus, the 32-bit EISA bus, and the host CPU bus. It will allow existing AT boards and the future EISA boards to coexist in an EISA system.

The 82352 EISA bus buffer is used to integrate the data swap logic, the address buffers, and the data parity buffer. It's designed to integrate approximately 17 components, thus lowering the system board chip count and cost. According to Intel, the 82352 chip is intended for those system manufacturers seeking higher integration on the system board.

The 82355 bus-master interface controller acts as an interface between the local functions of the bus-master card and the EISA bus-master protocol. The 82355 "arbitrates" for bus ownership and can take control of the bus from the host CPU for bus-intensive tasks, such as database management and high-performance file serving.

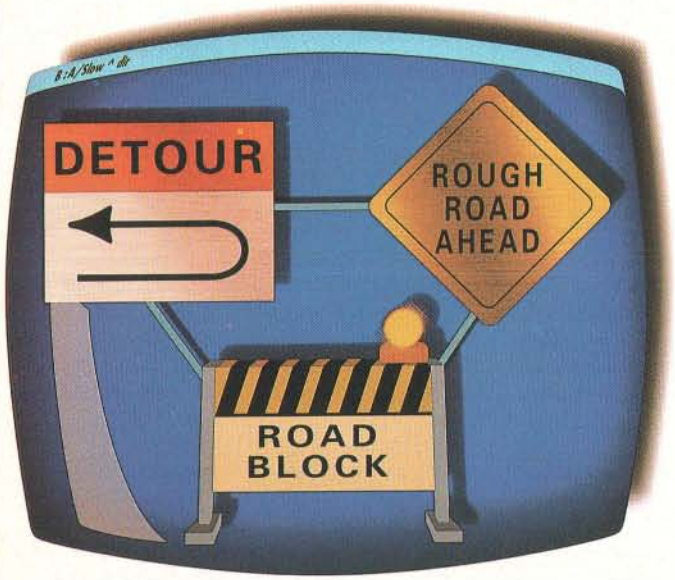
The new chip set won't add much to the cost of an EISA system, Intel said. At current prices, the EISA chips would increase the cost of a machine by $50 to $100 over an AT system, according to Intel. Company officials predict that by next year, EISA and MCA chip sets will cost the same as 16-bit AT chip sets, hence increasing the allure of 32-bit systems.

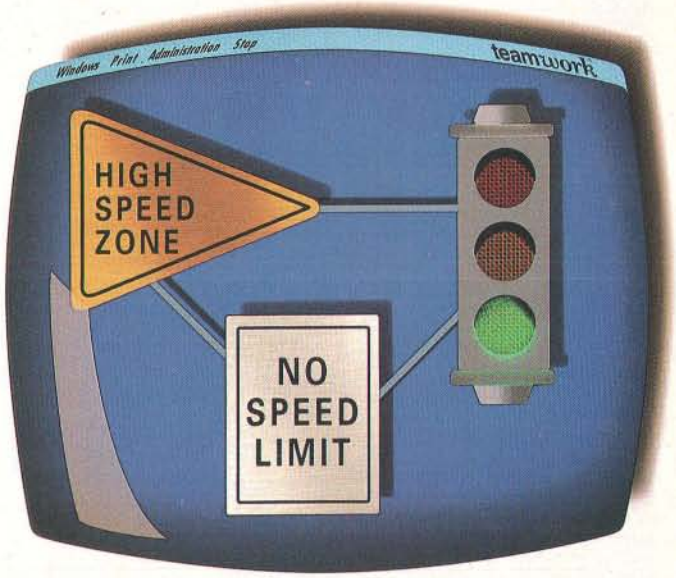
But Intel officials say the decision to buy an MCA or EISA system will ultimately be based on factors other than bus technology. These factors include loyalty to a particular manufacturer; prices of competing systems; proprietary features that manufacturers say increase performance of their systems; and 'geopolitical considerations,' purchasing decisions based on nontechnical or emotional issues.

NEWS STAFF SEEKS NEWS. DIAL (603) 924-9281.

The BYTE news staff is always interested in hearing about new developments that might affect microcomputers, the way they work, or the way people work with them. If you know of a project that could shape the state of the art, please give us a call at (603) 924-9281 or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. An electronic version of Microbytes, offering a wider variety of computer-related news on a daily basis, is available on BIX.

Without Teamwork® on your PS/2,





your development teams will never shift into high gear.

Now you can speed up the performance of your entire work group with a true multi-processing development environment for OS/2. Teamwork is the first CASE toolset to support OS/2 software developers. So if you've been driving DOS-based CASE tools and you're ready for workstation power, get ready to fasten your seatbelt.

The intuitive graphic user interface and the advanced multi-window, multi-tasking capabilities of Teamwork immediately improve individual and team productivity. Each developer creates, edits, and inspects multiple design views simultaneously with simple point and click operations. Teamwork fully integrates graphics and data for structured analysis, data modeling, real-time analysis, and structured design models. Rigorous support of standard methods, complete syntactical checking and balancing assure system quality.

Teamwork's own configuration management and project status help manage and control even your largest projects. Projects can be partitioned to allow parallel development by multiple analysts and designers. The project manager controls the process by the baseline, merge, and reconcile features of Teamwork.

If you're just getting started with CASE tools, Teamwork/PCSA is a DOS-based structured analysis tool that can also run on your PS/2. As your projects grow, Teamwork/PCSA gives you an easy migration path since it is fully compatible with Teamwork for OS/2.

Thousands of developers with applications ranging from financial to avionics already rely on the power of Teamwork. In fact, Teamwork is the world's leading workstation-based CASE toolset.

Cadre's hotline support, maintenance services, excellent documentation, and effective educational offerings make sure you get started right on the right track. That's all a part of Teamwork.

Call (401) 351-CASE

If you're ready to shift into high gear, then you're ready for Teamwork. Anything less, just won't meet your standards.

CADRE

Cadre Technologies Inc.
222 Richmond St.
Providence, RI 02903

Teamwork is a registered trademark of Cadre Technologies Inc. PS/2 and OS/2 are trademarks of International Business Machines.

Circle 28 on Reader Service Card

Circle 103 on Reader Service Card

See Your Data

MapInfo software can find, display and analyze your data geographically. See your prospects, customers, facilities —anything in your database. Find addresses by street, ZIP code, city, etc. (We can even supply the maps.)

Any point or region on the map can have a complete record of data behind it. See your *actual* dBASE data in a window to view, edit, and print. Draw your own boundaries. Add titles and legends for high quality presentations.

Perform analyses on your data to sum, average, or count your database records by location. Color sales territories by volume of orders, ZIP codes by numbers of leads, countries by your demographic data.

From street-level to worldwide, MapInfo can merge your databases with maps. Play visual "what if" with your data. See patterns, trends, and opportunities you never knew existed. If you need to map your data, MapInfo can do it for as little as $750.

MapInfo now includes a map of the world and the U.S. with all ZIP code locations. Runs on IBM PCs or compatibles with 640K memory, a hard disk drive, and graphics, and comes network-ready.

MapInfo™ Corp.

Changing The Way The World Looks At Information™

200 Broadway, Troy NY 12180
To order, call 1-518-274-8673
or 1-800-FASTMAP Toll free.

MapInfo is a trademark of MapInfo Corp. dBASE is a trademark of Ashton-Tate.

LETTERS

and Ask BYTE

Who Invented the Computer?

How can John William Mauchly Jr. (Letters, July) write an 800-word letter on the Atanasoff/Mauchly controversy (Book Reviews, September 1988) without acknowledging the court decision in *Honeywell, Inc.* v. *Sperry Rand Corp., et al.*, of October 1973?

Here is the record, developed in a trial lasting more than two years. Section 3 of Judge Larson's opinion states, among other things, that "Eckert and Mauchly did not themselves first invent the automatic electronic digital computer, but instead derived that subject matter from one Dr. John Vincent Atanasoff."

Mauchly the younger claims "ample evidence to the contrary." He mentions a letter, an experimental counter, and several unnamed students. Sperry Rand, in a case involving million-dollar patent rights, would not or could not produce any such evidence for the record. Instead, the court record shows a letter from Mauchly requesting permission to incorporate Atanasoff's ideas. If Mauchly's evidence is so clear-cut, why didn't Sperry use it to preserve its patent? Why didn't Sperry appeal the decision?

Anyone wishing to form an independent judgment should read Clark R. Mollenhoff's 1988 book, *Atanasoff: Forgotten Father of the Computer*.

George Wright
("georgew" on BIX)
Lutherville, MD

Warning Optional

We would like to commend Martin Heller for "Breaking the Memory Barrier with 386|VMM" (July). MicroEMACS consists of more than 570K bytes of C source code, and Heller only had to change 34 lines of code to compile it in MetaWare High C for both protected mode and virtual memory mode, either of which will access 4 gigabytes!

Our only complaint is that he didn't mention the compiler switch to turn off warning announcements. We think that warnings are a good thing, but if a user doesn't like them, they switch right off.

Heller will be happy to know that most of the minor changes he required are already in beta test here at MetaWare. We don't agree that old 8086 methods are best, particularly in this new 80386 arena, but programs are daily being migrated to the 80386 via High C. We will supply the functions to make conversion easy, and then lobby for better methods.

Steve Blackwell
Product Group Manager
MetaWare, Inc.
Santa Cruz, CA

Mac OS Wish List

My wish list for the Mac OS would include two items Don Crabb didn't mention ("The Mac Interface: Showing Its Age," Macintosh Special Edition, June): a simple but powerful text editor, and a print spooler for dot-matrix printing.

The TeachText editor that comes with the Mac operating system is too rudimentary to be much more than a toy. Its most serious problem is that it cannot reformat paragraphs that contain carriage returns at the end of each line. Simple text-file transfer among arbitrary computer systems requires the use of such files (i.e., those that end in hard returns). A capable text editor, preferably one that can edit multiple files at the same time, is an essential aspect of any operating system. Of course, the DOS EDLIN hardly qualifies; the Unix editor, vi, is only a slight improvement over EDLIN; and the Windows notepad has even more limitations than TeachText, so my opinion on this seems to be out of favor with operating system vendors.

continued

WE WANT TO HEAR FROM YOU. *Please double-space your letter on one side of the page and include your name and address. We can print listings and tables along with a letter if they are short and legible. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

Because of space limitations, we reserve the right to edit letters. Generally, it takes four months from the time we receive a letter until we publish it.

Take 1 of 3 sets for only $4.95

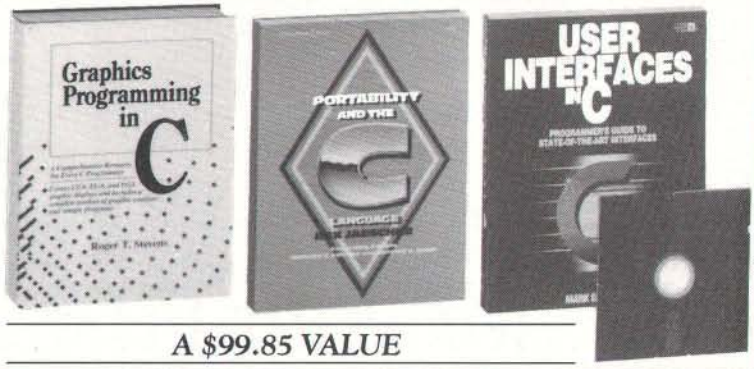
as your introduction to the
SMALL COMPUTER BOOK CLUB

VALUES TO $106.85

You simply agree to buy three more books—at handsome discounts—within the next 12 months.

C Programmer's Library

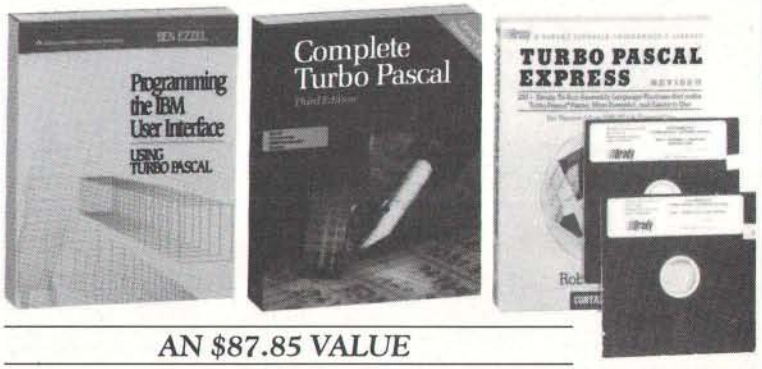
- Create full-color graphics and develop programs that interact with users via character displays and keyboards.
- Develop pop-up and pull-down menus, windows, on-line help screens, dialog boxes, and more.
- Write C codes that run under varying C implementations as well as different operating systems and hardware.



A $99.85 VALUE

Turbo Pascal Programmer's Library

- Make your Turbo Pascal programs faster, more powerful, and easier to use.
- Master routines for elaborate printer control, formatting and error recovery.
- Maximize use of windows, scroll bars, text graphics, and data compression.



AN $87.85 VALUE

dBASE Programmer's Library

- Convert and upgrade program files without a hitch while making the most out of user-defined functions.
- Develop databases for many different environments, using a range of dBASE products.
- Master the various features of SQL, dBASE IV, dBASE III Plus, Clipper, FoxBASE, and more.

A $106.85 VALUE

MEMBERSHIP BENEFITS • In addition to getting 1 of 3 sets for only $4.95 when you join, you keep saving substantially on the books you buy. • Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings of 65% off the publishers' prices. • At 3-4 week intervals (16 times per year), you will receive the Small Computer Book Club News, describing the coming Main Selection and Alternate Selections, together with a dated reply card. • If you want the Main Selection, do nothing, and it will be sent to you automatically. • If you prefer another selection, or no book at all, simply indicate your choice on the card and return it by the date specified. • You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

SMALL COMPUTER BOOK CLUB is a division of the Library of Computer and Information Sciences, the oldest, largest and most respected computer book club in the world. Unlike other microcomputer clubs, Small Computer Book Club offers books from a wide variety of leading publishers.

If reply card is missing, please write to Small Computer Book Club, Dept. Y-CG3, 900 Chester Avenue, Delran, NJ 08075, for membership information and an application. BYTE 10/89

Much of my work is done on DEC VAX systems, where I'm spoiled by edt and tpu, both highly capable editors intrinsic to the VMS operating system.

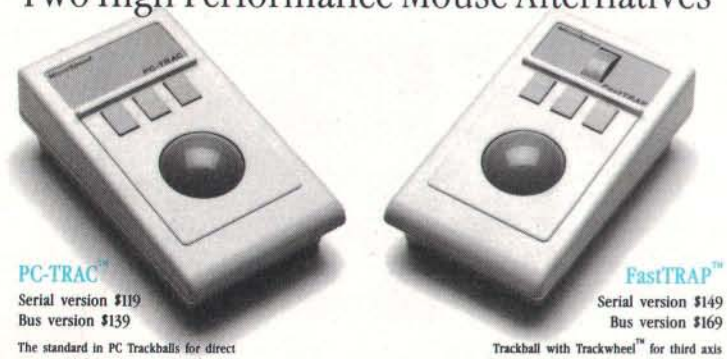
Dot-matrix printing is generally more time-consuming at the printer end than laser printing is. Therefore, it seems even more essential to provide a print spooler for dot-matrix printing than for laser printing. Yet Apple provides a spooler only for laser printers. It can't be any more difficult to spool Imagewriter files than to spool the wide variety of printer files that Windows can handle.

I think Apple should indeed be on notice that its operating system is showing signs of age. It's the best available, but right now its chief advantage over other competitors, such as DOS/Windows and Unix/X Window, lies in the wealth of excellent Mac software that has been written and in the transparent access to large amounts of RAM that it and the Macintosh provide. In view of the disarray apparent in the world of Windows/OS2/Presentation Manager, this may be enough of an advantage for the time being. But I hope that Apple will be objective enough to incorporate the best of the ideas that are being implemented by its competitors as elaborations of the graphical user interface, while demonstrating that the use of a graphical interface needn't involve the loss of any of the best features of text-based command-line interfaces.

Thomas E. Moore
Huntsville, AL

Finally, A Trackball for your PC

Two High Performance Mouse Alternatives



PC-TRAC™
Serial version $119
Bus version $139
The standard in PC Trackballs for direct mouse replacement

FastTRAP™
Serial version $149
Bus version $169
Trackball with Trackwheel™ for third axis pointing capability in advanced applications

Attention PC users. Introducing two products that have been quietly appearing on desks of thousands of PC users for over a year: MicroSpeed's PC-TRAC™ and FastTRAP™ trackballs.

- **Uses ⅓ the desk space of a mouse**

Free up your desk space to do what it was designed to do — hold your coffee cup and stacks of incoming work.

- **Plug and play compatibility**

MicroSpeed's advanced pointing device driver is fully compatible with application software supporting Microsoft™, Logitech™, and other popular mice. Also included is a Windows™ driver and a utility for use with non-mouse driven software.

- **PC-TRAC and FastTRAP work where you put them**

No more "row, row, row the mouse" when you run out of desk space before you run out of screen. Scroll across spreadsheets with finger tip control. Page up and down documents without so much as moving your wrist. Control CAD programs to a single pixel. All in a space less than 4 ¼ " wide.

- **Pinpoint accuracy automatically**

MicroSpeed's pointing device driver has "self adjusting" resolution from 50 to 1,000 dpi. Speeding across the screen or working with precision graphics, the MicroSpeed driver automatically adjusts to the resolution you need.

- **PC-TRAC and FastTRAP require no cleaning**

Our quiet, durable opto-mechanical design requires no cleaning or maintenance.

Looking for a proven mouse alternative for your PC? Give us a call. We're rolling!

1-800-232-7888
In California call (415) 490-1403
FAX (415) 490-1665

MicroSpeed, PC-TRAC, FastTRAP and Trackwheel are registered trademarks of MicroSpeed, Inc. Microsoft and Windows are registered trademarks of Microsoft Corporation. Logitech is a registered trademark of Logitech, Inc.

MICROSPEED™ INCORPORATED

Clarifying Chaos

I have a minor point of clarification to Hugh Kenner's fine review of Ian Stewart's *Does God Play Dice?: The Mathematics of Chaos* (Print Queue, July). Referring to the iterative system given by the logistic equation $y = kx(1-x)$, Kenner says, "And for values of k above 3, what we see is chaos." This wording may be miscontrued. While chaos certainly occurs at infinitely many values of k above 3, there is a dense set of values above 3 at which the system is periodic (i.e., nonchaotic).

Stan Franklin
Professor of Mathematical Sciences
Memphis State University
Memphis, TN

Windows and Multitasking

"A Guide to GUIs" (July) states that "You can also minimize a window under Microsoft Windows, but since Windows is not a multitasking operating system, the program in the window suspends operation until you 'maximize' it again."

This is not true and never has been. Has the author ever run the clock program? Or the rotating hypercube? Notice that the hands on the clock icon continue to move even when minimized. That's because the clock program is still running and because the icon is not a static bit map but is actually a small window, and the clock program is continually painting it.

Microsoft Windows is multitasking and always has been. (It's just not preemptive, which means that if one application wants to hog the system, Windows will not interfere with that application.) Nonpreemptive multitasking is genuine multitasking. It differs from preemptive multitasking (as in OS/2 with Presentation Manager) only in these few ways:

1. It is easier to write the system code.
2. It is faster at task switching than preemptive multitasking is (because it

continued

Circle 179 on Reader Service Card (DEALERS: 180)

WHEN YOU NEED YOUR DESK FOR MORE THAN JUST A COMPUTER...

Introducing Emerald's LANstation I.

he LANstation I, a 286 diskless workstation, elivers lightning fast performance, an ultra-mall footprint, dazzling EGA video display, and ompatibility with any network card or operating ystem at an affordable price.

merald has incorporated the latest technologies every feature to eliminate the typical space, oise, heat and security problems that plague andard PCs on a network.

esign experts agree . . .

. . that the LANstation I is the finest example in nctional ergonomic design. International Design lagazine said "products like yours express the ading edge of contemporary design."

Emerald provides the best warranty program in the industry. 48-hour repair or replace, guaranteed—at no charge!

For more information on the latest in diskless workstation technology contact your Emerald Computers marketing representative at (800) 321-5711.

$2,195.
Suggested List for 12 MHz 286

EMERALD COMPUTERS™

EMERALD COMPUTERS, INC. COMMMERCIAL PRODUCTS GROUP
7324 SW Durham Road Portland, Oregon 97224
(800) 321-5711 (503) 620-6094 FAX: (503) 639-7932

ID Designers' Choice — Annual Design Review — Industrial Design Magazine

Circle 97 on Reader Service Card

happens only at known safe times).
3. It puts the power (to choose when you will execute) in the hands of the application rather than the system (i.e., the Windows system is the slave; the Presentation Manager system is the master).

I am tired of seeing Windows dinged in the press as "not real multitasking" because it suffers from these advantages.

Marlin Eller
Seattle, WA

Graphical User Interfaces

Thanks for "A Guide to GUIs" by Frank Hayes and Nick Baran. The figure comparing features of the 12 top GUIs was especially lucid.

Your readers might want to know about two recent enhancements of the Commodore Amiga that Hayes and Baran did not mention. First, AmigaDOS 1.3 supports a second user through its AUX: device driver and a character-cell terminal connected to the serial port. Second, GfxBase (Milpitas, CA) now offers the X Window System for the Amiga.

I agree with Hayes and Baran's statement that "Intuition is arguably the father of MultiFinder." MultiFinder is more like an illegitimate son, given that it puts one task on hold when the user activates another task. In contrast, Intuition provides true multitasking, letting each task contend for CPU and direct-memory-access coprocessor time according to priority and demand.

Kirk Mahoney
Los Angeles, CA

Let's Hear It for Fixed-Point

"Floating-Point Revisited" by Rick Grehan (April) really points up why more applications should be using fixed-point operations. For most applications, especially in business, fixed-point will run circles around Grehan's decimal floating-point procedures, with no loss in capability.

We still suffer from certain hangovers from the days when 64K bytes was a lot of memory. There's not much excuse for using binary-coded decimal floating-point computing anymore. BCD is convenient for I/O formatting, but you don't need speed in I/O operations. Where you need speed is in invisible internal calculations. Division by 10 (used repeatedly in formatting binary numbers for output) is time-consuming to the extent that a few milliseconds might be needed for a very large number; given how slowly screens and printers operate, this is entirely negligible.

Correct use of fixed-point programming requires choosing units properly. For business purposes, you use cents, not dollars. The input $3.21 has to be parsed as 321¢. Actually, this may lead to some situations in which the last penny isn't right. You can adjust for this by using internally smaller units and still fit the national debt into 64 bits. Having units appropriate to the decimal system avoids the inconvenience of trying to work in base 10 on a binary computer.

Binary floating-point and fixed-point arithmetical operations do not differ at the core. For addition and subtraction, fixed-point is faster, while floating-point is faster for division and multiplication. The big distinction is that fixed-point can be kept precise, while floating-point has inherent round-off errors. This

continued

Compact Desk.

This pocket-sized box instantly turns a portable computer into a laptop office. Introducing the WorldPort 2496™ portable fax and data modem.

If your business is like most, fax is a way of life. The WorldPort 2496 is the fax of life on the road.

Weighing less than 8 ounces, with battery, it also runs on AC power and connects to RJ11s or optional acoustic couplers for public phone use anywhere. Via Bell or CCITT standards. It even sends and receives fax and data messages unattended or while you run other applications.

Suddenly, a laptop in the field is a full communications center. With up-to-the-minute incoming from your host. Overnight outgoing to the branches. And on-the-run faxes to any client. Over pay phones, hotel phones and PBXs worldwide.

Get the WorldPort 2496. It adds the power of your office to the portability of your laptop. And the advantages of a fax to the convenience of your desktop.

Call us today at 800-541-0345 (in New York, 516-261-0423) for more on the WorldPort line and the dealer nearest you.

Touchbase Systems, Inc.
160 Laurel Avenue
Northport, NY 11768
(516) 261-0423
Fax (516) 754-3491

WorldPort 2496 is a trademark of Touchbase Systems, Inc. © 1989 Touchbase Systems, Inc.

Circle 277 on Reader Service Card

Faster computers sooner. . . from FORTRON.

NetSet™ 286
12, 16, 20 MHz

NetSet™ 325, 333 DeskTop or Power

Desktop 286 or 386
12, 16, 20 MHz

As fast as products are designed, that's about how fast you can get them from Fortron. In early 1987 we were one of the first to ship an Intel 386™ based personal computer.

Now we're ready to dazzle you with speed again: the **NetSet™ 325** and **NetSet™ 333** personal computers, based on Intel 386™ 25 MHz and 33 MHz microprocessors. Designed for optimum performance of **CAD/CAM, UNIX, XENIX,** and **network server** applications.

Like all our other personal computers, these come with **one full year of service, free, at your site (USA).** We're that sure of the reliability. And because we manufacture the computers ourselves, right here in California, you know exactly who to call with any technical questions; and if they do need service, we can fix them fast. **Speed, service, and savings. That's Fortron.**

BASIC SYSTEM PRICES START AT:

NetSet 286-12	386-16	386-20 Plus	NetSet 386-325	NetSet 386-333
$995	**$1950**	**$2400**	**$3290**	**$5450**
512K	2MB	1MB	1MB	4MB

To Order Call Toll Free

1-800-821-9771

In CA **415-373-1008**

Leasing Program Available
International Distributors Wanted

"186" is a trademark of Intel Corp.
NetSet is a trademark of Fortron/Source Corp.

FORTRON

Fortron/Source Corp.
6818-G Patterson Pass Road
Livermore, CA 94550
Tel: **415-373-1008**
FAX: **415-373-1168** TELEX: **559291**

☐ Please have a sales representative call me.

☐ Please send me more information.

1. I am most interested in
   A. ☐ 286-based systems
   B. ☐ 386-based systems

2. I am a
   A. ☐ End User
   B. ☐ VAR
   C. ☐ Corporate Purchaser
   D. ☐ DP/MIS.

Name _____
Title _____
Company _____
Address _____
City _____
State _____
Zip _____
Phone No. _____

10/89

Circle 102 on Reader Service Card (DEALERS: 103)

Better is

The new 16″ MultiSync® 4D and 20″ 5D both offer compatibility with a wide range of graphics boards and computer systems.

NEC's award-winning multiple frequency technology, now available in larger, digitally controlled, high-resolution color monitors.

Both are optimized for the IBM PS/2, PC/AT/XT (and 100% compatibles) and the Macintosh II. Both offer a microprocessor-based digital control system for preset and custom graphics modes, automatic screen

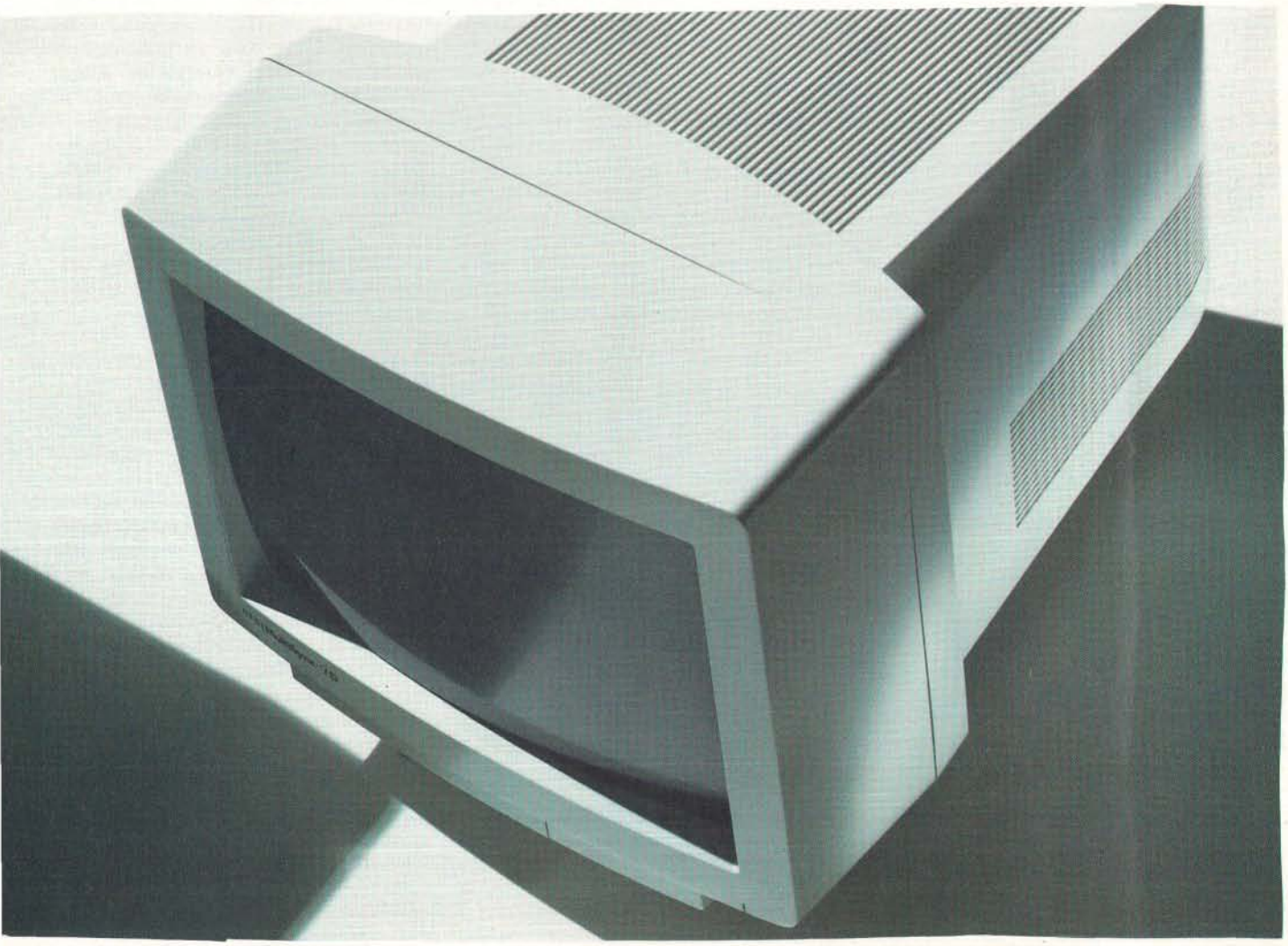
MultiSync is a registered trademark of NEC Home Electronics (USA) Inc.

NEC
WORLD CYCLING
INVITATIONAL

bigger.

configuration and optimal image. And both give you great resolution—

the 4D, from VGA up to 1024 x 768; the 5D, from VGA to 1280 x 1024.



The main difference: one is for large ideas. The other, for extra-

IBM PC/AT/XT and PS/2 are registered trademarks of the International Business Machines Corporation.

large. For literature, call 1-800-826-2255. For details, call NEC Home

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

Electronics (USA) Inc. 1-800-FONE-NEC.

©1989 NEC Home Electronics (USA) Inc.

NEC

Circle 189 on Reader Service Card

is not significant unless you are dealing with numbers larger than any that would occur in business applications. To be sure, floating-point is superior for transcendental functions. However, if you don't need high accuracy (e.g., in graphical display), fixed-point with lookup tables (e.g., for sines and cosines) will outperform floating-point. True algebraic operations, such as square root, are performed about the same in both.

The main distinction between fixed-point and floating-point programming arises in the storage of variables. Programming general-purpose modules requires you to anticipate exceptional cases. A floating-point variable occupies a fixed amount of memory. When there is insufficient space to carry out operations correctly, floating-point simply gives a wrong number. Try $x \times x - (x + 1) \times 8 (x - 1)$ where x fits accurately but x^2 does not. In fixed-point, however, intermediate operations may overflow any prescribed size. Thus, fixed-point requires dynamic memory allocation; the amount of memory set aside for the storage of a variable varies with the size of the variable and changes as the variable changes. The DOS file allocation table is a standard example of dynamic memory allocation. A little extra programming is required, but there is little loss of speed in most applications.

Numerical coprocessors change the picture. For intensive number-crunching, a floating-point coprocessor like the 80287 is much faster at fixed-point operations than is the 80286. There are several reasons for this. First, the 64-bit registers of the 80287 are effectively twice as fast for all arithmetical operations than the 16-bit registers of the 80286 if you're dealing with integers with more than 16 bits. Second, the hard-wired code on the coprocessor operates much more quickly than code fetched from memory. Third, with optimized coding, you can store variables in the 80287 stack rather than having to move them around in memory. The last two differences would matter less if you had a high-speed cache memory. Fourth, you can, with good coding, do coprocessing; the 80286 can compute the address of the next variable needed from memory while the 80287 is doing arithmetic. Finally, the overhead required for handling the variable size of fixed-point numbers adds up over thousands of iterations.

My original motivation for getting an 8087 was for use in a program where I had to deal with fairly large integers and didn't want to take the time to construct code for fixed-point operations. Alas, the numbers got too big—beyond the 64-bit limit—and I needed exact answers.

Carl Herz
Department of Mathematics and Statistics
McGill University
Montreal, Quebec, Canada

There now, see? With a little effort, you can extend my floating-point package to as many significant digits as you need. Yes, it would be slow—but it would work.
—Rick Grehan

Uncrackable Code?

The writers of the articles on security (In Depth section, June) consider it unsatisfactory to use a password that initiates a word-substitution program. The procedure, of course, is quite pedestrian. I have worked on these matters as a hobby and have come to use an algorithm that encrypts a text in such a way that I defy anybody to crack the code.

The secret is to take an obscure text of 200 words or so and "add" this text letter for letter to the text to be encrypted, producing a new ASCII code for each character of text. The "password text" is never stored on the hard disk but resides on a floppy disk that you insert when you want to do encoding and decoding.

No common analyses of letter frequencies would help you decode this encrypted text, because the translations change all the time: In one case, "a" may be represented by ASCII 202; in another, ASCII 72; and so forth.

Paul A. Elias
Fountain Hills, AZ

Your method is in effect a one-time pad, which is, indeed, a foolproof system when used properly. However, there's a flaw in your application. For the one-time pad method to work, the encryption text must be used just once. Therefore, it must be at least as long as the original text, and it cannot be reused for multiple encryption processes. If it is, sophisticated methods of pattern recognition and frequency analysis will leave the encrypted text open to decipering.—G. A. S.

ASK BYTE

I Love This Machine, But...

I purchased my IBM PS/2 Model 50 Z in August 1988, and up until about two months ago I had no problems with it. But since then, whenever I start up the computer, it gives me a `1782 error` message and directs me to the DOS manual for further information. The book told me to do a system test, so I did. The test reported a parallel port error. So I took the system to an authorized IBM center. A technician spent a week checking the CPU and the ports and found nothing. She then said that since a 1782 error is a hard disk error, she would like to format the hard disk to locate the problem. I reluctantly agreed. The check found nothing wrong. I took the system home and got it running again. Guess what? About a week later, the error came up again.

This was very frustrating, especially since the IBM center did not find anything wrong with the system. I should also mention that if I turn the computer off and back on again (sometimes several times), the error does not occur and the machine operates correctly. Rebooting doesn't work, so I am worried about constantly turning the system on and off.

Son C. Nguyen
Boston, MA

The `1782 error` *message actually refers to the hard disk drive controller card. The IBM PS/2 series of computers is unique partly because the IBM engineers tried to minimize the use of connecting cables. The hard disk drive in your Model 50 Z plugs directly into the hard disk drive controller card. You mention that the problem goes away after turning the computer on and off several times; the problem may be due to an intermittent connection in the connector between the hard disk drive and the controller card, between the controller card and the system bus, or within one of the chips on the controller card. The problem goes away after you turn the computer on and off because the internal components in the computer are "warmed" to their usual operating temperature and the thermal expansion of the components finally makes the electronic connection.*

I suggest that you remove your hard disk drive and controller card from the computer and clean the card edge connectors. Use a commercial electronic contact cleaner or denatured alcohol. Also, if there are any DIP chips on the card, make sure that they are firmly seated in their sockets. Then plug the card and drive back into your computer.

If the problem persists, have your IBM dealer test your hard disk drive controller card in another Model 50 Z.—S. W.

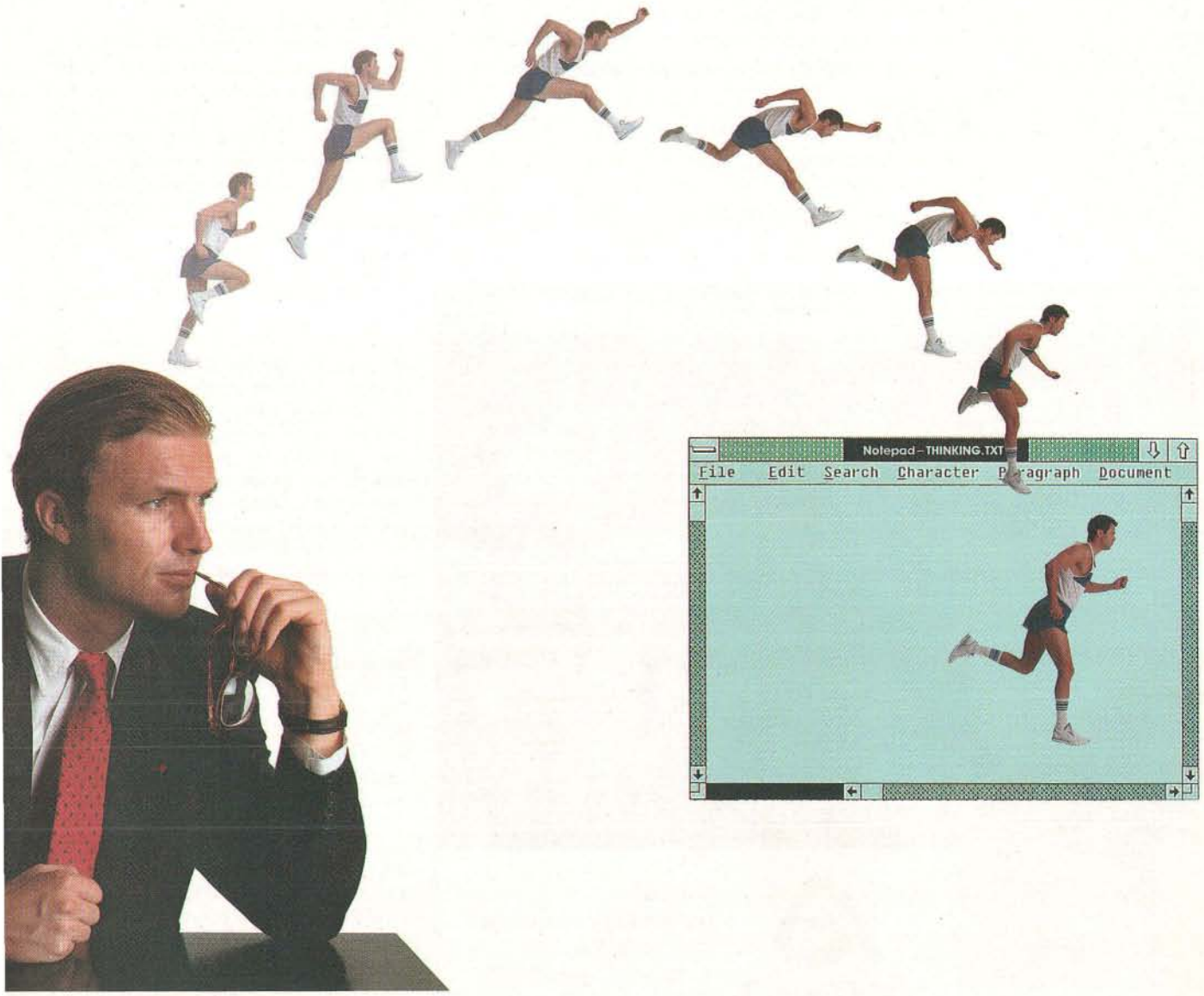
Database Security

I am a graduate student in computer science, and I'm currently working on a

continued

The fastest way to see what you think.

Introducing the MultiSync® Graphics Engine™ Board. Now when an idea pops into your head it won't take long to pop up on screen. Because NEC's MultiSync Graphics Engine is the first graphics board specifically designed to increase productivity in Windows, CAD/CAM and desktop publishing applications. For instance, it can run Windows 386 as much as four times faster. When used in conjunction with our accelerator software (purchased separately), Presentation Manager applications run up to five times faster. What's more, the MultiSync Graphics Engine Board is compatible with VGA, Super VGA (800 x 600) and 1024 x 768 interlaced and non-interlaced resolutions. So, whether you're a power user, professional designer or publisher, you can see your ideas on screen in world-class time. For technical details and information, call NEC Home Electronics (USA) Inc. at 1-800-FONE-NEC. For product literature call 1-800-826-2255. The MultiSync Graphics Engine Board. When you've got tons of thoughts racing through your mind, it's the fastest route from head to screen.



MultiSync is a registered trademark of NEC Home Electronics (USA) Inc. Graphics Engine is a trademark of NEC Home Electronics (USA) Inc. NEC is a registered trademark of NEC Corporation. Windows and Windows 386 are registered trademarks of Microsoft Corp. Presentation Manager is a trademark of the International Business Machines Corporation.
© 1989 NEC Home Electronics (USA) Inc.

C&C Computers and Communications

NEC

A Message To Our Subscribers

FROM TIME TO TIME WE MAKE THE BYTE SUBSCRIBER list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to the following address.

BYTE MAGAZINE
ATTN: SUBSCRIBER SERVICE
P.O. Box 555
HIGHTSTOWN, NJ 08520

ANTHRO®

Anthro®
Technology Furniture®
3221 N.W. Yeon St.
Portland, Oregon 97210
(503) 241-7113

Anthro, AnthroCart and *Technology Furniture* are registered trademarks of Anthro.

research paper on database security. I'd appreciate it if you could provide me with any information on the subject.

Earnest D. Harris
Memphis; TN

Your first stop should be BYTE's June issue, in which the In Depth section is devoted to security. Next, see if you can locate a copy of DataBase Management Systems, *edited by R. A. Frost (McGraw-Hill, 1984), which contains at least one case study focusing on database security. Finally, be on the lookout for* Computer and Communications Security *by James Arlin Cooper (McGraw-Hill, 1989), which includes discussions of network-systems security.*—R. G.

The Leap from Apple

I have a number of disks in Apple CP/M, formatted on an Apple II with 16 sector drives and a Microsoft Z80 SoftCard. The SoftCard Apple CP/M is a 60K-byte version 2.23. I would like to transfer the disks to an IBM PC XT running PC DOS 3.3. They contain programs in dBASE II, as well as files that I created with WordStar. I have tried using Xenocopy, but the Apple II is not among the systems that it supports.

M. S. C. Ong
Seremban, Malaysia

Whenever I receive a letter about file transfer between dissimilar machines, my first suggestion is always: Locate a public domain communications program for each machine, put a serial port together, and shoot the files across that way. That's usually the cheapest way to go; it involves some investment in time and a minimal investment in hardware. (I am, of course, presuming that both machines already have RS-232C interfaces installed.)

Depending on how much you're willing to spend, you might also want to look into PC Transporter from Applied Engineering (P.O. Box 5100, Carrollton, TX 75011, (214) 241-6060). Not only will you be able to copy files between Apple and PC format disks, you'll be able to run the programs on your Apple II.

—R. G.

PC Music

I want to build a music synthesizer on an IBM PC expansion board, using a number of dedicated chips such as the 6581 sound interface device (SID) found in Commodore machines. Are there other similar devices more appropriate for use on the PC bus? Alternatively, what sort

continued

GET THE PC NETWORK ADVANTAGE

Join Today -- Receive A FREE Surprise Package of Gifts, and More...

9 Reasons Why You Should Join The Club...

PC NETWORK BUYERS CLUB

Over 100,000 Satisfied Club Memberships. PC Network Members come to us for everything from basic software/hardware to complex computer system needs. We answer tough questions, offer great merchandise selection, and provide excellent service. When you join you receive...

1. **Red Carpet Service**
   Club members receive exclusive privileges, plus special merchandise offers, streamlined 24-hour order processing, shipping, and service.

2. **Warehouse Pricing**
   Club members get low warehouse-to-you prices every day. (Just take a "peek" at our specials.)

3. **Exclusive PC Network Credit Card.**
   Now you can apply for a credit card devoted to your computing needs. Great when you need fast warehouse-to-you shipments.

4. **Used Computer Hardware Exchange**
   Sell your used computer hardware to other Club members. Upgrade your system. Available to Club members at a nominal cost.

5. **Members ONLINE Bulletin Board**
   Download "Freeware" and "Shareware" from our massive collection of Public Domain software. Place orders. Get information. Not just a bulletin board, but a complete member information network.

6. **Club Leasing — Business Option**
   With other computer companies, if you wanted to lease computer hardware, you had to be a big business. Now small businesses and professional Club members have this option available.

7. **Dow Jones Information Retrieval**
   Have access to this information service at members only discount rates plus receive special discount certificates, worth over $50.00 in FREE services.

8. **No Minimum Purchase-EVER!**
   That's right. Club members have no pre-set purchase requirements. No complicated forms. No un-wanted or un-ordered merchandise-ever. You pick and choose what you want-when you want it.

9. **Exceptional Service-Unequalled Privileges.**
   You have toll-free direct lines to PC Network whenever you need to talk to a Technical Consultant or Computer Consultant. Plus, your very own Club Representative to answer your computer questions.

Members Take Advantage Of Specials Like These

NEC Multisync IIA VGA Display
$469

Toshiba T-1000 80C86 Laptop
$609

Panasonic KX-P1124 24-Wire
$299

Accept Our Invitation

Join today and receive our latest Buyers Guide and your New Members kit, with personalized I.D., PLUS--if your're one of the first 1,000 new members, you will automatically receive a special FREE surprise package of gifts. Open a world of exceptional service and unequalled privileges--all for only $19.95 a year. Join now, find out for yourself why "Personal Computing" magazine ranked PC Network, "Best for Overall Pricing-Overall Value!"

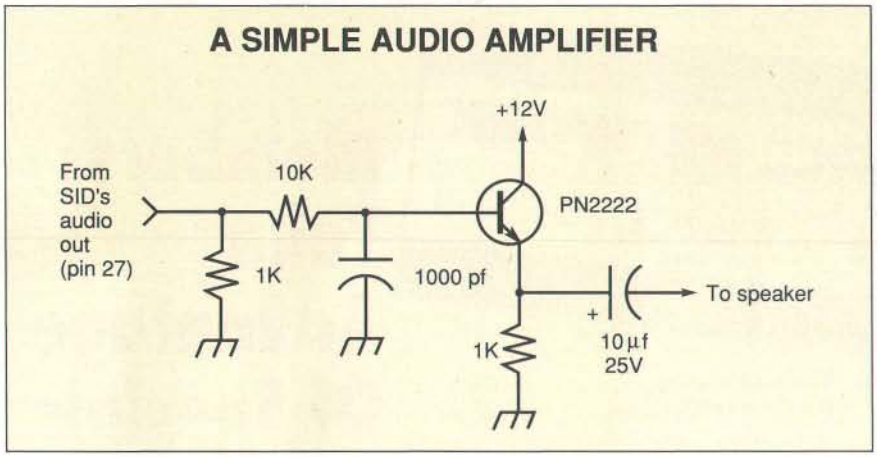
Join Now, 1-800-621-7283

PC NETWORK MMC MICROCOMPUTER MARKETING COUNCIL PC NETWORK LEASING VISA MasterCard DISCOVER

P.O. BOX 386, MONTOURSVILLE, PA 17754 HOURS: MONDAY-FRIDAY 8:00 AM - 9:00 PM SATURDAY 9:00 AM - 5:00 PM

PC6

Circle 217 on Reader Service Card



An audio amplifier circuit for the 6581 sound interface device (SID).

of adaptations must I provide to interface the 1-MHz 6581 with the PC bus?

Ivo Busko
Baltimore, MD

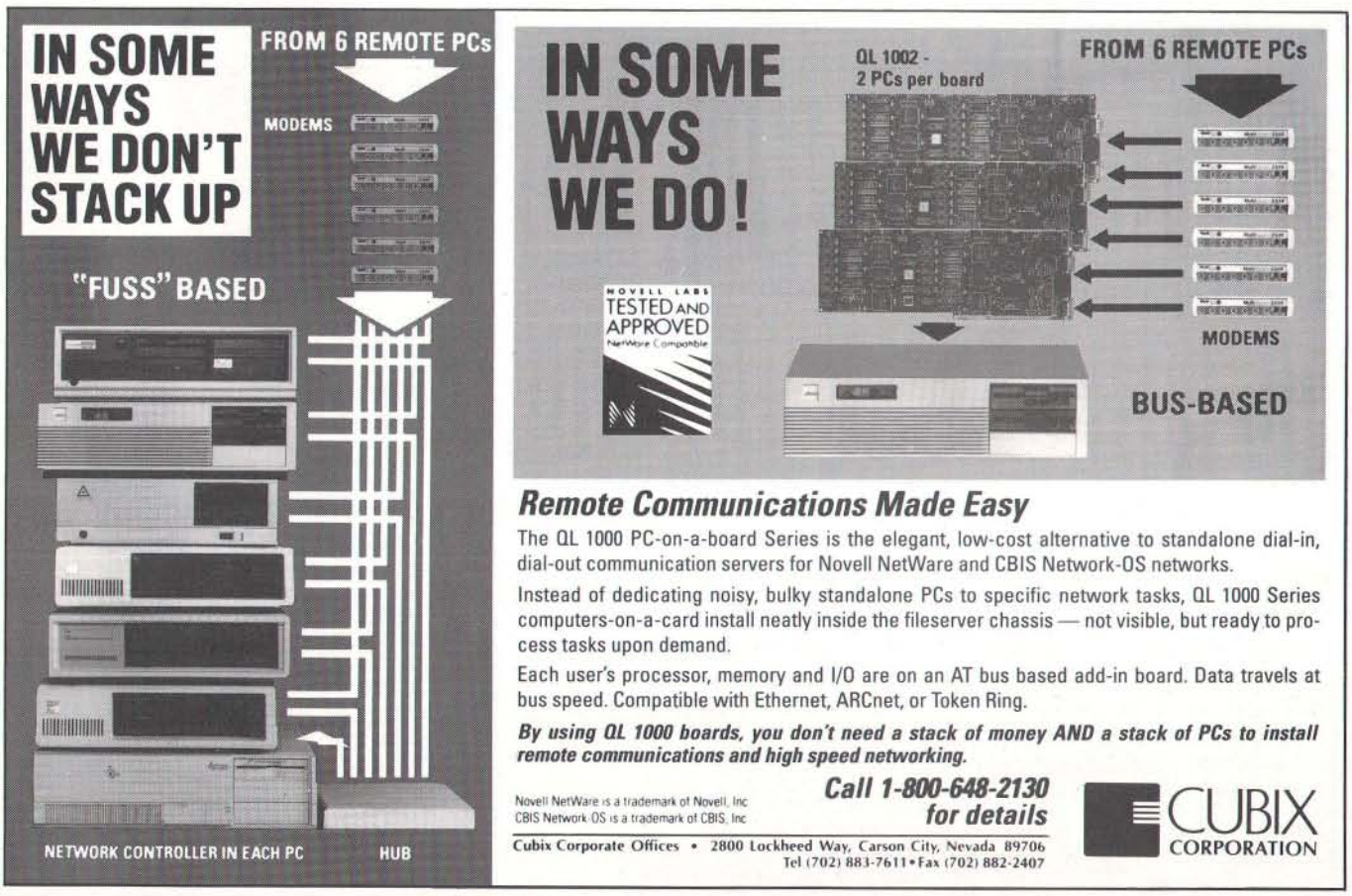
I might be telling you something you already know, but before you go putting together your own music synthesis card for the PC, you should look into the possibility of purchasing (or building) a MIDI interface for your PC. You'd probably get a lot more mileage out of MIDI than a do-it-yourself synthesizer card. Manufacturers of MIDI interfaces for the PC include Music Quest, Inc. (2504 Ave. K, Suite 500-492, Plano, TX 75074, (214) 881-7408), Roland Corp. (7200 Dominion Circle, Los Angeles, CA 90040, (213) 685-5141), and so many more that I wouldn't have space for them all. Locate a recent issue of Electronic Musician *magazine and do some browsing. You'll find plenty of possibilities.*

If you want to build your own MIDI adapter, "A MIDI Project" in BYTE's June 1986 issue should fill the bill. I've even heard of people modifying ordinary IBM PC serial interfaces to work with MIDI. Key Electronic Enterprises (9112 Hwy. 80 W, Suite 221-E, Fort Worth, TX 76116, (817) 560-1912) makes a device that operates off PC serial ports.

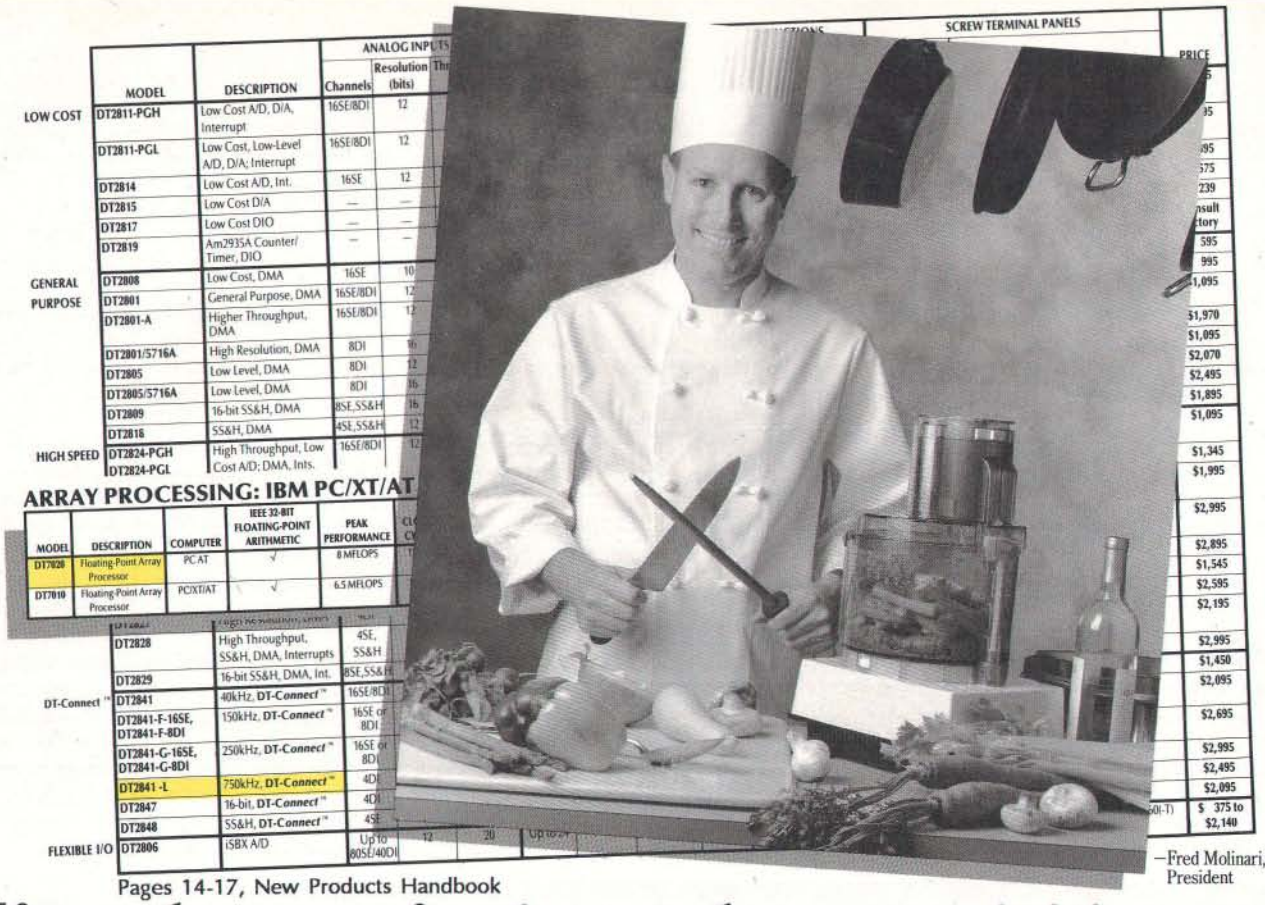
Finally, if you're simply desperate to put the 6581 SID into your PC, you could probably do it by building a parallel I/O board with an 8255 on it and controlling the inputs to the SID through the 8255's ports. As you've already noted, you'll have to include a 1.0-MHz source for the SID chip (easily done with a crystal from Jameco or JDR Microdevices).

For details on how to put together the 8255 interface, locate a copy of Handbook of Software and Hardware Interfacing for IBM PCs *by Jeffrey P. Royer (Prentice-Hall, Englewood Cliffs, NJ,*

continued



IBM PC Data Acquisition Highlights. No. 3 in a series.



	MODEL	DESCRIPTION	ANALOG INPUTS Channels	Resolution (bits)	SCREW TERMINAL PANELS	PRICE
LOW COST	DT2811-PGH	Low Cost A/D, D/A, Interrupt	16SE/8DI	12		
	DT2811-PGL	Low Cost, Low-Level A/D, D/A; Interrupt	16SE/8DI	12		
	DT2814	Low Cost A/D, Int.	16SE	12		
	DT2815	Low Cost D/A	—	—		
	DT2817	Low Cost DIO	—	—		
	DT2819	Am2935A Counter/ Timer, DIO	—	—		
GENERAL PURPOSE	DT2808	Low Cost, DMA	16SE	10		
	DT2801	General Purpose, DMA	16SE/8DI	12		
	DT2801-A	Higher Throughput, DMA	16SE/8DI	12		
	DT2801/5716A	High Resolution, DMA	8DI	16		
	DT2805	Low Level, DMA	8DI	12		
	DT2805/5716A	Low Level, DMA	8DI	16		
	DT2809	16-bit SS&H, DMA	8SE,SS&H	16		
	DT2818	SS&H, DMA	4SE,SS&H	12		
HIGH SPEED	DT2824-PGH DT2824-PGL	High Throughput, Low Cost A/D; DMA, Ints.	16SE/8DI	12		

ARRAY PROCESSING: IBM PC/XT/AT

MODEL	DESCRIPTION	COMPUTER	IEEE 32-BIT FLOATING-POINT ARITHMETIC	PEAK PERFORMANCE
DT7020	Floating-Point Array Processor	PC AT	√	8 MFLOPS
DT7010	Floating-Point Array Processor	PC/XT/AT	√	6.5 MFLOPS

	DT2828	High Throughput, SS&H, DMA, Interrupts	4SE, SS&H	
	DT2829	16-bit SS&H, DMA, Int.	8SE,SS&H	
DT-Connect™	DT2841	40kHz, DT-Connect™	16SE/8DI	
	DT2841-F-16SE, DT2841-F-8DI	150kHz, DT-Connect™	16SE or 8DI	
	DT2841-G-16SE, DT2841-G-8DI	250kHz, DT-Connect™	16SE or 8DI	
	DT2841-L	750kHz, DT-Connect™	4DI	
	DT2847	16-bit, DT-Connect™	4DI	
	DT2848	SS&H, DT-Connect™	4SE	
FLEXIBLE I/O	DT2806	iSBX A/D	Up to 80SE/40DI	

				$1,970
				$1,095
				$2,070
				$2,495
				$1,895
				$1,095
				$1,345
				$1,995
				$2,995
				$2,895
				$1,545
				$2,595
				$2,195
				$2,995
				$1,450
				$2,095
				$2,695
				$2,995
				$2,495
				$2,095
				$ 375 to $2,140

Pages 14-17, New Products Handbook

—Fred Molinari, President

If you hunger for faster data acquisition and processing, here's the recipe...in real time.

The DT2841 and DT7020. 750kHz throughput. 32-bit floating point processing. Data acquisition has never been faster.

If PC AT® throughput bottlenecks are frustrating you, Data Translation has the answer. Our external interface, DT-*Connect*™, surmounts the historically slow AT bus to deliver much faster data acquisition and array processing.

This is the answer for high-speed DSP operations such as filters and FFTs. It features A/D, D/A, DIO, and a Timer/Counter . . . plus, MACH™ Subroutine Libraries that support most programming languages.

At last. High-speed data acquisition and high-speed computation power.

Together. In one tasty package.

FREE 1989 Data Acquisition Handbook.

Call (508) 481-3700
In Canada, call (800) 268-0427

DATA TRANSLATION®

World Headquarters: Data Translation Inc., 100 Locke Drive, Marlboro MA 01752-1192 USA, (508) 481-3700 Tlx 951646
United Kingdom Headquarters: Data Translation Ltd., The Mulberry Business Park, Wokingham, Berkshire RG11 2QJ, U.K. (0734) 793838 Tlx 94011914
West Germany Headquarters: Data Translation GmbH, Stuttgarter Strasse 66, 7120 Bietigheim-Bissingen, West Germany 01742-54025
International Sales Offices: Australia (2) 662-4255; Belgium (2) 466-8199; Canada (416) 625-1907; China (1) 868-721 x4017, (408) 727-8222; Denmark (2) 274511; Finland (0) 372144; France (1) 69077802; Greece (1) 951-4944, (31) 527.039 (1) 361-4300; Hong Kong (5) 448963; India (22) 23-1040; Israel (3) 5401524; Italy (2) 82470.1; Japan (3) 502-5550, (3) 348-8301, (3) 355-1111; Korea (2) 756-9954; Netherlands (70) 99 6360; New Zealand (64) 9-545313; Norway (2) 53 12 50; Portugal (1) 545313; Singapore (65) 7797621; South Africa (12) 8037680/93; Spain (1) 455-8112; Sweden (8) 761-7820; Switzerland (1) 723-1410; Taiwan (2) 7020405

DT-Connect and MACH are trademarks and Data Translation is a registered trademark of Data Translation, Inc. All other trademarks are the property of their respective holders.

Circle 78 on Reader Service Card

1987). A simple audio amplifier circuit for the SID (as suggested by Commodore) appears in the figure. To keep digital noise out of the audio stage, be sure your ground connections for the SID and the amplifier stage are separate from the grounds used by the 8255 and its attendant support circuitry.—R. G.

More Megabytes

In January, I purchased—through mail order—Digital Electronics Company's DE386 20-/25-MHz Desktop VII computer with 1 megabyte of RAM. Since April, I have been unable to contact Digital Electronics (the company *was* located in Rockville, MD). Certified mail that I have sent to the company remains unclaimed and is returned to me.

Basically, my system performs without problems, although the turbo mode—which is supposed to speed up the system to 25 MHz—causes all my programs to freeze.

I am in desperate need of more RAM. The manual that came with the machine reads, "The system memory board will support up to 16-Mb of 32-bit expansion memory through the use of special Digital Electronics expansion memory boards which attach to the main memory board in piggy-back fashion." The memory board, now fully loaded with 2 megabytes' worth of 256K-byte chips, is manufactured in Taiwan and is imprinted with the following information: ET-3 Pulsar MDS USA87, serial number P8706306.

Do you have any information regarding Digital Electronics Company? If not, what is the best way for me to upgrade my existing 32-bit memory board to its full potential? Obviously, I'd be happiest if I could find a compatible piggyback board.

Daniel Kalmann
New York, NY

You're about to embark on one of the more interesting aspects of owning a personal computer—the care and feeding of orphans. The memory expansion on most of these AT clones is proprietary to the manufacturer. I've called around and have been unable to reach Digital Electronics or locate anyone with information on your motherboard. What to do?

First off, I'm guessing that you added 1 megabyte to your machine, bringing it up to 2 megabytes. Is the memory you added fast enough? Is it from the same manufacturer as the original RAM? Yes, it matters. Japanese RAM has different timing than American RAM. When you push a processor at 25 MHz, the subtle timing differences can become significant. You might try substituting different RAM chips for the ones that you added. Another sad fact is that many of these boards simply won't work at their "turbo" speed no matter what you do.

If it were my machine, I'd forget about expanding the system board and buy a memory card for the bus. The Intel AboveBoard, the Everex RAM 3000, or any good memory card may work. The memory will run a bit slower (being out on the bus), but you have the added advantage of being able to move the memory from this machine to another if this one ever dies. Depending on the BIOS, you may not even be able to add RAM on the bus.

The safest way would be to take the machine into a good computer store and try the memory card right in the store. If you buy a card mail order and it doesn't work, well...—H. E. ■

LOGITECH SOFTWARE

Finally. OS/2 debugging help has arrived.

Introducing MultiScope,™ an OS/2, multi-language, CodeView™-compatible debugger, like nothing you've seen before.

For a start, it provides 13 views of your program: Source—Data—Graphic Data—Assembly—Thread—Breakpoint—Watch—Register—Module—Call—Memory—Log—and Output.

Other unique features include: run-time and post-mortem debugging options; OS/2 text mode and Presentation Manager user interfaces; and even a graphical representation of your data structures! All for ***$299.***

Call toll free ***800-231-7717.***
In CA 800-552-8885. Fax 415-792-8901.

MULTISCOPE™ DEBUGGER

From LOGITECH Software

Circle 310 on Reader Service Card (DEALERS: 311)

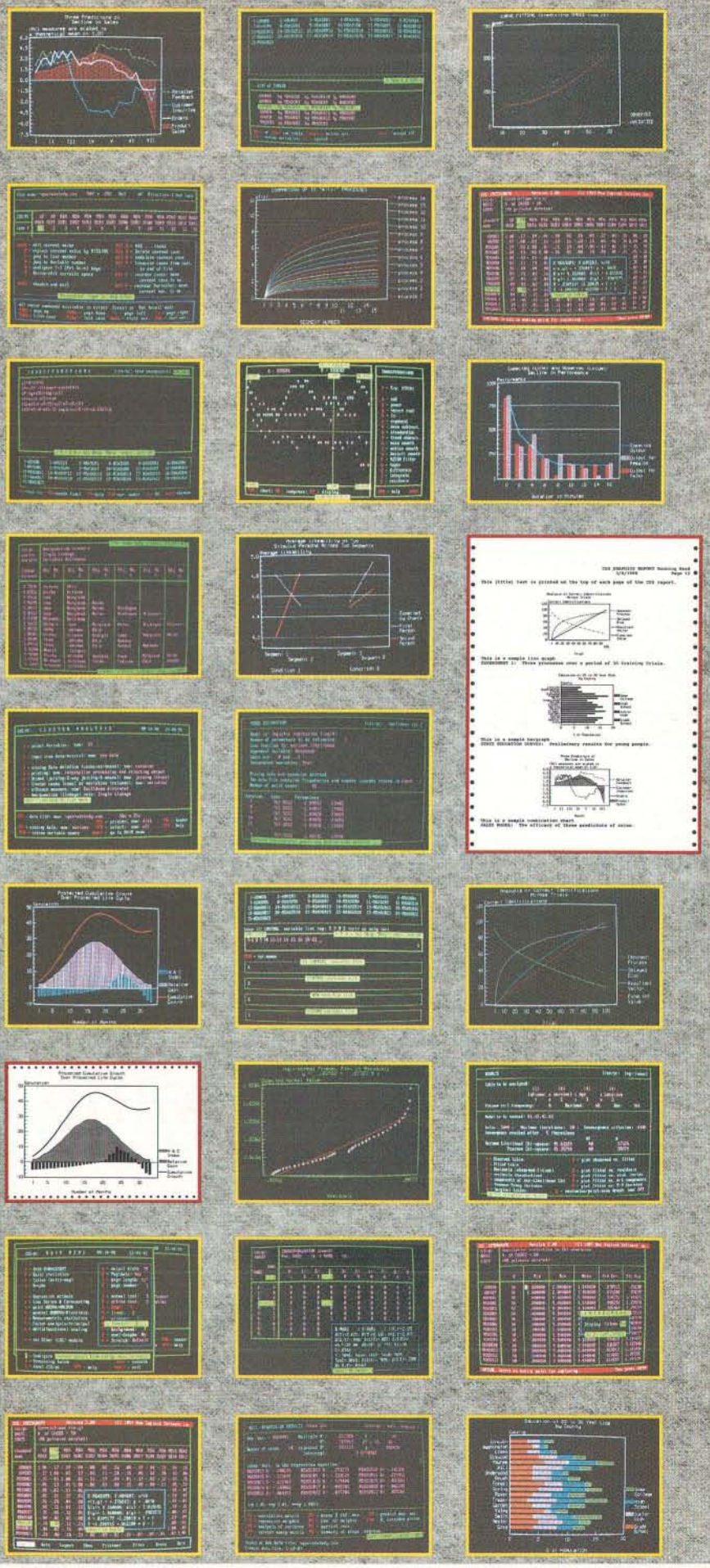
THE NEW STANDARD FOR HIGH PERFORMANCE STATISTICAL SOFTWARE

CSS

COMPLETE STATISTICAL SYSTEM
WITH DATA BASE MANAGEMENT
AND GRAPHICS

A powerful, comprehensive, elegant, and super-fast statistical package for IBM (PC, AT, PS/2) and compatible computers. ■ The CSS optimized user interface with fast hierarchical menus incorporates elements of artificial intelligence; even complex analyses require only a few keystrokes (batch processing is also supported). ■ CSS features comprehensive, state of the art implementations of: *Basic statistics, Multi-way frequency tables, Nonparametric statistics, Exploratory data analysis with analytic graphs, Multiple regression methods, Time series analysis with modeling and forecasting (incl. full ARIMA), General ANOVA/ANCOVA/MANOVA, Contrast analysis, Discriminant function analysis, Factor analysis, Principal components, Multidimensional scaling, Item analysis/Reliability, Log-linear analysis, Cluster analysis, Non-linear estimation, Logit/Probit analysis, Canonical analysis, Survival and Failure Time analysis (Censored data), Quality Control analysis, and much more.* ■ All statistical procedures are integrated with fast data base management and instant, presentation quality graphics (over 100 types); full support for all mono and color graphics boards (incl. VGA) and over 100 plotters and printers (incl. the HP and Postscript standards). ■ All CSS screen output is displayed via customized Scrollsheets™ (i.e., dynamic, user controlled, multi-layered tables with cells expandable into pop-up windows); all numbers in a Scrollsheet™ can be instantly converted into a variety of presentation quality graphs; contents of different Scrollsheets™ can be instantly aggregated, combined, compared, plotted, printed, or saved. ■ The flexibility of the CSS input/output is practically unlimited: CSS offers an intelligent interface (read/write) to all common file formats (Lotus, Symphony, dBII, dBIII+, DIF, SYLK, . . .) and special utilities to easily access data from incompatible programs; graphics can be saved in files compatible with desktop publishing programs (Aldus, Ventura). ■ CSS data files can be as large as your operating system (DOS) allows; OS/2 version coming soon. ■ CSS precision exceeds the standards of all common precision benchmarks. ■ *Technical note: The CSS user interface and all I/O were written in Assembler and bypass DOS; graphics and data management were written in Assembler and C; the computational algorithms were written in Assembler and optimized Fortran.* ■ $495 (plus $5 sh/h); 14-day money back guarantee.

Circle 259 on Reader Service Card



StatSoft

2325 East 13th Street ■ Tulsa, OK 74104 ■ (918) 583-4149
Fax: (918) 583-4376

Overseas Offices: StatSoft of Europe (Hamburg, FRG), ph: 040/4200347, fax: 040/4208724, **StatSoft UK** (London, UK), ph: 0438/310056 or 316561, fax: 0438/310001, **StatSoft Pacific** (Melbourne, Australia), ph: 613-663-6580, fax: 613-663-6117, **StatSoft Canada-CCO** (Ontario), ph: 416-849-0737, fax: 416-849-0918 **Available From:** CORPORATE SOFTWARE and other Authorized Representatives Worldwide: Holland: Lemax BV 02968-94210; France: Conceptel (1) 45669700; Sweden: AkademiData 018-696201; Korea: Geul Bang (02) 272-1973

"When Fosberry said a PS/2 with Micro Channel would let him juggle ten things at once and still have time to break for lunch, he meant it."

How're you going to do it?

These days, no matter what size your company, you've got to be able to keep a lot of balls in the air to stay competitive.

The Genius Of Micro Channel. Which is why IBM developed the Personal System/2® with Micro Channel.™ Micro Channel can support multiple operating microprocessors. So you can, for example, separately manage peripherals, while freeing up the main processor to crunch numbers. A bus master can even be sending a fax while another manages traffic on a network, all with greater reliability.

Naturally, every PS/2® with Micro Channel runs DOS and OS/2.™ So with OS/2 Presentation Manager,™ you can do multiple tasks concur-

IBM, Personal System/2 and PS/2 are registered trademarks and OS/2, Presentation Manager and Micro Channel are trademarks of International Business Machines Corporation. © 1989 IBM Corp.

PS/2 it!

rently, all with an easy-to-use graphical interface. What's more, with Micro Channel, there are no DIP switches to set, for simpler, more reliable installation. You can find and reset cards anywhere in the network—right from your desk!

The Solution Is IBM. So, to manage lots of information, jobs, hardware and software, invest in the PS/2 with Micro Channel. Contact your IBM Authorized Dealer or IBM marketing representative. For a dealer near you, call 1 800 IBM-2468, ext. 142. You'll learn there's almost nothing you can't do if you PS/2 it!

IBM®

"Number crunching's for when I'm in the office. Out here, just give me a great little PC. And I mean little."

ZENITH INNOVATES AGAIN™

The leader in laptop PCs* now brings you a notebook portable that fits your business and your briefcase.

Finally, desktop performance on a moment's notice. That's the sleek MinisPort™ from Zenith Data Systems.

Under 6 pounds, MinisPort rides in a briefcase like a notebook. But unlike other notebook PCs, it uses removable *MiniDisks* to store all the data you need...just like your desktop. You also get a *DayBright*™ backlit screen for crisp text in any light. And over 3 hours of battery life.

So bring your portable computing down to a more manageable size with Zenith's sleek MinisPort.

For your nearest Zenith Data Systems authorized dealer, call: *1-800-842-9000, ext. 1.*

ZENITH | data systems

THE QUALITY GOES IN BEFORE THE NAME GOES ON®

*Source: Dataquest—True portable PC sales.

Graphics simulate Microsoft® *Windows*, a product and trademark of Microsoft Corporation.

© 1989, Zenith Data Systems

Circle 295 on Reader Service Card

CHAOS MANOR MAIL

Jerry Pournelle answers questions about his column and related computer topics

ST Lacks Fax

Dear Jerry,

As an Atari ST owner, I'm aware that there doesn't seem to be any possibility of inserting a fax card into my machine, since there are no slots. However, there is a modem port. Could you please explain if there is some way of composing a document in memory and some describable protocol to send it to a fax receiver via a modem?

Also, are there any 9600-bps or higher fax machine protocols? Would the same protocols work for digitized documents, and are there different resolution standards? What else would be required to receive and store fax messages in memory, so they could be displayed on a monitor instead of having to be printed? We're all bracing for the coming fax revolution, and we're planning to get a digitizer for desktop publishing. It seems that with the proper elements we should be able to do both faxing and DTP, but it would help to know exactly how to make them work together properly.

Frederick Bernard
Vancouver, BC, Canada

Sorry, but I don't know of any way to do that. Perhaps one of BYTE's readers will know. They seem to know everything.
—Jerry

Face-Up vs. Face-Down Output

Dear Jerry,

Recently you complained about the face-up output of your LaserJet Plus printer. We have a similar machine at work, and it has a feature that enables you to switch the output between face-up and face-down. There is a two-position lever to the right of the output slot with some indecipherable symbols indicating this function. In one position the printer outputs each page face-up; in the other, it outputs face-down. I hope this reduces future problems.

Dave Swanson
Elgin, IL

Hmm. My LaserJet Plus is an original LaserJet (I got it way back in CP/M days!) that was upgraded to a Plus, and it certainly has no such switch. The LaserJet II has that option, of course. So does our big Kyocera printer and Mrs. Pournelle's Mannesman-Talley printer.

I have long thought that I ought to put the LaserJet Plus downstairs for the staff and bring the Kyocera up here; it's much the superior printer, so why should they have it? The only reason I can give for not having done it is sloth (and I don't do that much printing up here; most of it is done downstairs on the Tandon computer and the Kyocera printer).—Jerry

Windows in Monochrome

Dear Jerry,

The March issue of BYTE was full of good news for those of us who use and like Microsoft Windows. Mark Minasi reported on Micrografx's Mirrors, Ray Valdés reviewed XVT, and you had the wisdom to name Windows the Software Trendsetter of 1988.

Windows has its problems (how is it possible to design a graphical interface that doesn't manage the most graphical data structure, the directory tree?), but it does many things DOS can't, and at a far lower cost than OS/2. It even runs well on systems that can't run OS/2.

I would like to make some observations on your comment that you can get Excel and MacInTax for your AT, "provided you have a good EGA video system." Neither Windows nor Windows applications require high-resolution color. In fact, using an EGA or VGA color video system will slow down Windows considerably.

I have an AT&T PC 6310 AT compatible. It runs at 8 MHz with one wait state and has a 16-bit video card that provides a 640- by 400-pixel monochrome

continued

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "jerryp."

Circle 41 on Reader Service Card

situation:

Puzzled over which Pascal compiler is best for you?

solution:

BLAISE COMPUTING INC.

Our tools support both QuickPascal and Turbo Pascal.

POWER TOOLS PLUS/5.0 $149

Full featured function library
◆ Features context sensitive help screens
◆ window oriented pick lists ◆ multiple-line edit fields with fully configurable edit keys
◆ moving bar pull-down menus and windows
◆ in-memory sort routines ◆ EMS support
◆ TSRs and ISRs ◆ and much more!

ASYNCH PLUS $129

Asynchronous communication manager
◆ Features speeds to 19.2K baud
◆ XON/XOFF protocol ◆ support for up to 4 comm ports ◆ hardware handshaking
◆ XModem file transfer ◆ I/O buffers up to 64K
◆ and much more!

POWER SCREEN $129

Screen I/O manager
◆ Features screen painter ◆ virtual screens
◆ data validation ◆ context sensitive help
◆ unlimited screens ◆ definable keys
◆ and much more!

Fast, flexible and affordable!

Blaise Computing offers programming tools that are fast, flexible and affordable. Call now to order or to ask for a free brochure on our full line of products for C and Pascal.

FREE with these products!

Source code, complete sample programs, a comprehensive reference manual with extensive examples, the Norton Guides Instant Access Program, and a comprehensive online database.

Supports QuickPascal and Turbo Pascal!

All of these products support Turbo Pascal 4.0, 5.0, and 5.5 and Quickpascal 1.0.

Put Blaise tools to the test!

If at any time during the first 30 days you are not completely satisfied with their speed and flexibility, we'll refund your money.

Call (800) 333-8087 today!
FAX: (415) 540-1938

BLAISE COMPUTING INC.
2560 Ninth Street, Suite 316 Berkeley, CA 94710 (415) 540-5441

Turbo Pascal is a registered trademark of Borland International.
QuickPascal is a registered trademark of Microsoft Corporation.

display. This is hardly state-of-the-art technology, but it runs Windows very well. I've been trying out Windows software on systems that run far faster, have far more memory, and are equipped with fast 16-bit VGA cards. Windows' performance on these machines is miserable.

When you think about it, it's apparent why a high-resolution color video system slows Windows down. The CPU must deal with a much larger video RAM space and an equally large screen buffer in main memory. A monochrome display represents a far smaller load on the CPU. Unless your work absolutely requires color output, you should run Windows in a monochrome mode (I believe Microsoft supplies graphics drivers for the EGA 640- by 350-pixel and VGA 640- by 480-pixel monochrome modes).

A solution to this problem will probably come in the form of video coprocessors (I have this fantasy of an Amiga 500 motherboard as an AT video card). Until then, we should remind ourselves that black-and-white is different, not worse.

Noah Jacobs
San Francisco, CA

Well, but I sure do like color.—Jerry

Low-Cost Compiling

Dear Jerry,

I enjoy your Computing at Chaos Manor column. It was the column that originally sold me on BYTE, and it remains BYTE's major attraction. I appreciate your hands-on reviews and your willingness to express your opinions.

I'd like your advice and/or a reference to an appropriate review regarding the various C compilers on the market. I have experience with FORTRAN (college, circa 1970) and interpreted BASIC. I've been working with a Unix-based system in my office, and I've started learning some C with the AT&T System V compiler. I'd like to buy a C compiler for my AT clone at home. However, the advertised prices in BYTE range from $50 to $400, with only advertising copy for comparison. Can I get a potent compiler without breaking the bank?

Nic Steussy
Springfield, TN

Thanks for the kind words. BIX is getting less expensive because of new marketing techniques, and it's the ideal place to ask questions like this.

I am no C authority. I understand that Borland's Turbo C is very good and reasonably priced. After that, you'd better get more expert advice. BYTE did a Product Focus on C compilers in the February issue. There are a lot of C compilers, and they are not all equal.—Jerry

Amiga Notes

Dear Jerry,

I'm one of the great unwashed who scrimped and saved and finally splurged on an Amiga 1000 after your first very positive BYTE review. I've been reading your comments since then with some concern, and I have to agree that they've been fair and factual. Nonetheless, I was glad to see your report on more positive developments such as Unix, because despite everything I've grown rather fond of my idiot child.

It's fun to read your column and dream of being surrounded by great snarling 80386 beasts, as at Chaos Manor. I hope someday you'll install a 68030 board in your Amiga 2000, because, chip for chip, it is said to have four times the computing power of the 80386.

I often think your asides about the concrete problems of setting up an "ergonomic" work environment are your most useful and lasting contributions. I constantly use the copy holder I kludged onto a drafting light fixture after seeing you using something similar in a photograph taken eons ago. In addition to the wide, flat desk for global input of paperwork, I recommend cheap cork tiling on all walls not occupied by bookshelves. It holds reams of stuff you don't want to rummage for and provides a resilient surface for your skull during debugging.

Charles Heckel
Van Nuys, CA

Thanks.—Jerry

All Thumbs

Dear Jerry,

You responded to James T. Oitzinger's suggestion (April) that dividing a keyboard's space bar into two parts might result in a better keyboard by saying, "That sounds like an interesting idea. I've been watching, and I hardly ever use my left thumb for anything. Fascinating. Thanks for the suggestion."

I, too, thought it was an interesting idea, so I read Oitzinger's letter to my wife. Her response was that the left thumbs of keyboard users must be kind of lazy, because her (old) bassoon has eight different keys controlled by her left thumb, and sometimes she must depress four or five of them *at the same time.* (She also said that newer bassoons have nine keys for the left thumb.)

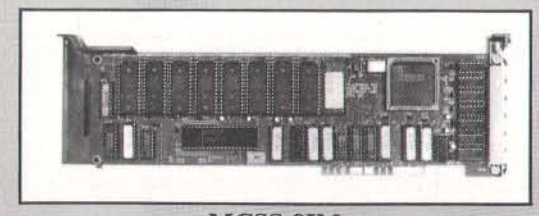
That really makes me appreciate my one-bar-for-both-thumbs keyboard!

Dr. Myron A. Calhoun
Manhattan, KS

Right! I'm using a Northgate keyboard, with the Backspace key where it belongs (up there where the [ ] keys are on other keyboards). Alas, they only made about five of them, and I think I have them all.

—Jerry ■

High Performance Multi-Channel Serial I/O



MCSS-9IM

GTEK, INC
Development Hardware & Software
P. O. Box 2310
Bay St. Louis, MS 39521-2310
Order Toll Free 1-800-255-GTEK (4835)
Fax: 1-601-467-0935 MS & Technical Support 1-601-467-8048

MCSS-9IM *For IBM Micro-Channel compatible bus*
- Serial Communication Co-processor with 9 channels per card.
- Dynamemory™ automatically finds and allocates up to 1 Megabyte of buffer memory. To add more memory just plug it in!
- Baud rates up to 57,600 baud. Upward compatible with the PCSS-8I.

PCSS-8IM *For IBM PC/XT/AT compatible bus*
- Serial Communication Co-processor with 8 channels per card.
- Dynamemory™ automatically finds and allocates up to 2 Megabytes of buffer memory. To add more memory just plug it in!
- Baud rates up to 57,600 baud. Upward compatible with the PCSS-8I.

MCSS-6T *For IBM Micro-Channel compatible bus*
- Serial I/O card adds 6 channels to a Micro-Channel machine.
- Compatible with the PCSS-8T, PCSS-8TX, and the PCSS-8TH.

PC/XT/AT and Micro-Channel are registered trademarks of IBM Corp.

Circle 107 on Reader Service Card (DEALERS: 108)

MCA Clones from France

The NS70-25 is a small Micro Channel architecture–compatible 25-MHz 80386 desktop system from France. Other NS systems include a 16-MHz 80286, a 16-MHz 80386SX, and a 20-MHz 80386.

All these machines use a proprietary Normerel BIOS; the company calls it "multilingual," because it is user selectable at setup to English, French, Spanish, or German. The NS70-25 includes 1 megabyte of RAM (upgradable to 4 megabytes), a 64K-byte disk cache, and one 1.44-megabyte floppy disk drive (with support for another 3½-inch internal drive and a 5¼-inch external drive). The standard hard disk drive is Quantum's 84-megabyte SCSI-based drive with a 19-ms average access time.

Included in the NS70-25 package is a 102-key PS/2-style keyboard and DOS 3.3. A 140-megabyte hard disk drive is optional.

The 16-MHz NS machines include your choice of 40- or 80-megabyte SCSI drives, but they don't include disk caching.

Price: NS70-25, $7229.
Contact: Normerel USA, Inc., 7665 Currency Dr., Orlando, FL 32809, (800) 940-8500 or (407) 240-8828.
Inquiry 1135.

DEC Gets Low on RISC

The DECstation 2100 is a low-priced small-footprint RISC system. It's based on the 12.5-MHz R2000 processor from MIPS Computer Systems, and it includes 8 megabytes of RAM (expandable to 24 megabytes), a 15-inch monitor with 1024- by 864-pixel resolution, a thick and thin Ethernet interface, a mouse, a keyboard, and Ultrix Workstation Software, which includes an Ultrix (DEC's Unix) license for up to two users. Software includes TCP/IP, NFS, a C compiler, and DECwindows/X Window System programming tools and applications.

The systems can hold two internal 104-megabyte SCSI hard disk drives. DEC provides SoftPC DOS-emulation software for running DOS applications.

Price: With monochrome monitor, $7950; with color monitor, $11,450.
Contact: Digital Equipment Corp., 146 Main St., Maynard, MA 01754, (508) 493-5111.
Inquiry 1134.

Normerel's 25-MHz NS70-25 has an MCA bus.

Back to the Basics with the HeadStart Explorer

The Explorer is for people who want to learn about computers but are reluctant to take the first step.

It's based on a 4.77-/9.54-MHz 8088 microprocessor and comes with 512K bytes of RAM (expandable to 768K bytes), one 720K-byte 3½-inch floppy disk drive, and a 40-megabyte hard disk drive. There's an attached 84-key keyboard. Built-in software includes DOS 3.4, a word processor, a calculator, a datebook, and an address book. The monitor is optional.

Price: $599.
Contact: HeadStart Technologies Co., 40 Cutter Mill Rd., Suite 438, Great Neck, NY 11021, (516) 482-4255.
Inquiry 1133.

SEND US YOUR NEW PRODUCT RELEASE

We'd like to consider your product for publication. Send us full information, including price, ship date, and an address and telephone number where readers can get further information. Send to New Products Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Information contained in these items is based on manufacturers' written statements and/or telephone interviews with BYTE reporters. BYTE has not formally reviewed each product mentioned. These items, along with additional new product announcements, are posted regularly on BIX in the microbytes.sw and microbytes.hw conferences.

Switchable CPUs and a Small Footprint, Too

The small-footprint desktop CompuStar II comes with your choice of interchangeable CPU modules in the Wells American tradition of the original tower-based CompuStar.

You can transform your CompuStar II from a 20-MHz 80286 Model 220 to a 33-MHz 80386 Model 333 simply by changing the CPU module. You can also make it a 16-MHz 80386SX, a 20-MHz 80386, or a 25-MHz 80386.

The basic chassis measures 16 by 16 by 4 inches and comes with ports for a keyboard, a modem, a serial connection, and a parallel connection. The basic system also includes a 101-key firm- or soft-touch keyboard. Inside, you'll find a 200-W power supply, a motherboard (minus the CPU), six 16-bit slots (one for the CPU module), snap-mount connectors for up to 8 megabytes of RAM, a disk controller with cabling, and a hard disk drive interface.

There's room for a 3½-inch hard disk drive, mounted vertically to the right of where you'll find three 5¼-inch slots. CompuStar II options include a 40-, 100-, or 200-megabyte hard disk drive.

Price: Chassis, $750; Model 220/40 with 42-megabyte hard disk drive and monochrome monitor, $2765; Model 333/100 with 104-megabyte hard disk drive and VGA color monitor, $6655.
Contact: Wells American, 3243 Sunset Blvd., West Columbia, SC 29169, (803) 796-7800.
Inquiry 1132.

continued

NEC Grasps More Graphics

The new graphics monitors from NEC include two analog color monitors, the MultiSync 4D and 5D, and a monitor for text-based applications such as desktop publishing.

The 4D has a 15-inch (diagonal) screen and supports VGA, SuperVGA, 8514/A (1024 by 768 pixels interlaced), 1024 by 768 pixels noninterlaced, and Apple Macintosh II graphics standards. The dot pitch is 0.28 mm. Variable horizontal scan rates range from 30 to 57 kHz, and vertical rates range from 50 to 90 Hz. The number of possible colors is determined by the graphics board you use.

The MultiSync 5D is a 19-inch display that adds support for 1280- by 1024-pixel (noninterlaced) graphics to those listed above for the 4D. The dot pitch is 0.31 mm. The monitor offers horizontal scan rates of up to 66 kHz. Like the 4D, it incorporates a microprocessor-based digital control system that NEC says "automatically scans the incoming video signal and adjusts the screen parameters to show the optimum image."

The third monitor is a 13-inch gray-scale unit called the MultiSync GS2A. The analog GS2A has a paper-white phosphor screen, offers virtually unlimited shades of gray (the maximum is determined by the graphics board), and supports VGA, SuperVGA, and Apple Mac II graphics standards (up to 800- by 600-pixel resolution).

Price: 4D, $1799; 5D, $3699; GS2A, $349.
Contact: NEC Home Electronics (U.S.A.), Inc., 1255 Michael Dr., Wood Dale, IL 60191, (312) 860-9500.
Inquiry 1137.

NEC's MultiSync 5D supports a variety of graphics modes, including VGA, SuperVGA, 8514/A, and Apple Mac II standards.

Seiko Enters Mac Market with New Color Printer

Seiko Instruments has announced a version of its CH-5500 color thermal printer for the Macintosh.

The QD5500 series includes a QuickDraw device driver that supports a set of 35 scalable outline fonts, similar in concept (but not identical) to the fonts that Apple will supply with System 7.0.

The printer offers 300-dpi resolution and comes in two sizes—8½ by 11 inches and 11 by 17 inches. It features a roll feed with an automatic cutter, which allows for a larger print area, Seiko says.

The 8½- by 11-inch printer includes 1 or 3 megabytes of RAM. The 3-megabyte version improves performance because you can access the entire color image in one pass through memory.

Price: 8½- by 11-inch printer with 1 megabyte of RAM, $7000.
Contact: Seiko Instruments USA, 1130 Ringwood Court, San Jose, CA 95131, (408) 943-9100.
Inquiry 1138.

A Half Gigabyte in a Half-Height Drive

Imprimis Technology's Wren VI is a SCSI-, ESDI-, or ST-506-based 502-megabyte hard disk drive that fits in a half-height 5¼-inch slot.

Data transfer is rated at 15 to 21 MHz, and the average seek time is 16 ms. The company claims that it can pack so much information in so little space because of its patented Zone Bit Recording method (also known as Constant Density Recording), which varies the frequency ranges of disk writing from the inside of the disk to the outside for optimum performance.

Imprimis also uses a "look-ahead buffer" with 32K bytes of RAM.

Price: $3200.
Contact: Imprimis Technology, Inc., 12501 Whitewater Dr., Minnetonka, MN 55343, (800) 828-8001, ext. 82.
Inquiry 1136.

A Large-Screen Monitor with a Budget Price

The MegaScreen Rival is a two-page, 19-inch monochrome display system for your Macintosh.

Features include 75-dpi, 1024- by 826-pixel resolution, a 75-Hz refresh rate, a paper-white phosphor display with darkened glass for glare reduction, and a built-in tilt-and-swivel stand. Each Rival system includes the monitor, add-in card, stand, and cables.

The MegaScreen monitor is 18 by 15 by 19 inches and weighs 46 pounds.

Price: For Mac SE, II, IIx, and IIcx, $1698; for Mac Plus, $1748.
Contact: MegaGraphics, Inc., 439 Calle San Pablo, Camarillo, CA 93010, (805) 484-3799.
Inquiry 1140.

Mac Drive Includes Five Types of Data Backup

The Silhouette Mac RD-44 is a removable SCSI-based Macintosh hard disk drive with a 25-ms access time and 44-megabyte disk cartridges.

The included software has five backup modes: shadow, periodic incremental, file-by-file, time-of-day, and mirror image. The drive comes with one cartridge.

Price: $1595; extra cartridges, $149.
Contact: Cumulus Corp., 23500 Mercantile Rd., Cleveland, OH 44122, (216) 464-2211.
Inquiry 1139.

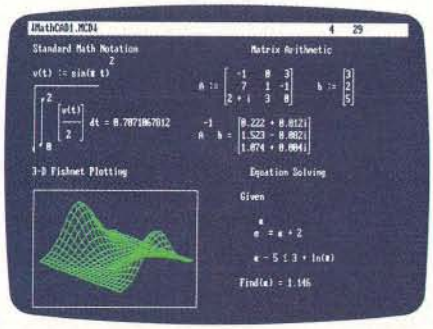
continued

After centuries of practice, mankind perfects engineering calculations: MathCAD.

Announcing MathCAD 2.5: The Dawn of a New Age.

What the historians will call it, only time will tell.

Perhaps the Century of Speed, or the Era of Ease. But whatever the name, this is the age of MathCAD 2.5, the only math package that looks and works the way you think.

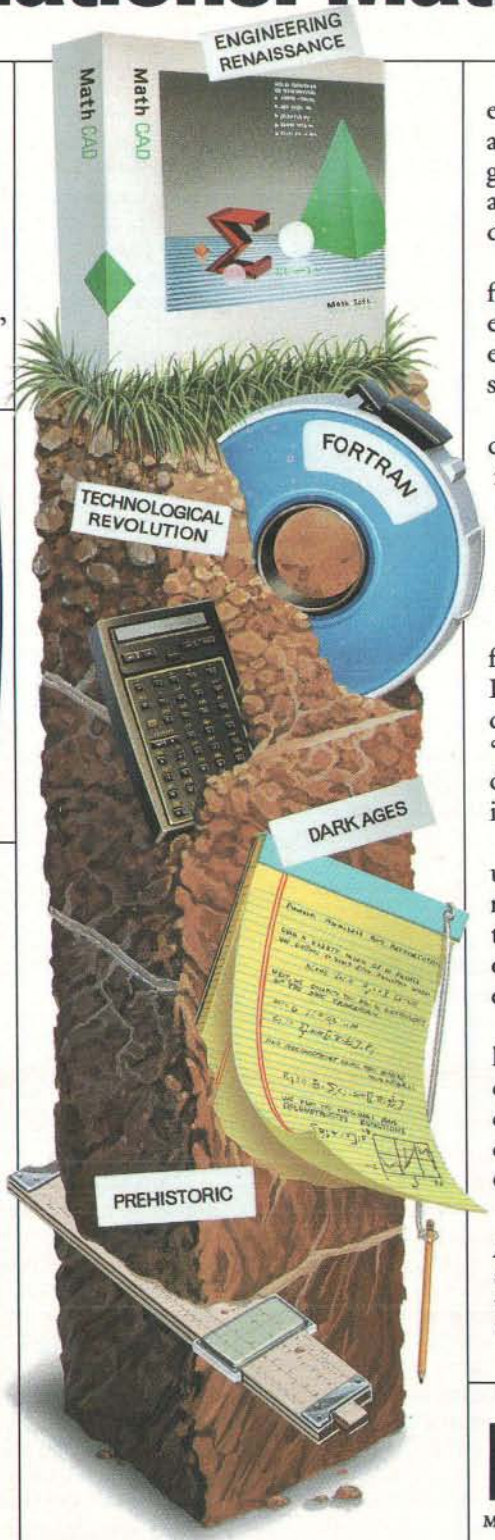


MathCAD 2.5 includes 3-D plotting, HPGL sketch import, and PostScript output.

MathCAD is far and away the best-selling math package in the world. Because it lets you perform engineering and scientific calculations in a way that's faster, more natural and less error-prone than the way you're doing them now—whether you're using a scratchpad, calculator, spreadsheet or program that you wrote yourself.

And now we've made the best even better. MathCAD 2.5 is a dramatically improved version that includes three-dimensional plotting, enhanced numerical analysis, and the ability to import HPGL files from most popular CAD programs, including AutoCAD.® And now you can print on PostScript® compatible printers.

And like before. MathCAD's live document interface™ lets you enter equations anywhere on the screen, add text to support your work, and graph the results. Then print your analysis in presentation-quality documents.



It has over 120 commonly used functions built right in, for handling equations and formulas, as well as exponentials, differentials, cubic splines, FFTs and matrices.

No matter what kind of math you do, MathCAD 2.5 has a solution for you. In fact, it's used by over 60,000 engineers and scientists, including electrical, industrial, and mechanical engineers, physicists, biologists, and economists.

But don't take our word for it; just ask the experts. PC Magazine recently described MathCAD as "everything you have ever dreamed of in a mathematical toolbox."

PC MAGAZINE EDITORS' CHOICE
March 14, 1989 issue.
Best of '88
Best of '87

And for Macintosh® users, we present MathCAD 2.0, rewritten to take full advantage of the Macintosh interface. Entering operators and Greek letters into equations is pure simplicity!

Look for MathCAD 2.5 at your local software dealer, or give us a call. For more information, a free demo disk, or upgrade information, dial 1-800-MATHCAD (in MA, 617-577-1017).

Available for IBM® compatibles and Macintosh computers.

TM and ® signify manufacturer's trademark or manufacturer's registered trademark respectively.

MathCAD®

MathSoft, Inc. One Kendall Square, Cambridge, MA 02139

U.K.: Adept Scientific 0462-480055; **France:** ISE CEGOS 1-46092768; **Germany:** Softline 07802-4036; **Japan:** CRC 03-665-9768.

Circle 165 on Reader Service Card

PE #3

HARDWARE • ADD-INS

Inexpensive Real-Time TV for Your Macintosh

The MicroTV II is a low-priced NuBus card that displays real-time TV (or any other video source) in 128 levels of gray on a Mac II equipped with an 8-bit color card and color monitor.

The video appears in your window, complete with a refresh rate of one-thirtieth of a second. It makes your window look like a black-and-white TV, complete with "knobs" for channel, volume, contrast selection, and an on/off switch. Software also lets you copy and paste.

The board is cable-ready, so you can plug the coaxial cabling from your local cable TV franchise directly into the back of the card. Then the 108-channel tuner takes over, manipulating composite and direct audio/video inputs.

To extend the software that makes use of the card, a developer's toolkit contains HyperCard and SuperCard external commands, interfaces for popular development systems, technical information, sample applications with source code, and MacApp object libraries.

Price: $395.
Contact: Aapps Corp., 110 Pioneer Way, Mountain View, CA 94041, (415) 961-4033.
Inquiry 1141.

Triple the Speed of the Mac II and IIx

DayStar Digital plans to speed up your Mac's CPU, bus, RAM access, video performance, and SCSI-peripheral-based performance with a line of add-in boards.

To do this, the company is starting with a line of accelerator cards (for CPU speeds up to five times faster) and is introducing a proprietary bus alternative that speeds up bus transfers by a factor of three. To run on the proprietary bus or to default to the slower NuBus, DayStar Digital's new RAM card doubles accessible RAM. The company is also developing video and SCSI cards with NuBus and proprietary bus interfaces. Now in beta testing, they are scheduled to be delivered before the year's end.

The Accelerator II and the Accelerator IIx (for the Mac II and IIx) are based on Motorola's 68030 microprocessor. They feature speeds of 25, 33, 40, and 50 MHz and attain zero-wait-state performance by incorporating a 32K-byte cache with 15-ns static RAM. A Motorola 40-MHz 68882 math coprocessor is an option with each accelerator.

To eliminate the NuBus bottleneck, DayStar Digital's Extended CPU Interface (XCI) backplane card features 33-MHz performance and three proprietary slots. (An XCI is included with every accelerator board you purchase.) The RAM card, with a proprietary port and a default port for NuBus, features 100-ns RAM, expandable to 16 megabytes.

Inside your Mac, the CPU accelerator board fits horizontally above the motherboard and doesn't use any of your six NuBus slots. The XCI backplane is a half-width card that fits across the front of your system and plugs into both the accelerator card and the front ends of the proprietary RAM card (and the video and SCSI cards, when they're available).
Price: 25/030 Accelerator II/IIx, $2995; 33/030, $4995; 40/030, $5995; 50/030, $6995.
Contact: DayStar Digital, 5556 Atlanta Hwy., Flowery Branch, GA 30542, (404) 967-2077.
Inquiry 1144.

Put a Padlock on Unpaid Computers

One of the continuing problems for computer dealers who rent or lease systems is what to do if clients don't make their payments. Collecting money or repossessing systems can be risky business.

Genesys has come up with a singular solution to the problem. Its uniquely named and uniquely featured Click/Clock is an add-in card for IBM PCs and compatibles.

It automatically locks up a system if a payment hasn't been received by a specific date that is programmed into the card.

Click/Clock operates independently of both DOS and the existing hardware, and it even has a tamper-resistant lock so that it can't be removed from the system. Since the computer is completely unusable once Click/Clock locks it up, you can use the customer's own data as collateral.
Price: $249.
Contact: Genesys, 2301 Lucien Way, Suite 105, Maitland, FL 32751, (407) 875-0101.
Inquiry 1143.

HARDWARE • OTHER

A Long and Happy Life for Your AT Battery

If you've ever had your IBM AT's battery suddenly die, you know that once the CMOS that stores your system parameters loses data, your computer is virtually useless. A dead battery causes loss of time/date, loss of drive setup data, and mysterious software and hardware errors. The lithium batteries that most ATs use are normally good for a year or two, but they are often difficult to purchase and a challenge to replace.

With its bATPac, Rupp Corp. offers the first rechargeable backup battery for ATs and compatibles.

The bATPac is a sealed rechargeable battery with an expected lifetime of at least 10 years, which will make it last long after your computer has become completely obsolete. It continually charges while the system is on and can keep the CMOS happy for at least a year of power-down.

The unit measures 2⅜ by 2⅜ by 1 inch. You install it by plugging it into your AT's internal battery connector. The battery is charged using power from a disk drive power connector. It includes a Y-connector, along with a Velcro attachment for securing the bATPac to the side of your system's power supply.
Price: $39.95.
Contact: Rupp Corp., 835 Madison Ave., New York, NY 10021, (212) 517-7775.
Inquiry 1145.

continued

If You Want To Talk Fast DBMS Call 1-800-db_RAIMA And Start Screaming

You'll be screaming, all right. db_VISTA III from Raima Corporation combines the flexibility of a relational DBMS and the lightning speed of the network database model.

C db_VISTA III is written for C Programmers. Source code available. The interactive database utilities and outstanding documentation make db_VISTA III easy to learn. All applications are portable to VMS, UNIX, OS/2, MS-DOS, even Macintosh. No royalties.

db_VISTA III is *Fast*. Using benchmarks originated at PC Tech Journal Laboratories, db_VISTA III measured *3 to 12 times faster than the average relational database!* Call us and we'll send you the results.

Relational and Network Model Technology for Programming Flexibility. Retrieve a record fast using the relational keyed access method and all related records can be immediately available using the network model. You decide how to combine these for best application performance.

db_VISTA III Database Development System		
Features	**Yes**	**No**
db_VISTA 3.1 High Performance DBMS:		
Single and Multi-User available	✓	
Relational B-tree Indexing	✓	
Network Database Model	✓	
Multiple database access	✓	
Referential integrity	✓	
Automatic recovery	✓	
Record & File locking	✓	
RAM resident		✓
db_QUERY 2.1 SQL-based Query:		
Relational Query & Report Writer	✓	
db_REVISE 1.0 Database Restructure Program:		
Total database redesign/restructuring	✓	
Operating Systems*: VMS, ULTRIX, UNIX	✓	
BSD 4.2, SunOS, XENIX, MS-DOS,	✓	
Macintosh and MS Windows, OS/2 compatible	✓	
C Compilers*: Most compilers supported	✓	
C++ compatible	✓	
LANs*: 3COM, Novell, Banyan, AppleShare	✓	
WKS Library:		
Read & Write WKS, WK1 & DBF files	✓	
SOURCE CODE AVAILABLE:	✓	
ROYALTIES: (Absolutely not!)		✓✓

*Other environments are supported: call for complete list.

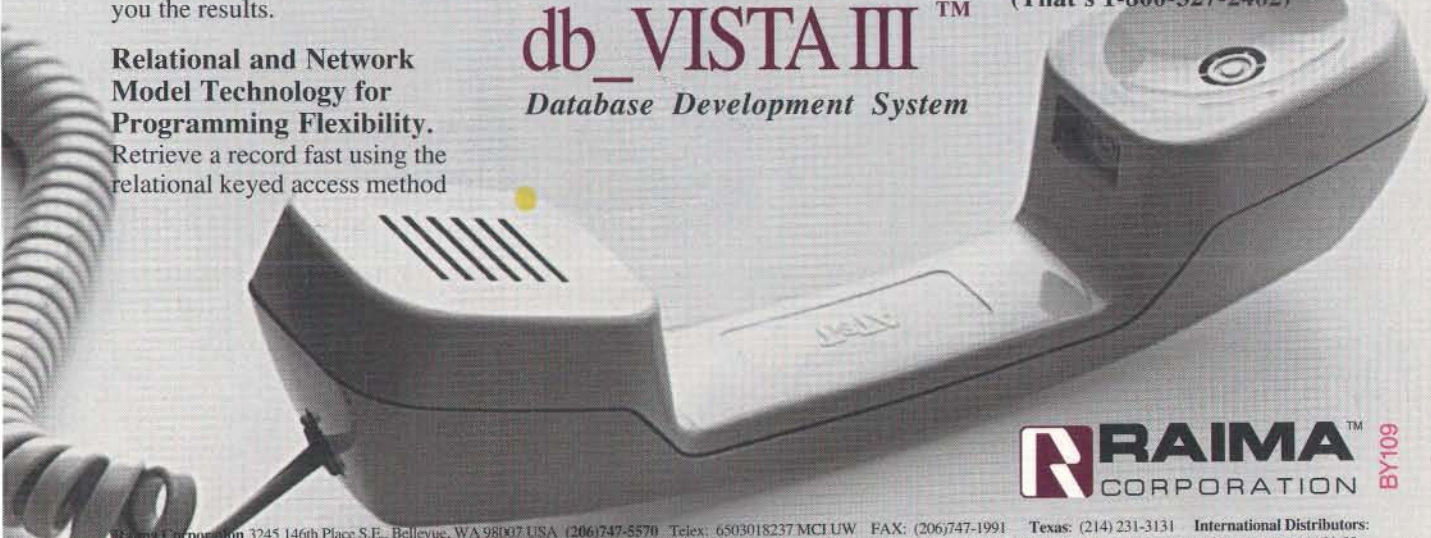
SQL Support with SQL-based db_QUERY, db_VISTA III's relational query and report writer.

db_VISTA Puts You in Some Fast Company. Thousands of C programmers in over 50 countries worldwide use db_VISTA III, including APPLE, ARCO, AT&T, EDS, Federal Express, Hewlett-Packard, IBM, NASA...

Don't wait. Call Raima for more information about how you can build applications that are *screaming-fast!*

Call 1-800-db_RAIMA
(That's 1-800-327-2462)

db_VISTA III™
Database Development System



RAIMA™ CORPORATION

BY109

Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA (206)747-5570 Telex: 6503018237 MCI UW FAX: (206)747-1991 **Texas:** (214) 231-3131 **International Distributors:** **UK:** (0734) 500919 **Germany:** 07127/5244 **Switzerland:** (01)725 0410 **France:** (1)46092828 **Benelux:** 31(02159)46 814 **Sweden:** (013)124780 **Italy:** 045/584711 **Norway:** 47 244 88 55 **Denmark:** (2)887249 **Singapore:** 468 3888 **Australia:** (02) 959 5122 **Japan:** (03)473 7432 **Taiwan:** (02)511 3277 **Mexico:** (83) 57 35 94 **Central America:** (506) 28 07 64 **Caribbean:** (809) 834 4069 **Colombia:** 57 1 218 9245 **Argentina:** 54 1 313 5371 **Chile:** 56 2 696-4308 **Uraguay:** 92 19 37 **Brazil:** (0192) 52 9770 © 1989

Get a long little doggie.
See you later.
Cat scan.
Uplifting.
Take the cake.
Show boat.
Roll over Beethoven.
Raise the roof.
Shoot the moon.
Pick up trucks.
Lift off.
Let her roll.
Give them a piece of your mind.
Off the wall.
See lion.
Make amends.
Polish Dog
Stanley Steam
Weiner Speci
Soft Drinks
Chips
Pretzels
$1.75
1.50
FREE KITTENS
BANANA CAKE
½ cup minus two table-
spoons butter
2 cups sifted flour
1 teaspoon baking powder
1 teaspoon soda
¾ teaspoon salt
1 and 1-3 cup sugar
½ cup buttermilk
1 cup mashed ripe bananas
2 eggs
½ cup coarsely chopped
nuts
1 teaspoon vanilla
Stir shortening to
sift in dry ingredie
one-quarter cup bu
and remaining ingr
NLIGHT SONATA
LUDWIG Von BEETHOVEN
FOR SALE BY OWNE
ADMAX
"The service's prices
a bring seller and buyer
gether without a broker."
-ENTREPRENEUR MAG.
"The Matchmaker ... serving
individual buyers and sellers
directly."-MONEY MAG.
"Saving time and money for
buyers and sellers."
-VENTURE MAG.
BEDROOM
BATH
LIVING ROOM
DINING ROOM
GARAGE
BEDROOM
BEDROOM
ON-LINE
COMPUTER
LOGITECH
COMMERCIAL LEASE
check on this
change name
?
What?

LOGITECH

What can a ScanMan™ scan, man?

Virtually anything. *Logos or photos. Digits or dingbats. Art or articles. A soda can. How can you get them into your PC? You could play cut and paste with the copier down the hall. Or use your own, do-it-in-a-flash, hand-held scanner. ScanMan.*

Images. *Select 1, 2, 3, or 400 d.p.i., then pop any image up to 4" x 14" into a file for your publishing program. Or into your Windows™ clipboard. Or use PaintShow Plus™—included with your ScanMan—for editing and coloring.*

Text. *Our Catchword™ software converts virtually any typeface into ASCII files for your word processor, desktop publisher, or spreadsheet. It reads horizontally or vertically, scans words or numbers from 6 to 20 point, and matches adjacently scanned columns perfectly.*

Should you buy it? *Once you've got it you'll wonder what you did without it. And it's only $339.* Backed by our Customer Satisfaction Guarantee, and 7 Days-a-Week Support.*

For information, call: **800-231-7717**

In California:
800-552-8885
In Europe: ++41
-21-869-96-56

LOGITECH

**For IBM PC and compatibles; includes Paintshow Plus. List price for the IBM Micro-Channel version is $399. Catchword is an optional extra for $199.*

Circle 161 on Reader Service Card (DEALERS: 162)

Voice I Translates from English to Spanish

The Voice I system is a small microprocessor-based system that translates spoken English into Spanish, Advanced Products claims. It's built on a proprietary platform with one 8-bit and two 16-bit microprocessors, and it uses a proprietary operating system.

Although it will operate as a stand-alone unit, it also includes an RS-232C port for personal computer connection.

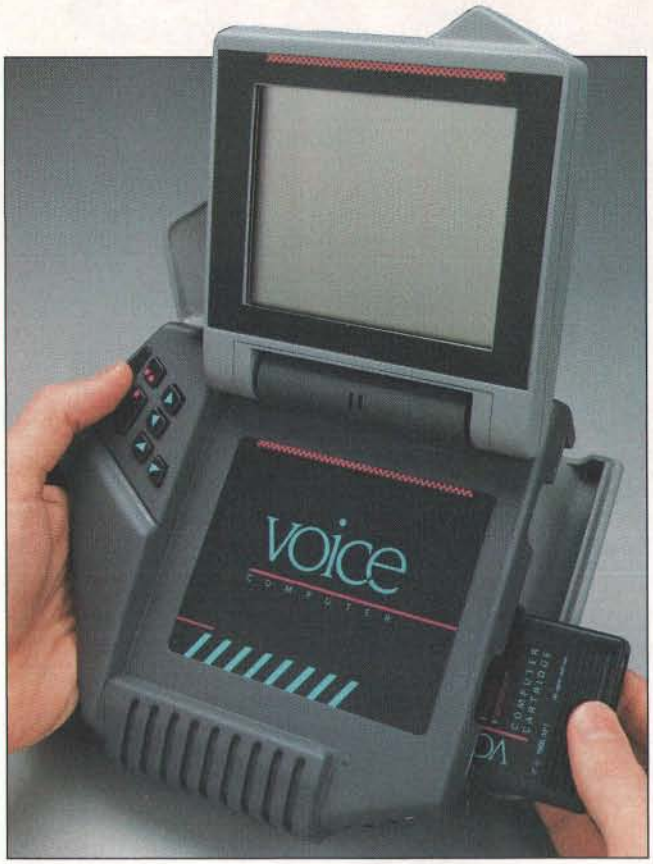
The Voice I is primarily designed to translate from English to other languages with specially designed cassette-size modules. The English to Spanish module can translate more than 35,000 phrases, the company claims.

A second module, scheduled to ship this month, will translate spoken English into French. There's also the Voice Assistant module, a personal information manager (with calendar, daily scheduler, phone list, and search capabilities) based on voice recognition and natural-language processing.

With a translation module, the 3-pound, 8- by 7- by 3-inch hand-held unit translates phrases almost instantly. But you have to speak slowly, word by word. Your words are also displayed on the 160- by 128-pixel LCD. The Voice I will work if the input rate is below 60 words per minute.

The basic system includes 4 megabytes of addressable memory. There's also an internal microphone and a speaker, a microphone jack for an external microphone and headset, an external speaker connector, a rechargeable battery, and an AC power adapter.

Price: $2000; Voice Assistant module, $300; English to Spanish module, $300.
Contact: Advanced Products & Technologies, Inc., 15444 Northeast 95th St., Redmond, WA 98052, (206) 883-8297.
Inquiry 1147.



When you say, "I don't speak Spanish," the Voice I says, "No hablo Español."

And the Word Became Code

Franklin Computer's Electronic Holy Bible includes a microprocessor, 1 megabyte of ROM, a tactile-feedback QWERTY keyboard, a supertwist LCD, and word processing–style software. It is available in both King James and Revised Standard versions.

The NEC V20 microprocessor allows the Bible-size, notebook-computer-styled device to almost instantaneously find specific text. If you don't know the exact spelling of the word on which you're doing a search, you can approximate the word phonetically.

The screen always displays the names of books of the Bible, which you can select with the cursor and access by pressing Return. Above the icons is room for four lines of type, with nearly 40 characters in each line. Each character cell has a resolution of 5 by 8 pixels.

Price: $299.
Contact: Franklin Computer, 122 Burrs Rd., Mt. Holly, NJ 08060, (609) 261-4800.
Inquiry 1148.

HP's Spectrum Analyzers Designed Around PCs

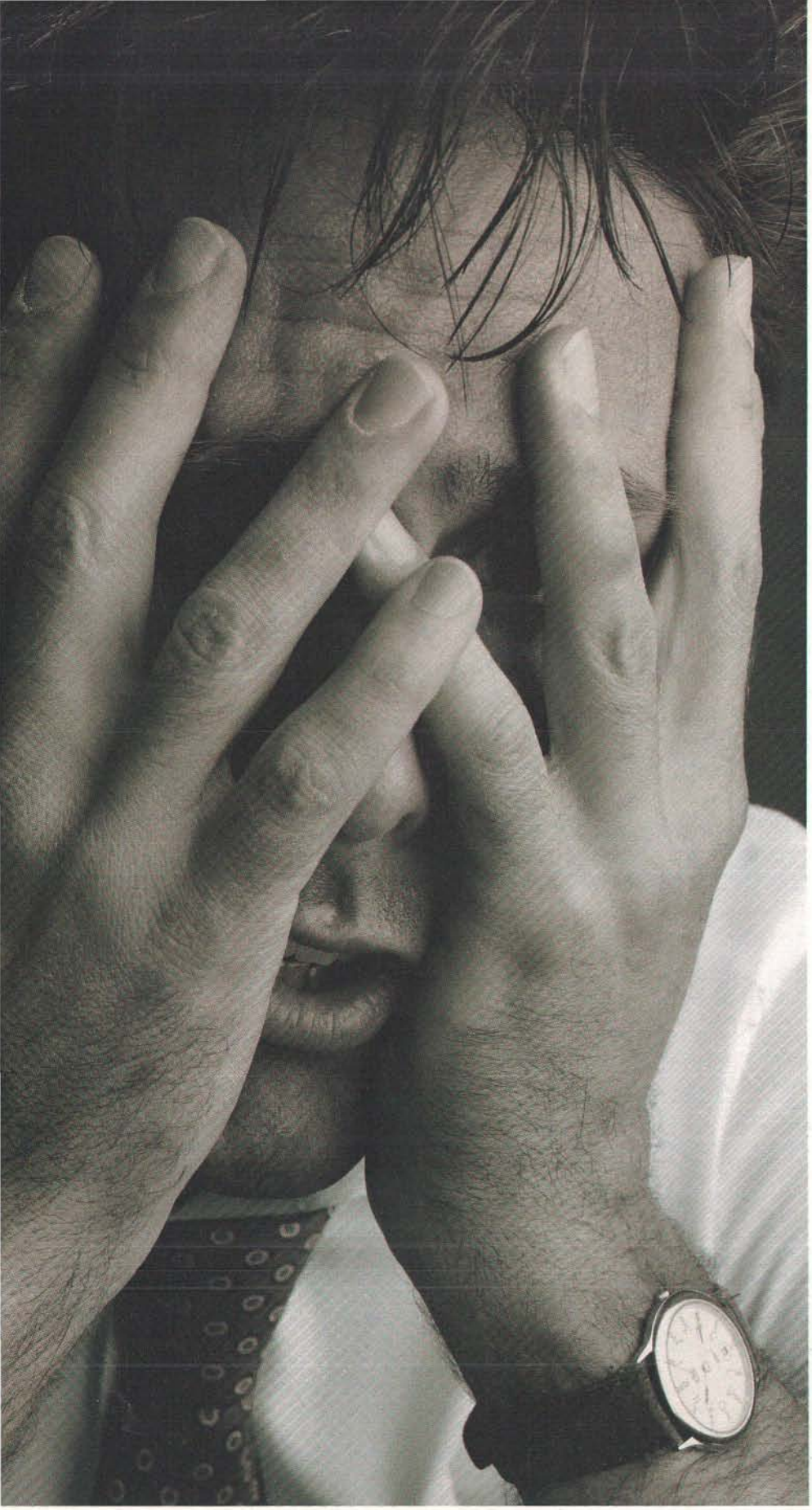
Hewlett-Packard's two new spectrum analyzers are PC-based instruments designed to help engineers solve mechanical-test, production-test, and signal characterization problems. Specifically, they measure frequency response functions, auto/cross correlation, transient-time capture, one-third octave with A-weighting, stimulus-response testing, and order tracking.

The two models, the HP 3567A and the 3566A, feature two and six channels, respectively.

You need at least a DOS-based 80286 machine running Microsoft Windows with EGA graphics. Each analyzer comes with a software driver, and you connect the fast Fourier transform module on the spectrum analyzer through cabling to your computer's serial port.

The software lets you manipulate up to 16 channels of incoming data, eight on-screen at a time. For measurement automation, you can access every automation feature by programs written in a variety of Microsoft-supported programming languages.
Price: HP 3567A, $18,000; HP 3566A, $22,000.
Contact: Hewlett-Packard Co. Inquiries, 19310 Pruneridge Ave., Cupertino, CA 95014, (800) 752-0900.
Inquiry 1146.

continued



Okay.

You're using dBASE. You're trying to develop a payroll application for the entire company, and you've just hit the wall. So the first thing you do is try a few workarounds, then some more. And ignore the fact that you don't have any decent back-up and recovery, data integrity, database security or multi-user concurrency.

No big deal. It's only the fate of the company, your closest friends, and their children.

dBASE® was the computing environment of the 80's. Back before businesses became dependent on LANs and multi-user applications.

ORACLE is the computing environment for the 90's. From the very beginning, Professional ORACLE® was designed for multi-user workgroup applications. Its SQL architecture is built in (not tacked on like dBASE) and includes all the fourth-generation development tools you need to develop applications that run on over 80 different platforms. And every major operating system, even OS/2.™

It's so reliable, in fact, that over 47 of the Fortune 50 rely on Professional ORACLE.

You can have Professional ORACLE for $1,299. Or the Trial Version for $199.

And if, after 30 days, you're not happy with it, return it for a full refund.

Call 1-800-ORACLE 1, Ext. 4956 to order. And enter the computing environment of the 90's.

ORACLE®
Compatibility · Portability · Connectability

If it's that important, develop with ORACLE on the PC. Call 1-800-ORACLE 1, Ext. 4956.

Offer valid in U.S. only. Professional ORACLE Requirements: MS-DOS—80286/80386 PC with MS-DOS V3.1+, hard disk, 640KB of memory and 896K extended memory required. 2.5MB of extended memory recommended (required for SQL*ReportWriter™). OS/2—80286/80386 PC w/ OS/2 V1.0+, hard disk, 3MB memory. SQL*ReportWriter™ not available for OS/2 and is replaced by SQL*Report.® Copyright ©1989 by Oracle Corporation. dBASE, dBASE IV and Ashton-Tate are registered trademarks of Ashton-Tate Corp. ORACLE and SQL*Report are registered trademarks of Oracle Corporation. SQL*ReportWriter is a trademark of Oracle Corporation. MS-DOS is a trademark of Microsoft Corp. OS/2 is a trademark of International Business Machines Corp.

Replace Cabling Headaches with Radio or Light

While there are few new choices in LAN cabling, there are now two cable-less networking solutions. Telesystems SLW has a cellular radio solution for NetWare-based LANs, and Photonics has an infrared-based LocalTalk-compatible transceiver.

The ARLAN 450 card plugs into any IBM PC or compatible and runs under Novell NetWare. The wireless two-thirds-length card uses cellular radio frequencies for 230-kbps data transmission rates. It's an 8-bit bus-based version of Telesystems' serial product.

Telesystems recommends that you use an ARLAN 450 (which has a built-in transceiver) at each of the nodes, and an ARLAN 440 and its separate transceiver, Model 010, at your file server. The 450 is the equivalent of the 440 with the 010, but by separating the transceiver, you don't have to locate your file server in the physical middle of the nodes. Both boards include NetWare drivers.

You use unshielded or shielded twisted-pair cable between the 440 in the file server and the brick-size 010 transceiver. Distance is limited to less than 2000 feet.

In an office environment with physical barriers, Telesystems recommends that you link no more than 10 450-based PCs in a radius of no more than 250 feet from the file server. In an open factory, the radius recommendation is 1500 feet. Or you can use the transceivers as bridges, as long as there's a clear line of sight, for transmission distances of up to 6 miles.

Using "spread spectrum" radio technology with radio output power of 1 W, there's no need for an FCC license to use the ARLAN card, Telesystems reports.
Price: ARLAN 450, $1500; ARLAN 440, $500; ARLAN 010, $2000.
Contact: Telesystems SLW, Inc., 85 Scarsdale Rd., Suite 201, Don Mills, Ontario, Canada M3B 2R2, (416) 441-9966.
Inquiry 1149.

Each Photolink transceiver replaces a strand of LocalTalk cabling.

Meanwhile, Photolink uses beams of invisible infrared light, reflected off the ceiling, to communicate between Macintosh computers. Photonics says that replacing cables with infrared light increases flexibility, lowers costs, and even improves security. The company is also working on a version that provides serial communications between terminals and hosts.

A Photolink installation consists of individual transceiver units mounted on top of office partitions and pointing toward a common spot on the ceiling. Each wedge-shaped unit, about the size of a telephone, can support up to four Macs, which plug in via phone cables connected to the LocalTalk network port.

Photolink is effective in an unobstructed area of roughly 70 feet in diameter, the company says. The ceiling does not have to be specially prepared; Photonics says the system will work on everything from acoustical tile to dark oak beams.

AppleTalk networks run at about 230 kbps, as does Photolink, although Photonics claims that the current units are capable of running at 1 Mbps. The company plans a 4-Mbps Token Ring model for 1990 and a 10-Mbps Ethernet version for 1991.
Price: Transceiver, $995.
Contact: Photonics Corp., 200 East Hacienda Ave., Campbell, CA 95008, (408) 370-3033.
Inquiry 1150.

Ready, Set, Network

ReadyNet might be for you if you want a simple, low-cost LAN for your home or small business. It's an unshielded twisted-pair-based (telephone wiring), bus-based network with XT- and AT-compatible adapter boards and CSMA collision avoidance. The data rate is 1 Mbps.

The start-up kit includes two boards, 50 feet of cabling with RJ-11 connectors on each end, and software drivers that configure the two-node basic network. You purchase each add-on node in a kit that includes a separate card, cabling, and a software driver. The primary server requires 184K bytes of RAM; each node requires 60K bytes.

ReadyNet has an automatic preconfigured connection feature and provides basic functions, such as messaging, file transfer, and printer spooling. There's also a remote-control "virtual console" function that lets one person at one ReadyNet PC control another person's application.

ReadyNet supports up to 24 PCs at distances of up to 1000 feet from the primary server. The network operating system was designed for this network and is therefore proprietary.
Price: Start-up kit, $499; each add-on, $249.
Contact: Corvus Systems, Inc., 160 Great Oaks Blvd., San Jose, CA 95119, (408) 281-4100.
Inquiry 1152.

continued

Here's How We Protect Your Software And Profits Better.

We'll Never Tell.

Because our key-interrogation routines are *encrypted*, and our hardware is custom-wired to distinguish each of our clients' keys, our clients have the highest degree of security available.

Unlike other manufacturers, our routines assume responsibility for all hardware, software and timing issues. And what this means is that your engineering time and money won't be wasted reinventing protection schemes.

We offer two high security products for copy control: the KEY and the MEMORY KEY.™

Our protection devices can also be used for serialization techniques, software leasing, modular software management, creative revenue collection, demo control and a path for future upgrades.

The information stored in the MEMORY KEY can be conveniently reprogrammed by your application software or at the end user's site via software disk or modem.

All our products attach conveniently to the printer port, are transparent and allow for unlimited back up copies.

For serious software protection, call now. And start protecting your profits.

Hands down, we're better.

Encrypted routines provide the highest degree of security

Custom hardware and software for each developer

No batteries to fail or replace

No programming adapters necessary

Can be dynamically reprogrammed at the user site via diskette or modem.

Over 55 languages supported in DOS, XENIX and OS/2

MICROPHAR

PROTECH
MARKETING, INC.
1-800-843-0413 *Se Habla Español*

In Europe: Microphar, 42, Ave. Sainte Foy 92200, Neully Sur-Seine France
Tel: 33-1-47-38-21-21 Fax: 33-1-46-24-76-91, Call to obtain distributor addresses in: Belgium, Ireland, Italy, Netherlands, Portugal, Spain, Switzerland, U.K. & W. Germany.

For Europe circle 211 on Reader Service Card

In the Americas and the Pacific: ProTech, 9600-J Southern Pines Blvd. Charlotte, NC 28217
Tel: 704-523-9500 Fax: 704-523-7651 **Hours: Mon-Thurs: 8:30-7:00 ET, Fri: 8:30-5:30 ET**
FOR A DEMONSTRATION PACKAGE OR ADDITIONAL INFORMATION, PLEASE WRITE OR CALL.

For Americas & Pacific circle 212 on Reader Service Card

Programmer's Paradise –when you

WE'LL MATCH NATIONALLY ADVERTISED PRICES.

	LIST	OURS
386 PRODUCTS		
386 ASM/LINK	495	435
386/VMM	295	239
386MAX	75	66
386MAX PROFESSIONAL	129	115
C Network Compiler/386	995	799
DESQview 386	190	169
Lahey F77L-EM/32	895	795
NDP FORTRAN-386	595	549
Paradox/386	895	625
VM/386	245	209
VM/386 Multi-User	895	759
VM/386 NetPak	150	129
VMOS/3	99	89
ADA LANUGUAGE		
IntegrAda	795	749
Janus/Ada Compiler	300	269
Janus/Ada Options Kit	500	449
Meridian:		
AdaGraduate	495	445
AdaStudent	50	45
AdaTutor	150	135
AdaVantage Developer's Kit	1095	985
AdaVantage PC Prof. Dev. Kit	1780	1599
ASSEMBLY LANGUAGE		
Advantage Disassembler	295	279
MS Macro Assembler	150	105
OPTASM	125	109
Sourcer w/ BIOS source	140	125
Turbo Assembler/Debugger	150	105
Visible Computer: 80286	100	89
BASIC LANGUAGE		
db/LIB	139	121
GraphPak Professional	149	129
MS BASIC/6.0	295	209
P.D.Q.	99	89
ProBas	135	125
ProScreen	99	94
QuickBASIC	99	69
Quick-Comm	139	125
QuickPak Professional	149	129
QuickWindows Advanced	139	125
True BASIC	100	69
Turbo Basic	100	69
C COMPILERS		
C Network Compiler	695	559
Lattice C 6.0	250	199
Microsoft C	450	299
MS QuickC	99	69
MS QuickC w/ Mouse	199	99
MS QuickC w/ QuickAssembler	199	135
Turbo C	150	105
Turbo C Professional	250	175
WATCOM C 7.0	395	319
Zortech C	90	79
C++		
Guidelines C++	295	269
M++	495	CALL
Zortech C++	150	129
w/ source	250	209
Zortech C++ Tools	100	89
Zortech C++ Video	CALL	CALL

	LIST	OURS
C-COMMUNICATIONS		
Breakout II	125	99
C Asynch Manager 3.0	189	139
Essential Communications	249	199
Greenleaf Comm. Library	299	209
Greenleaf ViewComm	559	475
Lattice Communication Library	250	209
C-FILE MANAGEMENT		
Btrieve	245	185
Btrieve for DOS 3.1 Networks	595	459
CBTREE	159	135
C Index + (Microsoft C)	195	179
C Index + (Turbo C)	99	89
C-ISAM	225	209
Codebase IV	295	219
c-tree	395	318
d-tree	495	395
r-tree	295	241
CQL	225	199
w/ PASS	395	349
dBC III	250	219
dBC III Plus	500	439
db_FILE Bundle	295	249
Essential B-Tree	99	89
pBase	149	135
XQL	795	599
Xtrieve PLUS	595	459
C-GENERAL LIBRARIES		
C TOOLS PLUS/6.0	149	109
C Utility Library	199	159
Greenleaf Functions	229	165
Greenleaf SuperFunctions	299	209
Turbo C TOOLS/2.0	149	115
C SCREENS		
C-Worthy w/ forms and source	495	CALL
FaceIt	99	89
Greenleaf DataWindows	395	279
JAM	595	529
Panel Plus	495	395
Vermont Views	395	CALL
w/ source code	790	CALL
Vitamin C	225	165
VC Screen	149	125
Vlib	149	129
C-SOURCE ANALYSIS		
AutoFlow-C	299	269
C/Analyst	150	135
Clear +	200	169
C:Lines/C:Tree	80	75
Codan	395	359
C-UTILITIES/OTHER		
Code Master v. 2	289	259
Csource	395	359
C-Terp	300	219
Heap Expander	80	70
JAKE	495	429
Norton Guides for C	100	65
PC-lint	139	105
PRO-C	675	569
TimeSlicer	295	279
w/source	1000	899
Vmem/C	189	169

	LIST	OURS
COBOL LANGUAGE		
Micro Focus:		
COBOL/2 w/ Toolset	1800	1499
COBOL/2 Toolset	900	749
Personal COBOL	149	129
MS COBOL	900	629
Realia COBOL	995	849
w/ RealMENU	1145	979
SCREENIO	400	375
DATABASE DEVELOPMENT		
Clarion 2.0	695	499
Clipper 5.0	695	439
dBASE IV	795	489
dGE	195	179
FoxBASE+	395	249
Magic PC	299	249
Paradox 3.0	725	509
R&R Report Writer	150	129
w/ Clipper/ FoxBASE module	200	159
R&R Code Generator	150	129
SilverComm Library 2.0	189	165
Tom Rettig's Library	100	80
DEBUGGERS		
386 DEBUG	195	159
Multiscope	299	CALL
Periscope II-X	145	105
Periscope IV/16 MHz	1995	1849
Periscope IV/20 MHz	2295	1995
Periscope IV/25 MHz	2595	2295
Sherlock	195	179
Soft Probe II/TX	395	345
VM Debug	99	89
EDITORS		
BRIEF	195	CALL
Epsilon	195	159
KEDIT 4.0	150	125
MKS Vi	149	129
Norton Editor	75	59
SLICK Editor	195	175
SPF/PC	245	199
VEDIT	69	59
VEDIT PLUS	185	115
FORTRAN LANGUAGE		
Grafmatic	135	119
Lahey F77L	595	529
Lahey Personal FORTRAN 77	95	89
MS FORTRAN	450	299
Plotmatic	135	119
Printmatic	135	119
RM/FORTRAN	595	499
GRAPHICS LIBRARIES		
Baby Driver	250	225
Essential Graphics	299	239
Font-Tools	150	135
Graf-Text	89	79
GraphiC 5.0	395	322
Graphics-MENU	195	175
GSS Graphics Devel. Toolkit	595	509
HALO	395	279
HALO Window Toolkit	595	419
Icon-Tools/Plus	150	135
MetaWindow	195	159
FontWindow	95	85
Menuet	250	225
PCX Effects	99	89
PCX Programmer's Toolkit	195	175
PCX Text	99	89
XVT	595	509
LANGUAGE DEVELOPERS		
LALR	99	90
MKS LEX & YACC	249	209
PCYACC Professional	395	359
LINKERS/LIBRARIANS		
Plink86plus	495	419
PolyLibrarian II	149	135
.RTLink	195	185
MODULA-2		
LOGITECH Modula-2:		
Compiler Pack	99	75
Development System	249	199
Repertoire	149	135
Solid B+ Toolkit	100	90
TopSpeed Modula-2:		
B-Tree Toolkit	80	72
Communications Toolkit	80	72
Compiler Kit	100	89
DOS 3-Pack	200	179
TechKit	60	55
VID	60	55
OS/2 TOOLS		
Brief	195	CALL
Btrieve	595	459
Greenleaf DataWindows	395	309
HALO	695	489
MKS RCS	395	335
MKS Toolkit V3.1	495	419
MS OS/2 Present. Mgr. Toolkit	500	349
MS OS/2 Present. Mgr. Softset	150	105
Paradox OS/2	725	543
Topspeed Modula-2	195	179
Vitamin C	345	279

	LIST	OURS
PASCAL LANGUAGE		
Asynch PLUS	149	115
B-tree Filer	125	99
MS QuickPASCAL	99	69
Object Professional	150	119
Power Screen 1.1	149	115
Power Tools PLUS/5.0	149	115
Turbo Analyst	99	79
TurboMAGIC	199	179
Turbo Pascal 5.5	150	99
Turbo Pascal 5.5 Professional	250	169
Turbo-Plus 5.5	150	129
Turbo Professional 5.0	125	99
PROTOTYPING		
Dan Bricklin's Demo II	195	179
Instant Replay III	150	135
Show Partner F/X	350	319
SMALLTALK LANGUAGE		
Smalltalk-80 (386)	595	535
Smalltalk/V	100	85
Goodies Libraries	50	45
Smalltalk/V 286	200	169
Smalltalk/V PM	CALL	CALL
UTILITIES		
1 DIR Plus	95	75
Copy II PC	40	35
Copy II PC Option Board	159	139
Disk Technician Advanced	190	159
Disk Technician Plus	130	109
Dr. Switch	60	55
Fast!	99	89
FASTBACK Plus	189	159
hTest:hFormat	90	80
Lotus Magellan	195	CALL
MACE GOLD	149	129
MKS Toolkit	249	209
Norton Utilities	100	65
Norton Utilities Advanced	150	105
PC Fullback	70	59
PC/Tools Deluxe	129	89
Spinrite	59	49
Vfeature Deluxe	120	109
V OPT	60	55
XENOCOPY-PC	80	70
XTreePro	129	109
VERSION CONTROL SYS.		
MKS Make	149	129
MKS RCS	189	159
Personal PVCS	149	125
PolyMake	149	125
Professional PVCS	395	335
Seidl Version Manager	300	269
TLIB	100	90
5 Station LAN	300	259
WINDOWS (MS) TOOLS		
Actor	495	429
Case:W	795	759
C-Talk/Views	450	375
dBFast/Windows	249	229
MS Windows Development Kit	500	349
Whitewater Resource Toolkit	195	169
WinTrieve	395	339

NEW RELEASES

WinTrieve™
Microsoft® Windows-based file management system for application programmers using C or Actor. WinTrieve efficiently manages large amounts of information by storing data records on disk in indexed sequential access method (ISAM) files.
List: $395 **Ours: $339**

MKS TOOLKIT V3.1
Excellent for learning UNIX! New 260 page *users guide* includes an overview to introduce novices to general commands. Contains full MKS AWK, KornShell and Vi tutorials. New *install* and *config* programs make it easy to set up the configuration that best suits your needs. 15 new utilities added.
List: $249 **Ours: $209**

SMALLTALK/V PM
Combines the power of the industry's leading object-oriented environment with the richness of Presentation Manager. Fully compiled, giving a PM application developer an extremely responsive environment with which to work. Source code compatibility with Digitalk's other Smalltalk products.
List: CALL **Ours: CALL**

needed it *yesterday!* (800) 445-7899

Special of the Month: NOVELL

The ***Novell C Network Compiler*** gives you a direct link into NetWare, the leading network operating system with the world's largest installed base of network application users.

Order the C Network Compiler from Programmer's Paradise before October 29 and save $95 on the purchase of any other software that we carry!

CALL FOR DETAILS!!

	LIST	OURS
ADDITIONAL PRODUCTS		
Baler Spreadsheet Compiler	495	459
EasyFlow, Interactive	150	125
Inside!	125	109
Logic Gem	198	179
Matrix Layout	150	129
muLISP-87 Interpreter	300	219
Opt-Tech Sort	149	129
Paginate	100	89
PC/Forth +	250	225
PC Metric	199	185
PC Scheme	95	79
Personal Rexx	150	129
Source Print	99	89
Tree Diagrammer	99	89
UNIX SOFTWARE		
Aspen Korn Shell	145	109
Basmark QuickBASIC	695	629
Epsilon	195	159
Interactive 386/IX	1095	989
PRO-C	1835	1559
SCO XENIX 386 Complete Sys.	1595	1355
for PS/2	1695	1439
SCO XENIX 386 Oper. Sys.	695	589
Terminal Control	995	879
VPIX 386 Unlimited	995	845
BLAISE		
Asynch Plus	149	115
C Asynch Manager 3.0	189	139
C Tools Plus/ 6.0	149	109
Exec	95	75
KeyPilot	50	39
Power Screen 1.1	149	115
Power Search	149	115
Power Tools Plus/ 5.0	149	115
Turbo C Tools/ 2.0	149	115
BORLAND		
Paradox 3.0	725	509
SideKick Plus	200	139
Sprint	200	139
Turbo Assembler/Debugger	150	105
Turbo Basic	100	69
Turbo C 2.0	150	105
Turbo C 2.0 Professional	250	175
Turbo Pascal 5.0	150	99
Turbo Pascal 5.0 Professional	250	169
Turbo Prolog	150	105
Turbo Prolog Toolbox	100	69
GREENLEAF		
Greenleaf Bus. MathLib	395	279
Greenleaf Comm. Library	299	209
Greenleaf DataWindows	395	279
Greenleaf Functions	229	165
Greenleaf MakeForm	125	95
Greenleaf SuperFunctions	299	209
Greenleaf ViewComm	559	475
MEDIA CYBERNETICS		
Dr. HALO III	140	101
HALO	395	279
HALO for MS Developers	595	419
HALO for OS/2	695	489
HALO for two languages	545	389
HALO Programmer's Workbook	80	59
HALO Window Toolkit	595	419
MICROSOFT		
MS BASIC/6.0	295	209
MS C	450	299
MS COBOL	900	629
MS Excel	495	299
MS FORTRAN	450	299
MS Macro Assembler	150	105
MS Mouse Bus or Serial		
w/ EasyCAD	175	125
w/ Paintbrush & Mouse Menus	150	105
w/ Paintbrush & Windows	200	139
MS OS/2 Present. Mgr. Toolkit	500	349
MS OS/2 Softset	150	105
MS Pascal	300	209
MS QuickBASIC 4.5	99	69
MS QuickC 2.0	99	69
MS QuickPASCAL	99	69
MS Sort	195	139
MS Windows	99	69
MS Windows/386	195	136
MS Windows Development Kit	500	349
MS Word 5.0	450	285
MORTICE KERN SYSTEMS		
MKS Awk	99	85
MKS Lex and Yacc	249	209
MKS Make	149	129
MKS Make for OS/2	249	209
MKS Programming Platform	665	565
MKS RCS	189	159
MKS RCS for OS/2	395	335
MKS SoftQuad Publishing Sys.	495	469
MKS Software Mgmt. Team	299	255
MKS Toolkit V3.1	249	209
MKS Toolkit V3.1 for OS/2	495	419
MKS Vi	149	129
MKS Vi for OS/2	199	169
NOVELL		
Btrieve Single-User	245	185
Btrieve for DOS 3.1 Networks	595	459
Btrieve for OS/2	595	459
Btrieve for XENIX	595	459
C Network Compiler	695	559
C Network 386 Compiler	995	799
NetWare C Interface for DOS	295	239
NetWare MHS	100	79
NetWare MHS Interface Guide	145	129
NetWare RPC	950	759
NetWare RPC for OS/2	1750	1399
NetWare SQL	595	459
NetWare System Calls for DOS	195	159
XQL	795	599
Xtrieve PLUS	595	459
Xtrieve PLUS for OS/2	595	459
POLYTRON		
Personal PVCS	149	125
Plink86plus	495	419
PolyAWK	99	85
PolyDoc	199	169
PolyLibrarian	99	85
PolyMake	149	125
PolyXRef	99	85
Professional PVCS	395	335
RAIMA		
db_FILE Bundle (Single User)	595	509
db_FILE Bundle (Multi-User)	295	249
WKS Library	195	165
SOUTH MOUNTAIN		
Breakout-II	125	99
C Utility Library	199	159
Essential B-Tree (w/ source)	99	79
Essential Communications 3.0	249	199
Essential Graphics	299	239
Hold Everything (w/ source)	129	109
Resident_C (w/ source)	198	159
ScreenStar (w/ source)	198	159
WHITEWATER GROUP		
Actor	495	429
Language Extensions I	99	85
Whitewater Resource Toolkit	195	169
WinTrieve	395	339

PROGRAMMER'S POLICIES

Phone Orders
Hours 9 AM-7 PM EST. We accept MasterCard, Visa, American Express. Include $4.00 per item for shipping and handling. All shipments by UPS ground. Rush service available.

Mail Orders
POs by mail or fax are welcome. Please include phone number.

International Service
Phone number required with order. Call or fax for additional information.

Dealers and Corporate Accounts
Call for information.

Unbeatable Prices
We'll match nationally advertised prices. (Subject to same terms and conditions.)

Return Policy
30-day no-hassle return policy. Some manufacturer's products cannot be returned once disk seals are broken.

Turbo Pascal 5.5

Borland's Turbo Pascal, the world-standard Pascal compiler with more than one million copies in use, has added object-oriented programming to its newest release, version 5.5. Borland combined the simplicity of Apples's Object Pascal language with the power and efficiency of C++ to create Turbo Pascal 5.5. With Turbo Pascal objects, your code will be compact, flexible and reusable. And it will be easier to extend and maintain.

Turbo Pascal 5.5: $99

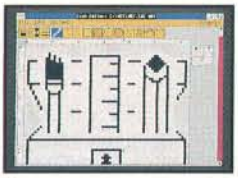
BORLAND ***Turbo Pascal Professional 5.5 (with Turbo Debugger): $169***

Whitewater Resource Toolkit™

The ***Whitewater Resource Toolkit*** is a new on-screen editor for creating and managing Windows resources such as menus and dialog boxes. Application developers and system integrators use the ***Whitewater Resource Toolkit*** for designing or customizing an application's look and feel.

Microsoft® Windows Resource Editor–NEW!

Special Price: $169



The Whitewater Group®

The toolkit is an integrated set of seven interactive editors to create dialog boxes, menus, color bitmaps, cursors, icons, strings and accelerators.

With it, you can manage resources for any new or existing Windows program written in C or Actor. The Windows SDK and resource compiler are not required.

C TOOLS PLUS/6.0

New from Blaise Computing

Filled with many advanced routines for developing high-powered Microsoft C applications, including: virtual, stackable menus and windows with full mouse support; multiple virtual pop-up help screens; functions for interrupt service routines, creating pop-up memory resident applications, and much more.

C TOOLS PLUS includes all source code, complete sample programs, and an online database compatible with the QuickC Advisor.

BLAISE COMPUTING INC.

Special Price: $109

db_FILE™ *Bundle*

db_FILE combines relational B-tree indexing and network model database technology assuring flexibility and optimum performance. Both access methods may be used independently or in combination for real power. db_FILE is written in C. Your db_FILE applications will be portable to most C language environments.

Special offer: Buy db_FILE now at our low special price and you will also receive complete C source code and db_RETRIEVE, the SQL-based Query and Report Writer.

Single User: $249 (Valued at $1,780)
Multi-User: $509 (Valued at $2,890)

RAIMA™ CORPORATION

International: **201-389-8950**
Customer Service: **201-389-8950**

Fax: **201-389-9227**

Call or Write for Latest Free Catalog!

1-800-445-7899

Programmer's Paradise™

A Division of Voyager Software Corp
1163 Shrewsbury Ave., Shrewsbury, NJ 07702

Circle 210 on Reader Service Card

Outfit Your PC for ISDN

If you're an IBM PC user who wants ISDN capabilities, the PC² is an economical board/software package that provides full 144-kbps connectivity through all three ISDN channels.

Like most other ISDN products for personal computers, it's compatible only with AT&T's 5ESS central office computer switch. For simultaneous voice and data, it uses a coprocessor, an 80C188, and TSR software on top of DOS. Memory requirements are 242K bytes with standard RAM.

PC² features seven applications, including an optional Screen Share package that lets two people simultaneously work on the same PC application from two different locations.

The Vadis system software provides ISDN connectivity through the built-in transparent DOS- or NetBIOS-based remote file access/file sharing system or through the onboard serial port emulation, with or without an AT modem command-set interpreter.

The Voice Call Manager initially helps you place a voice-based call to anyone on your phone list database. It also gives you a help screen for all 64 ISDN telephone voice features.

The Data Call Manager helps you place a data-only call to another ISDN device, with up to 16 "terminal profiles" selectable by name, and it lets you perform a file transfer in the background. It also lets you talk to others through an interactive conferencing system.

An E-mail function lets you send and receive messages between PC² devices and through established public or host-based E-mail systems. The Desktop Calendar is similar to most calendars in personal information management software, including an audible signal for reminders.

The Script Processing function gives you information on the people calling you before you pick up the phone, but only if they're on another PC² device.

Price: $1180; Screen Share, $125.

Contact: Vadis, Inc., 2201 Waterview Pkwy., Suite 1200, Richardson, TX 75080, (214) 690-2481.

Inquiry 1153.

PC² links up to seven ISDN applications to your phone and your DOS computer, including screen sharing.

LAN RAM Saver for NetWare

LANSpace, from Lan Systems, is a RAM saver for NetWare 286. It takes the NetWare drivers (Net3 or Net4) out of conventional memory and puts them into extended memory, saving 35K bytes of RAM.

LANSpace also allows you to load and unload NetBIOS without rebooting, for an additional savings of 21K bytes of RAM, the company claims.

Price: $495 per server.

Contact: LAN Systems, Inc., 599 Broadway, 11th Floor, New York, NY 10012, (800) 827-5267.

Inquiry 1151.

Crosstalk Now Appearing in Windows

Crosstalk, one of the most popular communications packages for the IBM PC, has moved over to Microsoft's Windows environment.

One of the main features of the program is its support of the Dynamic Data Exchange facility of Windows. This allows Crosstalk to import and export data easily to and from other Windows applications, such as Microsoft's Excel spreadsheet program. Digital Communications Associates reports that an Excel macro can automatically call a remote database, download a small list of stock prices, and graph the results.

Like other Windows packages, Crosstalk makes full use of pull-down menus and other user-friendly features. If you select a certain item from a menu with a mouse, Crosstalk will echo that item back to the host system.

The new Crosstalk is compatible with the script language of Crosstalk Mark IV.

Price: $195.

Contact: Digital Communications Associates, 1000 Holcomb Woods Pkwy., Suite 440, Roswell, GA 30076, (404) 998-3998.

Inquiry 1154.

Proteon Offers Unshielded Support for Token Rings

The company that introduced the first token-passing ring LAN in 1981 is now the first to ship unshielded twisted-pair wiring support for 4-, 10-, and 16-Mbps token-ring networks.

Support for 16-Mbps token ring over unshielded and shielded twisted-pair cabling lets Proteon take advantage of inexpensive, readily available wiring. Unshielded twisted-pair wiring is used by AT&T for Private Branch Exchange installations.

The key to Proteon's support for unshielded twisted-pair wiring is a new multi-access unit called the Series 70 Intelligent Wire Center. The p7202 modular hub supports the 4- and 16-Mbps data transmission rates afforded by IBM's 802.5-compliant Token Ring solution, as well as the 10-Mbps data rates supported by Proteon's eight-year-old proprietary networking hardware.

Electromagnetic interference problems, Proteon says, have been solved with passive filtering at both ends of the cable. Each multi-access unit supports a cabling distance of 279 feet.

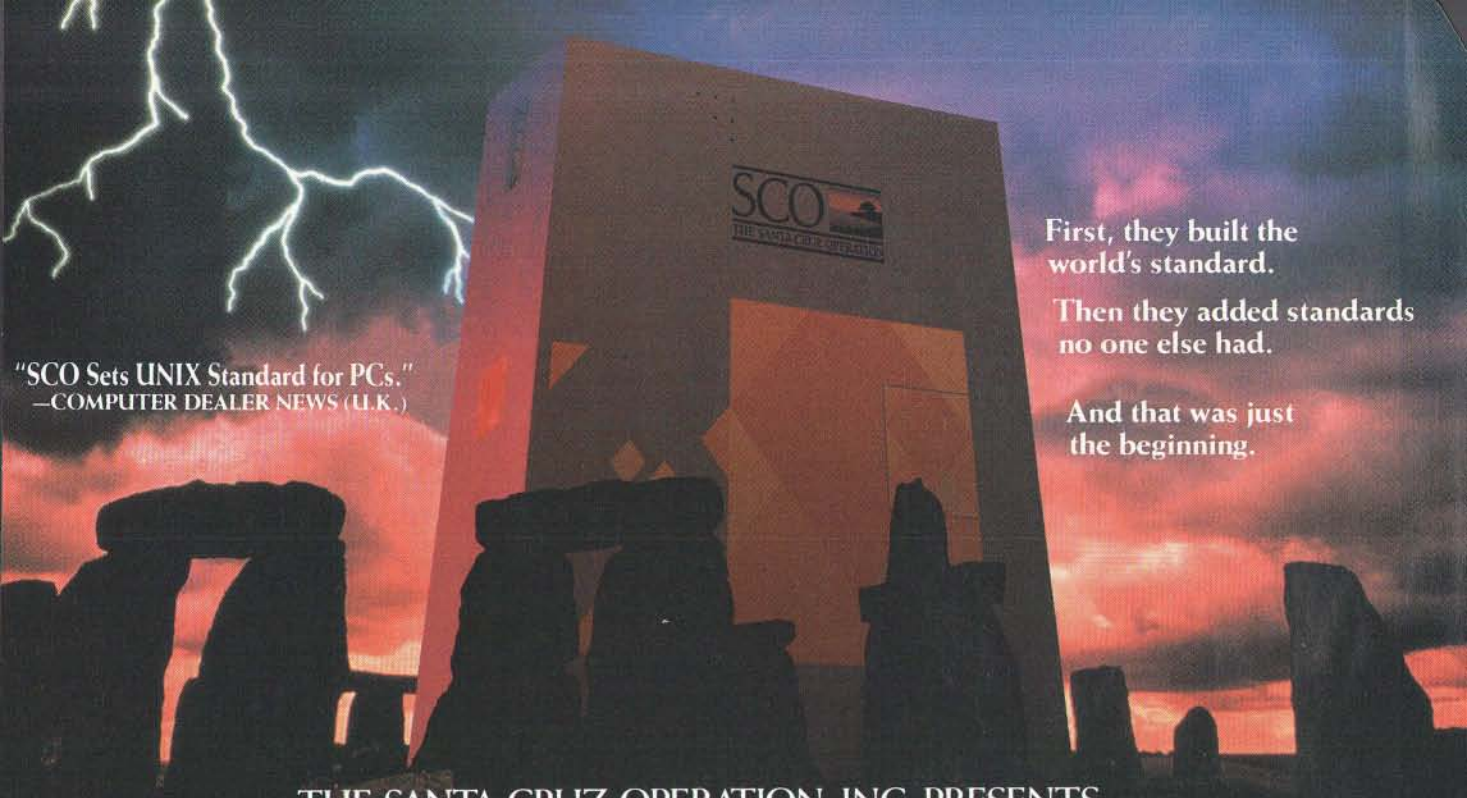
If you prefer IBM's wiring scheme and shielded twisted-pair media, Proteon offers the Series 70 p7201 modular hub. For the same price as the p7202, it supports 4- and 16-Mbps token rings, but not Proteon's proprietary 10-Mbps token ring.

Price: $1295, not including token ring PC boards.

Contact: Proteon, Inc., Two Technology Dr., Westborough, MA 01581, (508) 898-2800.

Inquiry 1155.

continued



"SCO Sets UNIX Standard for PCs."
—COMPUTER DEALER NEWS (U.K.)

First, they built the world's standard.

Then they added standards no one else had.

And that was just the beginning.

THE SANTA CRUZ OPERATION, INC. PRESENTS

UNIX NOW!

THE SCO LEGEND CONTINUES

AN SCO™ PRODUCTION IN EXCLUSIVE ASSOCIATION WITH MICROSOFT CORPORATION AND AT&T • SCO's BLOCKBUSTER 3.2 RELEASE OF UNIX® SYSTEM V/386 FOR ISA, EISA, AND MCA SYSTEMS "UNIX NOW!"
STARRING FIPS POSIX™ • X/OPEN® • C2 TRUSTED SECURITY • MICROSOFT® C, MASM, AND CODEVIEW®
CO STARRING AT&T FILE SYSTEM SWITCH, STREAMS, SHARED LIBRARIES, PCC, AND SDB • BERKELEY SELECT • DOS, OS/2,® AND XENIX® CROSS-DEVELOPMENT • COMPUTER GRAPHICS INTERFACE
ONLINE MANUALS • EXTENSIBLE CONSOLE, MOUSE, AND SCSI DRIVERS • ALL SCO XENIX FEATURES INCLUDING MULTISCREEN,™ SERIAL CONSOLE, AND AUTOMATIC POWER FAIL RECOVERY
AND INTRODUCING AUTOMATIC INSTALLATION • ACER® FAST FILE SYSTEM • TRANSPARENT DOS FILE SYSTEM • DEVICE DRIVER WRITER'S GUIDE (WITH ANNOTATED SAMPLE SOURCE CODE)
SYSADM SHELL AS THE EASY-TO-USE SYSTEM MANAGER • MULTIPLE GROUPS, JOB CONTROL, AND RELIABLE SIGNALS AS THE FIPS POSIX EXTENSIONS • MMDF II AS THE MAIL DELIVERY AGENT
SUPPORTING CAST SCO EROFF™ • SCO MULTIVIEW™ • SCO XSIGHT® X WINDOW SYSTEM™ • SCO NFS™ • SCO TCP/IP • SCO VP/ix™ • SCO uniPATH™ SNA-3270
PLUS HUNDREDS OF SUPPORTED PERIPHERALS INCLUDING TERMINALS, PRINTERS, SERIAL CARDS, TAPE DRIVES, AND ST506, RLL, ESDI, AND SCSI CONTROLLERS
PLUS THOUSANDS OF PROVEN APPLICATIONS SUPPORTED EXCLUSIVELY ON SCO SYSTEM V INCLUDING THE SCO PORTFOLIO™ FAMILY, SCO FoxBASE+™, MICROSOFT WORD, AND AutoCAD®

PRODUCED, DEVELOPED, AND DIRECTED BY THE SANTA CRUZ OPERATION, INC. "UNIX" TRADEMARK CONFORMANCE SPECIFICATION BY AT&T

NOMINATED FOR MOST OPEN-SYSTEM STANDARDS! ★ EASIEST-TO-USE UNIX SYSTEM! ★ FASTEST 386/486 UNIX SYSTEM! ★ BEST XENIX COMPATIBILITY! MOST APPLICATIONS SUPPORTED! ★ MOST PERIPHERALS SUPPORTED! ★ MOST COMPLETE DEVELOPMENT SYSTEM! ★ BEST INTERNATIONALIZATION! BEST UNIX SYSTEM DOCUMENTATION! ★ BEST SUPPORT! ★ BEST TRAINING! ★ BEST WORLDWIDE DISTRIBUTION! ★ MOST WORLDWIDE OEM SUPPORT!

OS | OPEN SYSTEM
RECOMMENDED FOR AUDIENCES WITH STANDARDS

SCO™
THE SANTA CRUZ OPERATION

OPEN DESKTOP™
IS BASED ON SCO UNIX SYSTEM V/386

SCO, the SCO logo, MultiScreen, SCO MultiView, SCO Portfolio, Open Desktop, and the Open Desktop logo are trademarks of The Santa Cruz Operation, Inc. • UNIX is a registered trademark of AT&T in the USA and other countries. • POSIX is a trademark of The Institute of Electrical and Electronics Engineers (IEEE). • X/Open is a registered trademark of X/Open Company Ltd. • Microsoft, CodeView, and XENIX are registered trademarks of Microsoft Corporation. • OS/2 is a registered trademark of International Business Machines Corporation. • Acer is a registered trademark of Acer International. • Eroff is a trademark of Elan Computer Group, Inc. • Xsight is a registered trademark of Locus Computing Corporation. • X Window System is a trademark of Massachusetts Institute of Technology. • NFS is a trademark of Sun Microsystems, Inc. • VP/ix is a trademark of Phoenix Technologies Ltd. and Interactive Systems Corporation. • uniPATH is a trademark of Pathway Design, Inc. • FoxBASE+ is a trademark of Fox Software, Inc. • AutoCAD is a registered trademark of Autodesk, Inc.

©MCMLXXXIX The Santa Cruz Operation, Inc. All Rights Reserved. The Santa Cruz Operation, Inc., 400 Encinal Street, P.O. Box 1900, Santa Cruz, California 95061 USA. The Santa Cruz Operation, Ltd., Croxley Centre, Hatters Lane, Watford WD1 8YN, Great Britain, +44(0)923 816344, FAX: +44(0)923 817781, TELEX: 917372 SCOLON G

NOW SHOWING AT AUTHORIZED SCO RESELLERS!

OPEN DESKTOP™ **WORLDWIDE TECHNICAL SEMINARS FOR DEVELOPERS**
CALL SCO'S OPEN DESKTOP™ SEMINAR HOTLINE TODAY!

(800) SCO-UNIX (726-8649)
(408)425-7222
FAX: (408)458-4227
E-MAIL: . . . !uunet!sco!info info@sco.COM

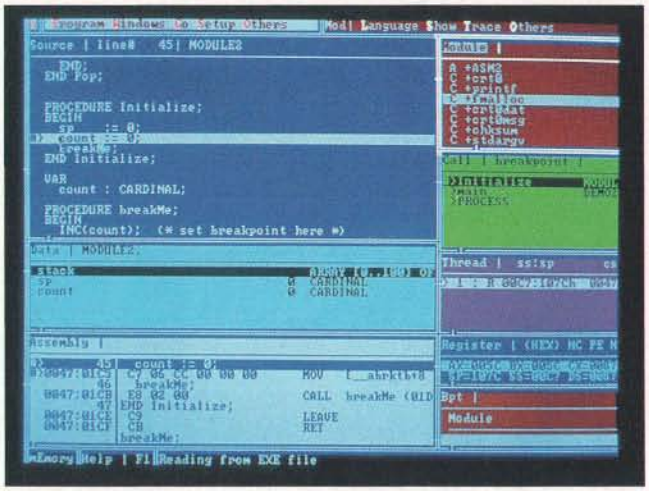
Circle 248 on Reader Service Card

Find the Bugs in OS/2 Code

Logitech's MultiScope Debugger is designed specifically for those of you attempting to cope with the slings and arrows of OS/2 development. It offers run-time and postmortem debugging options. The run-time debugger controls execution with a set of control features and stepping commands. The postmortem debugger captures the program execution state of an application running outside the debugger at the time of the crash. You can then examine the resulting dump file to find the program crash condition.

The debugger uses multiple overlapping windows to display up to 13 different program views simultaneously. You can create custom configurations of source, assembly, data, register, memory, module, breakpoint, watchpoint, graphical data, threads, call chain, log, and output views. MultiScope also includes complete support for debugging threads, dynamic link libraries, and child processes.

One of the program's unique features is a specialized data display that shows complex data structures in a graphical form. MultiScope is compatible with any language that generates standard CodeView OS/2 debugging information, including Logitech Modula OS/2, Microsoft C, and IBM C/2. It works in OS/2 text mode and under Presentation Manager.
Price: $299.
Contact: Logitech, Inc., 6505 Kaiser Dr., Fremont, CA 94555, (415) 795-8500.
Inquiry 1102.



Developed with OS/2 for OS/2, MultiScope works under Presentation Manager and in text mode.

Express C Compiler for OS/2, DOS

The TopSpeed C Professional Edition compilers automatically create dynamic link libraries and support Microsoft Windows and the OS/2 Presentation Manager. The Jensen & Partners International (JPI) compiler is based on an optimized code generator that lets you integrate routines from multiple languages into a single application.

The code generator automatically detects the type of source code in each window, calls the appropriate compiler, and links the routines. It provides a common run-time library and consistent memory allocation routines for all the JPI language implementations (currently, Modula II, C, and Assembler).

The Professional Editions include start-up assembler code, full source code to libraries, and a watch utility for viewing any selection of DOS calls.

The TopSpeed C compiler includes a Make facility that automatically updates and maintains file dependencies. It is fully ANSI-compatible. The company hopes to ship a C++ compiler early next year, and an Ada compiler is under development.
Price: Standard Edition (includes debugger and compiler), $199; DOS Professional Edition, $395; OS/2 Professional Edition, $495.
Contact: Jensen & Partners International, 1101 San Antonio Rd., Suite 301, Mountain View, CA 94043, (800) 543-5202 or (415) 967-3200.
Inquiry 1103.

Search Engine Zeros in on String Patterns

Blaise Computing says that Power Search, a library of C functions, uses a new technology to execute fast searches for strings or expressions in DOS- and OS/2-based applications. It generates and executes custom machine code that's optimized for a specific pattern.

Power Search matches both ordinary strings and regular characters. Strings can include metacharacters that represent common character classes, such as digits or lowercase letters.

The package includes precompiled libraries for Microsoft C, QuickC, and Borland Turbo C. For Microsoft C, it includes libraries for generating bound applications that run under both DOS and OS/2.
Price: $149.
Contact: Blaise Computing, 2560 Ninth St., Suite 316, Berkeley, CA 94710, (415) 540-5441.
Inquiry 1104.

Zap Your Apps into PROMS

If you need to turn an IBM PC into a diskless standalone workstation or protect your custom code from prying eyes and piracy, Annabook's PromKit can help by putting any DOS program (or even DOS itself) into EPROM or static RAM (SRAM).

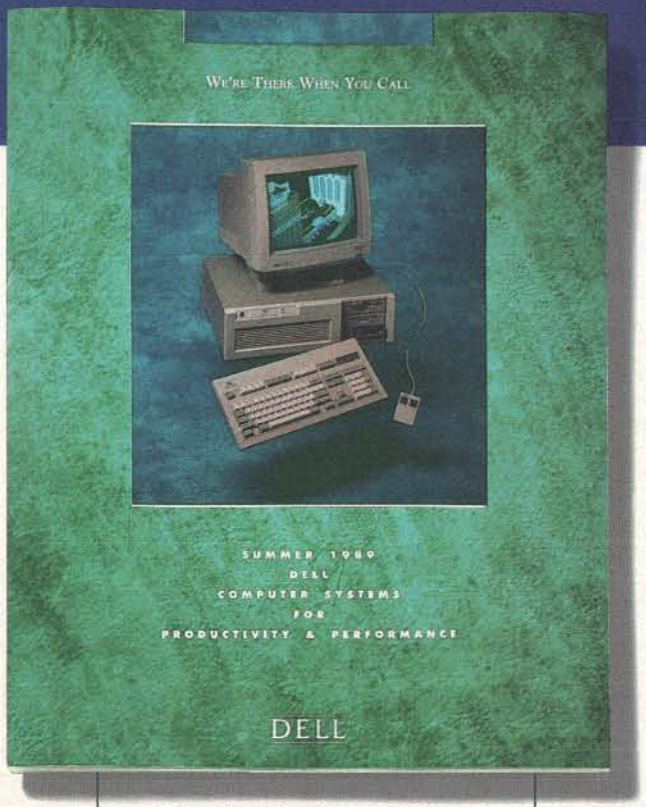
With a one-line command, you can turn an application or DOS into a binary image that you can load into a PROM and place into a PC motherboard or add-in card. PromKit lets you choose which drives you want to emulate. And if you use SRAM, the PC can even write to the drive.

The company says that even though the PC's EPROM address space is limited, you can use paged EPROMs to emulate a full 360K-byte drive by using three 27011 chips for data and a single 27128 for the driver module.

PromKit comes with complete source code (written in Microsoft C 5.1), including listings for utilities that convert files from binary to Intel hex format, and split files into even and odd bytes. To use PromKit, you'll need an IBM PC or compatible, 640K bytes of RAM, a hard disk drive, and an EPROM programmer.
Price: $179.
Contact: Annabooks, 12145 Alta Carmel Court, Suite 250–262, San Diego, CA 92128, (619) 271-9526.
Inquiry 1105.

continued

SEND AWAY FOR YOUR VERY OWN COMPUTER STORE.



When you buy a computer, about 35% of your money goes to the store.

But we'd much rather see your money go to somebody who deserves it a lot more.

You.

So we give you a completely different kind of computer store.

The Dell Computer Store.

Instead of a crowded, high-overhead showroom, you get our brand new 44-page catalog. Which gives you a full line of 386™ and 286 systems, printers, peripherals, software, and accessories.

And since you buy direct from the manufacturer, you save about 35%.

But there's a lot more to it than saving money. We offer you the most complete service and support in the industry. Including a 30-day money-back guarantee. A toll-free technical support hotline. Self-diagnostic software. And next-day deskside service from Xerox Corporation.

If you read our ad in the front of this magazine, it will tell you a lot more about the systems we offer. And the service we put behind them. So if you'd like a much more intelligent way to buy a personal computer, have a look at our ad. Or call us at 800-426-5150. Or send us the card on this page.

And we'll send the best computer store you've ever seen.

One you don't have to set foot in.

DELL COMPUTER CORPORATION

TO ORDER, CALL US.

800-426-5150.

FOR DELL IN CANADA, CALL 800-387-5752.

©1989 Dell Computer Corporation. 386 is a trademark of Intel Corporation. ΔService in remote locations will incur additional travel charges.

11EK9

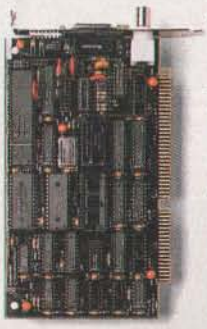
Circle 81 on Reader Service Card

What better way to run Novell's 386 NetWare.

Novell's new 386 NetWare® will do for networking what gunpowder did for negotiating leverage. Provided you've got a 386 machine that's designed to be 100 percent compatible with it.

Not to worry.

Samsung's LAN hardware was co-designed by Novell.® Which should put any compatibility concerns to rest. That's why the Samsung/Novell co-label is on our 386AE Fileserver and our PCterminal/286 LAN workstation.



NETWORKING vs. NOTWORKING.

Both the Samsung 386AE and PCterminal/286 have been tested exhaustively by Novell for compatibility with popular networking hardware and NetWare products. In fact, no other LAN hardware has ever undergone such extensive testing.

But then Samsung and Novell didn't set out to desig just another make-do desktop computer.

Samsung's 386AE Fileserver, for example, wa designed from the bus up to be a high-performance fileserver, starting with its Novell developed BIOS. It also sports eight expansion slots for the inevitable inventory of interface and controller cards. Plus an oversize power supply capable of driving the requisite 100 megabyte-plus hard disk, tape backup system etc. And it includes 4 megabytes of high-spee RAM for disk caching.

A TOTAL LAN SOLUTION.

To maintain NetWare compatibility throughout

© 1989 Samsung Information Systems America, Inc. Novell and NetWare are registered trademarks of Novell, Inc.

your network, choose Samsung's PCterminal/286, a Novell-tested LAN workstation. Inside you'll find a built-in Ethernet interface adapter, and functional features like Novell's NetWare Autoboot EPROM.

THE NO BOTTLENECK ETHERNET CARD.

Our new SE2100 Ethernet interface eliminates the network bottleneck. Designed by Samsung, this high-performance 16-bit card provides twice the throughput of other Ethernet interfaces. And you can retrofit your existing workstations and fileservers with the SE2100 for dramatic improvements in your network's productivity.

LOOK FOR THE CO-LABEL.

The partnership between Samsung and Novell has created a hardware/software compatibility standard unparalleled in the industry. That means your network can experience all the speed of Novell's new 386 NetWare without being subjected to a lot of hardware hiccups.

Just look for the Samsung/Novell co-label. You'll find it at your nearest reseller. For the location, call **1-800-366-7472.**

SAMSUNG

Circle 301 on Reader Service Card (DEALERS: 302)

Generic Moves in Three Dimensions

A fairly intuitive drawing process and two navigational aids to help three-dimensional drawing are what make Generic 3D Drafting an easy-to-use 3-D CAD program, reports Generic Software.

The program's interface is the same as in Generic's 2D CADD program, making it easy for 2-D users to move up to 3-D, according to Generic. You can also draw 2-D objects and then extrude and further manipulate them to create a 3-D object.

One of the navigational aids is a color-coded cursor, which you can label with *x*, *y*, and *z* directions. The other aid is called *tracking*, which allows you to move along any axis to any given point in space by moving the cursor instead of typing in coordinates.

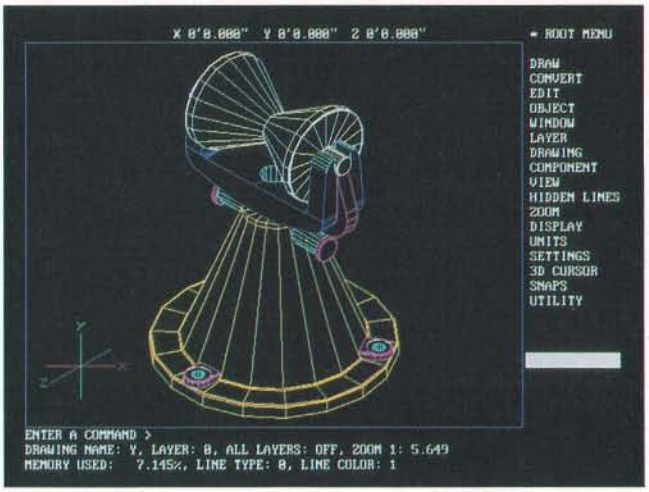
3D Drafting is compatible with Generic CADD drawing files. It also gives you 256 layers, 256 colors, and 256 line types. An in-depth tutorial not only instructs you on how to use the program but also gives you basic lessons in 3-D drafting.

The program requires an IBM PC with at least 640K bytes of RAM and a graphics display with a resolution of at least 640 by 200 pixels. The company recommends EMS memory and a math coprocessor.

Price: $249.95.

Contact: Generic Software, Inc., 11911 North Creek Parkway S, Bothell, WA 98011, (800) 228-3601 or (206) 487-2233.

Inquiry 1123.



You can draw three-dimensional objects such as this gravity saw support using Generic's familiar 2D interface.

Bring Non-CAD Drawings into the AutoCAD Fold

A program called LunaSeries lets you scan non-CAD drawings into a CAD program and view, archive, edit, and store the image on your CAD system or network. Once a raster image is loaded into the CAD system, you can make on-screen changes. The program displays the original image and your changes. After editing the image, you can merge the original drawing with your changes and save them in CAD format.

Version 2.31 of the program now supports all high-resolution graphics cards. At press time, American Imaging Systems was developing a version that supports all Hewlett-Packard Graphics Language plotters.

LunaSeries runs on the IBM AT or higher with 640K bytes of RAM, 512K bytes of expanded memory, AutoCAD 2.6 or higher, VersaCAD 5.3 or higher, or CADKEY 3.5 or higher. Later this year, according to the company, the program will support IBM CAD and Sun workstations.

Price: $2185 per workstation.

Contact: American Imaging Systems, Inc., 2315 Luna Rd., Carrollton, TX 75006, (800) 234-7226 or (214) 484-3339.

Inquiry 1121.

AutoCAD Site-Planning Modules for the Mac

A set of applications from LandCADD lets you capture AutoCAD designs and customize them for land planning. The Site Planning and Landscape Design module includes a symbols library and routines for parking, coordinate geometry, topography, and cut and fill.

LandCADD runs on the Mac II or IIx with AutoCAD, 4 megabytes of memory, and 8 megabytes of free space on your hard disk drive.

Price: Site Planning and Landscape Design, $695; Irrigation Design, Quadrangle DTM, and EZ-Estimate Plus, $595 each; CADD Construction Details, $895; Plant Specifier, $295.

Contact: LandCADD, Inc., 7519 East Highway 86, Franktown, CO 80116, (303) 688-8160.

Inquiry 1120.

continued

AutoCAD Add-on Helps Draw Industrial Facilities

FactoryCAD is an industrial facilities design and drafting program you can use within AutoCAD. The program's functions and routines automatically generate walls, doors, grids, docks, conveyor belts, and other functions that help you design facilities.

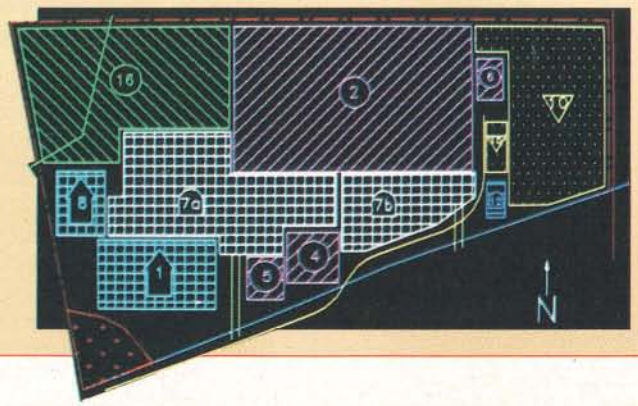
The program has more than 70 predefined layers; you can extract a layer from one drawing and insert it into another. FactoryCAD's utilities can draw power lines, water, compressed air, gas, and steam, each on its own layer with its own color.

The program works on the IBM AT or higher with 640K bytes of RAM, a math coprocessor, 1.5 megabytes of extended memory, and AutoCAD release 9 or 10.

Price: $695.

Contact: Cimtechnologies Corp., 525 East Second, Suite 500, Ames, IA 50010, (515) 232-9914.

Inquiry 1118.



QNX®
The OS for over-achievers™

QNX programmers have a decided advantage.

You see, people who use QNX enjoy the freedom that comes only with a flexible, modular OS. They appreciate the elegance of a **message-passing architecture**. And they marvel at the fact that QNX runs so lean—under 150K—yet out-performs any other PC operating system.

QNX users never worry about whether their applications will make it at runtime, because they know QNX has proven itself again and again in the real world.

It's no wonder that QNX users have achieved so much since the product was first released for the PC in 1982: over 80,000 systems installed in 47 countries world-wide, in all kinds of applications—from making cars to selling books to handling online credit card transactions.

One reviewer dubbed QNX "The multi-everything OS." Now, you might expect multiuser and multitasking, but realtime? *And* integrated networking? *And* true distributed processing? Best of all, these terms take on a new meaning with QNX.

Multiuser, for instance, means up to 32 terminals per micro. **Multitasking** cashes out as 150 tasks per machine. **Realtime** means not only priority-driven, preemptive task scheduling, but also speed: at 6,896 task switches/sec on a 16MHz 286, QNX is at least a full order of magnitude faster than a typical UNIX system. **Integrated networking** means you won't need yet another layer of software to set up a LAN, and you can use *any mix* of Intel-based micros—from vintage '81 PCs to PS/2s.

Distributed processing with QNX sounds too good to be true. But it is: *Any task can access any resource*—programs, files, devices, even CPUs—without going through the bottleneck of a central file server.

Besides the satisfaction that QNX developers get from using a fast, powerful, and flexible OS, did we mention that they also enjoy *free technical support?*

If you're wondering why you don't already know all about this great OS, you could try asking the over-achievers who are smugly guarding the secret of their success.

Better yet, give us a call. We'll tell you everything you need to know to become an over-achiever yourself.

QNX

Circle 229 on Reader Service Card

For more information or a free demo disk, please phone (613) 591-0931.

Quantum Software Systems Ltd., 175 Terrence Matthews Crescent, Kanata, Ontario, Canada K2M 1W8

QNX is a registered trademark of Quantum Software Systems Ltd., UNIX is a registered trademark of AT&T. PS/2 is a registered trademark of International Business Machines Corporation.
© 1989 Quantum Software Systems Ltd.

Microstat-II Now With Graphics Interface and New Multivariate Module

2.0 Release

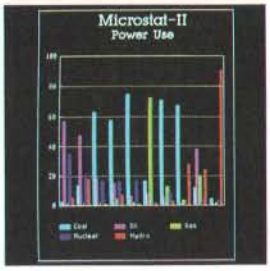
Now you can use YOUR favorite graphics package with Microstat-II.

Just some of the packages covered include *3-D Perspective Jr., Harvard Graphics, Microsoft's Chart, Grapher,* and others.

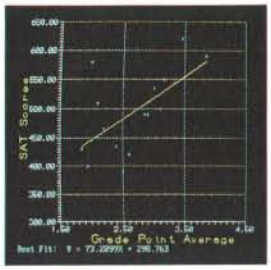
Microstat-II also includes new procedures for:

- **Canonical Correlation**
- **Factor Analysis**
- **MANOVA**
- **Discriminant Analysis**
- **Principal Components Analysis**
- **Cluster Analysis**
- **Covariance Analysis**

3-D Perspective Jr.



Harvard Graphics



Grapher

While Release 1.0 was good:

"... one of the fastest IBM PC statistical packages we have tested... using Microstat-II is a breeze."
Infoworld

"Installation of Microstat-II is simple... The user interface is clean... a pleasant package to use..."
PC Magazine

Microstat-II Release 2.0 is even better!

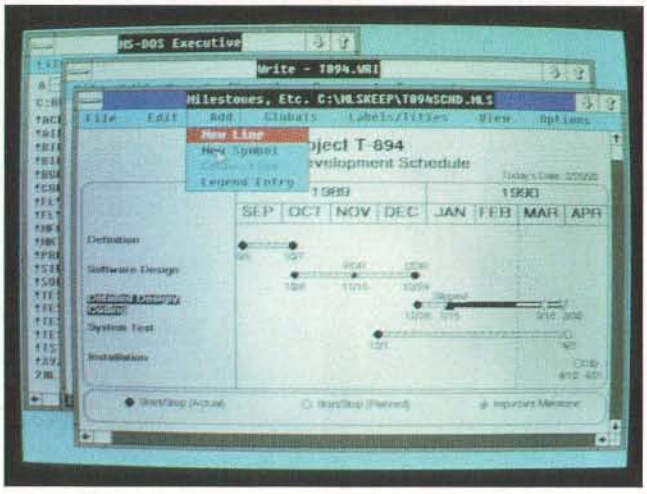
For a limited time, you can purchase Microstat-II Release 2.0 for $395.00. Microstat-II requires an IBM PC, XT, AT, PS2 or compatible with 512K memory or more with either a hard disk or two floppy drives. For more information, contact your local computer dealer or call:

Ecosoft, Inc.
6413 N. College Ave.
Indianapolis, IN 46220
Orders: 1-800-952-0472
Info: 1-317-255-6476
FAX: 1-317-251-4604

Microstat II™

ECOSOFT

3-D Perspective Jr., Harvard Graphics, Grapher, Microsoft's Chart and IBM are all registered or unregistered trademarks of the following companies respectively: 3-D Graphics, Inc., Software Publishing Corp., Golden Software Inc., Microsoft Inc., IBM Inc.



Milestones, Etc. lets you place lines, symbols, and legend entries anywhere on your chart.

Create Gantt, Milestone Charts Under Windows

SoftPro developed Milestones, Etc. for businesses that need to create presentation-quality Gantt and Milestone charts. The program runs under Windows and features 28 symbol types, 15 connections, and the ability to lock a symbol onto a specified date.

With the program's current date–sensitive option, the program automatically blackens symbols prior to the current date and makes them hollow after the date. With this option, you can produce an updated chart that reflects the project's progress. Charts can be several pages long, and multiple-page charts can be numbered.

You can merge charts created with Milestones, Etc. with PageMaker, Ventura Publisher, WordPerfect, and any other program that accepts Windows metafiles or the Hewlett-Packard Graphics Language format.

Milestones, Etc. works on the IBM AT or higher with Windows 2.0 or higher and a Microsoft-compatible mouse.

Price: $89.
Contact: SoftPro, P.O. Box 1167, Manchaca, TX 78652, (800) 666-3886 or (512) 282-1544.
Inquiry 1125.

Five Forecasting Programs

Sales and marketing managers can use TSM Associates' Forecaster program to generate sales forecasts for products, companies, and individual sales personnel. The program comes in two versions: the distributor's version for the multiline distributor and manufacturer's representative, and the manufacturer's version.

Each version generates a variety of reports and has databases for forecast records, products, and individual personnel; the distributor's version also has a principal's database and breaks down sales by sales representative, products, customer, and time to purchase.

The Forecaster runs on the IBM PC with 512K bytes of RAM and a hard disk drive.
Price: $495.
Contact: TSM Associates, 4 La Cerra Dr., Rancho Mirage, CA 92270, (619) 321-5730.
Inquiry 1128.

continued

Intelligent Database Tools are Here!

Is your Database an Asset or just a File?

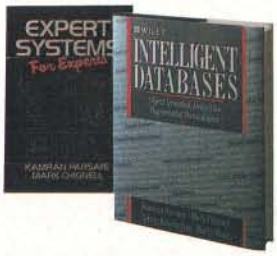
As your database grows, its potential value increases. Your challenge is to keep it error-free, understand it, and use it to make effective decisions. These are the tools you need:

DATABASE SUPERVISOR Maintain data quality and data integrity. Keep your database error-free. Database/Supervisor analyzes your databases and identifies *suspicious data items*, and patterns which are out of the ordinary. It automatically detects errors which violate statistical or logical integrity constraints. *If your database is being corrupted, Database/Supervisor will show you where.*

IXL The Machine Learning SYSTEM Discover *hidden patterns and unexpected relationships* in your large database. IXL analyzes your database and generates easy-to-read rules using artificial intelligence and statistical techniques. While Database/Supervisor detects errors, IXL produces rules and decision-making insight. *The solutions you are looking for may already be in your database, waiting to be discovered.*

NEURAL/QUERY Don't deny yourself inexact, but potentially valuable, answers to your database queries. Close matches are more valuable than *no response*. IXL and Neural/Query are perfect partners. IXL generates rules which can be exported. However, Neural/Query analyzes your large database, builds a network of partial matches, and provides the closest matching answer to your database queries. *Use the full informational content of your database.*

Intelligence COMPILER The highest-level, easiest-to-use intelligent database environment today. Build dialogs automatically, link them with rules, frames and hypertext *in minutes*. Develop your intelligent application quickly and efficiently, then run it on multiple operating systems. The built-in relational database combines expert system logic with SQL-based object oriented queries. *Accomplish in hours what would otherwise take weeks.*



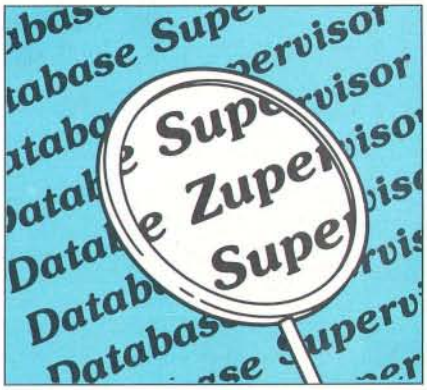
Our leadership in this field of technology is unsurpassed. Ask for our books *Intelligent Databases* and *Expert Systems for Experts* by K. Parsaye, et al., published by John Wiley.

Experts love our software:

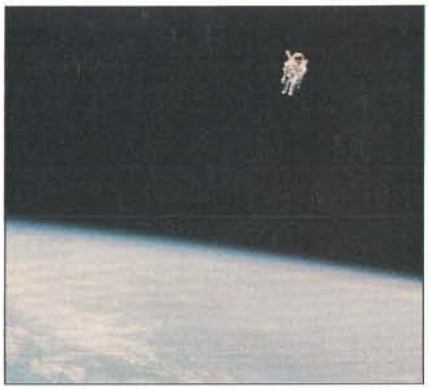
The Intelligence/Compiler is a powerful state of the art system for real-world applications. Its intelligent editing and debugging facilities are a bonus. *AI/Expert Magazine*, February 1988.

Considering the variety of features that the Intelligence/Compiler provides, it is hard to believe that you can get better value for your money. *PC/AI Magazine*, June 1989.

Having used IXL on a large database of geological test data, we were surprised by the many relationships it found. This has greatly helped us to interpret our Oil Company database. *Mr. James Brown*, Oil Industry Consultant, July 1989.



Will your database errors live forever?



Alone in a universe of data? Let IXL be your guide.

Are you sure you have no listing for the *Vite House*.

IntelligenceWare
The Next Level in Computing
Circle 132 on Reader Service Card

Yes, I want to win with your easy-to-use intelligent database tools.

☐ Send me your complete collection of intelligent database tools for $1,490.

☐ Send me the three components: _____, _____, _____, for $990.

☐ Send me the single component: _____ for $490.

Computer system: ☐ IBM/PC ☐ PS/2 ☐ Macintosh

Also available on VMS, Unix and OS/2

Name _____

☐ Check enclosed, Charge to: ☐ Visa ☐ MC ☐ AMX

Company: _____

Card No: _____ Expiration _____

Address: _____

Telephone: _____

For telephone orders call (800) 888-2996
Shipping and handling: US $9, Canada and Hawaii $20,
Overseas Air $50. California residents please add 6.5% sales tax.

IntelligenceWare
9800 S. Sepulveda Blvd.
Los Angeles, CA 90045-5228
Telephone: (213) 417-8896
Telefax: (213) 417-8897

Inside: Bonus Graphics Supp
BYTE
33 MHz
SIA's new
386/32

Thalarctos maritimus

#3 in a series on consumer habits

The polar bear is the great white hunter of the Arctic Circle. Migrating long distances over the vast frozen desert, it tracks large prey such as seals and sea lions. In a sprint, it can reach speeds of up to 25 mph. When it raids the ice box, it doesn't waste energy on small fish. The readers of BYTE magazine are just as selective. For they, too, are relentless hunters with big appetites. They are advanced personal computing experts whose hunger for new product information is insatiable. They seek technical analyses. Extensive reviews. A complete rundown of product comparisons. Which is what they get in every BYTE. Some publications may promise you more paid readers than BYTE's 450,000. But none so voracious.

McGraw-Hill

Circle 156 on Reader Service Card

Easy and Effective Data Security For Your Computer

Data Guard is a transparent data encryption program. With Data Guard, you don't have to encrypt or decrypt your files each time you use them. Data Guard does it for you automatically.

Because Data Guard's operation is transparent, it's far superior than other encryption programs. (see Martin Kochanski's article [BYTE: 6/89 p260] about transparent encryption)

Data Guard takes the burden away from the user to insure maximum safety for your system.

If you are serious about protecting sensitive information on your IBM PC or compatible system. Data Guard is the ideal choice.

For more information, Please call (617) 695-0549

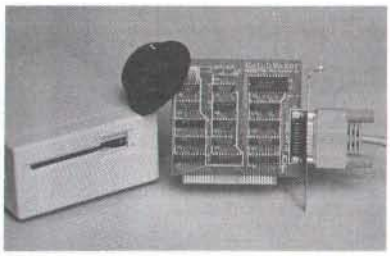
To order: send $195 + $4 S/H
MA resident add 5% tax
(Check or MO) To:

LogicVision
P.O. Box 32
Boston, MA 02112

Read Mac Disks in a PC

MatchMaker

– the best way to share data between a PC and a Mac. The **Match**Maker card lets you plug a Macintosh floppy drive into a PC.



- Easy-to-install half-size card.
- Use any external Macintosh drive.
- DOS-like command software included.
- 1 year warranty, Made in USA.
- Also available; **MatchPoint-PC** to read/write Apple II disks.

"...by far the most cost effective solution..." PC WEEK

MicroSolutions
Computer Products

132 W. Lincoln Hwy.
DeKalb, IL 60115
(815) 756-3411

The NAI Forecasting System handles personnel forecasting for companies, including those that are in growth or downsizing cycles, acquiring other companies, or shifting personnel among divisions.

The program identifies human resource shortages and personnel for each of five future time periods, which you designate. The program's front end, a human resource data-gathering system, can import planning data from a Human Resource Information System database.

The NAI Forecasting System runs on the IBM AT or higher with a hard disk drive, DOS 3.0 or higher, 640K bytes of RAM, and a math coprocessor.
Price: $15,000.
Contact: Nardoni Associates, Inc., 157 Route 31, Lebanon, NJ 08833, (201) 730-9444.
Inquiry 1129.

With Tomorrow, you highlight a range of historical information on your Lotus 1-2-3 spreadsheet, including subtotals, summaries, and other formulas, and the program does the rest. Tomorrow doesn't require that you understand the complicated statistics of forecasting.

Tomorrow runs on the IBM PC with Lotus 1-2-3 release 2, 2.01, or 2.2 and requires 55K bytes of free RAM.
Price: $129.95.
Contact: Isogon Corp., 330 Seventh Ave., New York, NY 10001, (800) 662-6036 or (212) 967-2424.
Inquiry 1130.

ForeCalc is a statistical forecasting program that's designed as an add-on for Lotus 1-2-3 and Symphony.

As with Tomorrow, you specify from within your spreadsheet the history of the data, and ForeCalc automatically generates the forecasts. ForeCalc is designed for people with no prior knowledge of statistics.

ForeCalc incorporates several exponential smoothing models to create the forecasts and to choose the best technique automatically.

Unlike ForeCalc, Forecast Master Plus is for people familiar with statistics. Business Forecast Systems developed it for the professional business forecaster familiar with complicated forecasting models. You can choose from eight forecasting models, ranging from exponential smoothing and Box-Jenkins to variable parameter regression.

Forecast Master Plus works on the IBM PC with 640K bytes of RAM, a hard disk drive, and a math coprocessor.
Price: ForeCalc, $149; Forecast Master Plus, $695.
Contact: Business Forecast Systems, 68 Leonard St., Belmont, MA 02178, (617) 484-5050.
Inquiry 1131.

TopDown Steps up into Windows

TopDown, the project management program that lets you break down projects into a series of hierarchically arranged tasks, now supports Microsoft Windows, taking advantage of the Clipboard to export data to other Windows applications.

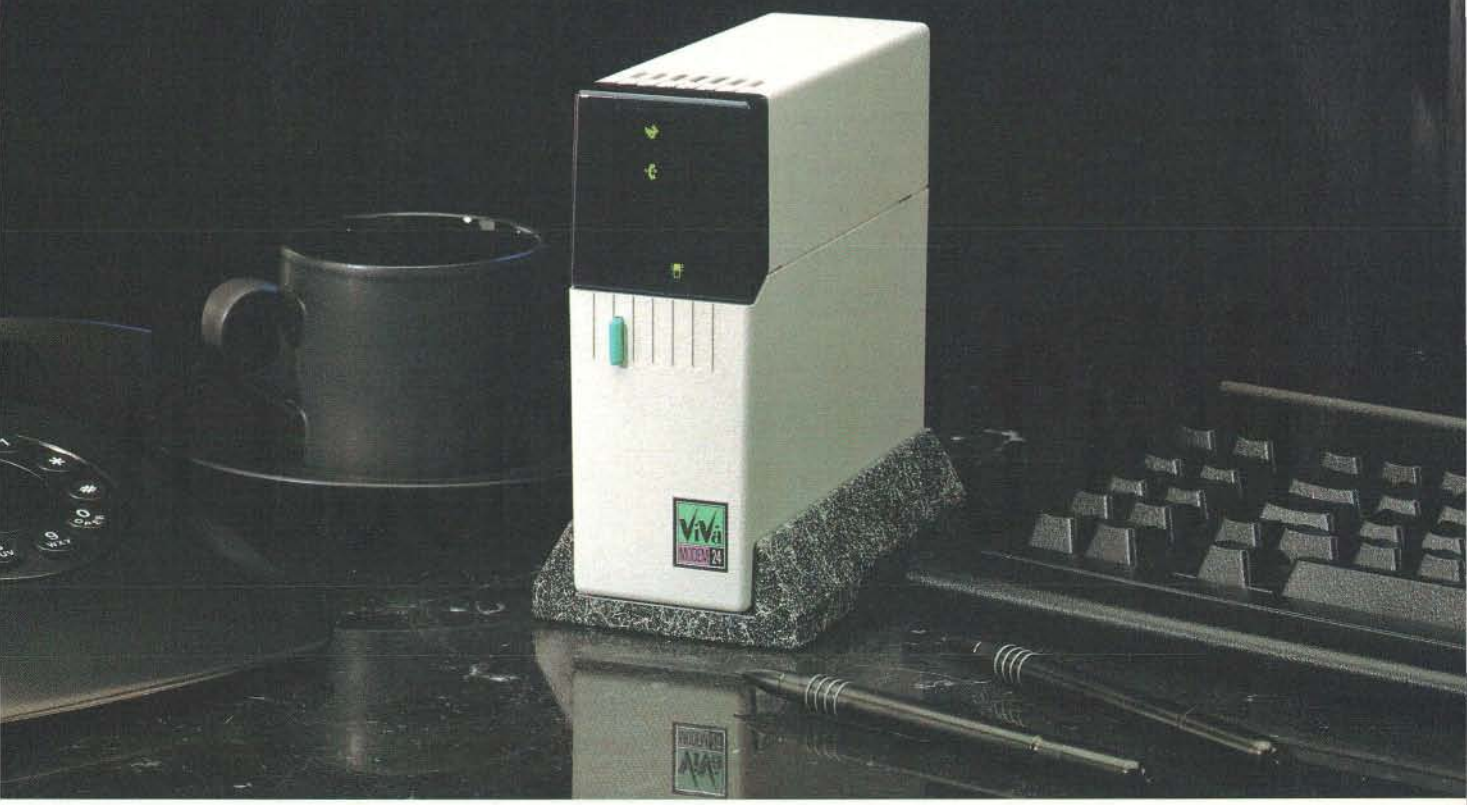
You can edit your PERT and Gantt charts in any window, and the program will flag critical and late activities.

TopDown Project Planner for Windows runs on an IBM AT or higher with Windows 286 or Windows/386.
Price: $249.
Contact: Ajida Technologies, Inc., 613 Fourth St., Santa Rosa, CA 95404, (707) 545-7777.
Inquiry 1124.

continued

 Circle 174 on Reader Service Card

If Looks Could Kill...



The ViVa24 Modem knocks 'em dead with style and convenience.

Finally! An affordable, state-of-the art modem designed to maximize any work station or desktop and take up minimal space. The new 2400 baud modem from Computer Peripherals, Inc. is a 100% Hayes compatable external modem which boasts more high-tech features than its competition at an unbelievable price tag.

The compact, distinctively sleek tower design simplifies placement, and it's easily accessible, front panel power switch eliminates fumbling around the back of the unit. The handsome weighted base holds the ViVa24 firmly in place, and sharp LED indicator lights are aligned for comfortable viewing, utilizing international graphic icons that make the ViVa24 simple to understand.

The small tower design creates a natural flow of air over the surface of the board, allowing the ViVa24 to run cooler and affording you 24-hour, worry-free operation. The Viva24 modem provides the user compatability with IBM PC, XT, AT, IBM PS/2, Apple Macintosh computers and any computer that supports RS-232C.

The ViVa24 modem represents innovation from its footprint up with features such as: use of the Hayes "AT" command set, asynchronous data format, auto-dialing, auto answer, adaptive equalization, non-volatile memory, automatic tone and pulse dialing, remote access while your computer is unattended, self-test and built-in diagnostics. Best, of all, the ViVa24 is fully backed with a five-year limited warranty.

Before investing in an ordinary modem, be sure to investigate the ViVa24. For more details, call your Ingram MicroD representative now at:

1-800-456-8000 (East)
1-800-642-7631 (West)

HIGH FIDELITY™

By Computer Peripherals, Inc.
667 Rancho Conejo Blvd.
Newbury Park, CA 91320
TEL: (805) 499-5751

Trademarks: IBM, International Business Machines, Corp.; Hayes Microcomputer Products; Apple Macintosh; High Fidelity, Computer Peripherals, Inc.

Circle 322 on Reader Service Card

Automation For The 90's From The Heartland

CORPORATE COMPUTERS OF IOWA provides the nation's most aggressive prices on our entire line of state of the art 286 and 386 desktop computers as well as all TOSHIBA*, EPSON*, NEC* and PANASONIC* printers, FAX machines and laptops.

Call one of our account executives today and experience the performance and quality you'd expect for the "Heartland."

CCI AT 286/12 MHZ

- 80286 Processor Running at 6 to 12 MHZ
- Phoenix Bios/Digital Speed Display
- 80287 Math Co-Processor Socket
- 8 Expansion Slots 6-16 Bit, 2-8 Bit
- 2 Meg of 0-Wait State Memory (Expandable to 4)
- 1.2 Meg Floppy
  1.44 Meg Floppy
- 40 Meg Seagate ST 251-1 (28 MSEC.)
  WD Controller (1-1 Interleave)
- Norton SI 15.3
- FCC Class B Approved
- 14" Multisynch Monitor 800 × 600 Tilt Swivel
- Orchid Prodesign and 512K VGA Card
- 1-Parallel, 2-Serial, Game Port
- 101 Key at Keyboard with Dust Cover
- DOS 4.01 with GW Basic or DOS 3.3 with GW Basic
- Surge Supressor
- 1 Year Parts and Labor Warranty (FREE)
- 1 Year On-Site Service
- 30 Day Money Back Guarantee
  (No Restocking Fee)
- 2nd Year Warranty ($49.95)

Complete System Price $2195.00

FREE

Free with the purchase of any CCI System . . . one year, on-site warranty through Data Access Systems Inc. Provides response time of 8 business hours and covers all parts, labor, travel and technical support. Extended warranty available.

CCI AT 286/20 MHZ

- 80286 Processor Running at 20, Switchable to 10
- Phoenix Bios/Digital Speed Display
- 80287 Math Co-Processor Socket
- 8 Expansion Slots, 6-16 Bit, 2-8 Bit
- 2 Meg RAM 0-Wait State (Expandable to 8)
- 80 Meg Seagate ST 4096 (28 MSEC.)
  WD Controller (1-1 Interleave)
- Norton SI 22.5
- FCC Class B Approved
- 14" Multisynch Monitor 800 × 600 Tilt Swivel
- Orchid Prodesign and 512K VGA Card
- 1-Parallel, 2-Serial, Game Port
- 101 Key at Keyboard with Dust Cover
- DOS 4.01 with GW Basic or DOS 3.3 with GW Basic
- Surge Supressor
- 1 Year Parts and Labor Warranty (FREE)
- 1 Year On-Site Service
- 30 Day Money Back Guarantee
  (No Restocking Fee)
- 2nd Year Warranty ($49.95)

Complete System Price $2799.00

1-800-533-0948 **FAX 712-277-8626**

Prices subject to change with D-RAM Flexuation

1-800-533-0948

CCI 386/25 MHZ CACHE

80386-25 MHZ Intel Processor 0-Wait State (32K Cache Memory)

AMI 386 Bios with an in ROM Set-up Routine

Socket Support for 80287, 80387 and Weitek Co-Processors

One 32 Bit Slot, Five 16 Bit Slots, and Two 8 Bit Slots

4 Meg Memory on Board, Expandable to 8MB, 1MB/2MB when using 256K D-RAM, 4MB/8MB when using 1M Bit D-RAM, Expandable to 16MB

1.2 Meg Floppy
1.44 Meg Floppy

80 Meg Seagate-4096 (28 MSEC.)
WD Controller (1-1 Interleave)

Norton SI 30.5

FCC Class B Approved

Mitsubishi Diamond Scan 14" 800 × 600 Tilt Swivel

Orchid Prodesign and 512K VGA Card

1-Parallel, 2-Serial, Game Port

101 Key at Keyboard with Dust Cover

DOS 4.01 with GW Basic or 3.3 DOS with GW Basic

Surge Supressor

1 Year Parts and Labor Warranty (FREE)

1 Year On-Site Service

30 Day Money Back Guarantee (No Restocking Fee)

2nd Year Warranty ($49.95)

Complete System Price $3999.00

"FREE" HI-REZ MOUSE

EPSON PRINTERS

	RETAIL	CCI PRICE
LX-810	$ 299.00	$174.00
LQ-510	$ 529.00	$315.00
LQ-850	$ 859.00	$505.00
LQ-950	$ 949.00	$560.00
LQ-1050	$1,199.00	$695.00
LQ-2550	$1,499.00	$899.00

"FREE" Printer Cable

PANASONIC PRINTERS & FAX MACHINES

	RETAIL	CCI PRICE
KXP-1180	$ 299.95	$ 179.00
KXP-1191	$ 399.95	$ 230.00
KXP-1592	$ 649.95	$ 389.00
KXP-1595	$ 729.95	$ 429.00
KXP-1124	$ 529.95	$ 315.00
KXP-1524	$ 899.95	$ 539.00
UF-150 FAX	$1,795.00	$ 955.00
UF-260 FAX	$2,795.00	$1,479.00

"FREE" Printer Cable

NEC LAPTOPS

		RETAIL	CCI PRICE
PRO-SPEED	286-20 MB	$5,099.00	$3,025.00
PRO-SPEED	286-40 MB	$5,599.00	$3,189.00
PRO-SPEED	386-40 MB	$7,699.00	$4,299.00
PRO-SPEED	386-100 MB	$8,999.00	$5,275.00

TOSHIBA LAPTOPS

	RETAIL	CCI PRICE
T-1000	$ 1,249.00	$ 759.00
T-1200 F	$ 2,099.00	$1,279.00
T-1200 FB	$ 2,199.00	$1,350.00
T-1200 H	$ 2,799.00	$1,699.00
T-1200 HB	$ 2,999.00	$1,800.00
T-1600	$ 4,999.00	$3,025.00
T-3100 E	$ 4,299.00	$2,599.00
T-5100	$ 7,199.00	$4,295.00
T-5200 (40)	$ 9,499.00	$5,700.00
T-5200 (100)	$10,999.00	$6,699.00

Corporate Computers of Iowa Policies

- Toll Free Number 1-800-533-0948 For Ordering And Post Sale Support
- Master Card, VISA, No Surcharge. American Express - Add 3%
- C.O.D. Cashier Checks
- 30 Day, Money Back Guarantee
- Prices Subject To Change In Manufacturers Pricing
- Allow 10 Days For Personal Checks To Clear
- Call For Corporate Purchase Orders

VISA
MasterCard
AMERICAN EXPRESS

CCI
CORPORATE COMPUTERS OF IOWA

P.O. Box 714
Sioux City, Iowa 51102
712/277-2100
Toll Free: 1-800-533-0948
Corporate Showroom
609 5th Street
Sioux City, Iowa 51101

Circle 71 on Reader Service Card (DEALERS: 72)

NEW FROM NOVAS

The Leader in High Performance Since 1982

NOVAS NEAT 286-20MHz 40MB VGA SYSTEM

1 MB SIMM Module RAM
1.2 MB or 1.44MB Diskette Drive
High Speed 1:1 Dual Controller
Enhanced 101 Tactile Keyboard
200W Power Supply
Mini-Tower Case
40MB 28ms Hard Drive
16 Bit High Speed VGA Controller
High Resolution VGA Monitor
DOS 3.3 w/GW Basic
- 80286 Harris CMOS
- 16MHz CPU Running at 20MHz
- Chips & Technologies 286 Neat Chipset
- Interleave/Page Mode 0 Wait
- Shadow RAM, Clock, Battery, AMI BIOS
- 8 I/O Expansion slots, EMS 4.0 support
- Expandable to 8MB on Motherboard
- 287 Socket, 2 Serial, & 1 Parallel Port

POWER METER MIPS = 3.38

$2195

***Option: 80MB VGA System $2375**

NOVAS 386-25MHz W/CACHE 80MB VGA SYSTEM

1 MB SIMM Module RAM
1.2 MB or 1.44MB Diskette Drive
Chips & Technology 82C307 Cache
High Speed 1:1 Dual Controller
Enhanced 101 Tactile Keyboard
200W Power Supply
Tower Case
80MB 28ms Hard Drive
16 Bit High Speed VGA Controller
High Resolution VGA Monitor
DOS 3.3 w/GW Basic
- 80386 Intel 25MHz CPU
- Chips & Technologies 386 Chipset
- Interleave/Page Mode 0 Wait
- Shadow RAM, Clock, Battery, AMI BIOS
- 8 I/O Expansion slots, EMS 4.0 support
- Expandable to 16MB on Motherboard
- Socket for 287/387/Weitek
- 2 Serial, & 1 Parallel Port

POWER METER MIPS = 5.87

$3495

***Option: 150MB ESDI VGA System $4295**

1. Baby Neat 286-14MHz (12MHz CPU) Motherboard W/OK $315
2. Baby Neat 286-20MHz (16MHz CPU) Motherboard W/OK..... $425
3. Baby 386-20MHz (20MHz CPU) W/OK $645
4. AT 386-25MHz (25MHz CPU) W/OK W/Chips 82C307 Cache Controller..... $1395
5. NOVAS 4000 Super 16 Bit VGA 1MB INSTALLED 1024 x 768, 16 COLORS 800 x 600, 256 COLORS $295

"...FULLY LICENSED TO UTILIZE IBM PATENTS..."

NOVAS

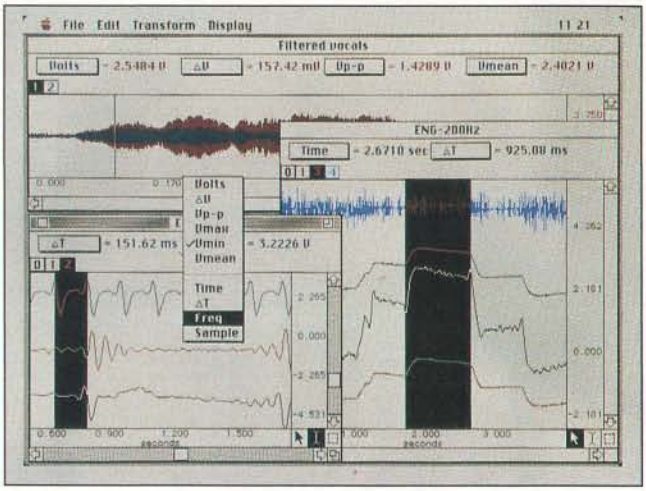
Quality Products From
COMPUTRADE CO.
780 MONTAGUE EXPRESSWAY,
SUITE 501, SAN JOSE, CA 95131

SPECIAL PRICING FOR OEM, VAR, & DEALERS
Corporate & University Discounts

**VGA, XT, AT & IBM are trademarks of International Business Machines*
**Prices & specs subject to change*

U.S. SALES:(408) 435-2662
U.S. FAX: (408) 435-5458

SCIENCE AND ENGINEERING



Transform your Mac into a digital signal processing workstation with AcqKnowledge.

Generate Waveforms Two Ways

Snap-Generator is a menu-driven program that generates waveforms using a D/A converter. You can generate standard functions, such as sine, cosine, square, triangular, and ramp, or you can define your own. For sources of output, you can use previously acquired data or HEM's Snap-Calc.

To run Snap-Generator, you specify the shape of the waveform and select AC or DC amplitudes within the range of the D/A. The waveform can be bipolar or unipolar. Swept-frequency waves let you quickly assess frequency response characteristics of the device under test, according to HEM. Sweep rates can be linear or logarithmic. The maximum D/A rate is 30,000 kHz. Up to 32,768 points are generated for a channel before the waveform is repeated. Snap-Generator can output eight channels, with each independently defined. It will also drive an x,y recorder.

Hardware requirements include an IBM PC running HEM's Snapshot Storage Scope and Snap-Calc, and an analog I/O board from Burr-Brown, Intelligent Instrumentation, or Heath/Zenith.
Price: Snap-Generator, $395; $1185 for all three software programs.
Contact: HEM Data Corp., 17336 Twelve Mile Rd., Suite 200, Southfield, MI 48076, (313) 559-5607.
Inquiry 1115.

AcqKnowledge lets you and your Mac work with waveform data. Included in the package are measurement, transformation, filtering, and spectral analysis functions, and both printing and file handling capabilities. For presentations, you can cut and paste AcqKnowledge graphics into any word processing or desktop publishing package.

Among AcqKnowledge's waveform processing capabilities are digital filtering (low-pass, bandpass, high-pass, and notch); spectral analysis using fast Fourier transfers; waveform integration, differentiation, and smoothing; scalar and delta amplitude and time measurements; and waveform arithmetic.

Biopac says that AcqKnowledge is directly compatible with all of the company's data acquisition hardware, but it also works with any data acquisition system that can store data in a text format. If you want to customize the

continued

 Circle 67 on Reader Service Card

More Powerful Than Ever
. . . Up To 5 KVA

STANDBY UPS MODELS

- 250 To 1600 Watt Output
- Synchronized Sinewave with 1 msec Switching Time
- Full One Year Warranty

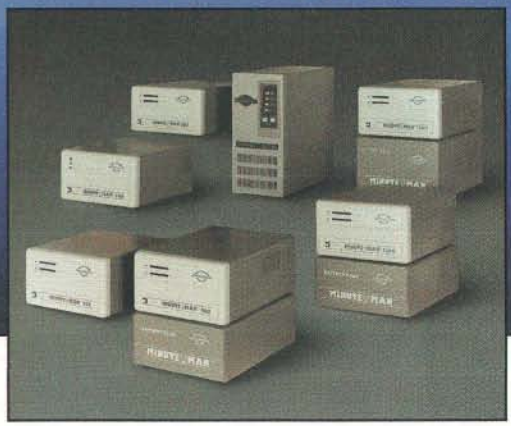
ON-LINE UPS MODELS

- 1000 To 5000 VA Sinewave Output
- True On-Line — Total Isolation
- Static Bypass Switch Standard

SHUTDOWN SOFTWARE

- Auto Shutdown of Local Area Networks for Unattended Operation
- Compatible with SCO XENIX 2.2.3 and above
- Novell ELS 2.12 and above
  Advanced Netware 2.11 & above
  SFT Netware 2.11 and above

MINUTEMAN®
UNINTERRUPTIBLE POWER SUPPLIES



STANDBY UPS MODELS

Power Output	120 Volt Models	208-240 Volt Models
250 WATT	$ 379.00	$ 429.00
300 WATT	$ 549.00	N/A
500 WATT	$ 699.00	$ 799.00
600 WATT	$ 899.00	$1049.00
900 WATT	$1249.00	N/A
1200 WATT	$1499.00	$1749.00
1600 WATT	$1999.00	$2299.00

TRUE ON-LINE UPS MODELS

Power Output	120 Volt Models	208-240 Volt Models
1000 WATT	$2249.00	Available
3000 WATT	$5495.00	Available
5000 WATT	$8950.00	Available

UL LISTED

FOR L.A.N.
NOVELL LABS TESTED AND APPROVED
NetWare Compatible

PARA SYSTEMS, INC.

1455 LeMay Drive
Carrollton, TX 75007

Telephone:
(214) 446-7363

1-800-238-7272

FAX: (214) 446-9011

TELEX: 140275 OMEGA

Circle 202 on Reader Service Card

Want to save Time, Money, & Headaches?

GET SUPERSOFT's
SERVICE DIAGNOSTICS

All the software, alignment diskettes, parallel/serial wrap-around plugs, ROM POSTs and extensive, professional documentation to provide the most comprehensive testing available for IBM PCs, XTs,ATs and *all compatibles* under DOS or Stand Alone. No other diagnostics offers such in-depth testing on as many different types of equipment by isolating problems to the board and chip level.

NEW: SuperSoft's **ROM POST** performs the most advanced **Power-on-Self-Test** available for system boards that are compatible with the IBM ROM BIOS. It works even in circumstances when the Service Diagnostics diskette cannot be loaded.

NEW: 386 diagnostics for hybrids and **PS/2s!**

For over nine years, major manufacturers have been relying on SuperSoft's diagnostics software to help them and their customers repair microcomputers. End users have been relying on SuperSoft's Diagnostics II for the most thorough hardware error isolation available. Now versions of Service Diagnostics are available to save everyone (including every serious repair technician) time, money, and headaches in fixing their computers, even non-IBM equipment.

All CPUs & Numeric Co-processors
System Expansion & Extended Memory
Floppy, Fixed & Non-standard Disk Drives
Standard & Non-standard Printers
System Board: DMA, Timers, Interrupt, Real-time Clock & CMOS config. RAM
All Color Graphics & Monochrome Monitors
Parallel & Serial Ports
Mono, CGA, Hercules & EGA Adapters
All Keyboards & the 8042 Controller

Join the ranks of XEROX, NCR, CDC, SONY, PRIME, ... who have bundled SuperSoft's diagnostics with their microcomputers at no risk because of our 30 day money back guarantee.

Service Diagnostics for PC, PC/XT, and compatibles only	$169
Alignment Diskette for PC, PC/XT and compatibles (48 tpi drives)	$ 50
Wrap-around Plug for PC, PC/XT and compatibles (parallel and serial)	$ 30
Service Diagnostics for AT and compatibles only	$169
Alignment Diskette for AT and compatibles (96 tpi drives)	$ 50
Wrap-around Plug for AT (serial)	$ 15
ROM POST for PC, PC/XT and compatibles only	$245
ROM POST for AT and compatibles only	$245
Service Diagnostics: The KIT (includes all of the above—save $502)	**$495**
Service Diagnostics for 386 or V2, V30, or Harris, etc. (please specify)	$195
Diagnostics II is the solution to the service problems of users of all CP/M-80, CP/M-86 and MS-DOS computers	$125
ROM POST for PS/2 and compatibles only	$245
Alignment Diskette for PS/2 and compatibles (3.5 inch)	$ 50

To order, call 800-678-3600 or 408-745-0234
FAX 408-745-0231, or write SuperSoft.

your microcomputer repair solution

SuperSoft

FIRST IN SOFTWARE TECHNOLOGY P.O. Box 611328, San Jose, CA 95161-1328 (408) 745-0234 Telex 270365

SUPERSOFT is a registered trademark of SuperSoft, Inc.; CDC of Control Data Corp.; IBM PC, AT & XT of International Business Machines Corp.; MS-DOS of MicroSoft Corp.; NEC of NEC Information Systems, Inc., PRIME of PRIME INC.; Sony of Sony Corp.

package, it comes with both textual and mathematical descriptions of the signal-processing algorithms that it uses. AcqKnowledge works with all models of the Macintosh from the 512KE up.
Price: $495.
Contact: Biopac Systems, 5960 Mandarin Dr., Suite D5, Goleta, CA 93117, (805) 967-6615.
Inquiry 1116.

Interactive Neural Network Simulation

Desire/Neunet is an integrated environment that simulates neural networks. It includes a screen editor, compiler, and debugger and lets you combine up to 16,380 neurons and 16,380 interconnections.

The run-time compiler generates processor-specific 80287 or 80387 machine code for matrix computations and differential equations. You can simulate network paradigms, such as back propagation, counterpropagation, bidirectional associative memories, competitive learning, and adaptive resonance. The program also offers six integration rules and handles multirun experiments, complex frequency-response plots, fast Fourier transforms, and matrices.

Desire/Neunet runs on the IBM AT with 500K bytes of RAM, an 80287 or 80387 math coprocessor, and an EGA or VGA card.
Price: $695.
Contact: Korn Industrial Consultants, 6801 Opatas St., Tucson, AZ 85715, (602) 298-7054.
Inquiry 1112.

Math and a Whole Lot More

Formula/One, a math program that features presentation graphics, now supports dBASE II, III, and III Plus databases, and Lotus 1-2-3 and Excel spreadsheets. It is also compatible with CGA, EGA, VGA, MCGA, and Hercules graphics cards.

According to Ocean Isle Software, Formula/One 2.0 solves up to 250 simultaneous equations and processes arrays of up to 8000 entries. It fits linear and nonlinear curves to your data and performs advanced multivariable linear-regression analysis for up to 10 independent variables.

You can input your equations with values for all known variables, and the program will solve for all unknown variables no matter where they appear in the equation. It also has 73 built-in functions, including common trigonometry, logarithms, and general math functions, and a set of business math functions.

You can also create an application display in which you can create a fill-in-the-blanks-type screen for an inexperienced user to fill in with any known values. The program will then fill in the rest.

The program also supports a mouse and features pull-down menus.

Formula/One 2.0 runs on the IBM PC, XT, AT, and PS/2s with DOS 2.1 or higher and 385K bytes of RAM. It also supports math coprocessors.
Price: $295.
Contact: Ocean Isle Software, Ocean Isle Square, Building 3, Ocean Isle Beach, NC 28459, (800) 882-8664.
Inquiry 1113.

BYTE

INTERNATIONAL

80IS-5 **Prolog Goes Parallel** *by Dick Pountain*
PC-Parlog, a new implementation of Prolog, designed for execution on parallel computers

80IS-17 **Short Takes**
pUMa, *a graphics board with transputer power and QPDM chips*
Autoroute Plus, *a new and improved road-mapping program*

80IS-21 **What's New**

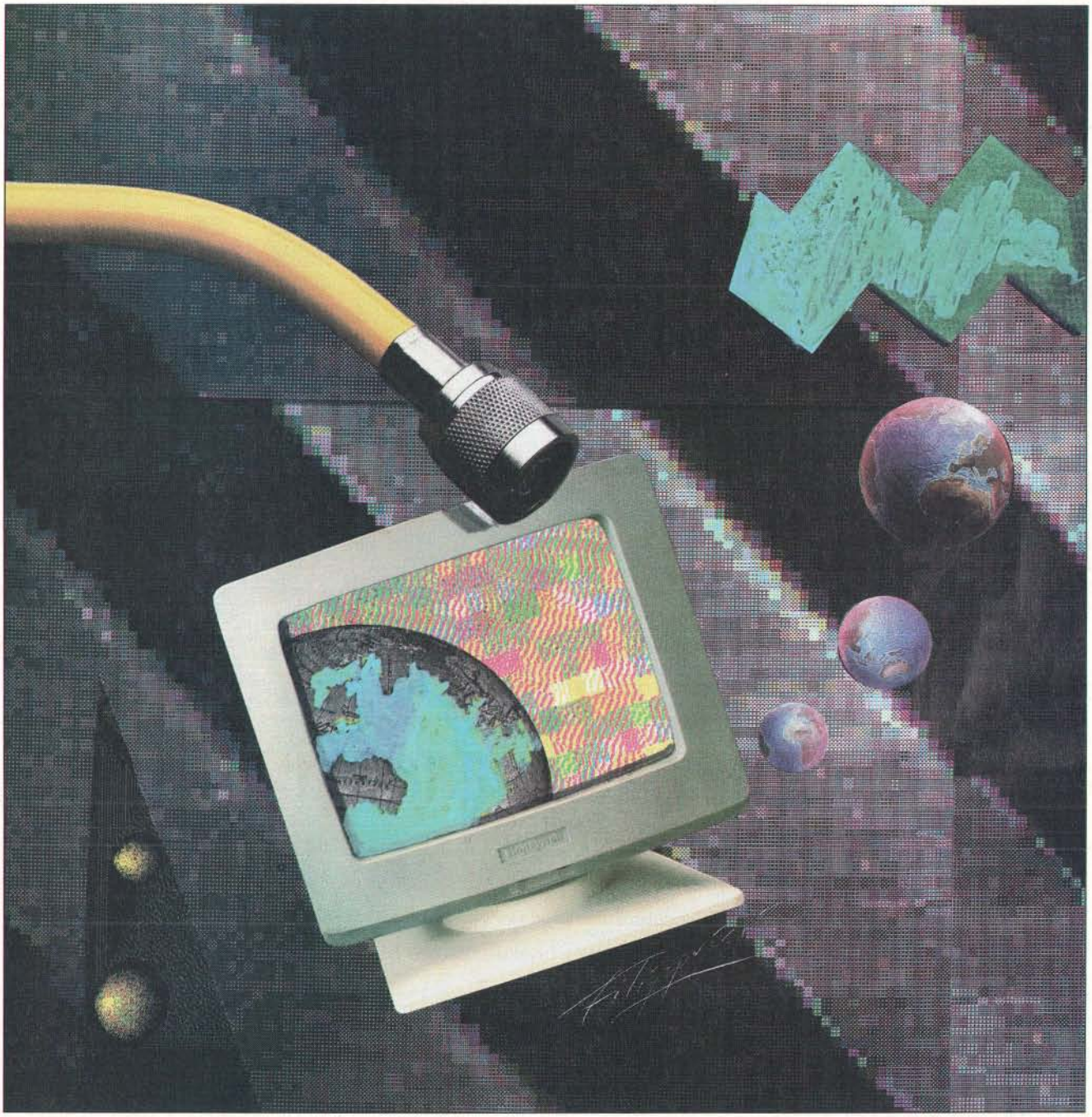


ILLUSTRATION: SANDRA FILIPPUCCI © 1989

You'll be left with fewer worries with our new managed data network service.

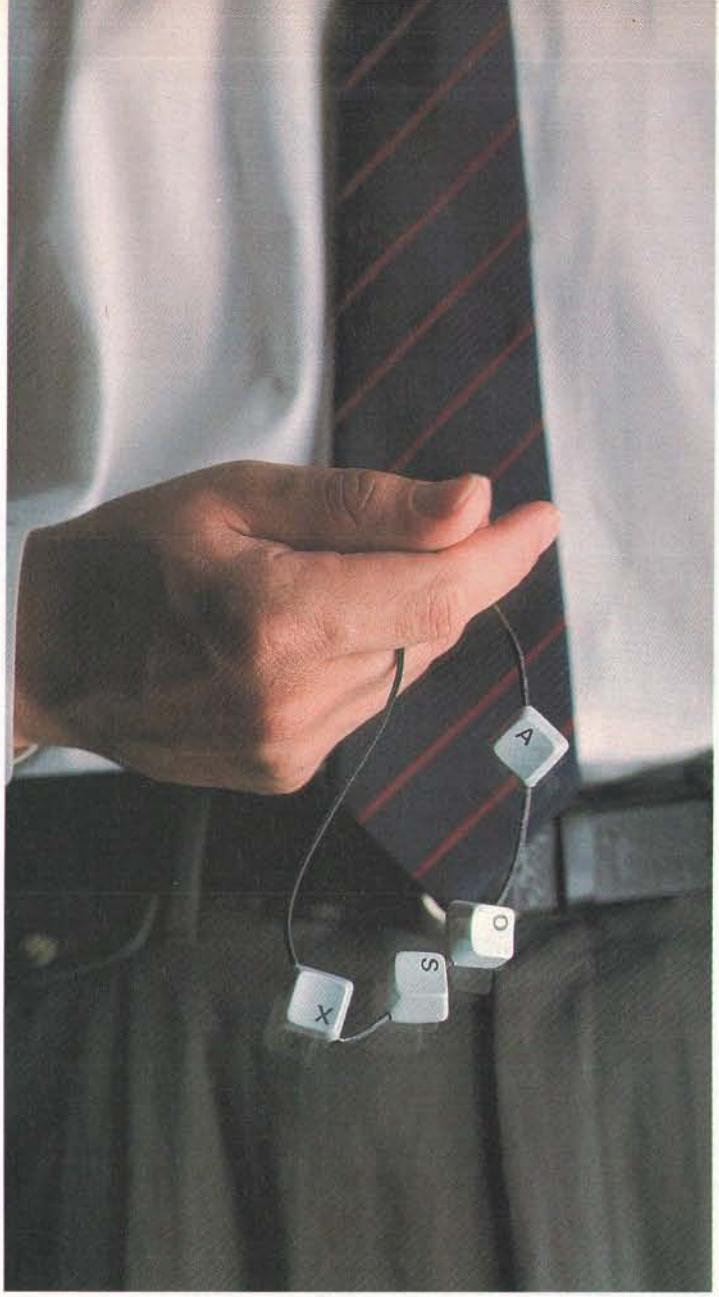
They'll begin to disappear even before you start using the service.

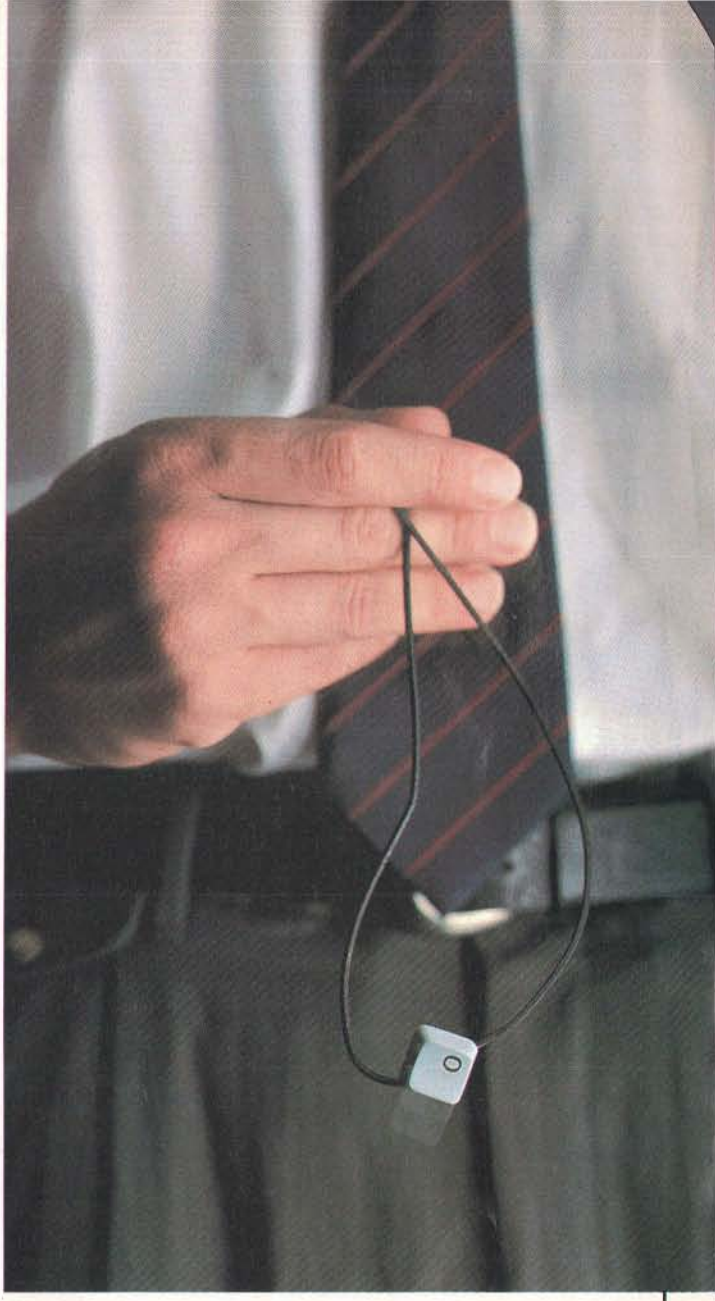
That's because you'll be paying a fixed annual rental, with no extra charges, so it's unlikely you'll ever go over budget.

PSS Plus, as we call it, is a wide area data networking solution. Ideal for corporate networks and requiring a much smaller investment than conventional private networks.

It's fully compatible with international OSI and X25 networking standards, so it supports most types of equipment and allows you to keep your options open for further developments in the future.

As you'd expect from one of





Britain's leading suppliers of managed data networks, we offer a comprehensive support package.

Firstly, you'll be provided with your own Project Manager. Together you can plan a network that will take care of your particular set-up and operational requirements.

Then there'll be your nominated Systems Engineer, an expert who'll be on call to answer any queries you may have on technical matters.

We'll also provide you with an on-line network monitoring facility, in addition to monthly reports on network performance.

Everything about the service is designed to take care of day-to-day networking issues, leaving your hands free for more important matters.

If you'd like further information on the subject, send the coupon or call us free on 0800 800 818. We're sure we'll be able to put your mind at rest.

CALL FREE 0800 800 818 ANYTIME

Please send me more information about PSS Plus.
Title Mr/Mrs/Miss Initials
Surname
Job Title
Telephone Code No.
Company Name
Company Address

Postcode

To: British Telecom, Dept. ASL, ASH046B1089
FREEPOST 800, Bristol BS1 6GZ. No stamp needed.

British TELECOM

It's you we answer to

Circle 469 on Reader Service Card

The End of Plain Vanilla PC Graphics

More Vibrant Colors and Higher Resolution. Any Way You Scoop it.

Now, Genoa dishes up more ways to eliminate the monotony of monochrome. Or the lifeless look of low-res color. With a brilliant line-up of IBM compatible graphics cards, designed to please any palate.

Your choice of flavors, a la any mode. Genoa serves up a full menu of SuperVGA™ and SuperEGA cards. All of which extend the IBM standards—with VGA resolutions of up to 1024 x 768 in 16 colors in both noninterlaced and interlaced modes, and up to 800 x 600 in 256 colors.

The pint-size combo package. For sparkling color and monochrome graphics in one economical half card, choose our SuperSpectrum™. It's 100% CGA, MDA and Hercules compatible, with double scanned CGA for quality game images. Plus 132-column text for full spreadsheets.

So if your graphics board is producing nothing but "board-dom," go to your dealer today and order some Genoan graphic excitement. Or write Genoa Systems Corporation, 75 E. Trimble Rd., San Jose, CA 95131; FAX (408) 434-0997.

See us at Comdex/Fall LVCC, Booth #588

Hypec Elec. in **Australia:** 61-2-8083666; (Fax) 61-2-8083596. Megavision in **Australia:** 61-2-9751877; (Fax) 61-2-9751609. I.T.C. in **Austria:** 43-55-2229607; (Fax) 43-55-2224938. Omnilogic in **Belgium:** 32-2-2525600; (Fax) 32-2-2525700. MCA Tronix in **Belgium:** 32-41-674208; (Fax) 32-41-674208. Metric in **Denmark:** 45-42-804200; (Fax) 45-42-804131. Access Data in **Denmark:** 45-2-397847; (Fax) 45-2-397822. E.C.S. in **Egypt:** 20-2-3608801; (Fax) 20-2-3608805. Tahinik in **Finland:** 358-0-5653233; (Fax) 358-0-5653571. Hyquest in **France:** 33-1-45210554; (Fax) 33-1-46581834. Rea Informatique in **France:** 33-1-47469452; (Fax) 33-1-47460132. Ergodata in **Greece:** 30-1-9510922; (Fax) 30-1-9593160. Hantarex in **Italy:** 39-55-49731; (Fax) 39-55-268486. S.C.I. in **Kuwait:** 965-2-448642; (Fax) 965-2-403554. Akam in **Holland:** 31-79-443200; (Fax) 31-79-421734. Senmex in **Mexico:** 528-3-353959; (Fax) 528-3-355304. Basedois in **Portugal:** 351-1-9869972; (Fax) 351-1-870581. Tae Il in **S. Korea:** 82-2-7765340; (Fax) 82-2-7525340. Computer Universe in **Saudi Arabia:** 966-2-6608347; (Fax) 966-2-6608347. Powermatic in **Singapore:** 65-2-500555; (Fax) 65-2-557916. Siscomp in **Spain:** 34-3-3234565; (Fax) 34-3-3234654. Caelsa in **Spain:** 34-91-2414179; (Fax) 34-91-2415578. Dator Design in **Sweden:** 46-2-2415582; (Fax) 46-2-4454010. E.M. in **Switzerland:** 41-61-615353; (Fax) 41-61-614860. Global Data in **Switzerland:** 41-22-438780; (Fax) 41-22-436455. Genoa Taiwan in **Taiwan:** 886-2-7763933; (Fax) 886-2-7769036. Teleteknik in **Turkey:** 90-1-1525033; (Fax) 90-1-1518456. Genoa U.K. in **U.K.:** 44-1-8725560; (Fax) 44-1-8725539. Tim GmbH in **West Germany:** 49-6121-270930; (Fax) 49-6121-261603.

IBM is a trademark of IBM Corp. Hercules is a trademark of Hercules Technology. SuperHGA, SuperVGA 16-bit Graphics Adapter, SuperVGA, SuperEGA HiRes and SuperSpectrum are trademarks of Genoa Systems Corp.

Circle 426 on Reader Service Card

Insist on Genoan Value.

Genoa

Prolog Goes Parallel

Dick Pountain

PC-Parlog, a new implementation of Prolog, is designed for execution on parallel computers

Last fall, in my article "Parallelizing Prolog" (November 1988 BYTE), I mentioned the new language Parlog, developed at London's Imperial College. PC-Parlog, a version of this language for the IBM PC and compatibles, has now been released by Parallel Logic Programming Ltd. (PLP). PLP was set up by Steve Gregory, the principal designer of Parlog, and Tom Conlon, whose excellent book on Parlog programming has recently been published.

Overview of Parlog

In many ways, Parlog is similar to Prolog, and if you've already learned a version of Prolog, you'll be able to convert quickly. However, this involves a true conversion; although the differences in the languages look superficial, they lead to quite different programming styles.

Prolog and Parlog are both logic programming languages. To be more precise, they are computerized translators for the Horn Clause subset of First Order Predicate Logic. You solve problems in either language by first entering into the computer, in a special syntax, a number of clauses that express all the known facts and relationships as logical assertions and implications. Then you can extract problem solutions by presenting queries (called *goals*) to the interpreter, which it answers by making inferences from the known facts. The strategy that the interpreter follows when making these inferences is a crucial part of the design of a logic language, and strategy is where Prolog and Parlog differ.

A logic program is conceptually of the form

```
A(X,Y) if B(X,Y) and C(X) and D(Y)
A(X,Y) if E(X) and F(Y)
A(X,Y) if G(X,Y)
```

where there may be many different clauses that describe the relation A, and these may depend on a conjunction of other relations like B, C, and D, or E and F. A query like A(Tom,Jerry) means "Is relation A true of Tom and Jerry?" The interpreter tries to solve it by finding the appropriate clause A and then reducing the problem to one of solving its subgoals, say B, C, and D.

In this process, the variable arguments X and Y get bound to various values. The interpreter must have a strategy for choosing both the order in which to try clauses and the order in which to attempt to solve subgoals, and this strategy has a strong effect on the efficiency of program execution.

Prolog, which is designed to work on sequential computers, chooses clauses by examining them one at a time from the top (i.e., in textual order), and it solves subgoals from left to right in textual order. Because this strategy may fail to find an answer on the first try, Prolog employs *backtracking*, which means undoing all variable bindings that have been made so far in an unsuccessful attempt and then trying the next option. Backtracking occurs even after a successful attempt, so that if a query has many solutions, Prolog will go on to find them all.

Parlog is designed to be executed on parallel computers, and it chooses a clause by examining all of them simultaneously and then "committing" itself irrevocably to the most likely prospect. There is no backtracking, so only one solution can ever be found to a problem. (This apparent limitation can be circumvented by altering your program style so that a list of solutions is produced.) Parlog also solves subgoals in parallel unless it is told, by the use of the & operator, to solve them sequentially. On suitable hardware, Parlog can be more efficiently executed than Prolog because of all the potential concurrency and because it eliminates the time-consuming business of backtracking.

Parallel execution always brings you up against the concepts of communication and synchronization; when you are performing several parts of a job concurrently, it's important to know when each part is ready, as others may not be able to proceed without it. Parlog recognizes three possible outcomes for a call—Succeed, Fail, or Suspend—and synchronization is automatic as a suspended call waits patiently until the values for its arguments become known. This implies that arguments have to be directional, with some being used for input and others for output, and this is enforced in the syntax of the language by mode declarations. A typical Parlog procedure definition looks like this:

```
mode append (list1?,list2?,
  joined_list^).
append([U|X],Y,[U|Z]) <-
  append(X,Y,Z).
append([],Y,Y).
```

The <- symbol is Parlog's way of writing the IF that separates the head of a clause from its body (Prolog uses :-, at least in its Edinburgh syntax). The ? symbols mark list1 and list2 as inputs, while the ^ symbol marks joined_list as an output. Thus, arguments become communication channels between concurrent processes, and the execution

continued

of a Parlog program can be viewed as a data-flow network in which progress depends upon the availability of data.

PC-Parlog is, of course, executed on a sequential computer and merely simulates parallel execution by time slicing, so there is no performance advantage to be gained. It is, however, an excellent way to learn the techniques of concurrent logic programming without exotic hardware. A Macintosh version called Mac-Parlog is also available from PLP.

Using PC-Parlog

PC-Parlog comes on a single 360K-byte floppy disk containing just four binary files that make up the PC-Parlog interpreter and its overlays and a subdirectory with source code for 10 sample programs. You also get a slim comb-bound operation manual and a copy of Tom Conlon's book *Programming in Parlog* (Addison-Wesley, 1989) as a tutorial text that refers directly to the sample programs. Running the interpreter is merely a matter of typing Parlog at the DOS prompt.

PC-Parlog is actually an incremental compiler rather than a pure interpreter, and it compiles programs on a procedure-by-procedure basis into memory. It maintains four separate memory spaces: a 64K-byte evaluation space for heaps and stacks, an 8K-byte storage space for floating-point numbers, a 32K-byte text space where atoms are stored, and the remainder, if any, which is program space for compiled code.

Experienced users can alter the relative sizes of the first three spaces using command-line switches when Parlog is started, to suit various programming conditions. The default sizing on my 640K-byte system left 120K bytes of free program space, but that was with 116K bytes of resident programs, including SideKick Plus, loaded. At a pinch you can run PC-Parlog on a 512K-byte machine with one floppy disk drive. A minor irritation is that it takes a long time to load (50 seconds from my hard disk), and some optimization of the disk loading routines might be appreciated.

The opening screen is a banner displaying the copyright notice and the sizes of the four memory areas, followed by the <- prompt, which looks very Spartan compared to the multiwindow displays of products like Turbo Prolog and Micro-Prolog. This may suggest that PC-Parlog is going to be nasty to use, an impression that turns out to be quite wrong; it has nice built-in features for editing, tracing, and debugging programs, but it does not flaunt them immediately.

At the <- prompt, you can type queries and have them immediately executed. For example, typing

```
<- X: X is 3+4+5.
```

will return the answer "X = 12, succeeded." PC-Parlog supports a "typeless" high-precision arithmetic, where you can represent integers or real numbers up to 10^{255} and mix them freely in expressions.

Programs can be loaded from disk with the built-in primitive `load(filename)` and saved by `save(filename)`. To enter a new program from the keyboard, you first type `load(user)`, which makes PC-Parlog take its input from the predefined channel `user`, representing the keyboard. To complete a keyboard entry, you press Control-Z. Programs

continued

PARALLEL PROCESSING SOLUTIONS

Products:

Worker card
- T414 or T800 transputer.
- 1, 2, 4 or 8 Mbytes of 70ns dynamic RAM.
- No wait states.
- 3 cycle access.
- Subsystem reset and analyse generation.
- 16 bit I/O port with 512 addresses. Allows peripherals to be attached to the **Worker** card.
- Can be used in conjunction with **PC Link** card to develop stand-alone accelerator code in C, Fortran etc.

Q–Worker card
- 4 transputers each with 1Mb of DRAM on one extended Eurocard.

PC Link card
- Inmos B004 compatible link interface to IBM P.C. or 100% compatible, requiring a single expansion slot.

Cluster
- Accommodates up to 9 Worker type cards in an electronically configurable stand-alone cabinet.
- Can be linked to a P.C. via **PC Link** card.

A/D card
- Includes local transputer with 1Mb of memory.
- Fast A/D means that the system is capable of 150kHz 12 bit conversions.
- Can be coupled in transputer networks.

Software
An MS Windows environment has been developed for the products. This environment includes GKS libraries for most transputer languages and also graphic configuration software for the cluster.
The Helios operating system can also be supplied for the system.
All the hardware options can run the following transputer software – Parallel languages from 3L including C, Fortran and Pascal; Inmos tool set and compilers including occam; Transputer Development System.

General Information
In conjunction with a **PC Link**, the **Worker** card can be installed inside the P.C. It can also be used outside the P.C. via a cable, obtaining it's power from within the P.C. effectively making it a portable transputer card. *No electrical or mechanical changes are required.* For use outside of the P.C. a tough case is provided to protect your Worker card from damage.

Pricetrend

Pricetrend Limited
'Sky High', Vache Lane
Chalfont St. Giles
Bucks., HP8 4SB

Telephone:
02407 2003
Fax:
02407 71649

Circle 445 on Reader Service Card

A Complete Range of Superior Displays by InterQuadram

- ★ **CM 1401** – 14" EGA – with 640 x 350 resolution in EGA mode and 640 x 200 in CGA for XT/AT.
- ★ **MS 1422** – 14" Multiscan colour monitor for XT/AT and PS/2 families of Personal Computers.
- ★ **AM 1412** – 14" Analog Mono high resolution 720 x 480 ideal for DTP and WP type applications.
- ★ **AC 1432** – 14" Analog Colour VGA monitor compatible with all VGA systems including the IBM PS/2 range.

For more information and details on your local distributor please call us:-

INTERQUADRAM LTD

InterQuadram Limited, 653/654 Ajax Avenue, Slough, Berkshire SL1 4BG, England
Tel: (44) 753 34421 X 139 Telex: 847542 INTQUAD G. Fax: (44) 753 77256

Germany: InterQuadram Computer GmbH. Tel: (49) 6102 17095
France: InterQuadram S.A.R.L. Tel: (33) 1 46840515

Circle 434 on Reader Service Card

entered in this fashion can be edited by typing `edit(procname)`, whereupon the source code for the procedure will be listed and you can edit the text with full-screen cursor movement using a subset of the familiar WordStar commands.

For listings longer than the screen, you can scroll up and down, and all the basic insertion and deletion commands are supported, but there are no block moves or search-and-replace functions. This same editor is available as a line editor when entering queries at the <- prompt, and pressing Control-R recalls the edit buffer contents, DOSEDIT-style, to let you reissue old commands. You use Control-Backspace to stop processes from running.

For more serious editing, it is advisable to use an external editor, preferably a pop-up one. I used the SideKick Plus Notepad facility very successfully for this purpose. When you redefine a procedure in PC-Parlog with the same name, the new version replaces the old without warning, so you can squirt text directly out of your pop-up editor instead of loading the disk file, which makes for a very fast edit cycle.

PC-Parlog is a "lazy compiler" that compiles procedures the first time you call them rather than when they are entered; they need be compiled only once unless you make changes to their text. A built-in primitive called `compile` allows you to force compilation when appropriate. The progress of compilation is displayed in a pop-up window that disappears upon completion.

PC-Parlog has excellent tracing and debugging facilities that all use this same system of pop-up windows. Below the trace/debug mode proper are three special output modes that let you examine program workings. The first of these, Incremental output, is signaled by using a double colon in a query:

```
<- X :: integers(1,20,X)
```

This mode causes a window to open in which each value is displayed as soon as it is ready rather than when the whole query terminates; the example produces a list of the first 20 integers one at a time. The second special mode is Snapshot output, in which the current value of each variable is displayed in a separate window, updated dynamically at each cycle of the process scheduler. This mode is signaled with three colons:

```
<- X ::: integers(1,20,X)
```

Finally, four colons produce Compact Snapshot mode, in which a single window appears listing all the variables, one to a line, with their current values continuously updated:

```
<- X,Y,Z :::: myproc(10,12,X,Y,Z)
```

You can mix these types of output in a single query, so that

```
<- X : Y :: Z ::: myproc(10,12,X,Y,Z)
```

provides normal terminal output for `X`, incremental for `Y`, and snapshot for `Z`.

Full debugging requires your procedures to be recompiled with the "debuggable on" switch set. Tracing is then toggled with "trace/notrace" and causes a trace of procedure calls to appear in a pop-up window. Whenever a call spawns two or more subprocesses, one process

continued

CO/SESSION™

sets new standards in remote access, speed, graphics and ease!

Reduce travel and gain remote access to PCs everywhere. Proclaimed as the "Fastest Remote Software" by InfoWorld in March, 1989, Triton has now enhanced CO/SESSION to version 4.0.

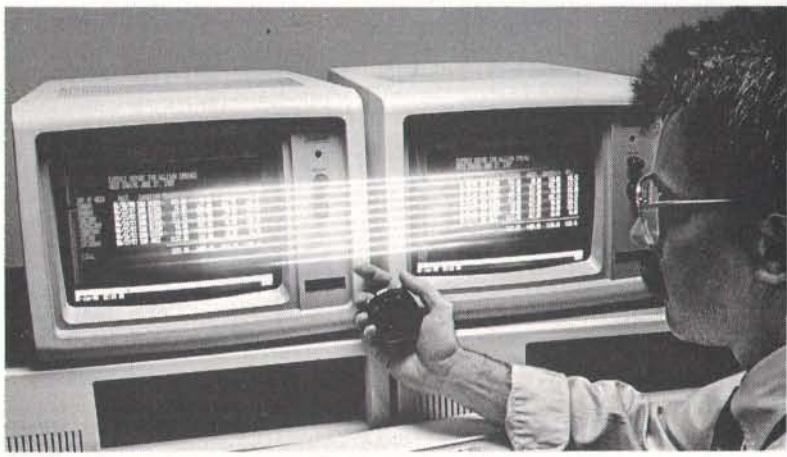
Featuring a new user interface, faster file transfers and full graphic support including EGA and VGA graphics, CO/SESSION allows one PC to remotely control a second PC.

HOME COMPUTING Use CO/SESSION to work at home and run your office PC as if you were there. Access files, execute DOS commands, run programs, print reports and more.

CUSTOMER SUPPORT Provide on-site support and training to customers without moving an inch. CO/SESSION allows you to work with remote users as if you were there.

NETWORK ACCESS Link remote users and offices to your network and enjoy on-line access to all the network resources.

FILE TRANSFERS Transfer files by modem or direct cable. CO/SESSION is ideal for laptops, home and remote offices!



AUTOMATED SESSIONS. Add the ability to automate and schedule file transfers, printing and running of programs on remote PCs, 24 hours a day with SESSION/XL.™

BETTER THAN CARBON COPY PLUS™ CO/SESSION is up to 400% faster, easier to use, more powerful and lockup free.

SHIPPING NOW! CO/SESSION and SESSION/XL are available from dealers worldwide in English, Swedish, German, or Danish. Call or Fax today for information.

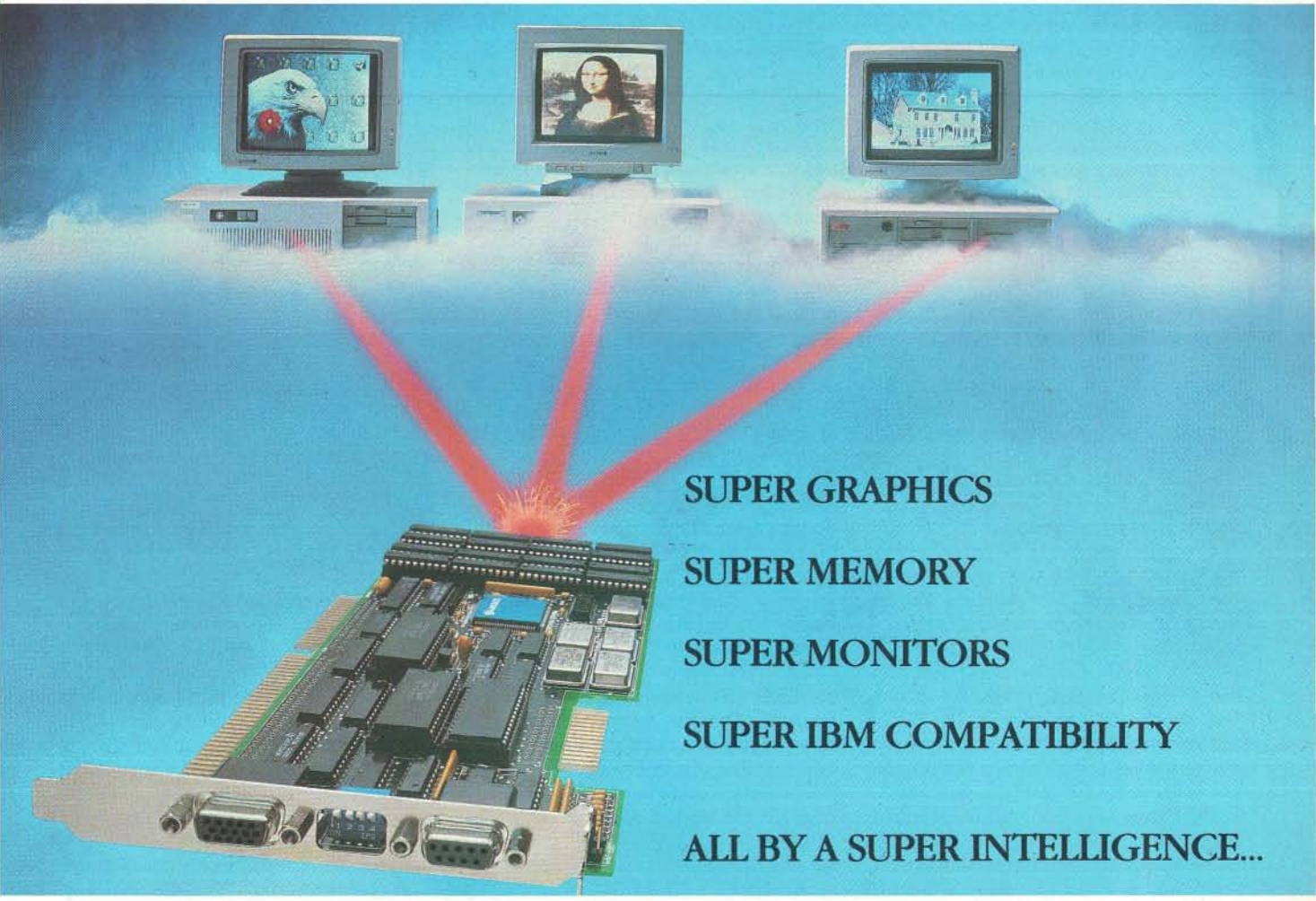
See us at Fall COMDEX
Nov. 13-17, 1989
Las Vegas, NV

***CALL*-201-855-9440**
***FAX*-201-855-9608**

TRITON
Triton Technologies Inc. 200 Middlesex Turnpike, Iselin, NJ 08830

Circle 461 on Reader Service Card (DEALERS: 462)

INTERQUADRAM HERALDS A NEW DAWN FOR COMPUTER PRODUCTS.



Consider InterQuadram's display of super intelligence products and you will never consider anything else...

Call us for more details...

INTERQUADRAM have distributors all over Europe

AUSTRIA, *Micropoint Warenwertriebs GmbH. Tel: 02236 82575* **BELGIUM,** *Sagitta B.V.B.A. Tel: 015 202322*
CYPRUS, *Mechatronic Ltd. Tel: 02 444192* **DENMARK,** *Techware A/S. Tel: 42 94 80 33* **FINLAND,** *Amic OY. Tel: 90 673200*
HOLLAND, *Akam Electronics bv. Tel: (0) 79 443200* **ICELAND,** *Ortolvutaekni-Tolvukaup hf. Tel: 354 1 687220*
IRELAND, *Sound Systems plc. Tel: 01 537841* **ISRAEL,** *Mono-Mode Trading Ltd. Tel: 03 5711170-1*
ITALY, *Tradinform S.r.l. Tel: 06 451911* **NORWAY,** *Dataimport AS. Tel: 05 314085*
PORTUGAL, *Decada Equipamentos de Electronica e Cientificos S.A. Tel: 01 410 3420* **SPAIN,** *SDI SA. Tel: 91 413 72 46*
SWEDEN, *Dataimport AB. Tel: 08 716 94 55* **SWITZERLAND,** *Mini-Peripherals AG. Tel: 042 36 58 77*
YUGOSLAVIA, *Boman Establishment (Liechtenstein). Tel: 23945.*

INTERQUADRAM
LIMITED

InterQuadram Limited, 653/654 Ajax Avenue, Slough, Berkshire SL1 4BG, England.
Tel: (44) 753 36464/(44) 753 34421 ext: 139. Telex: 847542 INTQAD G. Fax: (44) 753 77256.

Germany: InterQuadram Computer GmbH. Tel: (49) 6102 17095.
France: InterQuadram S.A.R.L. Tel: (33) 1 46840515.

Circle 435 on Reader Service Card

All trademarks fully recognised.

shares the parent window and new windows open in tiled fashion for the other processes so that you can see all the concurrent processes executing and single-step, skip, or let them run free.

You can make tracing selective by setting spypoints on named procedures only. As you can imagine, in a concurrent system, such a debugging system can generate lots of information, perhaps too much on occasion. The `debug_options` procedure lets you tailor the trace model to omit some stages of Parlog execution. You may, for example, not want to trace processes that are suspended every time they retry to see if their arguments are ready. At a minimum you can simply be told when each call succeeds or fails. You can also disable the dynamic pop-up windows and have all trace output sent teletype-fashion to the main screen, which saves some memory.

Compiler and run-time error reporting is adequate, with fairly comprehensible messages and error numbers, but the listing of error messages in the manual is incomplete, documenting only four of 35 possible run-time errors, which is infuriating. This omission aside, the editing and debugging facilities in PC-Parlog are good enough to allow a truly interactive style of programming reminiscent of the better BASIC or Forth systems.

PC-Parlog has 92 built-in primitive procedures, including all the arithmetic and comparison operations, disk I/O, windowed screen I/O, and a number of meta-level primitives that you can use to construct and dissect terms and thus write self-modifying programs.

The disk I/O primitives are easy to use and resemble those in conventional languages like Pascal. You open a file with `open(filename)`, after which you can `read()` or `write()` Parlog terms to it or `put()` and `get()` ASCII characters. All I/O operations work on screen windows just as for disk files, and all I/O operations cause the suspension of any concurrent processes until they are completed. The exception to this is the procedure `key`, which suspends until any key is pressed but does not halt other concurrent processes.

PC-Parlog supports an operator syntax (infix, prefix, or postfix) that it uses for arithmetic operators like + and −, and you can define your own procedures as operators, too.

A Sample Program

To give some flavor of how different the programming style of Parlog can be from that of Prolog, I've concocted a sample program based on the ideas in Conlon's book. I'll define two procedures, as shown in listing 1.

The first procedure, `integers()`, produces an unending list of the integers starting from the number given as its first argument. You could write the equivalent of this in Prolog, but it would not be very interesting because it would never terminate and so would hang your machine. Indeed, if you query it in Parlog like this,

```
<- T: integers(223,T).
```

you will not see much in the way of activity, as `T` will never be output. But if you query it with

```
<- T:: integers(223,T).
```

you'll see a window open and the numbers [223,224,225,226...] will be output as they are generated. The variable `T` never becomes *ground*, which in Parlog terminology means bound to a value that contains no variables; it always remains of the form [223,224|Rest], where Rest is still unknown. Nevertheless, the incremental output operator :: can display just that part of `T` that is known. You can think of `integers()` as a generator that produces a stream of integers.

The second procedure, `test()`, takes a list of numbers as its argument and tests them one at a time to see if they are divisible by five, outputting Yes if they are and No if they're not. The test is performed in the two "guard" tests `N mod 5 =:= 0` and `N mod 5 =\= 0`, which are separated from their clause bodies by a colon that marks the end of the clause head. If a guard is present in a Parlog clause, it is considered part of the clause head, and the guard test must be true in addition to all the arguments matching for the clause to be a candidate for committal. Parlog guards aren't allowed to bind input variables (such as `N`) because, with no backtracking, such bindings can't be undone if the program commits to another clause that was being examined concurrently. This is the reason for the arithmetic tests (=:= for "equals" and =\= for "does not equal") that suspend until both their

continued

Laplus 286/386 Plasma Laptop with 20/40/100MB HDD

A-8400
☆80286 NEAT, 12MHz
☆640KB RAM, upto 2.6MB
☆1.44MB FDD/40MB HDD
☆EGA compatible display w/4 gray scales
☆Serial/parallel/RGB/ Ext. FDD & Keypad ports

FCC Approved

A-9400
☆80386 CPU, 20MHz
☆2MB RAM, upto 6MB
☆1.44MB FDD
☆40MB/100MB HDD
☆VGA compatible display w/16 gray scales
☆Two standard 8/16bit & one 32-bit slots
☆Serial/parallel/RGB/ Ext. FDD ports

ADVANTEK INTERNATIONAL LTD.
Rm 50-52, 13/F, Profit Industrial Bldg., 1 Kwai Fung Crescent, Kwai Chung, N.T., HONG KONG.
Tel: (852) 0-4238046, (852) 0-4238057 Fax: (852) 0-4202972

KOSLAP COMPUTER INC.
20 Wertheim Court, Unit 19, Richmond Hill, Ont. L4B 3A8, CANADA
Tel: (416) 731-2078 Fax: (416) 731-1707

Circle 409 on Reader Service Card

GET THE CLEAR ADVANTAGE OF VGA. WITH A PHILIPS PRO MONITOR.

► A Philips Pro Monitor gives you the clear advantage of VGA: higher-than-ever resolution, more colours and brilliant image quality. All making VGA today's high-performance display standard. Both for your present software, and for advanced graphics-oriented programs and environments.

► The Philips colour VGA monitors have Black Matrix tubes, with an ultra-fine dot pitch down to 0.29 mm for maximum sharpness. Resolution is up to 640 x 480 in graphics mode, with up to 256 colours on-screen.

► Or if you prefer monochrome, there's a VGA Pro Monitor with a flat, square paper-white display and resolutions up to 920 x 480. Plus high-resolution graphics with a full 16 grey scales.
Every Philips VGA Pro Monitor has a large 14" CRT. With anti-glare treated dark glass for reflection-free working comfort.

► If you combine a VGA Pro Monitor and a Philips 16-bit VGA video adapter board, you'll also get total compatibility with all your existing software - whether it's MDA, Hercules, CGA or EGA.

► So why not get the clear advantage of VGA today? With a VGA Pro Monitor from Philips.

► For more information, visit your Philips dealer, or return the coupon to Philips International B.V., SFF-836, 5600 MD Eindhoven, The Netherlands.

B10

Name:_____

Company:_____

Address:_____

_____

Postal/ZIP code:_____

MDA, CGA and EGA are trademarks of IBM Corporation. Hercules is a trademark of Hercules Computer Technology, Inc.

PHILIPS

PHILIPS

Circle 444 on Reader Service Card

arguments are ground, rather than = and \=, which in Parlog mean unification and nonunification.

You could try test () out on a finite list like this:

```
<- test([3,4,5]).
   No No Yes
```

but it is more interesting to run it concurrently with integers(), like this:

```
<- integers(223,T),test(T).
   No No Yes No No No No
      Yes .........
```

Listing 1: *Two sample Parlog procedures, designed to generate a sequence of integers starting with 223 and then test each integer to see if it is divisible by 5.*

```
mode integers(int ?,intlist ^) .
integers(N,[N|Rest]) <-
  Next is N + 1,
  integers(Next,Rest) .

mode test(intlist ?) .
test([]).
test([N|Rest]) <-
  N mod 5 =:= 0 :
  write('Yes '),
  test(Rest).
test([N|Rest]) <-
  N mod 5 =\= 0 :
  write('No '),
  test(Rest).
```

Here, the parallel conjunction produces a never-ending stream of Noes and Yeses. What you have is stream communication between two parallel processes using the list T as a channel, and this trivial example epitomizes one main style of Parlog programming. Figure 1 illustrates the data flow.

Using this technique, you can write the Sieve of Eratosthenes as a parallel data-flow program, as shown in listing 2. In theory, this program calculates all the primes to infinity, although obvious memory and precision constraints will intervene on a real computer. It won't win any awards for speed on an IBM PC, because it takes several minutes to cover the first 1899 primes of the BYTE benchmark.

Implementation Issues

The pseudoconcurrency of PC-Parlog is implemented by a process scheduler that employs busy-waiting. Any process that suspends is added to the rear of a queue of runnable processes, and the process scheduler takes processes from the front of this queue and gives them a time slice. A suspended process will periodically inspect the arguments it is waiting on, regardless of whether they are ready or not—hence the term busy-waiting. This system is rather inefficient and can waste much processor time

continued

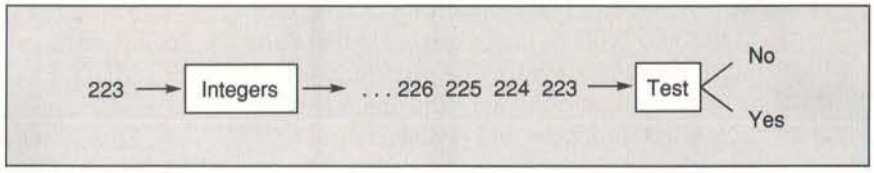


Figure 1: *Dataflow diagram of the Yes/No Parlog example given in listing 1.*

Listing 2: *A parallel Sieve of Eratosthenes in PC-Parlog.*

```
mode primes(primes^).
primes(List) <-
  integers(2,List1),
  sift(List1,List).

mode integers(int ?,intlist ^).
integers(N,[N|Rest]) <-
  Next is N + 1,
  integers(Next,Rest).

mode sift(list?,sifted_list^).
sift([Num|Rem_list],[Num|Shifted_rem_list]) <-
  filter(Num,Rem_list,Filtered_list),
  sift(Filtered_list,Shifted_rem_list).

mode filter(prime?,list?,filtered_list^).
filter(Filter_num,[Num|List1],[Num|List2]) <-
  0 =\= Num mod Filter_num :
  filter(Filter_num,List1,List2).
filter(Filter_num,[Num|List1],List2) <-
  0 =:= Num mod Filter_num :
  filter(Filter_num,List1,List2).
```

"We have just finished our first Multi-Lingual Scholar™ produced job — a service manual in Russian for SAAB Marine Electronics. The result was quite good and the customer is satisfied. It seems we cut his costs some 30%."
— TEKNISK SPRÅKSERVICE
Västra Frölunda, Sweden

SOFTWARE THAT SPEAKS YOUR LANGUAGE

Multi-Lingual Scholar,™ a single software program for wordprocessing and high quality printing with multiple languages in the same document. Supports on-screen foreign characters — with accents and vowel points — with no hardware modifications. Arabic, Farsi and Hebrew edit right to left, and a font editor lets you design your own characters and customize keyboard layouts.

☐ **Standard package** includes 5 alphabets: Roman (for English, European and Scandinavian languages), Arabic/Farsi, Cyrillic, Hebrew and Greek. Supports 9-pin and 24-pin dot matrix printers. $350 + $20 s/h
☐ Also available with Hindi (Devanagari) replacing Hebrew. **Laser Printer** option, $150 additional.
☐ **Optional languages** available: Armenian, Amharic, Sanskrit, Indian dialects, Syriac and most ancient Biblical languages; please inquire.
☐ **Demo program** — same as standard package except file size and printing have been limited. Comes with tutorial. $15 (applies toward purchase) + $7 s/h.

VISA/MC/AMEX, or bank draft in US dollars accepted. **Or write for a list of dealers world-wide.**

Multi-Lingual Scholar

A product of Gamma Productions, Inc.

710 Wilshire Boulevard, Suite 609
Santa Monica, CA 90401 USA
Tel. 213-394-8622
Tlx: 510 600 8273 Gamma Pro SNM

Requires: IBM PC/XT/AT or compatible, 640K, graphics (Hercules, CGA, or EGA), 1 disk drive, 1 parallel port. Works with most dot matrix (9- and 24-pin) printers and Hewlett Packard Laserjet+/Series II or compatible laser printers.

ALTOS WITH XENIX

Series 500	16 MHz	CALL
Series 1000/2000	16 MHz	CALL
Series 2000	20 MHz	CALL
Series 1000	25 MHz	CALL

Series 1000 33MHz ... CALL

Altos Software ... CALL

SOFTWARE

CAD SOFTWARE

IMAGRAPH 1 Year Warranty	CALL
DESIGN CAD	$ 220
EZ CAD	139
FAST CAD	1459
TURBO CAD	69

MULTI USER

SCO Xenix 386	$495
Concurrent DOS 386 10 User	310

All software sales are final.

LASER PRINTERS

QUME APPLE & IBM	3199
CITIZEN OVERTURE 110	1499
PANASONIC 4450	1375
TOSHIBA PAGE LASER 12	2695

CANON

LBP-8 IIR Prints on Two Sides	$2619
LBP-8 II	1595

PRINTERS

OTC TriMatrix™

OTC-850XL 850CPS ... CALL

OKIDATA ... CALL

Canon BJ-130 BUBBLE JET PRINTER ... $725

GENICOM ... CALL

ALPS AMERICA

Allegro	180CPS	$345
324E	240CPS	735
224	240CPS	589

Panasonic Office Automation

KXP-1092	240 CPS	$320
KXP-1124	192 CPS	330
KXP-1180	192 CPS	185
KXP-1191	224 CPS	239
KXP-1524	240 CPS	530
KXP-1595	240 CPS	419
KXP-3131	17 CPS	313
KXP-3151	22 CPS	490

Toshiba .... CALL CITIZEN. CALL

ELECTRONIC TYPEWRITERS

Panasonic

Jetwriter	$347
Jetwriter IIe	457

LEASING AVAILABLE

PLOTTERS

CalComp

1023 Artisan Pen Plotter	$3528
1025 Artisan Pen Plotter	4595
1043 Dual Mode	5856
1044 GT W/Plot Mgr	8717

HOUSTON INSTRUMENTS

DMP-29/40	$1687/895
DMP-52/52 MP	2423/2795
DMP-61	3158
DMP-62	3895

IOLINE

A&D/LP 3500	$2339
A&E/LP 3700	2889
LP-3700-8	3129
LP-4000-1	3579
LP-4000-8	3935

HEWLETT PACKARD

H.P.-7440 A	$ 973
H.P.-7475 A	1424
H.P.-7550 A	2928
H.P.-7570 A	2999
H.P.-7575 DXL	3791
H.P.-7576 EXL	4953
H.P.-7595 A Draftmaster I	8349
H.P.-7596 A Draftmaster II	9921

MURAL
1 Year Warranty

Model 7000 A-C	$1899
Model 8000 A-D	2059
Model 9000 A-E	2829

Roland DESKTOP PLOTTERS
1 Year Warranty

DXY-1100	$ 914
DXY-1200 Electrostatic Paper Hold	1339
DXY-1300 Electrostatic Paper Hold	1759

Roland DRAFTING PLOTTERS
1 Year Warranty

GRX-300 A-D Size	$3579
GRX-400 A-E Size	4999

Roland FLATBED PLOTTERS
1 Year Warranty

DPX-2000 8 Pen w/Stand	$1989
DPX-2200 8 Pen w/Elct Paper Hold	3859
DPX-3300 8 pen w/stand	3329

Roland CAMM MACHINES

Software & Accessories ... CALL

OPTICAL SCANNER & SOFTWARE

Princeton Graphics LS-300 Scanner	$ 875
Data Copy	CALL
Panasonic AS-505/506	$1037/$1315

Authorized Ventura & Auto Cad Training Local & Onsite Classes Available Call For Details

DIGITIZERS

KURTA

Lifetime Warranty On Kurta IS-1

IS-1 12x12 w/4 Button Puck & Dual SW Pen	$439
IS-1 12x17 w/12 Button Puck & Cordless or Dual SW Pen	645
GTCO	CALL
HITACHI	CALL

Summagraphics

12x12	$355
12x18	599
Cal Comp 23120-12x12	335
Cal Comp 9100 Series	CALL
Cal Comp 9500 Series	CALL

Call for pricing on larger digitizers.

LOGITECH MICE

Hi Rez Serial	$109
Hi Rez	95
Serial	79
Bus	79
Mouse Pad/Touch Pad	$6.99
Antistatic Mouse Pad/Touch Pad	8.99

TERMINALS/MONITORS

WYSE TERMINALS

Wyse WY-30 Green	$ 299
Wyse WY-50 Green	377
Wyse WY-60 Green/ White/Amber	405
Wyse WY-85 Green	370
Wyse 99GT	468
Wyse 150	415
Wyse 212	1489

Qume

QVT 101 Plus G/A/W	$316
QVT 119 Plus G/A/W	395
QVT 203 Plus G/A/W	443
QVT PCT G/A/W	385

TeleVideo ... CALL

HEWLETT PACKARD

H.P. 700-43	$355
H.P. 700-71	508
H.P. 700-22	369

IBM TERMINALS

IBM 3 Year Warranty	CALL
Altos IV	379
Altos V	513
Link MC 5	395

MONITORS

NEC 2A/3D	$499/649
NEC Monograph	1355
Mitsubishi Diamond Scan	528
Seiko 1430	599
Sony 1303/1302	$577/649
Hitachi Super Scan	1999

MONITERM

Viking 2 Landscape Mon. 19"	$ 777
Monochrome Monitor 24"	$1175
Viking Color Monitor 21"	2569

WYSE MONITORS ... CALL

ImTec 1256A/2611W	$ 79/110
ImTec 1453/1453Q	355/349
ImTec 1455-N	419

Call Scottsdale Systems today for quality brand name products and expert service at competitive prices.

Scottsdale Systems

—Since 1980—

1555 W. University Dr., Tempe, AZ 85281

602-966-8609 For Inquiries **1-800-777-2369** Toll Free — For Orders **602-966-8634** FAX

Prices listed are for cash. MasterCard and Visa add 1.67%; AZ residents add 6.5% tax; add $6.00 for C.O.D.; add 5% for P.O.; all items are new with manufacturer's warranty; Returned products subject to 20% restocking fee and in new condition in original packaging, with all warranty cards, manuals and cables; No credit issued after 30 days from date of shipment; We do not guarantee compatibility; Personal and company checks take up to 5 days to clear; Prices and specifications subject to change; Product subject to availability; all applicable trademarks recognized and on file.

AST® RESEARCH INC.

CALL

WYSE 386 25 MHz

- 1 Year Warranty ... $5558

WYSE 386 ... $2276

WYSE 286

- Model 2200 ... $1449
- Model 2108 ... 1032
- Model 2112 ... 1484

MATH CO-PROCESSORS

CALL

Panasonic Office Automation

FX-1650	$ 644
FX-195	2845

SAMSUNG

S-800 20 MHz	$2795
S-550 8 & 12 MHz	1249
S-330 XT 10 MHz	711

MultiTech Systems ... CALL

IOMEGA

Bernouill Box

B-120-I 21.4 MB Internal	$895
144-I 44 MB Internal	$1094

Prices do not include interface.

NOVELL

ARCNET

Cards, Cables & Hubs	CALL
Modems	CALL

ALLOY

P.C. Slave/16N	$738
NTNX	612
Retriever 40	367

LAPTOPS

NEC MULTISPEED E.L. ... $1565

TOSHIBA
1 Year Warranty

T-5200-40	$7077
T-5202-100	8194

POWER PROTECTION

Datashield	CALL
Safe Power Systems	CALL

TAPE BACKUPS

Emerald Systems	CALL
Genoa	CALL
Priam	CALL
Irwin	CALL

HARD DRIVES

CDC IMPRIMIS
1 Year Warranty

72 MB thru 600 MB ... CALL

BOARDS

Computon 99 Year Warranty	CALL
Genoa	CALL
Intel	CALL
Verticom All Models	CALL
BOCA	CALL
Cobra All Models	CALL
Paradise VGA Plus	$289
Paradise Prof	495
Control Systems	CALL
Number Nine	CALL
Vermont Microsystem	CALL

VIDEO SEVEN

Video 7 V Ram	$475
Fastwrite	355
Vega Deluxe	225

Circle 451 on Reader Service Card

if many processes are suspended, but it is small and easy to implement. Some other single-processor implementations of Parlog use a more efficient scheme where the variable that a suspended process is awaiting acts as a semaphore and wakes up the process only when a value is ready.

The scheduling system in PC-Parlog uses a "bounded depth-first" algorithm that can be fine-tuned to some extent. Every goal in a program is assigned a "depth allowance" that you can control with the `depth()` primitive. Whenever a goal spawns new processes, they are added to the front of the queue, and its depth allowance is reduced by 1. When a goal's depth allowance reaches 0, all its newly spawned processes are added to the back of the queue like suspended processes. Setting the depth allowance to 1 (the default) gives the maximum illusion of parallelism, but setting it to a higher value will yield faster execution when a computation-intensive process is being slowed down by a great many suspended processes. The penalty is that this makes stack overflow more likely.

PC-Parlog departs slightly from the Parlog model by matching the input variables in goal with the arguments in a clause head sequentially rather than in parallel. The order of matching is arranged by an optimizer in the interpreter so that those arguments used in all the clauses get matched first. You can turn off this optimization, which means that case matching will proceed from left to right.

A Logical Approach

PC-Parlog works well and, with its powerful tracing features, provides an ideal way to experiment with the exciting new methodology of parallel logic programming. Conlon's book not only provides an excellent Parlog tutorial but also has the best account of logic programming in general that I have read.

At $200 the package is not cheap, but a 25 percent discount is offered for educational users, and larger discounts for multicomputer licenses. ■

Editor's note: *For more information on PC-Parlog, contact Parallel Logic Programming Ltd., P.O. Box 49, Twickenham TW2 5PH, U.K.* Programming in Parlog *by Tom Conlon (Addison-Wesley, 1989) costs $18.95.*

Dick Pountain is a BYTE consulting editor, technical editor, and software consultant living in London, England. You can contact him on BIX as "dickp."

Talk to your customer instead of your computer

Control your IBM PC while you control your audience. All by yourself, you can give picture-perfect, PC-assisted sales presentations, make super group demonstrations, or even teach classes. In every case your attention will be focused on your audience, not on your PC.

The secret is Remote Keyboard...a hand-held control device for running and manipulating programs on your PC or compatible from as far away as 50 feet.

A fingertip touch on a button lets you display, alter or change data in the blink of an eye. You can roam the room, keeping in eye contact with your audience while controlling your computer with Remote Keyboard's infrared signals.

"It's neat," Remote Keyboard users say. They're right, too. It fits the palm of your hand and is UL-listed and FCC-approved. With Remote Keyboard, you don't need an aide at the keyboard. You're in control of the audience and your PC.

It installs in less than a minute — without tools! Even if you're all thumbs, Remote Keyboard is simple to install. It has just three components — your wireless, hand-held device, a receiver which plugs into your PC's serial interface, and a software driver on a diskette. Put it together, touch a button, and you're in complete control.

Pay more attention to your prospects, and sell more successfully! Remote Keyboard is a wonderful teaching tool, too, and a must for PC-assisted product demonstrations.

JUST $395...30-DAY MONEY-BACK GUARANTEE ...USE YOUR CREDIT CARD. This handy device is just $395.00 plus $5.00 for shipping and handling. It comes with a 1-year limited warranty. So put yourself in control...order RISK-FREE now by calling:

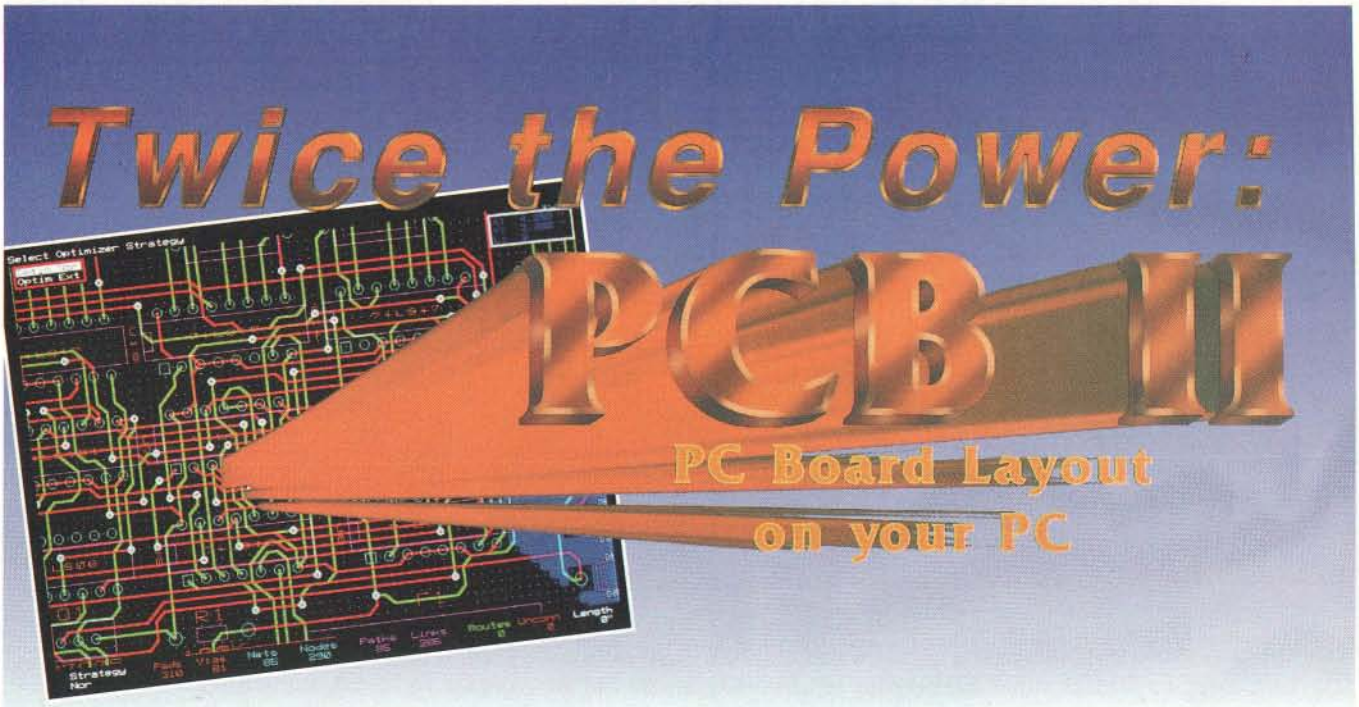
MasterCard VISA

(800) 331-3903

FORTÉ COMMUNICATIONS

680 W. Maude Avenue • Sunnyvale, California 94086
Phone (408) 733-5100 • FAX (408) 733-5600

Remote Keyboard is a trademark of Forté Communications, Inc.
IBM and IBM PC are trademarks of IBM Corporation. © 1989 Forté Communications, Inc.



OrCAD Systems Corporation, the world's largest marketer of PC-based CAE software, has completely upgraded it's popular printed circuit board layout software.
Now you can have all the power features you need for your board designs on the PC you already own.

Twice the capacity
OrCAD/PCB II has over double the capacity using a flexible, user-definable memory allocation system. The product now supports over 270 14-pin IC equivalent designs, 6000+ pads, 16,000+ equivalent track segments.

Twice the options
OrCAD/PCB II comes with over 50 different printer drivers including most popular dot matrix and laser printers, over a dozen plotter drivers and over 50 display drivers. We conform to your system better than anyone.

Twice the features
- Improved autorouting strategies means a faster route with more completions.
- Design Rule Check available as OrCAD/PCB II runs. Parameters are user configurable.
- Via and Track Optimization. Minimize vias and improve routing automatically.
- On-Line module browsing and reading. Call up modules and browse through their graphic descriptions.
- Gerber Viewer generates screen version of Gerber file to check output.

Twice the value
OrCAD's commitment to you is that all of our powerful software will give you workstation performance without extra hardware, all handled within 640k RAM.
And the price? The package comes complete with autorouter, printer and plotter support, excellent documentation and more for a very reasonable price.
The price also includes one year of technical support, free product updates and access to our 24 hour BBS.

Curious? Try it yourself with our demo disk.
Call for our demonstration disk and information packet. You'll see why more designers look to OrCAD for their design solutions.

OrCAD®
Systems Corporation
1049 S.W. Baseline St. Ste. 500
Hillsboro, OR 97123
(503) 640-9488

OR8944-Intl.

Call today for your demo disk

If you would like more information about this or any other OrCAD product, contact your local OrCAD representative.

AUSTRIA
Dahms Elektronik
0316/64030-0
Fax: 64030-29

BELGIUM
INEX
(02) 649.99.91
Fax:(02)649.27.92

DENMARK/ NORWAY
NordCAD
98 17 32 99
Fax: 98 17 37 41

UK
ARS Microsystems
(0276) 685005
Fax:(0276) 61524

FINLAND
Elektrotel OY
(358 0)754-3122
Fax: 754-2593

FRANCE
ALS Design
(331) 46 04.30.47
Fax: 48 25.93.60

ITALY
BRM Italiana
0117/710636
Fax: 0117/710198

ITALY
MicroData Systems
0187/966123
Fax:0187/988322

SPAIN
Next-For S.A.
504 02 01
Fax: 504 00 69

SWEDEN
Technology Partners
(468)790 97 75
Fax: (468)16 77 86

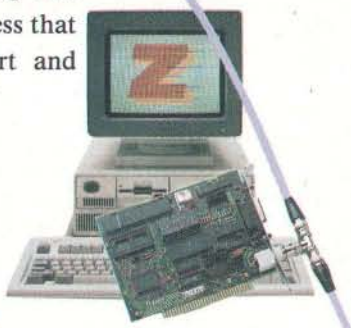
SWITZERLAND
Logmatic AG
056/83 38 38
Fax: 056/83 38 40

W. GERMANY
Compware, GmbH
4940/81 80 74
Fax:4940/81 10 37

Circle 442 on Reader Service Card

Why we developed a network for small business?

Unlike other LANs that try to make a sale out of complexity in the name of technical excellence, D-Link gives you the practical solution with product quality and solid performance that you can afford. Take our D-Link LANsmart network operating system software, for example. Its DOS and NetBIOS compatibility gets you right away into information/peripheral sharing with all existing applications available in the market. Its easy operating and flexible configuration features make it ideal for any small business that cannot afford the expenses of constant professional support and dedicated server computers.



From Ethernet to ARCnet to our own twisted-pair network, D-Link gives you the one-stop shopping convenience to select hardware to fit your specific requirements of networking PC/XTs, AT/386s and PS/2s together. All D-Link hardware also gives you an additional benefit: it not only runs our own LANsmart software but also is fully compatible with other major LANs, such as Novell's NetWare. Which makes your investment on D-Link even more valuable and long-lasting.

So if you think of a network for small business, think of D-Link.

D-Link®
the easy link

Head Office
D-Link Systems Inc.
3303 Harbor Blvd., E-8
Costa Mesa, CA 92626
TEL: (714) 549-7942
FAX: (714) 549-8953

D-Link (UK) 01-209 1300
West Germany 09131-22553
France 086-914416
Italy 0733-586423
Spain 03-3233151

Portugal 02-9487514
Switzerland 032-410111
Belgium 03-4803797
Sweden 040164180
Finland 0-5653811

Circle 418 on Reader Service Card

All trademarks belong to their respective companies.

SHORT TAKES

INTERNATIONAL

BYTE editors' hands-on views of new and developing products

Graphics Board with Transputer Power and QPDM Chips

The **pUMa** from U-Microcomputers is a single-board computer driven by an INMOS T800 floating-point transputer and twin American Micro Devices (AMD) Quad Pixel Data Manager (QPDM) graphics processor chips. The board approaches the performance of dedicated workstations, like Silicon Graphics' Iris, on purely vector drawings (on which it can achieve real-time animation). However, it lacks the latter's hardware support for rendering (i.e., shading); it is slower on three-dimensional solid graphics. The pUMa board can produce 1280- by 1024-pixel graphics in 256 colors chosen from a palette of 16 million shades.

The pUMa board is almost a complete computer in itself. It only requires the host to provide a disk file system. I tested it in a U-Microcomputers 3000-Series host, but an IBM PC compatible should prove just as suitable as the 3000-Series machine I used. Applications run in the pUMa's own program memory, and the host only needs to run a small server program to load code from disk via a transputer link.

The host unit I used was a 68020-based hard disk system with the Mirage operating system. The setup included a serial terminal for interacting with the host machine and a Hitachi 20-inch RGB graphics monitor with a bandwidth of 110 MHz; you can't use an ordinary multisync monitor with this system.

A 6-layer triple Eurocard, pUMa is roughly the size of the motherboard in a small-footprint personal computer. It contains a T800 transputer with its own program memory of from 1 to 8 megabytes (mine had 4) and a separate 4-megabyte graphics buffer, which is written to exclusively via the two AMD QPDM chips. The QPDM chip is a bit-plane-organized, highly pipelined RISC graphics processor that supports vector drawing operations and bit-block transfers; you can gang the chips up so that each chip adds four bit planes to the system.

An 8-bit palette chip and a cursor generator complete the system. The cursor generator controls a 64- by 64-pixel hardware cursor without slowing the video system; a dual universal asynchronous receiver/transmitter chip provides direct input to the pUMa from a mouse and a keyboard. The pUMa also has room for up to 256K bytes of EPROM, which you can use to hold boot code and graphics libraries, such as the Graphical Kernel System (GKS), and 2K bytes of nonvolatile static RAM that can hold system setup parameters.

I was supplied with a program called CHEMMOD, a powerful chemical modeling package that I described in my December 1986 BYTE U.K. column. Aimed primarily at the pharmaceutical industry, CHEMMOD lets you build "designer" molecules on-screen from a library of components. You can then display the molecules in stick or solid form with rotation and scaling and perform energy calculations on them, including steric congestion and bond torsion.

The pUMa board transforms the performance of CHEMMOD—complex calculations that took minutes on the 68000-based system that I first tried the program on now take seconds. You can now perform "what-if" trials that would have been too tedious to contemplate before.

One consequence of this improved performance is that the user interface of CHEMMOD begins to look slightly old-fashioned and less interactive than it could be. For example, you have to enter many parameters as atom numbers rather than by pointing to atoms, and the filenames are displayed and entered on the serial terminal rather than on the graphics monitor. U-Microcomputers is aware of this problem and is currently rewriting the interface—the company supplied me with some demos that use parts of the new code.

The demos let you use a mouse to perform all movements in three-dimensional screen space. One demo consisted of the famous wire-frame drawing of the Columbia space shuttle, which I could rotate in all dimensions in real time; it was impossible to move the mouse fast enough to induce detectable lag. Another demo did the same for a large segment of DNA, which I could rotate in similar fashion.

U-Microcomputers also produces an eight-transputer board called the UTP (which I did not test). You can fit up to eight of them into the 3000-Series workstation, adding some 70 million floating-point operations per second of extra computational performance. However, to get any benefit from the UTP, you would have to write suitable distributed parallel software; CHEMMOD can't, at present, make use of such a parallel accelerator. Writing such software will become much easier when U-Microcomputers completes its port of the Helios parallel operating system to replace Mirage, which should happen this year. This will let you use a choice of C, FORTRAN, Pascal, or Occam development systems, as well as GKS graphics libraries. In addition to powering a cost-effective dedicated chemical workstation, pUMa offers an excellent springboard for building new high-performance graphics products.

—Dick Pountain

continued

THE FACTS

pUMa
£5040 with 1 megabyte of RAM; £6480 with 4 megabytes of RAM; £7920 with 8 megabytes of RAM; £200 for an IBM PC or PS/2 interface; £3749 for U-Microcomputers 3000-Series host computer with a 40-megabyte hard disk drive; £11,980 for the pUMa workstation as tested.

Requirements:
A U-Microcomputers 3000-Series host computer or a full-size slot in an IBM PC and a 110-MHz professional graphics monitor.

U-Microcomputers Ltd.
12 Chetham Court
Calver Rd.
Winwick Quay,
Warrington,
Cheshire WA2 8RF, UK
44-0925-54117
Inquiry 882.

New and Improved Autoroute

In the November 1988 BYTE (International Short Take, page 88IS-3), I reviewed a road-mapping program called Autoroute. Now the publisher, NextBase Ltd., has released a greatly enhanced version called **Autoroute Plus**, which is sufficiently different to warrant another review. Autoroute Plus is aimed primarily at business users. It offers features for costing and route optimization, so you can, for example, plan visits to clients or coordinate pick-up and drop-off points for deliveries. In addition, the new version also lets you manually alter the map and construct a database of your own geographical information, such as factory or customer sites.

THE FACTS

Autoroute Plus
£299
Postcode module: £199
Optimization and Costing module: £199
Gazetteer Editor: £149

Requirements:
An IBM PC with at least 512K bytes of memory, a graphics adapter, DOS 3.0 or higher, and a hard disk drive; the company recommends a Microsoft or Mouse Systems mouse and a graphics printer.

NextBase Ltd.
Unit 18,
Central Trading Estate
Staines, Middlesex
TW18 4XE, UK
44-0784-460077
Inquiry 881.

The basic mapping engine is the same as that in the original Autoroute. It uses information from the Ordnance Survey of the British Isles, which features 67,000 miles of mapped U.K. motorways, including A, B, and minor roads, most ferries, and more than 6000 place names. It lets you enter the starting point and destination of a journey and choose several places you want to pass through en route, as well as indicate sections or places you wish to avoid. The program then works out a selection of possible routes for you, including the quickest, shortest, and cheapest routes, and calculates your journey time. The program can display the resulting routes as high-resolution graphics maps (on screen or printer) or as a detailed itinerary listing that you can take with you, which includes road and junction numbers, place names, turn-off points, and expected arrival times.

The most noticeable improvement in Autoroute Plus is that it's far more interactive than the original. You can now use a mouse to point to your starting, intermediate, and destination points on the screen map itself. A new command produces a rubber-band line, which you can use like a tape measure to find straight-line distances.

You can also use a mouse to edit the map and change the status of individual road segments, such as Avoid (i.e., impassable), Slow, or Urban. Autoroute Plus permanently stores such information in its map files, and the Map Maintenance module lets you review all changes, reset them to original values, or make the changed values the new default. This facility is invaluable for transport managers who need to incorporate topical information about road conditions more frequently than the annual updates of the main map. You can also mark a place on the map with the mouse for use with the Gazetteer Editor module.

Another powerful new feature is the place search; pressing the F3 key brings up a Goto prompt at which you type a place name. If it is a place that Autoroute Plus knows, the cursor moves there. The program retains the excellent fuzzy search facility, which offers you a menu of names closest to what you typed in. Also new is the internal detail provided for Greater London, so you can plan trips from, say, Camden to Clapham with a resolution of about 1 mile; other major cities have yet to receive this privilege.

An important improvement in Autoroute Plus is expandability. You can now buy add-on modules that appear on the menus and become an integral part of the program. The Costing and Optimization module lets you set rates for various classes of vehicles that you want to charge on a mileage or petrol basis; Autoroute then estimates the costs for each journey. This module also solves the "traveling salesman" problem—namely, how to minimize the distance and cost of a trip that must pass through certain places. Computer scientists describe this problem as intractable, since the computation grows exponentially—it cannot be solved for more than a dozen or so locations even using the largest computer on earth.

Autoroute Plus offers an exact solution for trips via up to eight places, but it switches automatically to an approximate algorithm for larger numbers. You can also select the approximation to save time, and the solution is likely to be very close to the optimum. I timed the optimization on an HM Systems Minstrel workstation with a 20-MHz 80386SX microprocessor; it took 3.5 minutes for five towns and 6.8 minutes for eight towns. On a humble IBM XT clone, full optimization might take an hour or more. The approximate solution was roughly invariant at about 25 seconds.

The software has the ability to overlay extra data onto the map—for example, the railway network or the national Post Code districts. This function also lets you add villages and natural features, giving much more low-level detail than before. Such objects appear as named dots on the map beyond a certain zoom scale, and they are first-class objects in the sense that you can Goto a village or landmark and make it a starting point or destination.

These features are contained in separate files called gazetteers, which you can enable and disable at will from a menu; villages and natural features come with Autoroute Plus, but Post Codes are optional. I was impressed by the detail in natural features, which, for example, names most of the major fells and tarns in the Lake District.

An add-on Gazetteer Editor module enables you to create and edit your own gazetteer files, which can contain a panel of information about each place, including arrival and departure instructions. You can display these instructions by pointing and pressing F2. The Nearest Place key, F7, then asks you "Nearest What?" and you reply with a gazetteer name such as Depot, Customer, or Dealer. Autoroute Plus also lets you import gazetteers as plain ASCII files, from a word processor or, perhaps, from another database.

Autoroute Plus is an altogether more useful program than the original Autoroute, which now looks rather like a "taster" for the enhanced version. You could certainly use it for serious commercial transport-management duties, and the new expandability promises that its uses will expand rapidly in the future. It has also acquired a more business-like price—the modules I tested add up to a hefty £850.

—Dick Pountain

£5899

SFT Netware v2.15
Fault tolerant, up to 100 users,
Can also connect to Apple PCs.

PLUS

Elonex 386S-200 File-server,
4MB RAM, **300MB hard disk (SCSI),**
NP600 intelligent server card.

£4679

Advanced Netware v2.15
Up to 100 users,
Can also connect to Apple PCs.

PLUS

Elonex 386S-200 File-server,
4MB RAM, **150MB hard disk (SCSI),**
NP600 intelligent server card.

£2778

ELS-II Netware v2.12
Entry level, up to 8 users,

PLUS

Elonex 386S-200 File-server,
2MB RAM, **44MB hard disk,**
NE2000 16-bit Ethernet card.

£1911

ELS-II Netware v2.0a
Entry level, up to 4 users,

PLUS

Elonex 286S-120 File-server,
1MB+640K RAM, **40MB hard disk,**
Ethernet card.

£625

PC Workstation
with Ethernet card and boot ROM

Prices are for sample configurations and are exclusive of VAT.

Your networking headaches taken care of.

As a leading supplier of IBM-compatible PCs, we have gained a solid reputation for service and technical back-up.

As a NOVELL OEM, we can help you take the pain out of choosing the right configuration that meets both your present and future requirements.

Whether you're equipping a small office or large department, you can be confident of getting the best hardware and software solutions, at prices others can only envy.

LONDON OFFICE
Elonex plc, Rays House, North Circular Road, near Hanger Lane, London NW10 7XB
Fax: 01-965 3246
Tel: 01-965 3225

NORTHERN OFFICE
Elonex plc, 7-9 Campus Road, Bradford Science Park, Bradford, West Yorkshire BD7 1HR
Fax: (0274) 307294
Tel: (0274) 307226

NOVELL

ELONEX

IBM, NOVELL Netware and APPLE are registered trademarks.

Please send me information about the Elonex product range and services **NV/BYTE/10/89**

NAME COMPANY NAME

POSITION ADDRESS

TELEPHONE

Simply Brilliant...

GTCO's DIGI-PAD® Super L Series™... The next generation of digitizers.

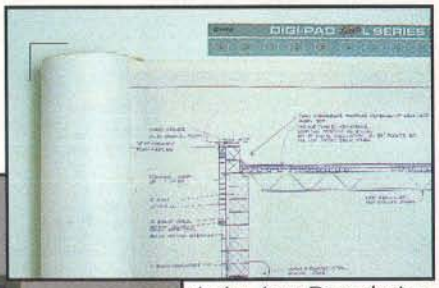
Light in Weight. Light in Cost. Heavy in Features.

Exclusive Super Set Menu System
Allows instant digitizer configuration to a wide variety of software application programs. Located outside the active area, the Super Set Menu lets you change between applications without changing switches.

Super Set Menu

The Lightest Digitizers Available
Super L Series digitizers are completely portable because they're lighter than ever before - 35% to 75% lighter than competitive tablets. They are easier to ship, set-up, and move. From 17" x 24" (6 lbs.) to 42" x 60" (32 lbs.), there's a lightweight size for every need.

Easiest To Set Up
Position drawings and application menus quickly and easily using the active area corner marks.



Active Area Demarkation

Most Wanted Features
Digitize directly through plan books up to 1 inch thick. Receive superior performance with a resolution of 1000 points per inch.

Transducers For Every Application
Choose from the 4 or 16 button ClearVu™ cursors, or a pen-shaped Binary Stylus™. All three have a diagnostic LED to indicate tablet status and active area.

4 Button & 16 Button Cursors, Binary Stylus

The Lowest Cost Large Tablet Available
Get a high performance, new generation digitizer that's lightweight without a heavyweight price. To order your Super L Series tablet call your local dealer or contact GTCO...the leader in large format digitizers.

Making Brilliant Ideas Better

GTCO Corporation 7125 Riverwood Drive Columbia, MD 21046 Phone: 301/381-6688 Fax: 301/290-9065 Telex: 898471
GTCO Europe 75 Windsor Avenue, Hillingdon Middlesex, UK UB109AU Tel: 44 895 39812 Fax: 44 895 810180

DIGI-PAD, Super L Series, Binary Stylus and ClearVu are trademarks of GTCO Corporation.

Circle 428 on Reader Service Card (DEALERS: 429)

A3-Size Desktop Plotters

The MP4000 series of A3-size, flatbed desktop plotters from Graphtec accepts a wide range of media, from standard plotting paper to overhead-projector film. All four models in the series feature electrostatic paper-hold (except for the MP4100, which uses magnetic hold) and come with RS-232C serial and Centronics parallel interfaces as well as switch-selectable General-Purpose Graphics Language and Hewlett-Packard Graphics Language emulation command sets.

Other features include a built-in 60-degree-tilt stand; automatic pen up, return, and cap; pen sorting (MP4300/4400); and LCD (MP4300/4400).

The entry-level MP4100 and MP4200 have 8-bit CPUs, microstep stepper motor drives, and 5K-byte buffers. They can achieve a plotting speed of 50 cm per second and a resolution of 0.00625 mm. The top-of-the-line MP4300 and MP4400 feature 16-bit CPUs and digital servo drives. They can achieve a plotting speed of 64 cm per second and a resolution of 0.005 mm.

The MP4400 also features a built-in 1-megabyte 3½-inch floppy disk drive for data storage (up to 152 plot files) and off-line plotting, in addition to its standard 40K-byte RAM buffer.

Price: 128,000 yen for the MP4100; 148,000 yen for the MP4200; 198,000 yen for the MP4300; 268,000 yen for the MP4400.

Contact: Graphtec Corp., Mita 43rd Mori Building, 13–16, Mita 3-chome, Minato-ku, Tokyo 108, Japan, 81-03-453-0511.

Inquiry 929.

Graphtec's MP4000 desktop plotters can handle media from standard plotting paper to overhead-projector film.

Proofread Your Own Mac Documents

MacProof is a desk accessory for the Mac that detects errors and provides correction suggestions for punctuation, capitalization, spelling, word usage, writing style, and the structure of parts of a text or a full document. European MacProof is an extended version of the program designed for people writing in English as a second language. It includes Language Interference checks to detect and correct mistakes frequently made by those who speak French and German but are writing in English.

The Interference Checks include False Friends, words that look similar in the writer's native language and in English but have different meanings; Noun Number, plural nouns that should be singular (or vice versa) and incorrect plural forms; and Verb Inflections, incorrect verb inflections.

The program also checks for usage problems, such as words that may offend some readers; words that are possibly inappropriate to general writing, that carry little specific meaning, or that are easily confused with similar words; words that are used in spoken English and are less acceptable in written form; redundant words; or verbose words and phrases. You can also create your own set of words and phrases that you want the program to flag.

In addition, European MacProof performs style and structure checks, including checks for weak passive constructions; for verbs that have been made into nouns by the addition of the suffixes *tion*, *ance*, *ence*, or *ing*; for text displayed as a numbered list of sentences; and for repeated phrases displayed in a list or highlighted in the text.

MacProof and European MacProof run on the Mac Plus, SE, or II with 1 megabyte of RAM and two 800K-byte floppy disk drives or one floppy disk drive and a hard disk drive. They are compatible with most Macintosh word processors and are format-compatible with Aldus PageMaker, MacWrite, MacWrite II, MindWrite, and Microsoft Word. If you use the programs with Aldus PageMaker or MultiFinder, you need at least 2 megabytes of RAM.

Price: 295 Swiss francs.

Contact: Lexpertise Linguistic Software SA, Château de Vaumarcus, CH-2028 Vaumarcus, Switzerland, 41-38-55-31-31.

Inquiry 900.

Add More Memory to Your IBM PC

If you've been looking for a memory-expansion board for your IBM PC that can meet the memory requirements of OS/2, DOS 4.0, and EMS 4.0 applications, then the Hyperam 286 is for you. The slim-line full-size board comes with 2 megabytes of 16-bit memory that you can increase to 8 megabytes using 1-megabyte zig-zag in-line packages.

The Hyperam 286 also ships with RAM disk and print-spooling software. In addition, the slim-line design lets you use the board in the new generation of slim-line, low-profile ATs and PS/2s, as well as in 8-bit IBM PCs and XTs.

Price: £999 with 2 megabytes of memory; £1635 with 4 megabytes; £2907 with 8 megabytes.

Contact: Logitek Plc., Markham Point, 1a Stoke Rd., Slough, Berkshire SL2 5BN, UK, 44-0753-824707.

Inquiry 895.

continued

If you would like your new product considered for publication in the international section of BYTE, send press releases to BYTE, Attention: Martha Hicks, One Phoenix Mill Lane, Peterborough, NH 03458, U.S.A.; or Dick Pountain, BYTE, McGraw-Hill Publishing Co., 34 Dover St., London W1X 3RA, UK; or Nikkei BYTE, 1-1, Kanda-Ogawamachi, Chiyoda-ku, Tokyo 101, Japan. All press releases must contain price information, address, and telephone number.

Buy The Brooklyn Bridge from Softsel

White Crane Systems has added a powerful new file manager to version 2.0 of The Brooklyn Bridge (see the October 1988 What's New, page 86). This file transfer package consists of RAM-resident file transfer software and an 8-foot universal cable to connect two computers via the serial ports.

Called Filer, the new file manager makes it easier for you to transfer files (at a rate of 115,200 bps) between IBM-compatible desktop, portable, and laptop computers. Now you can choose between Filer with a dual-screen directory display and Lotus-style menus for simple point-and-shoot operations, or the shortcut DOS file transfer commands.

In addition, The Brooklyn Bridge features DOS utilities (e.g., move, rename, copy, and backup) as well as a run utility that provides for dual-independent processing. The package also lets you share peripheral devices such as printers, plotters, and tape backup systems.

The Brooklyn Bridge 2.0 runs on the IBM PC, portables, and laptops with 5K bytes of RAM on the master computer, 70K bytes of RAM on the slave computer, and DOS 2.0. A 50-foot desktop-to-desktop universal cable is also available separately.

Price: £95.

Contact: Softsel Computer Products Ltd., Softsel House, Syon Gate Way, Great West Rd., Brentford, Middlesex TW8 9DD, UK, 44-01-568-8866.

Inquiry 901.

You can connect two computers via the serial ports and transfer files between them with The Brooklyn Bridge package.

Answers to Office Health Issues on Disk

Now you can get information on more than 100 topics relating to office health issues on a series of floppy disks from David Brown. The content is supplied by occupational health experts and is presented in three databases: discomfort, work design, and stress reduction.

If you have work-related discomforts, The Floppy Ergonomist is for you. First it asks you a series of simple questions to help you arrive at the root of your problem. Then it presents practical, helpful information on the possible causes, symptoms, preventions, and remedies for your complaint.

The other programs include The Floppy Office, which guides you on the best ways to set up and perform many common office activities, and The Floppy De-Stressor, which examines the causes, symptoms, and remedies for stress, covering both job-related causes and personal habits that contribute to feeling tense.

The Floppy Ergonomist, The Floppy Office, and The Floppy De-Stressor run on the IBM PC with 256K bytes of RAM and DOS 2.0. The Floppy Ergonomist is also available for the Mac running under HyperCard. Macintosh versions of the other two programs are currently under development.

Price: $95 Australian for The Floppy Ergonomist; $65 Australian for The Floppy Office; $35 Australian for The Floppy De-Stressor.

Contact: David Brown, Occupational Health Centre, 12 Pritchard St., Annandale N.S.W., 2038 Australia, 61-02-810-6049.

Inquiry 890.

A Guide on Optical Disk Storage and Image Processing

Are you involved with random-access mass storage, the archiving of large quantities of documents or data, records management, or document image processing? If you are, then Cimtech's *Optical Disk Storage and Document Image Processing: A Buyer's Guide to Products and Systems* should interest you.

The guide, edited by Arthur Shiel, covers 26 optical disk drives, 29 optical disk subsystems, 24 optical disk jukeboxes, 36 document image-processing systems for office-type applications, 15 DIP systems for drawing, scientific, or photoimage-type applications, and 68 addresses for manufacturers and suppliers. Although the guide predominantly covers WORM (write once, ready many times) optical disks, Cimtech also includes information on rewritable disks, as well as on system integrators, document and drawing sizes, and typical WORM disk storage capacities.

Price: £18.

Contact: Cimtech, The Hatfield Polytechnic, P.O. Box 109, College Lane, Hatfield, Hertsfordshire AL10 9AB, UK, 44-07072-79691.

Inquiry 945.

Smalltalk-80 Ported to Sony NEWS

A version of Fuji Xerox Information Systems' Smalltalk-80 System Package is available for Sony's NEWS. This is the first version released specifically for a Japanese-manufactured workstation, according to the company.

The Smalltalk-80 System Package consists of four floppy disks and an English manual. You can run it on NEWS 1700, 1800, and 1900 series machines with at least 4 megabytes of main memory, NEWS-OS 3.0, X Window System 11 release 2, and a 20-megabyte hard disk drive.

Price: 940,000 yen.

Contact: Fuji Xerox Information Systems, Nippon Seimei Hatsudai Building, 1-47-3 Hatsudai, Shibuya-ku, Tokyo 151, Japan, 81-03-378-8011.

Inquiry 922.

continued

ANNOUNCING DAILY NON-STOP DELIVERIES TO EUROPE! AT UNBELIEVABLE PRICES!

LATEST ARRIVALS!

386/VMM by PharLap Software	$ 418
Corel Draw v1.1 by Corel Systems	$ 608
dB_FILE & db_Retrieve w/Source by Raima	$ 359
HyperPAD by Brightbill-Roberts	$ 111
Lotus 1-2-3 v3.0 by Lotus	$ 649
MathCAD v2.5 by Mathsoft	$ 599
Microsoft FORTRAN v5.0 by Microsoft	$ 518
Microsoft QuickPascal by Microsoft	$ 120
Modula-2 with Multiscope by Logitech	$ 544
PixelPaint v2.0 by SuperMac Technologies	$ 376
Professional Oracle v5.1b by Oracle	$ 1694
Turbo PASCAL Professional v5.5 by Borland	$ 299
UNIX 386/ix X11 Windows Development by Interactive	$ 1039
ViewLink by Travelling Software	$ 161

386 PRODUCTS:	Price
DESQview 386 by Quarterdeck	$ 210
FoxBASE+/386 by Fox Software	$ 564
Microsoft Windows/386 by Microsoft	$ 231
Paradox 386 by Borland	$ 990
QEMM Expand. Memory Mgr./386 by Quarterdeck	$ 65
Turbo Assembler and Debugger by Borland	$ 182
VM/386 by IGC	$ 299

ARTIFICIAL INTELLIGENCE:

Arity Combination Pack by Arity Corporation	$ 1319
PC Scheme by Texas Instruments	$ 109
PROLOG-2 Programmer by Expert Systems	$ 545
Turbo Prolog by Borland	$ 179
VP Expert by Paperback Software	$ 219

ASSEMBLERS & LINKERS:

Microsoft Macro Assembler by Microsoft	$ 179
Plink86Plus by Phoenix Technologies	$ 431

BACKUP:

Back-It by Gazelle Systems	$ 161
Backup Express by Digitran	$ 94
Copy II PC by Central Point Software	$ 37
FastBack Plus by Fifth Generation	$ 194

BASIC:

Microsoft QuickBASIC by Microsoft	$ 120
Turbo Basic by Borland	$ 115

BUSINESS:

Adobe Illustrator by Adobe Systems	$ 693
FormWorx with Fill and File by FormWorx	$ 178
Gem/3 Presentation Team by Digital Research	$ 500
Grammatic III by Reference Software	$ 99
GrandView by Symantec	$ 300
GRASP by Paul Mace Software	$ 199
Harvard Total Project Manager III by Software Pub.	$ 735
Microsoft Excel v2.2 by Microsoft	$ 444
Microsoft Word by Microsoft	$ 419
PFS: Professional Plan by Software Publishing	$ 111
Q&A Write by Symantec	$ 204
Quattro: Professional Spreadsheet by Borland	$ 277
SQZ! Plus by Symantec	$ 107
Super Project Expert/2 by Computer Associates	$ 880
TimeLine by Symantec	$ 613
WordPerfect-English by WordPerfect Corp.	$ 438
WordPerfect-French by WordPerfect Corp.	$ 502
WordPerfect-German by WordPerfect Corp.	$ 659
Wordstar Professional by Micropro	$ 451

C :

C ASYNCH MANAGER by Blaise Computing	$ 215
C-tree by FairCom	$ 479
Essential Communications by Essential Software	$ 213
Greenleaf Communications by Greenleaf Soft.	$ 248
Microsoft QuickC by Microsoft	$ 120
r-tree by FairCom	$ 359
Turbo C Professional by Borland	$ 295
Turbo C Tools by Blaise Computing	$ 184

CADD :

AutoCAD Release 10 by Autodesk	$ 4205
Design CAD 3D by American Small Business	$ 381
DRAFIX CAD ULTRA by Foresight Resources	$ 353
Generic 3-D by Generic Software	$ 355
VersaCAD 2 D by VersaCAD Corporation	$ 2999

COBOL:

Microsoft COBOL v3.0 by Microsoft	$ 1033
RM/COBOL-85 Development Sys. by Ryan-McFarland	$ 1425

COMMUNICATIONS:

Carbon Copy Plus by Meridian Technology	$ 239
CO/Sessions Complete by Triton Tech.	$ 304
Crosstalk Xvi by DCA/Crosstalk Comm.	$ 181
Mirror III by SoftKlone	$ 99
Procom Plus by Datastorm Technologies	$ 85
Remote2 Complete by DCA/Crosstalk	$ 181
Smartcomm II by Hayes	$ 169
TenNet Plus by DCA/Crosstalk	$ 559

DATABASE & FILE MANAGEMENT:

ALPHA Four by Alpha Software	$ 561
Btrieve by Novell	$ 299
Clarion Professional Developer by Clarion	$ 788
CQL by Machine Independent Software	$ 400
dB_FILE & db_Retrieve w/Source by Raima	$ 359
dB_FILE & db_Retrieve Multi w/Source by Raima	$ 719
dbFAST Compiler by Bumble Bee Software	$ 114
DBXL Diamond by WordTech Systems	$ 209
FoxBASE+ by Fox Software	$ 373
Omnis Quartz by Blyth Software	$ 857
R &R Clipper/FoxBASE+ Module by Concentric Data Syst.	$ 65
R:BASE for DOS by Microrim	$ 803
Reflex: The Analyst by Borland	$ 173
XQL by Novell	$ 959

DEBUGGERS:

Periscope I by PERISCOPE Company	$ 659
Periscope IV-25MHz by PERISCOPE Company	$ 3379

DESKTOP PUBLISHING:

Halo DPE by Media Cybernetics	$ 223
Page Perfect by IMSI	$ 500
PFS: First Publisher by Software Publishing	$ 145
Publish It ! by TimeWorks	$ 217
Ventura DeskTop Publisher by Xerox	$ 905
Ventura Professional Extension by Xerox	$ 683

DISK/DOS UTILITIES:

Disk Technician Advanced by Prime Solutions	$ 209
MACE Utilities by Paul Mace Software	$ 104
Norton Utilities Advanced by P. Norton Comp.	$ 152
OPTune by Gazelle Systems	$ 125
Q-DOS II by Gazelle Systems	$ 101
XTree Pro by Xtree Co.	$ 131

EDITORS:

Emacs with Source Code by Unipress	$ 869
VEDIT PLUS by CompuView	$ 190

FORTRAN:

ASMUTIL2 & BUTILE by Impulse Engineering	$ 170
Cruise Library by Cruise Scientific	$ 155
GRAFMATIC & PLOTMATIC by Microcompatibles	$ 293
I/O PRO - NO LIMIT by MEF Software	$ 154
RM/FORTRAN Development Sys. by Ryan-McFarland	$ 719

GRAPHICS:

Designer Deutsch by Micrografx	$ 1158
Designer English by Micrografx	$ 761
Essential Graphics by Essential Software	$ 346
GSS Graphic Development Toolkit by Graphic Solution	$ 695
HALO '88 by Media Cybernetics	$ 427
Harvard Graphics by Software Publishing	$ 512
PCPaintBrush IV by ZSoft	$ 97
Perspective Junior by Three D Graphics	$ 166
STATGRAPHICS by STSC	$ 990
Vp Graphics by Paperback Software	$ 125
Windows Draw Plus by Micrografx	$ 440

INTEGRATED:

Ability Plus by Migent	$ 258
Framework III by Ashton-Tate	$ 800
Lotus Symphony by Lotus	$ 811
Microsoft Works by Microsoft	$ 175

LAN:

Advanced NetWare 286 by Novell	$ 3115
Btrieve/N by Novell	$ 719
Framework III LAN (5 Users) by Ashton-Tate	$ 1143
Harvard Graphics for 5 Users by Software Pub.	$ 1908
Microsoft Word for Network by Microsoft	$ 425
Networker Plus by WordTech Systems	$ 271
Paradox LAN Pack by Borland	$ 1163
Q-DOS II for Network by Gazelle Systems	$ 255
R:BASE for DOS Network by Microrim	$ 1100
Super Project Expert Lanpak by Computer Associates	$ 742
TimeLine for Network by Symantec	$ 204
Ventura Network Server by Xerox	$ 1531
WordPerfect - English for Network by WordPerfect	$ 612
Wordstar Professional for Network by Micropro	$ 564
Xtree Net by Xtree Co.	$ 391

MACINTOSH:

Back Fax by Solutions International	$ 250
Copy II Mac by Central Point Software	$ 45
Curator by Solutions International	$ 145
dB_FILE by Raima Corporaton	$ 479
DiskFit by SuperMac Technologies	$ 99
FastBack by Fifth Generation	$ 105
FoxBASE+ by Fox Software	$ 376
Full Impact by Ashton-Tate	$ 452
FullWrite Professional by Ashton-Tate	$ 452
Generic Cadd-Level 1 by Generic Software	$ 155
Guide 2 by Owl International	$ 245
Hyperworks Organizer by TimeWorks	$ 111
Just Enough Pascal by Symantec	$ 92
LapLink MAC by Travelling Software	$ 149
Mac SQZ! by Symantec	$ 87
MacBrain by Neuronics	$ 305
MacFlow by Mainstay Software	$ 188
Macprint by Inside	$ 151
MacSchedule by Mainstay Software	$ 188
Omnis 3+ for Tops Network by Blyth Software	$ 995
Pagemaker by Aldus	$ 660
Showcase F/X by Aegis	$ 400
SideKick by Borland	$ 121
Smalltalk/V by DigiTalk	$ 245
Symantec Utilities by Symantec	$ 107
Think's Lightspeed C by Symantec	$ 294
Think's Lightspeed Pascal by Symantec	$ 178
ThinkTank by Symantec	$ 200
Turbo Pascal by Borland	$ 115
XTree by Xtree Co.	$ 100

MEMORY RESIDENT PROGRAMS:

DESQview by Quarterdeck	$ 135
Magic Mirror by SoftLogic Solutions	$ 105
SmartKey by Software Research Technologies	$ 67
SoftwareCarousel by SoftLogic Solutions	$ 85
Tornado by Micro Logic	$ 91
Window DOS by Window Dos	$ 57

MODULA-2:

EmsStorage with Full Source by PMI	$ 94
Logitech Modula-2 Compiler by Logitech	$ 102
Multiscope Debugger by Logitech	$ 364
Repertoire/Btrieve Toolkit by PMI	$ 154
Topspeed Modula-2 OS/2 Compiler Kit by JPI	$ 278

OOP:

Actor by Whitewater Group	$ 599
Smalltalk/V 286 by DigiTalk	$ 245
Zortech C++ with Source Code by Zortech	$ 199

OPERATING SYSTEMS:

Concurrent DOS XM 3 Users by Digital Research	$ 306
SCO XENIX 386 Complete by Santa Cruz Operations	$ 1507
SCO XENIX Complete for PS/2 Mod.80 by Santa Cruz	$ 1623
UNIX 386/ix Complete by Interactive	$ 1429

OS/2 PRODUCTS:

Btrieve by Novell	$ 719
GSS Graphics Devel. Toolkit by Graphic Solutions Sys.	$ 695
KEDIT for OS/2 by Mansfield Software	$ 213
Microsoft OS/2 Presentation Mgr. Toolkit by Microsoft	$ 575
Norton Guides by Peter Norton Computing	$ 169
Paradox by Borland	$ 850
Poly AWK by POLYTRON	$ 244
R:BASE for OS/2 by Microrim	$ 990
SCO TCP/IP Development System by Santa Cruz Oper.	$ 347

OTHER LANGUAGES, TOOLS & MISCELLANEOUS:

AskSam by AskSam Systems	$ 318
Guide 2 for PC by Owl International	$ 335
LapLinkIII by Travelling Software	$ 142
Logitech Mouse with Plus Software by Logitech	$ 148
Microsoft Mouse with EasyCAD by Microsoft	$ 215
PolyMake by POLYTRON	$ 184
RPG II Development Sys. v3.0 by Lattice	$ 2245
Show Partner F/X by Brightbill-Roberts	$ 361
SmarTerm 470 by Persoft	$ 321
SSP/PC Scientific Subroutine Library by Lattice	$ 390
Surfer by Golden Software	$ 484
Tallgrass TG-1100 External Backup by Tallgrass	$ 699
The Complete Hand Scanner by The Complete PC	$ 284
Turbo EMS by Lantana	$ 125

PASCAL:

B-Tree Filer by TurboPower Software	$ 155
Pascal ASYNCH MANAGER by Blaise Computing	$ 215
POWER SCREEN by Blaise Computing	$ 160
Turbo Analyst by TurboPower Software	$ 124
Turbo Pascal V5.5 by Borland	$ 176
Turbo Professional by TurboPower Software	$ 155

SCREEN DESIGN & WINDOWING:

Flash-Up Developer's Toolbox by Software Bottling	$ 59
Greenleaf DataWindows w/Source by Greenleaf	$ 306
Microsoft Windows Development Kit by Microsoft	$ 585
Microsoft Windows/286 by Microsoft	$ 120
PANEL Plus II by Roundhill	$ 505
Vermont Views by Vermont Creative	$ 479

TRANSLATORS:

BAS_PAS Commercial by GoToLess Conversion	$ 341
BAS_C Commercial by GoToLess Conversion	$ 455
dBx dBASE to C by Desktop AI	$ 775
FOR_C by Cobalt Blue	$ 905

UNIX/XENIX PRODUCTS:

BAS_C Comm. for SCO XENIX/386 by GoToLess	$ 563
Microsoft FORTRAN Compiler-XENIX/286 by Microsoft	$ 811
Microsoft Pascal Compiler-XENIX/286 by Microsoft	$ 811
Microsoft Word for XENIX by Microsoft	$ 701
RM/COBOL Dev. Sys.-UNIX/XENIX 286 by Ryan-McF.	$ 1425
SCO Lyrix by Santa Cruz Operations	$ 695
SCO MultiView 386 by Santa Cruz Operations	$ 463
SCO VP/ix for XENIX 386 by Santa Cruz Operations	$ 579

USA SOFTWARE

LIMMATQUAI 116 • 8001 ZURICH, SWITZERLAND

PHONE: (01) 252-6710 FAX: (01) 252-7795 TELEX: 814460

(Attn: USA SOFTWARE)

Terms: EUROCHEQUE, AMERICAN EXPRESS, VISA, MASTERCARD, EUROCARD, C.O.D.
30 day billing for qualified companies in Switzerland.
Special discounts for large or corporate buyers. All prices in US dollars.
Add shipping charge from Zurich at prevailing rates.
Prices subject to change without notice.
Hours: 8:30 AM - 5:30 PM.

B1089

Circle 466 on Reader Service Card

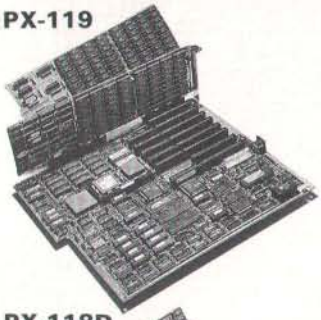
Kaotec

THE HIGHEST PERFORMANCE BOARD IN THE 386 WORLD

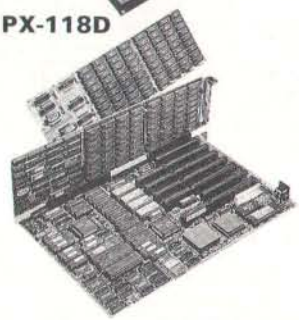
A STATE-OF-THE ART DESIGN FROM AMERICAN MEGATRENDS INC. U.S.A.

KT-9000 • 386-BASED PCS

PX-119



PX-118D



PX-119

1. Intel 32-Bit 80386-25 CPU 8/25MHz
2. 64KB Cache Memory On Board controlled by bus
3. 128KB 32-Bit ROM BIOS (AMI BIOS + video)
4. Socket for 80387-25 Coprocessor
5. Eight-Layer Printed Circuit Board
6. Nine Expansion Slots: 32-Bit×1, 16-Bit×6, 8-Bit×2
7. Standard AT Size: 12"×13.7"
8. 32-Bit Memory Bus for Expansion up to 16MB (Option: 2MB/8MB RAM Card Can Be Expanded to 10MB/16MB by Installing 8MB Piggyback)

PX-118D

Same as PX-119, But With the Following Differences:

1. Eight Expansion Slots: 32-Bit×1, 16-Bit×5, 8-Bit×1
2. Baby AT Size: 8.5"×13"

PX-118B

Same as PX-118D, But With the Following Differences:

1. Intel 32-Bit 80386-20MHz CPU
2. Six Expansion Slots: 32-Bit×1, 16-Bit×4, 8-Bit×1

MIT GROUP CORP.
14741 CARMERITA RD., NORWALK, CA 90650 U.S.A.
FAX NO: 213-802-9218
TEL NO: 213-921-6669

Hwa Hsin Electronic Co., Ltd.
5F., NO. 12, LANE 538, CHUNG-CHENG RD., HSINTIEN, TAIWAN, R.O.C.
TEL: 886-2-9153375 FAX: 886-2-9186892
TELEX: 35210 TRONIX

Vinspex II compares a test-piece picture and the input from a video camera to inspect objects on a conveyor belt.

A Visual Inspection System

Eltime Vision Systems claims that its Vinspex II is an entirely new automatic visual-inspection system that can handle a variety of inspection tasks. It looks for missing components in printed circuit board assemblies, missing or incorrect labels on packages, damaged containers, surface imperfections, printing on cartons, and fill levels of containers.

First, you take a master picture of a standard piece, and then you store it as a reference for the Vinspex II. The system works by comparing the test-piece picture with objects on a moving flow line. If it detects any differences or errors, Vinspex II sets off an alarm or triggers a mechanical device to remove the faulty piece from the flow line.

Based around the Image III image-processing system (see August What's New International, page 80IS-26), Vinspex II uses the input from a video camera to capture an unblurred picture of each object. You use front-panel switches to synchronize the speed or position of the conveyor belt and to set the system for variations in grayness (light levels) and allowable error size. Once you set these switches, the entire inspection procedure and alarm facility takes only 0.2 second. Therefore, each test item needs to be held in position for only about 100 ms for Vinspex II to inspect it.

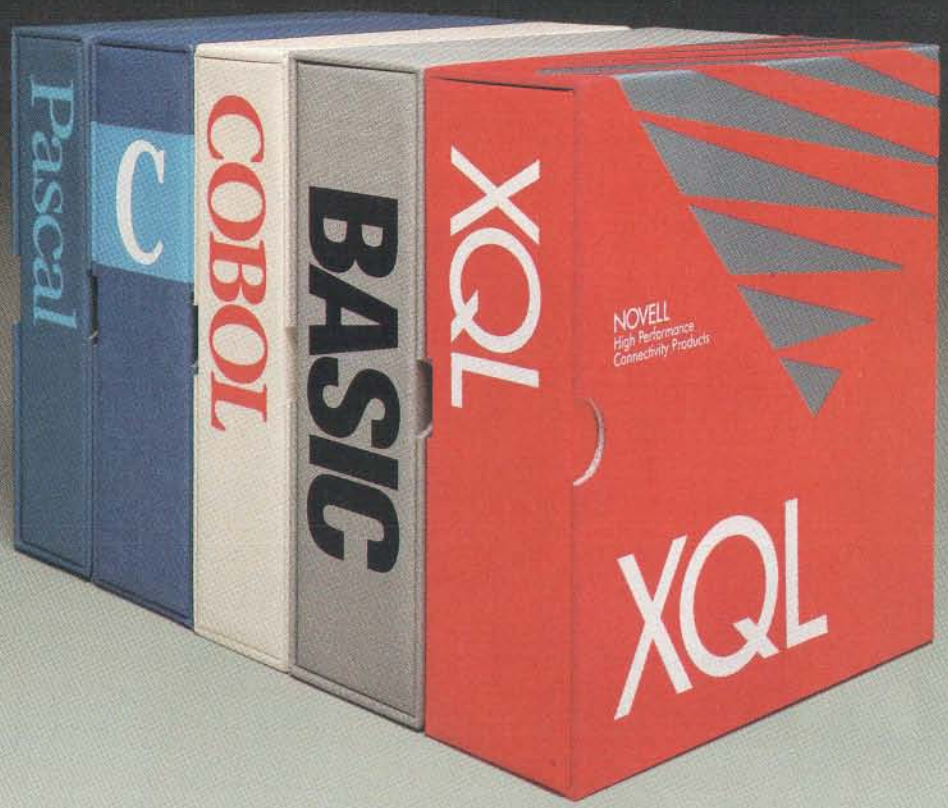
Price: About £5000.
Contact: Eltime Vision Systems, 10/14 Hall Rd., Heybridge, Maldon, Essex CM9 7LA, UK, 44-0621-859500.
Inquiry 894.

Protection Against Voltage Fluctuations

Wiesemann & Theis offers a new type-84iso50 interface (20 mA passive to RS-232C bidirectional) that gives you up to 50 kV isolation for protection against voltage fluctuations. The protection comes from a 10-cm optical fiber that is integrated into the interface. The interface uses μPower Technology to draw its power from signal voltage levels, and it needs no adapter—it is housed in a small swelling in the 4-meter-long data cable that the company supplies.

Price: 298 deutsche marks.
Contact: Wiesemann & Theis GmbH, Winchenbachstrasse 3b, D-5600 Wuppertal 2, West Germany, 49-02-02-505077.
Inquiry 896.

continued



Finally, there's an SQL that gets back to BASIC. And COBOL. And C. And Pascal.

As a programmer, you've probably already faced it—the database dilemma. Do you use an SQL for easy database handling, or a true programming language for maximum power and flexibility?

Now you can do both with XQL®, the relational data management system from the developers of Btrieve.®

The Programmer's SQL. With XQL, you can access your data with the ease of Structured Query Language through simple subroutine calls from traditional programming languages. XQL supports standard SQL syntax, including subqueries, unions and security groups.

XQL Relational Primitive Operations. In addition, XQL lets you bypass the SQL level and perform highly efficient, relational primitive operations directly. You get all the functionality of a relational database model without the constraints of a 4th generation language.

Building on Btrieve. The heart of Novell's family of data management tools is Btrieve. By letting you access multiple records at a time, XQL adds a powerful dimension to Btrieve. XQL incorporates sophisticated data manipulation features which allow you to access data by field name, move forward or backwards through the database, compute fields from other fields or constants, and even work with composite records built from multiple, joined Btrieve files.

Like Btrieve, XQL offers features like multi-user support, fault tolerance, comprehensive documentation, and expert technical support. And you never pay royalties on your XQL applications.

Solve the database dilemma with XQL, the SQL that speaks your language. See your authorized Novell dealer, or call us for more information.

Novell GmbH
Schiess-Strasse 55
4000 Düsseldorf 11
West Germany
Tel. (0211) 5973-0

Novell UK Ltd.
Avon House
Sweetwell Road
Bracknell
Berkshire
RG12 1HH
United Kingdom
Tel. 0344 860400

NOVELL

Circle 441 on Reader Service Card

Requires Btrieve 4.1x and PC-DOS or MS-DOS 2.x, 3.x.

Project Your Computer Screen on an OHP

If you have been involved in making presentations, you are familiar with the problems that can arise with overhead transparencies—they can be dirty, damaged, incorrect, or missing altogether. But now Davis's Transview 480 data screen lets you prepare the images in advance using a personal computer, and then display them in large format on the computer screen and an overhead projector simultaneously.

You connect Transview to the RGB output of your computer and place it on top of an overhead projector. The unit automatically detects the output format from the computer, performs screen setup, and optimizes the screen picture for any given computer or software. You can also key in additional information during the presentation and project it simultaneously.

The Transview 480 has a 640- by 480-pixel high-contrast double-supertwist black-and-white display that lets you choose from 384 color combinations with eight shades of gray and six hatching patterns. You simply press Auto on the remote control, and an internal microprocessor analyzes the incoming RGB signal for the number of horizontal lines, the number of dots per horizontal line, and the horizontal and vertical position of the image. Then Transview 480 adjusts itself.

The remote control also lets you override all automatic functions, including hold, clear, inverse video, and contrast adjustment. You can use Transview 480 with most personal computers—including the IBM XT and AT, IBM PS/2s, and the Mac—that have normal analog or digital TTL RGB output and dot clocks in the range of 14 to 30 MHz. The unit measures 376 by 291 by 43 mm.

Price: 17,000 Norwegian krones.

Contact: Davis, P.O. Box 380, N-3001 Drammen, Norway, 47-3-83-55-90.

Inquiry 911.

Transview 480 lets you prepare a presentation using a personal computer and then display it on the computer and an overhead projector simultaneously.

Connect Your IBM AT to ProNET-4

Proteon's p1345 network interface card connects IBM ATs with its ProNET-4 IEEE 802.5 token-ring LAN. It operates at 4 megabits per second.

The card's bus-master implementation provides faster and more-efficient data transfers, increased throughput, and greater computer utilization than non-bus-master adapters. It is fully compatible with industry standards, including FTP Software's TCP/IP, Novell's NetWare, and Banyan's VINES.

The card has one 16-bit IBM AT peripheral-slot mounting and one ProNET-4 9-pin D-sub-type connector. It also offers 18K bytes of onboard memory, expandable to 30K bytes.

Price: £450.

Contact: Proteon International Ltd., The Business Park, Technology Dr., Beeston, Nottingham NG9 2ND, UK, 44-0602-431311.

Inquiry 903.

continued

PC-WAND® Portable Data Collector

Collect data anywhere!

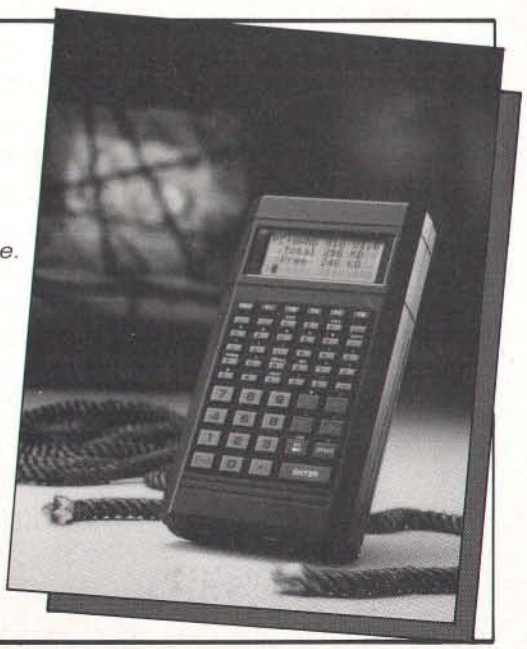
* *4 line display, 55-key keypad, removable batteries.*
* *Real time clock, calculator, RS-232C interface.*
* *Bar coding, Data verification and editing, up to 256K RAM.*
* *Powerful software tools, Job Generator or C programming language.*
* *Optional mini-printer.*
* *Free PC communication software.*

WEDGE READERS: The easiest way to read Bar Codes.
Supports Keyboard Emulation or Twin RS-232 connections.
Compatible with PC/XT/AT/PS2, MACII and many popular terminals like VT-200, WYSE 60, HP, WANG .....

NETWORK READERS: Best cost/performance solution for multiple user data collection.
4 channel multidrop Data Concentrator connecting up to hundred readers. Intelligent RS-232/485 on line Bar Code reader.
Free Host communication routines for PC, VAX and HP computers.

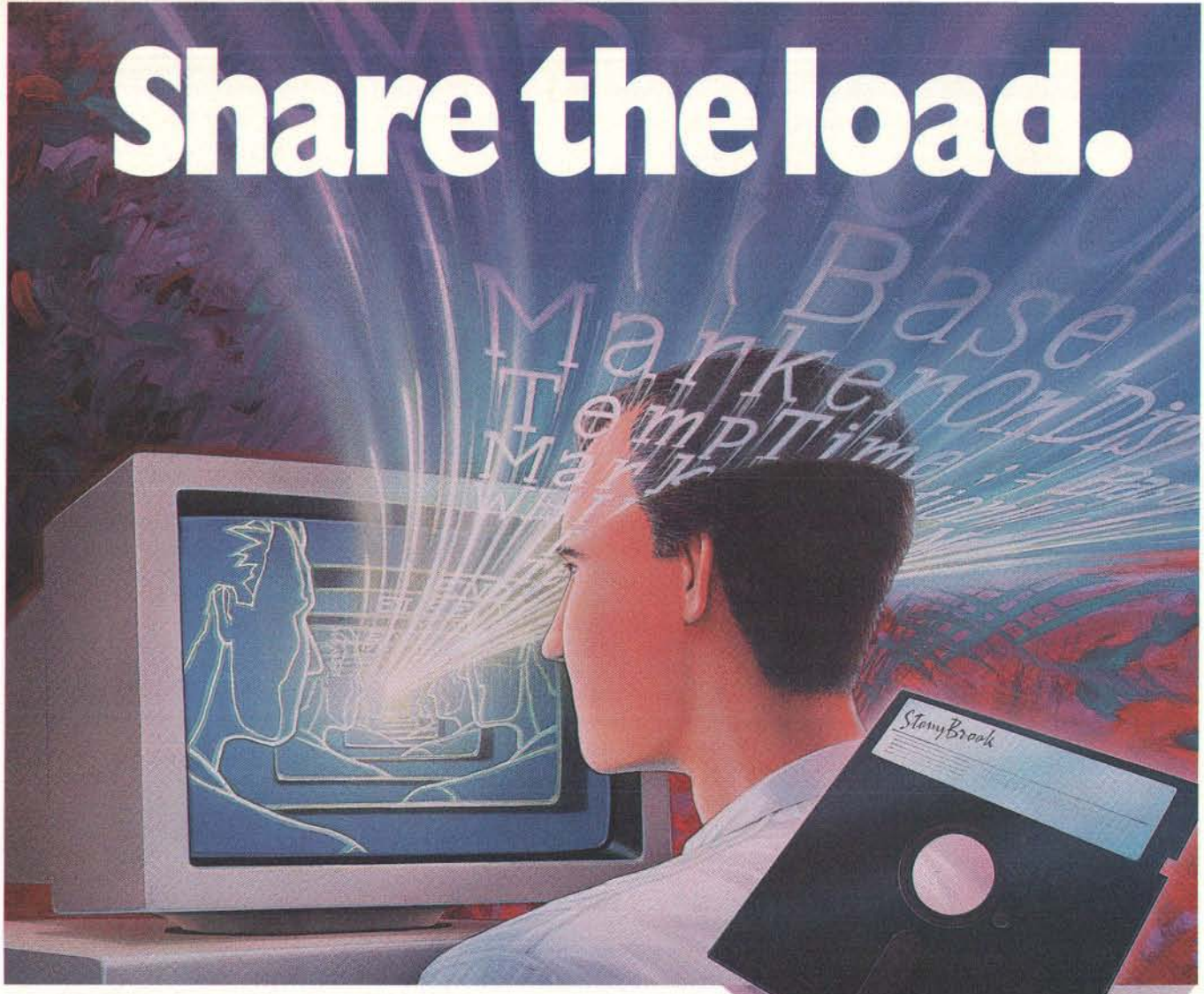
unitech

UNITECH COMPUTER CO., LTD.
2nd Fl., 325 Fuhsing N. Rd., Taipei, Taiwan, ROC
Tel: (02) 716-8610 Tlx: 13251 UNITEK Fax: (02) 716-9498



Circle 465 on Reader Service Card

Share the load.



Professional Modula-2 Compiler... Just think what the two of you can do.

Find out what Stony Brook's fully optimizing compiler can do for you. You can use Modula-2 for all your development requirements or you can link with any other language that produces Microsoft object modules. You can engineer the fastest and smallest program possible taking advantage of our highly optimized code generation. You can compile your applications for DOS and OS/2 with no changes in the source code. You can outperform the competition. You can do more than you ever could before.

The Professional Modula-2 package includes an editor, intelligent linker, symbolic debugger, execution profiler, and an automatic make facility. All these functions can be performed from the fully integrated environment or as separate command line utilities.

© 1989 Gogesch Micro Systems, Inc.

We also include the best runtime library in the industry, interface libraries for Microsoft Windows, presentation manager, and QuickMod high productivity environments for DOS *and* OS/2. All for $295.

The source code for the runtime library is available as an option for those who need it. You can also purchase the QuickMod environment, in DOS *or* OS/2, without the optimizing capabilities for $95.

Stony Brook—we design our products specifically to improve developer performance. And we know software engineering. Put us to work for you.

Call us direct and we'll mail product information to you within 24 hours.

800/624-7487
805/496-5837 California and International
805/496-7429 Fax

Stony Brook SOFTWARE

Your Partner in Software Development

187 East Wilbur Road, Suite 9,
Thousand Oaks, CA 91360

Circle 454 on Reader Service Card (DEALERS: 455)

A Laptop with a Black-and-White Display

The new 3200 laptop computer from Abbey Microsystems features two of the latest technological advances in portable computing: a cold-cathode fluorescent tube (CCFT) screen for greater legibility, and a power management facility to increase battery life.

The CCFT screen gives you a resolution of 640 by 400 pixels, and it lets you switch between black-on-white or white-on-black display. The power management facility lets you use the Abbey 3200 continuously for 3 to 4 hours from the battery but automatically powers down the screen, hard disk drive, and other components if you don't use it for a user-specified period of time. The high-capacity battery recharges at high speed through a built-in battery charger.

In addition to these features, the Abbey 3200 offers a 12-MHz 80286 microprocessor, 1 megabyte of memory (expandable to 5 megabytes), and a 20-megabyte hard disk drive; a 40-megabyte hard disk drive is available as an option. Ports include serial, parallel, keyboard, and 5¼-inch floppy disk drive options. The expansion chassis incorporates two full-size industry-standard slots, and an internal modem is available as an option. The included operating system is DOS 3.3, but the Abbey 3200 can also run under OS/2, PICK, Unix, or Xenix.

The Abbey 3200's dimensions are 36 by 32 by 6 cm, and it weighs 6 kgs. The company reports that it is currently working on a VGA screen for the computer.

Price: £2395.

Contact: Abbey Microsystems Ltd., Chanton House, 25 Northolt Rd., South Harrow, Middlesex HA2 0XN, UK, 44-01-422-0151.

Inquiry 943.

Abbey Microsystems' 3200 laptop includes a cold-cathode fluorescent-tube screen and a power management facility.

Manage Documents on LANs

You can locate, organize, and control documents across a LAN with ReferencePoint, a set of file management utilities formerly available only on mainframe and minicomputer systems, according to M-Trade.

The program maintains a catalog card with file descriptions for project, document name, author, software type, and keywords (which you can use to find and access files), and it automatically tracks file size, date of last revision, and current user.

Much as you borrow books from a public library, you check out files for work from ReferencePoint as you need them. When you create a new file or edit an existing file, ReferencePoint automatically invokes the appropriate applications software. When you are finished with a file, you return it before leaving the ReferencePoint program, so files are always available and the network remains uncluttered.

ReferencePoint works with most popular application programs, including Lotus 1-2-3, Symphony, WordPerfect, Microsoft Word, MultiMate, and DisplayWrite. You can invoke any DOS-compatible program automatically from within ReferencePoint. It is also compatible with major network operating systems, including Novell NetWare, 3Com 3+, Banyan VINES, IBM PC Network, and Microsoft Networks. System requirements include an IBM PC with 256K bytes of RAM, DOS 3.0, and one double-sided floppy disk drive.

Price: £450 for each five-user license.

Contact: M-Trade (UK) Ltd., 11 Northfields Prospect, Putney Bridge Rd., London SW18 1HR, UK, 44-01-877-1711.

Inquiry 944.

SUSIE Verifies Your Schematic Designs

SUSIE, which stands for Standard Universal Simulator for Improved Engineering, is Riva's new universal design verification system for schematics. Within seconds, the program can build a software breadboard from your schematic, and then it can check the entire design during each clock cycle for problems such as bus conflicts, glitches, and timing violations. The software's simulator and libraries are written entirely in assembly language, resulting in a simulation speed in excess of 260,000 gates per second on an IBM AT.

In addition to diagnosing problems, SUSIE also tells you what you need to do to fix the design; fixes are resimulated in seconds. The software breadboard behaves exactly like a hardware version, so you can change ICs, wiring, JEDEC fuse maps, and hexadecimal files in real time. You can have inputs and outputs grounded or fed with test vectors, and you can modify them, on-the-fly, during simulation. SUSIE can also verify programmable logic devices and microprocessors at system level, avoiding surprises at board level.

SUSIE requires an IBM AT or 80386 computer with 512K bytes of RAM and DOS 2.1.

Price: £1495.

Contact: Riva Ltd., 3 Bentley Industrial Centre, Bentley, Farnham, Surrey GU10 5NJ, UK, 44-0420-22666.

Inquiry 902.

continued

CREATE DBMS APPLICATIONS FASTER AND EASIER THAN YOU CAN IMAGINE.

With or Without Programming

You deserve rich DBMS applications created your way—whether you're a serious programmer or a dedicated non-programmer. Clarion gives you outstanding benefits either way, without compromise; and the Clarion Developers are a DBMS family that your requirements can never outgrow.

VERSION 2.0
NOW IMPORT/EXPORT dBASE, 1-2-3 AND ASCII

PROFESSIONAL DEVELOPER SLASHES DEVELOPMENT TIME AND COST. Thousands of users of Clarion's Professional Developer have slashed development time and cost 2-10 times…and you can too. PC Week said: "Clarion makes…dBASE and R:base look tired, crotchety and limited in scope." And no wonder. Professional Developer satisfies every need of the most demanding, experienced programmer, yet its application generator lets casual database developers use it easily and comfortably. Applications are totally customized, with your own unique "look and feel." And they are completely open-ended.

A COMPLETE PROGRAMMING ENVIRONMENT. Professional Developer's robust language is surrounded by a full set of integrated utilities. You can even include routines written in C and Assembler. Test programs without linking. Copy and distribute your programs as .EXEs…free. You have precise control of file relationships, buffers and caching, transaction processing and encryption. There's no practical limit to keys, fields, records or files. And there are optional Graphics, Communications and Financial Language Extensions. Unlimited network support is included in the base price…no "LAN Packs" to buy.

dBASE FILES? NO PROBLEM. Although the Professional Developer includes import and export of dBASE, BASIC or DIF files it can optionally process dBASE records as they are, without conversion.

A LEARNING CURVE THAT'S A GENTLE SLOPE. With Professional Developer you'll create a dazzling application in your very first session. PC Week also said…"CLARION is easy to learn and easy to use." You'll get all the help you'll ever need from Clarion Software's full range of support services."

PERSONAL DEVELOPER IS SIMPLY AMAZING. Even if you don't need or want a programming environment you can still create colorful and flexible multiple file applications. With Clarion's Personal Developer you'll enjoy the same application generator that is included with its "big brother."

"QUICK START" APPLICATIONS IN STOP WATCH TIME. Personal Developer includes the unique Quick Start module. You only take about a minute to fill out one screen and describe your data in everyday terms—then watch as Personal Developer produces your applications: file, screens and reports…in a total of 3 to 5 minutes!

APPLICATIONS WITH ROOM TO GROW. After Quick Start you can include additional files, screens, reports, or change things—almost anything—to suit yourself. Add relational file "look-ups," computed fields, and "hot keys." You can continue to tailor your application weeks or months later. And as a bonus you get eight documented applications that you can modify or use as is.

SHARE YOUR CREATIVITY WITH OTHERS. Copy and distribute your programs with a free run time.

MONEY BACK GUARANTEE. ***Order the Clarion Personal Developer from Clarion Software today for only $199; if not completely satisfied, return it within 30 days for a complete refund, less a $15 handling charge.***

THE "MOVE UP" REBATE. Because programs and data created with Personal Developer are 100% upward compatible with Professional Developer you may choose to take advantage of the additional power and flexibility it offers. For a limited time only, if you want to "move up" from Personal Developer to Professional Developer, Clarion Software will send you a Manufacturer's Rebate of $75 after you purchase Professional Developer.

Call for information about products, services, and dealers nearest you.

THE CLARION PRODUCT INFORMATION CENTER
800-354-5444

CLARIONSOFTWARE™

150 East Sample Road, Pompano Beach, Florida 33064
305-785-4555, Fax 305-946-1650

Clarion Software Products run on any IBM PC, PS/2, or true compatible with 512K of memory and a hard disk. Clarion Professional Developer, Clarion Personal Developer and Clarion Software are trademarks of Clarion Software. Copyright 1988 Clarion Software. dBASE is a registered trademark of Ashton-Tate. R:base is a trademark of Microrim.

Circle 412 on Reader Service Card (DEALERS: 413)

Industrial PS/2s from Blue Chip

Blue Chip Technology has signed an agreement with IBM that makes it the first to offer a range of industrial versions of IBM's PS/2 Models 50 and 70. The computers are designed for use in factories, workshops, and laboratories, and in places where adverse operating conditions, such as dust, dirt, oil, water, and rough handling, would damage a standard computer.

The industrial PS/2s run in parallel with the existing range of computers. Blue Chip mounted the IBM motherboard together with the standard IBM peripherals within a heavy-gauge steel chassis to protect the unit against physical damage and electrical interference. The company also added special air filters for dusty environments.

A cast-aluminum plate covers the front of the unit and houses an inset, 6-mm-thick, perspex window. The perspex window, which locks for added security, closes onto a neoprene seal, making the front of the unit splashproof and dustproof.

Triple extending slide rails let you mount the unit into standard 19-inch cabinets and let you withdraw them for maintenance or installation of I/O cards.

Three monitors are available that you can also mount in a 19-inch rack along with the base unit. The monitor housing features a steel chassis and perspex cover and is splashproof and dustproof. You can use a standard IBM keyboard or a fully sealed wipe-clean version.

Blue Chip has added a special facility to the machines that automatically monitors internal temperature, fan speed, power-supply voltages, a watchdog timer channel, and two opto-isolated external inputs. In the event of a fault developing in the computer, it generates an interrupt and closes an alarm relay output. This makes the system suitable for use in high-reliability applications.

Several base units are available, including the 80286-based Model 50 and the 16-, 20-, or 25-MHz 80386-based Model 70. The machines feature the Micro Channel architecture and include bidirectional parallel, serial, mouse, and keyboard ports; VGA graphics; 3½-inch floppy disk drives; and hard disk drives with capacities ranging from 20 to 120 megabytes.

You can use Blue Chip Technology's industrial IBM PS/2s in places where adverse operating conditions would damage a standard computer.

Price: £4145 and up.
Contact: Blue Chip Technology, Main Ave., Hawarden Industrial Park, Deeside, Clwyd CH5 3PP, UK, 44-0244-520222.
Inquiry 936.

Electronic Painting for VGA and Beyond

Noble Campion designed its Cameo Paint electronic painting package to take full advantage of the capabilities of a VGA card and color monitor. The company designed the package to run on high-resolution and 24-bit-per-pixel systems, and then ported it down to the VGA standard so you can upgrade the software to meet the ever-increasing levels of performance and sophistication offered by more hybrid graphics controllers.

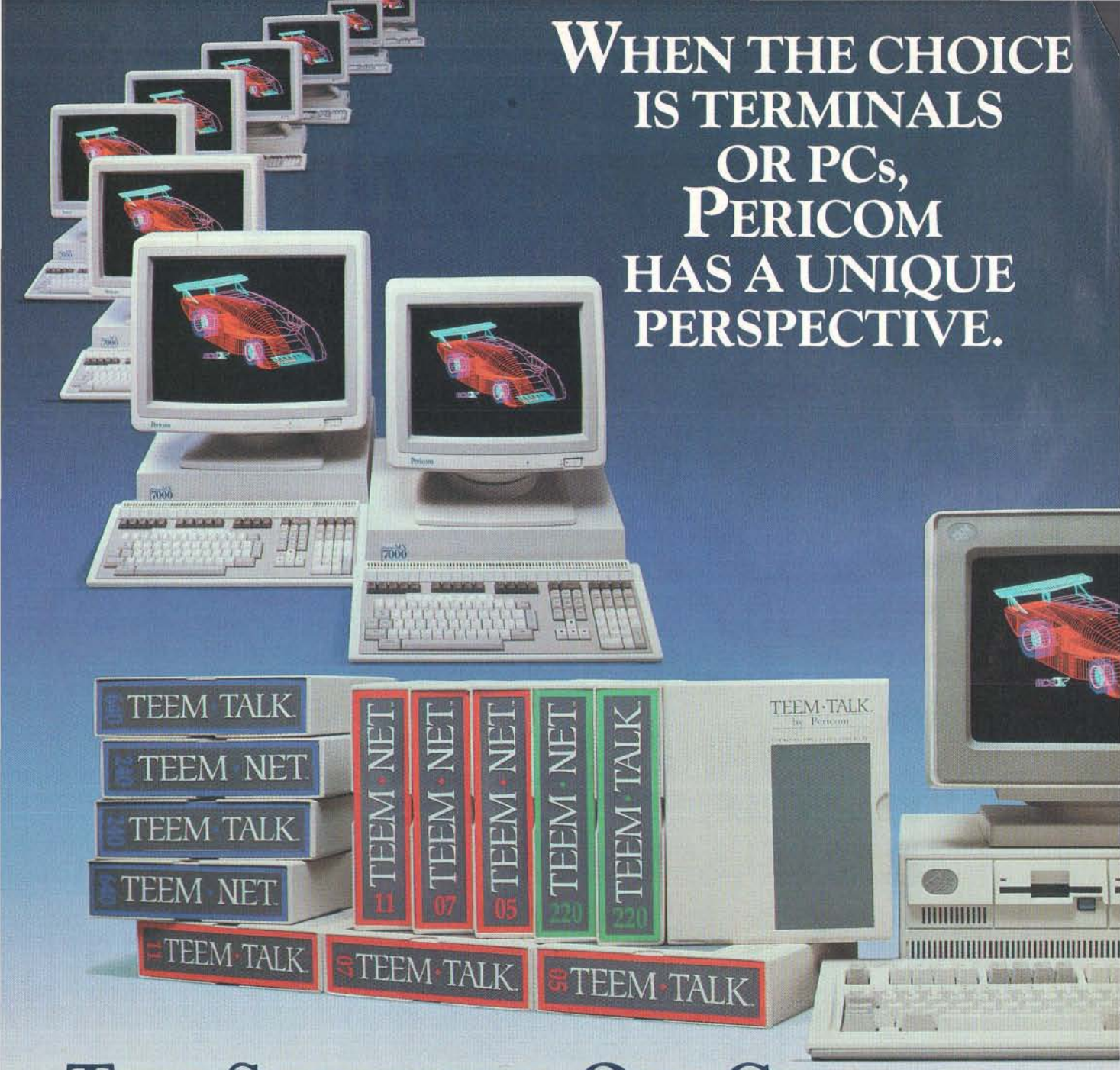
The package offers over 120 graphics functions, including antialiasing, frame grabbing, air brushing, flood and boundary fills, scaling, variable-size grids, image merging, spline curves, perspective distortion, and single-degree rotation. Cameo Paint makes full use of the 256 on-screen colors with delicate palette manipulation commands and variable speed and directional color cycling. The software also includes 12 raster fonts and six vector fonts with full control of kerning, antialiasing, and drop shadowing.

A design-action replay facility lets you replay the creation of designs and paintings at variable speeds for training and presentations.

You can use the package in conjunction with a frame-grabbing board. This facilitates full-color 8-bit image capture, and it lets you input conventional artwork via a video camera. You can then solarize or contrast images to produce dramatic effects and store your images on disk or output them via a color printer or film recorder. A built-in desktop publishing link lets you import images into popular desktop publishing systems.

Cameo Paint runs on the IBM AT with 512K bytes of RAM, DOS 2.0, a 20-megabyte hard disk drive, a VGA card, and a color monitor. If you install the hardware frame grabber, the company recommends 640K bytes of RAM.
Price: £440.
Contact: Noble Campion Ltd., Premier House, 112 Station Rd., Edgware, Middlesex HA8 7AQ, UK, 44-01-951-5656.
Inquiry 906.

continued



WHEN THE CHOICE IS TERMINALS OR PCs, PERICOM HAS A UNIQUE PERSPECTIVE.

TWO SOLUTIONS, ONE COMPANY.

At Pericom our perspective is different. Unique in fact, because we manufacture a complete range of alphanumeric and graphic terminals *and* produce an innovative range of emulation software called TEEM·TALK and TEEM·NET.

Our hardware and software products provide compatibility with industry standard protocols such as DEC VT220, ReGIS, TEK 4205, 4207 and 4111. Specialist protocols including DG200 and VT640 are also available together with support for an extensive range of I/O devices.

The world's leading mainframe application software, from Data Processing to Computer Aided Design, will be at your fingertips as a Pericom user, whatever your choice.

To help you make your decision we've prepared an informative new booklet called *"Terminals or PCs – the right choice"*.

Get your free copy today by calling direct on: –

UK (0908) 568129 · FRANCE (1) 30 61 50 25

After all, it makes a lot of sense to buy terminal emulation software from a company that knows something about emulating terminals. Or vice versa.

PERICOM
PRODUCT DIVISION

TEEM·TALK and TEEM·NET are trademarks of Pericom PLC.
DEC is a trademark of Digital Equipment Corp. TEK is a trademark of Tektronix Inc. DG is a trademark of Data General

Circle 443 on Reader Service Card

Document Storage Using WORM Drives

Sarde offers a system that combines safe, long-term storage of very large document libraries with the ability to rapidly locate and access any document in the collection—even over intercontinental distances.

The Sarde system can store up to 5 million pages, depending on the configuration. Linking the system to databases makes it simple to display, manipulate, or print your document at any station connected to the central server, either by a LAN or by high-speed (56,000 bps) public networks, such as Transcom International and the AT&T Accunet 56. At this speed, you can transmit a letter-size page over any distance in under 6 seconds, according to the company.

The Sarde system combines long-term storage of large document libraries with easy and rapid access of any document in the collection.

You input paper documents via a 300-dpi digitizing scanner using standard Group 3 and Group 4 fax compression methods. Alternatively, you can send documents that are already in digital form directly to a WORM (write once, read many times) optical disk drive for storage. In either case, the system stores the documents as pure images; there is no distinction between graphics and text. The Sarde system can handle up to five WORM drives through direct access, or it can work through a jukebox that manages up to 131 disks on four drives.

Once your document is on an optical disk, a management unit links it to various databases. By querying the databases, you can easily and rapidly locate the document and transmit it to your workstation. You can select a workstation that meets your specific needs, but the company recommends an 80386 machine with at least 2 megabytes of RAM, DOS 3.31, and a 40-megabyte hard disk drive.

Once the document reaches your workstation, you can view it on a high-definition

continued

VERSATILE, SMALL COMPUTERS: AVAILABLE FROM THE LAPTOP SPECIALIST.

■ SMALL IS "BIG"

The TL-3240EL is powerful enough for the most demanding situations, and it goes everywhere the user goes. The battery-operated 12MHz, 286 with hard and floppy disks and a wide viewing-angle, electroluminescent display is perfectly suited for today's professional working environment.

The TL-3240 has built-in EGA capabilities for exceptional, color graphics on external monitors or the 16-gray-level, plasma display. The fast 80286-12/16 provides plenty of power, with internal memory from 1MB to 4MB. The 40MB hard disk and 3.5" floppy disk are compatible with OS/2 MS-DOS 3.3 and other major operating systems to help boost personal productivity.

■ VIRTUALLY REPLACES DESKTOPS

The TL-5600 has more than enough power to replace virtually any desktop PC. But we haven't just concentrated on powr and portability, we've also reinforced our machines to be more durable, more reliable and easier to use. They are controlled by a 20MHz, 32-bit 80386 with VGA display, 2MB RAM, fastaccess 40MB or 100MB hard disk and 1.44MB flopy disk.

■ LINK & COMMUNICATION CAPABILITIES

Fax cards and modem cards plug into our computers for worldwide communication; anytime, anywhere. And in the office, our laptops serve as workstations for efficient handling of all data.

SMAU SHOW Milan 5-9 October 1989 Booth No. G09

TOP-LINK

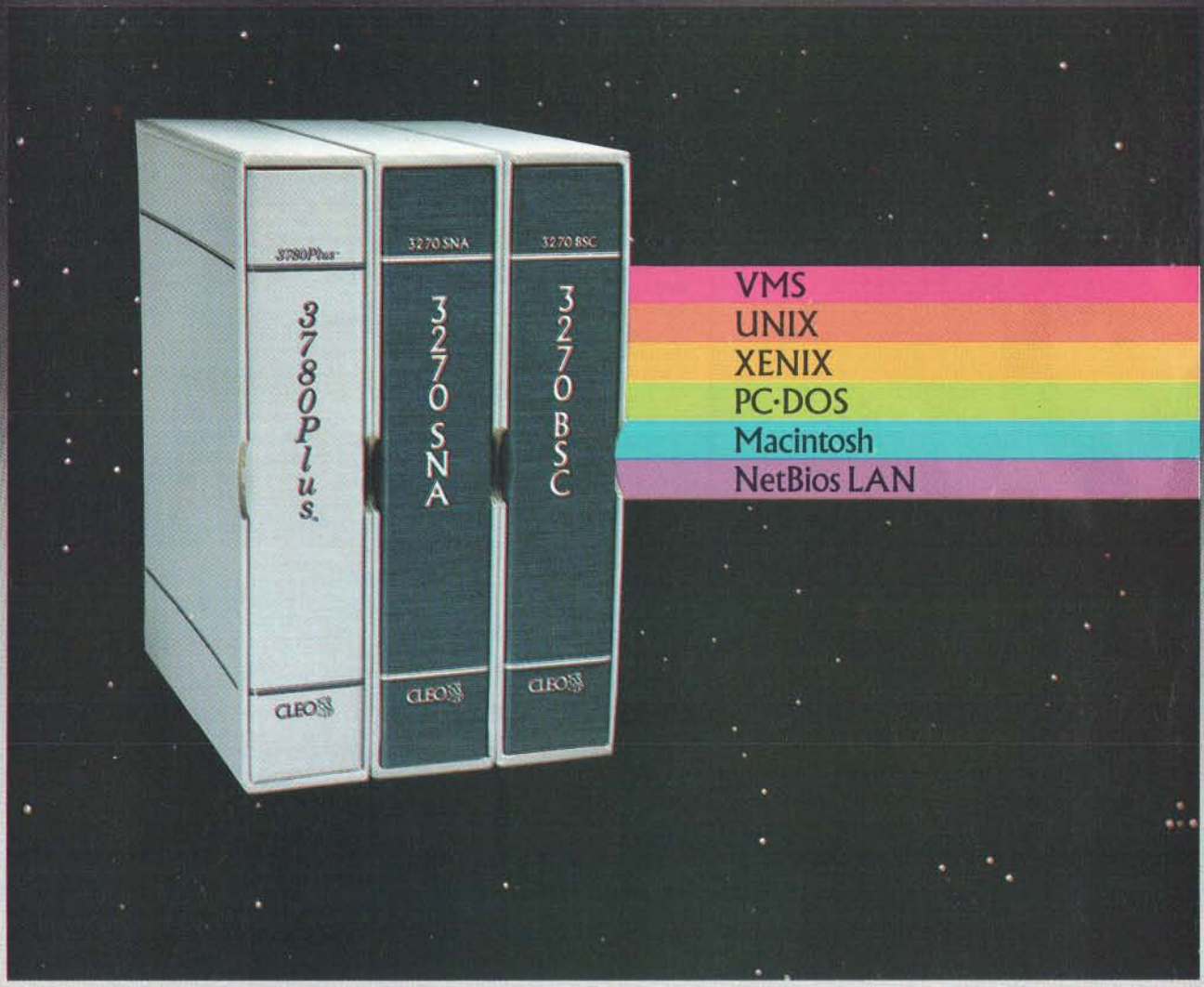
TOP-LINK COMPUTER CO., LTD.

No. 6, Lane 333, Hsin Hsu Rd., Hsin Chuang, Taipei, Taiwan, R.O.C.
Fax: 886-2-9018569 Telex: 31182 Tel: 886-2-9013576—8 9041551.

(IBM PC/XT, AT, AND EGA/CGA/MDA/HERCULES ARE REGISTERED TRADEMARKS OF THE INTERNATIONAL BUSINESS MACHINES CORP.)

Circle 458 on Reader Service Card

CLEO is your SNA, BSC and Coax Gateway



Sharing Information

Whatever your industry, your computers need to share information with your mainframe. Or, they need to exchange data with other computers. In either case, you need a total communications solution. You need software, hardware interfaces and modems that all work together smoothly. You need CLEO!

CLEO software products allow your computer to communicate with mini-computers and mainframes, and to emulate their workstations. Since 1981, CLEO has provided communications between micros, minis, and mainframes for the automotive, insurance, medical and banking industries. Today over 78,000 CLEO users worldwide are running on all major computer brands. The greatest number of these users run CLEO software on IBM Personal Computers and NETBIOS LANs.

Circle 414 on Reader Service Card

Complete Software/Hardware Package

Every CLEO package contains all the software and hardware accessories you'll need. Your selected CLEO SNA, BSC, or Coax software is packaged with 1) an internal modem card for dial-up applications, or 2) an interface card and cable for use with your existing modem, or 3) a Coax card for local connectivity. There's no waiting for non-CLEO add-ons. And, you get prompt, single-source service.

Package prices range from $795.00 for most stand-alone packages, up to $1,995.00 for the 32-user SNA gateway.

Call us today to discuss your application.

CLEO Software
2652 Eastrock Dr.
Rockford, IL 61109
FAX 815/397-6535

Headquarters:
USA: **1-800/233-2536**
Canada: 514/484-8787
International: 815/397-8110

Sales and Distribution:
Canada, East: 800/361-3185
Canada, West: 800/361-1210
Canada, Montreal: 514/737-3631
Colombia, S.A.: 12172266
Denmark: 02 94 81 19
England: (0993) 776543
Italy: (0331) 634 562
Mexico City: 550-8033
Sweden: 4687405070
W. Germany: 06151 55095

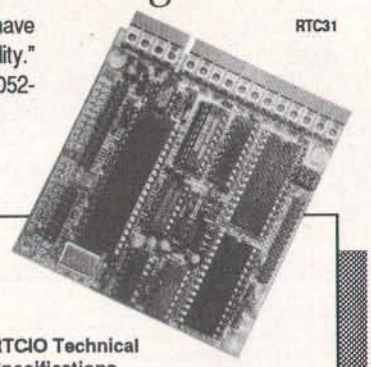
CLEO®

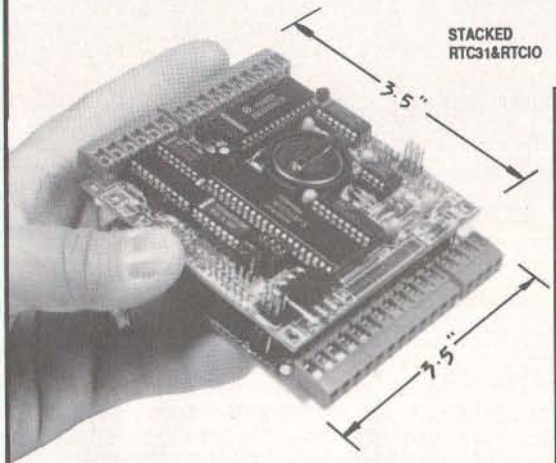
CLEO and 3780Plus are registered trademarks of CLEO Software. IBM is a registered trademark of International Business Machines Corporation.

Circle 440 on Reader Service Card

MICROMINT Introduces *"Micro"* Controlling!

After years of experience in manufacturing OEM controller boards and talking to customers, we think we have hit upon just the right combination of format and function to satisfy even the toughest case of "relay mentality." Realizing that not every computer-controller application warrants a Cray X/MP, Micromint offers a tiny 8031/8052-based controller board for those dedicated and cost-sensitive installations.





RTC31 and RTC52 Technical Specifications
- 8031 processor (RTC31) or Micromint 80C52-BASIC processor (RTC52)
- 11.05-MHz system clock
- Uses 8K or 32K memory chips
- Up to 64K bytes of RAM or EPROM
- 5-volt-only operation
- 110–19200 bps RS-232 and/or RS-485 serial port
- Use stand-alone or networked
- 12 bit of parallel I/O
- Vertical-stacking expansion bus
- Screw terminal connections
- Small 3.5"x3.5" format
- 80 mA typical operating current (RTC52)

RTC31-1 8031 Controller	£ 93
RTC31-1 OEM 100-Quanity Price	£ 60
RTC52-1 80C52 Controller	£ 107
RTC52-1 OEM 100-Quanity Price	£ 69

RTCIO Technical Specifications
- Three bidirectional parallel ports (24 bits)
- 8-channel, 8-bit A/D (0–5V); 9,000 samples/sec
- 4-channel, 8-bit D/A (0–5V); 2-µs response time
- Battery-backed clock/calendar with presettable time-interrupted capability
- DC To DC conversion–5-volt-only operation
- Screw terminal connections
- Small 3.5"x3.5" format

RTCIO RTCIO board with parallel I/O and A/D converter	£ 98
RTCIO OEM 100-Quantity Price	£ 69

Call to Order:
J.B. Designs & Technologies
15 Market Place
Cirencester, Glos. GL7 2PB England
Tel: **0285-658122** • Fax: **0285-658859**

Micromint, Inc. 4 Park Street • Vernon, Connecticut 06066 • Tel: **(203) 871-6170** • Fax: **(203) 872-2204**

monitor (1660- by 1220-pixel resolution recommended), print it (preferably on a laser printer), or manipulate it.

A complete configuration includes software, a CPU, a scanner, a printer, an optical disk drive, and one optical disk.

Price: 400,000 French francs.

Contact: Sarde S.A., 2, rue Maurice Hartmann, 92130 Issy Les Moulineaux, France, 33-47-36-70-70.

Inquiry 937.

A Low-Cost, High-Resolution Color Monitor

If you've been looking for a high-resolution color monitor that doesn't cost an arm and a leg, then you should check out Digivision's Magus. The monitor works with most personal computers and is particularly suited for applications in which high resolution is required, such as CAD and desktop publishing.

The large screen (500 mm or 20 inches diagonally) offers a resolution of up to 1160 by 870 pixels, so it can display even fine details. The horizontal frequency range is 15.5 to 37 kHz, while the vertical frequency range is 48 to 90 kHz. This variation in the frequencies means that when you use the Magus monitor with a multistandard computer, such as the Acorn Archimedes, it can automatically adjust to display whatever format the computer sends.

The Magus monitor has a dot pitch of 0.31 mm and supports VGA, EGA, MDA, MCGA, CGA, and Hercules graphics standards. It comes on a tilt-and-swivel stand.

Price: £1100.

Contact: Digivision Ltd., Parker Dr., Leicester LE4 0JP, UK, 44-0533-351224.

Inquiry 921.

Easier Programming of NC Machines

If you wish there were an easier and faster way to manually program numerical control (NC) tooling machines, then SW Consulting's NC-CAD add-on software for AutoCAD 10 is for you.

The software lets you develop interactive, visual (graphics) NC code over the original AutoCAD drawing. It consists of several modules (some of which are implemented in Lisp as part of AutoCAD, and others that are implemented as stand-alone programs) that help you develop programs for cutting, lathing, and milling machines. Part of the package is a universal postprocessor that you can adapt and configure by changing the command table. NC code is fed to the machine through an RS-232C serial link or by punched tape.

The requirements for NC-CAD are the same as for AutoCAD 10, including VGA or higher color graphics.

Price: 10,000 to 20,000 deutsche marks, depending on the number of tooling machines.

Contact: Jure Spiler, SW Consulting, Jesenkova 5, 61000 Ljubljana, Yugoslavia, 38-61-314-069.

Inquiry 920.

continued

Special Volume Discounts
Latest U.S. Versions
at U.S. Prices

1333 60th Street
Brooklyn, N.Y. 11219
Fax: 718-438-2315
Telex: 627-30170 or 910-240-3918

WE'VE MADE THE WORLD OUR BUSINESS.

Software

Word Processing/Editors

Ami'	$135
Brief	$call
Lotus Manuscript	339
Microsoft Word	229
Multimate Advantage II	289
PFS:Professional Write	139
Q&A Write	129
SPF/PC V 2.1	159
Sprint	135
Volkswriter 4	109
WordPerfect	229
Wordstar Pro	239
Wordstar 2000+	289
Xywrite III Plus	219

Desktop Publishing

Arts & Letters Pres Pak I	209
A & L Graphics Composer	255
A & L Graphics Editor	449
DB Publisher	439
Formfiller	99
Formtool	69
Formworx w/Fill'n File	99
Gem/3 DTP	179
Pagemaker	499
Per:form	179
PFS:First Publisher	85
Publish-it!	129
Publisher's Type Foundry	319
Ventura Publisher	469

Database & Tools

Btrieve	159
Btrieve/N	385
c-Tree	319
Clarion personal	109
Clarion professional	429
Clipper	449
d-Tree	399
DBase IV	479
DBase IV Devel Edition	799
DBXL	149
Foxbase Plus	199
Foxbase Plus 386	319
Foxbase + Xenix/286	549
Genifer III	219
Informix 4GL	895
Informix SQL	719
Paradox 3	479
PC Focus V 4.0	579
PFS:Professional File	179
Q&A	229
Quicksilver	359
r-Tree	239
R:Base for DOS	499
R:Base compiler	629
Rapidfile	199
Revelation	499
UI Programmer 2.0	359
Vermont Windows for Data	295
XDB-SQL	459
XQL	619
Xtrieve +	399

Statistics

CSS with graphics	369
SPSS/PC+	675
Statgraphics	569
Systat w/Sygraph	599

Spreadsheets

Allways	$ 99
Lotus 123 V 2.01	309
Lotus 123 V 3.0	359
Lotus Agenda	269
Lotus Hal	109
Lucid 3-D	79
Microsoft Excel	249
Multiplan	135
Quattro	169
Supercalc 5	319
VP Planner Plus	129

Communications

Carbon Copy +	119
Crosstalk MK4	125
Crosstalk XVI	99
Mirror II	59
PC Anywhere III	75
Procomm Plus	59
Relay Gold	159
Remote 2	99
Smartcom III	145

Integrated Packages

Enable OA	459
Framework III	459
Lotus Symphony	459
Microsoft Works	105
Smartware II	419

Desktop Environments

Desqview	85
Desqview 386	115
MS Windows 286	75
MS Windows 386	129
Sidekick Plus	139

Graphics

Autosketch 2.0	109
Designer	449
Draw Plus	259
Gem/3 Artline	289
Gem/3 Draw Plus	179
Gem/3 Graph	179
Gem/3 Presentation	289
Generic CADD Level 3	169
Graph Plus	325
In-a-Vision	319
Harvard Graphics	289
Lotus Freelance Plus	329
Master Graphics	299
MathCad 2.5	309
Microsoft Chart	259
Org +	69
PC Paintbrush Plus	95

Project Management

Proj Mgr Wkbench Advanced	819
Flowcharting II +	159
Interactive Easyflow	
Harvard Total Project Mgr 3	409
Microsoft Project	349
Superproject Plus	259
Timeline	389
Timeline Graphics	129

Languages & Programming Tools

Lattice C compiler	$ 229
Microfocus Cobol Level II	1699
MS Basic compiler	209
Microsoft C	319
MS Fortran	319
MS Macro Assembler	109
MS Quick Basic	79
MS Quick C	79
Norton Editor	55
Norton Guides	69
RM/Cobol	619
RM/Fortran	389
Smalltalk V/286	175
Source Print	89
Tree Diagrammer	69
Turbo Assembler	99
Turbo Basic	79
Turbo C	99
Turbo C Professional	169
Turbo Pascal	99
Turbo Pascal Professional	169
Turbo Pascal	169
Turbo Prolog	99

Utilities

Copy II PC	34
Copywrite	75
Dan Bricklin Demo II	119
Fastback Plus	109
Gofer	59
H-Test/H-Format	65
Laplink III	89
Lotus Magellan	109
Mace Utilities	65
Qemm 386	49
386 Max	65
V Cache (Golden Bow)	55
Norton Commander	65
Norton Utilities	69
Norton Utilities Advanced	85
PC Tools Deluxe	89
Vaccine	99

Multiuser/Network

Novell ELS I	429
Novell ELS II	959
Novell SFT Netware 286	3019
Novell Adv. Netware 2.15	1799
PC-MOS 5 user	469
PC-MOS 25 user	799
RM/Fortran Xenix	499
SCO Xenix Dev. Sys. 286/386	409/549
SCO Xenix Oper. Sys. 286/386	389/479
Tops for DOS	109

Hardware

Laptops

Toshiba T1600	3869
Toshiba T3100	3099
Toshiba T5100 w/40 MB	3899
Toshiba T5200 w/40 MB	4799
Toshiba T1200 HB	2215

Multifunction Boards

AST Six Pak Plus (64K)	129
AST I/O Mini II - AT	79
AST Rampage + 286 (512K)	439
AST Rampage +/MC (512K)	549
Intel AboveBoard + (512K)	439
Intel AboveBoard + I/O (512K)	479
Intel Inboard 386AT	1075
Intel Inboard 386PC	679

Display Boards

AST VGA Plus	349
ATI EGA Wonder 800	185
ATI VGA Wonder 512K	359
Hercules graphics Card +	179
Hercules VGA	199
Paradise Autoswitch EGA 480	185
Paradise VGA Plus	259

Emulation Boards

AST 5251-11 +	579
Irma II PCA/MCA	749
Irma 3 Convertible	449

Modems

Evercom 24 Internal	135
Hayes 1200/1200B	299
Hayes 2400/2400B	449
Pract Periph 1200 Ext	85
Pract Periph 1200 Int.	75
US Robotics 2400B	159

Networking

SMC Arcnet Active hub	349
SMC Arcnet Passive hub	79
SMC Arcnet PC 130	139
WDC Ethercard + (AT)	239

Printers / Plotters

Diconix 150 Plus	369
HP 7440 Colorpro plotter	1075
HP 7475A plotter (6 pen)	1475
HP 7550 plotter (8 pen)	3099
HP Deskjet Plus	769
HP Laserjet II	1695
HP Laserjet II D	3250
IQ Supercartridge 1E	459
Pac Data 1 MB for Laserjet II	345
Pac Data 25-in-1 Cartridge	299

Mass Storage/Backup

Mountain 40MB Int. Tape	405
Plus Hardcard 20	550
Plus Hardcard 40	699
Seagate ST225 w/Int. (XT)	269
Seagate ST238 w/Int. (XT)	309
Seagate ST251-1 (AT)	379
Seagate ST252 (AT)	359
Seagate ST 4096 (AT)	639
Irwin 80MB Ext. tape w/int. (AT)	629
Irwin 40MB Ext. tape w/int. (AT)	729
Irwin 40MB Int. tape w/kit	469
Irwin 80MB Int. tape w/kit	569

Input Devices

Complete Hand Scanner 400	169
HP Scanjet Plus w/int.	1699
Keytronics KB 101+ Keybrd	99
Logitech Hi-Rez bus mouse	89
Logitech Hi-Rez mouse PS/2	79
Logitech C-7 serial mouse	79
Logitech ScanMan	209
Microsoft mouse w/windows	109
MS mouse w/PC Paintbrush	149
PC Mouse w/Paint	99

✓ LOW PRICES ✓ SHIPPING EXPERTISE
✓ VOLUME DISCOUNTS ✓ KNOWLEDGEABLE STAFF

MasterCard

To Place your order by telephone, please call **Fay Chayne** • Intl. Sales Mgr.

1-718-438-6057

VISA

TERMS: ALL RETURNS REQUIRE PRIOR AUTHORIZATION. 20% RESTOCKING FEE ON RETURNS. ALL PRICES SUBJECT TO CHANGE, CALL FOR CURRENT PRICES. PAYMENTS MAY BE MADE BY BANK CHECK, WIRE TRANSFER, L/C, MASTER OR VISA CARD (3% HANDLING FEE ON CREDIT CARD ORDERS). GOODS ARE SHIPPED VIA AIR MAIL (RECOMMENDED FOR SMALL ORDERS) OR AIR FREIGHT. ADD FREIGHT COSTS TO PREPAYMENT OR GOODS ARE SHIPPED FREIGHT COLLECT.

A Color and Monochrome Flatbed Scanner

The GT-4000 helps you transfer black-and-white and color images from paper to your computer.

Epson's GT-4000 flatbed scanner helps you easily transfer monochrome and color pictures and text from paper to your computer, where you can then further process the images.

You can scan items in black-and-white mode, which offers up to 256 gray shades, in about 50 seconds. The scanned area is the size of an A4 page, and you get 16 resolution steps between 50 and 400 dpi.

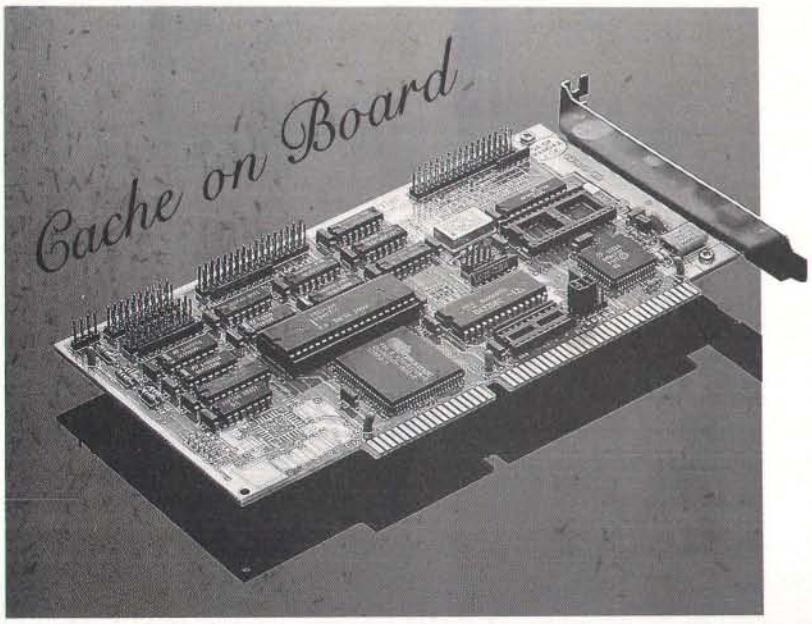
For scanning color images, the GT-4000 offers a resolution of 200 dpi and two scanning modes. When you are transferring images directly into your computer without manipulation, page sequence mode gives you red, green, and blue colors, which it scans in separately in sequence. If you want to manipulate colors, you use line sequence mode, which scans the document, line by line, in one run for all three colors. In this mode, the GT-4000 can correct colors, and it lets you adapt your color output to match different printer technologies (e.g., high-density 24-pin printers, low-density 9-pin dot-matrix printers, and high-contrast printers).

A zoom function lets you enlarge and reduce images between 50 percent and 200 percent in 1 percent steps. You can also adjust the brightness of the reproduction in seven steps.

The GT-4000 has a bidirectional parallel interface and an RS-232C serial interface. To use the parallel interface, you install a bidirectional interface card into your computer; a general-purpose interface bus card is available for the Mac. You can also connect the scanner directly to Epson 24-pin color printers or Hewlett-Packard PaintJet

continued

Mandax Is Ahead Of The Competition



M A N D A X series

MANDAX DC-15 AT HARD DISK/FLOPPY CONTROLLER with **CACHE ON BOARD**

- 100% IBM AT PORT AND BIOS COMPATIBLE
- 1:1 INTERLEAVE
- COMPATIBLE WITH DOS, NOVELL, UNIX, XENIX AND OS/2
- MFM DISK DATA RATE AT 5MBITS/SECOND
- PC AT HOST BURST TRANSFER RATE TO 6.75MBYTES/SECOND
- DMA OR PROGRAMMED I/O PC AT TRANSFERS
- 2K INTERNAL BUFFER RAM
- OPTIONAL 32KX8 STATIC RAM FOR HIGH END PRODUCT WITH CACHEING
- PRIMARY & SECONDARY I/O ADDRESS FOR BOTH HARD DISK AND FLOPPY
- ALLOW "DISABLE" OPTIONS FOR BOTH HARD DISK & FLOPPY
- ALLOW 250/300/500 KBITS/SEC FLOPPY TRANSFER SPEED

MANDAX DC-16 ESDI CONTROLLER with **CACHE ON BOARD,** Available in October 1989

MANDAX DC-17 PC AT INTELLIGENT SCSI HOST ADAPTER with **"BUS MASTER" OPERATION,** MICROCHANNEL/EISA/AT/NUBUS INTERFACE Available in December 1989

IBM IS THE TRADE MARK OF INTERNATIONAL BUSINESS MACHINE CORP

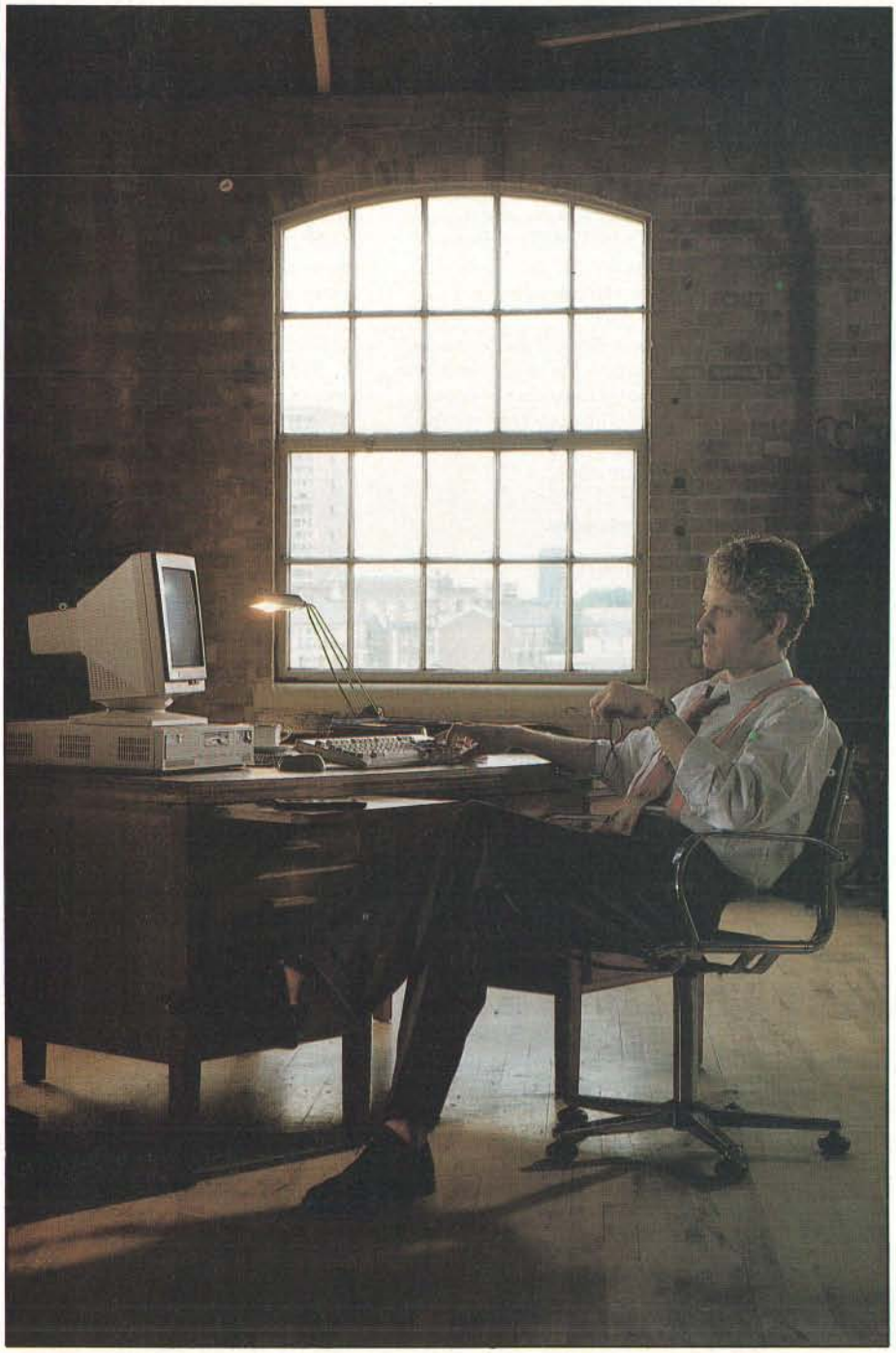
Mandax

C & D TECHNOLOGY, INC.

P.O. Box 146 Nei Hu, Taipei, Taiwan, R.O.C.
Tel: (02) 791-4167 (Rep.) Cable: CDTECH TAIPEI
Telex: 24458 CDTECH. Fax: 886-2-7916312.

Circle 417 on Reader Service Card

The Kaypro Guide to Upward Mobility



No. 1
Start small & keep it simple

Successful businesses are built by hard work and careful planning. By starting small with a clear simple objective, success is, as the saying goes, only round the next corner.

In the beginning, the choice of your company's computer system is crucial. You'll probably need a computer that will handle everything from Word Processing to Accountancy, in one integrated environment, but what about in a year's time, when your business has grown?

Here's where the new Kaypro Micro Series comes in. Available in two sizes; the space saving Micro 1 small footprint or the expandable Micro 2.

Both systems feature Kaypro's state of the art Passive Backplane structure which enables the computer's processor and video components to be mounted on plug-in cards, facilitating easy servicing and upgrade.

The Kaypro Micro Series can be the most cost effective investment for your business. Whatever your computing needs, there is a Kaypro Micro Series solution for you today and tomorrow.

MICRO 2

System Upgrade Plan

When you purchase any Micro Series system you will be able to upgrade the processor to any available processor type in the Kaypro range, (e.g. from a 286-10 MHz to a 286-16 MHz, or even any of the superfast 386 processors), within 18 months of purchase, for the price difference between the new and existing processor. Your Kaypro Authorised Dealer or Diamond Centre has all the details.

For more information on any system in the Kaypro range
dial 100 and ask for **FREEPHONE KAYPRO**

KAYPRO®
computers

... your future's built in

Circle 437 on Reader Service Card

Circle 415 on Reader Service Card

SOFTWARE SECURITY MODULE

An easy to use hardware/software combination for securing data/programs.

Our security modules can be used simply as 'Dongles' through to advanced encryption – decryption systems.

- ★ For IBM PC family (and compatibles)
- ★ Variants for other systems
- ★ Advanced construction – rugged and compact
- ★ Proven throughout the world
- ★ Transparent operation – user friendly
- ★ Driver software supplied for variety of applications

master charge

VISA

CTL Control Telemetry of London
11 Canfield Place, London NW6 3BT
Tel: 01-328 1155 Fax: +441 328 9149

POWER AND MORE .....

A-77066	12MHz Baby 286 Mainboard
A-77266	12MHz Baby 286 Mainboard W/RS-232 on Board
A-77166	16MHz Baby 286 Mainboard
A-78020A	20MHz Baby 386 Mainboard
A-78020B	25MHz Baby 386 Mainboard
A-78020C	25MHz Baby W/Cache memory 386 Mainboard
A-78016A	VGA (Cirrus 8-Bit) Card
A-78016B	VGA (Trident 16-Bit) Card
AP-AT1	12MHz 286 System
AP-AT3	12Mhz 286 System
AP-AT5	20MHz 386 System
AP-AT6	25MHz 386 System
AP-AT7	25MHz W/Cache 386 System

ACME TECHNOLOGY CORP.

6TH.FL. NO. 133 Chung Hsiao E. RD. Section 5 Taipei Taiwan R.O.C.
TEL : (886-2) 763-1863 FAX : (886-2) 768-1987 TLX : 29107 KAIBOARD

printers without a personal computer. In this configuration, the scanner and printer simulate a color copier.

The GT-4000's dimensions are 125 by 310 by 410 mm, and it weighs 10 kilograms.

Price: 4000 deutsche marks.
Contact: Epson Deutschland GmbH, Zülpicher Strasse 6, D-4000 Düsseldorf 11, West Germany, 49-211-56-03-0.
Inquiry 941.

Drafting on Your Mac

System 3R claims that its MGMStation (for Micro Graphic Manufacturing Station) CAD 2.5 release 2 is easy to learn and use, yet it provides facilities that outperform more-expensive and less-user-friendly CAD systems.

More than 200 functions let you have multiple windows, filleting, chamfering, sectioning, hatching, transformation, and Macintosh editing commands, plus drawing in absolute, incremental, polar, and freehand coordinate systems. Two versions of CAD let you choose black-and-white or color output to various devices to an accuracy of 16 decimal places.

You can have grids of any size, metric or English units, and up to 64 distinguishable layers, visual group representation, and groupings by region or by entities. Available libraries include mechanical engineering, architecture, interior design, and electronic design. In addition, MGMS Geometry provides facilities for perimeter, area, center of gravity, and moment or inertia calculations.

System 3R also offers MGMStation CADCAM, a design and manufacturing software system that incorporates modules for milling, turning, punching, and wire electrodischarge machining (EDM). With all the modules, you use MGMStation CAD to describe the geometry of the piece or part to be manufactured, and then MGMStation automatically outputs computer numerical control (CNC) programs to suit most machine-tool control systems.

You can define and modify tool libraries to suit your requirements. Within each module there is an RS-232C serial communications facility for inputting and outputting CNC files to and from machine-tool controls and other peripheral equipment like tape punches and printers. You can add the optional IGES, DXF, and PICT translator module to use other drawings for geometry input.

The Mill module provides features for face milling, compensated milling of contours and entities, pocketing of irregular shapes and cavities with or without islands, and multiple hole cycles for drilling, tapping, boring, and reaming.

The Turn module includes diameter and radius programming; face turning, roughing, and finishing cycles for compensated turning of contours and entities; face pocketing of cavities; and cycles for grooving, drilling, tapping, boring, and U-drilling.

The Punch module provides the basic features of punching contours and entities with or without bridges, area clearance of irregular shapes, and multiple cycles on patterns of holes. MGMStation displays and checks all clamps and dead zones and displays the turret layout so you can select the station you want to use.

The Wire EDM module recognizes all facets of wire EDM, including two- and four-axis work, with independent *u* and *v* axes, wire diameter compensation, start holes, nozzle heights, E-numbers, arc precision, and use of all M-

continued

ASII 山汶電腦

ASII-168

16 MHZ VGA LAPTOP COMPUTER

- Intel 80286-16 CPU
- 16 MHz, 0 Wait State
- Two Serial Ports
- Bi-Directional Centronics Port
- Memory Expandable to 5MB
- Detachable LCD Display, Back-Lit
- 640 × 480 Resolution
- VGA Mode With 16 Grey Scale
- EGA/CGA/MGA Compatible
- LCD Power-Down Capability
- Toshiba Compatible Expansion Slot
- Weighs Only 5 Kgs.

Circle 408 on Reader Service Card

Aquarius SYSTEMS INC.

6F., No. 394 Keelung Rd., Sec. 1, Taipei, Taiwan, R.O.C.
Tel: 886-2-7069140 Fax: 886-2-7069255 Telex: 13138 AQUSYS

GREAT THINGS COME IN SMALL PACKAGES

Specs. / Model	Dimensions (inch) (L×W×H)	Number of Disk Driver 5¼" FDD	5¼" HDD	3½" FDD	3½" HDD	Meet then Main Board size		Coated conductive paint on the back of front panel	Power supply
IW-E13	16.5"×16"×4.2"	1		1	1	Baby AT	XT	V	PS/2
IW-F13	16.5"×16"×4.2"			2	1	Baby AT	XT	V	PS/2

FEATURE:
① For PS/2 system
② Meet to FCC requirement
③ Dust free
④ Special front pauel design, can istall different kinds disk

IN WIN DEVELOPMENT INC.
P.O. Box 101-346, Taipei, Taiwan, R.O.C.
Office: 1/F, No. 41, Alley 13, Lane 512.
Ming Tsu E. Rd., Taipei, Taiwan, R.O.C.
Tel: (02)501-2451 . Telex: 27092 INWIN.
Fax: 886-2-5012450

27MHZ 286 SYSTEM
35MHZ 386 SYSTEM
(16MB ON BOARD)

FASTFAME CO., LTD.
TEL:886-2-7610835, 7610154, 7568431, 7690210, 7564445 FAX:886-2-7639581
TLX: 15112 FASTFAME 2FL., 68, 4 SEC, PATEH RD., TAIPEI, TAIWAN, R.O.C.

functions inherent to wire machines.

MGMStation CAD and the CADCAM software packages run on the Mac 512KE, Plus, SE, II, and IIx. The system supports Apple ImageWriter, ImageWriter II, ImageWriter LQ, and LaserWriter printers, and Hewlett-Packard, Houston Instrument, Roland Gould, and Graftec plotters.
Price: £968 for the black-and-white version of MGMStation CAD; £1392 for the color version; £5960 and up for the MGMStation CAD/CAM software packages.
Contact: System 3R (UK) Ltd., 2 Duke St., Princes Risborough, Buckinghamshire HP17 0AT, UK, 44-08444-4339.
Inquiry 916.

Produce Sheet Music on Your Mac

Designed by music theorists and professional music typesetters, Music Publisher 2.0 is music notation software for the Macintosh that helps you produce high-quality sheet music. The package includes the Music Publisher program disk; the Presto High-Speed Music Entry instrument; Presto cables for the Mac Plus, SE, and II; a system installer disk; and the Repertoire PostScript font.

The software gives you notation specifications, such as note values up to and including 128th notes; transposition by chromatic, diatonic, or modal (by key or by octaves); automatic placement of ties, accidentals, bar indents, accents, and staccato markings; alignment of lyrics to notes; playback via the Mac's internal speaker; and automatic beaming (standard, complex, cross stave, center, and adjustable angles).

In addition, you get standard and complex time signatures; markings such as slurs, crescendos and decrescendos, repeat signs, pedals, glissandos, and fingering numbers; a choice of automatic or manual stem direction; customizable automatic proportional spacing; and measure numbers with full layout options.

The Page Layout specifications let you display your music as a page; transfer via PICT to other applications; set up to 20 tabs per page with four alignment choices; vertically justify staves, music systems, and text blocks; and draw solid and dotted lines, squares, and rectangles in a wide range of point sizes. You also get four on-screen stave and note sizes; five preformatted systems; five page views; and automatic or manual leading from 6 to 72 points in 0.5-point increments.

You can play back and proof your musical scores, input from a music keyboard via step-time entry, and isolate and mute individual voices with the package's 16 channels, 128 patches, and user-selectable channel mapping. You get a complete set of accidental symbols and percussion symbols, guitar slashes, flexible symbol placement and movement, multiple dotted notes, and the ability to print on any PostScript-compatible laser printer. Presto specifications include eight function keys (for chords, size, spaces, symbols, and grace notes) and four octaves.

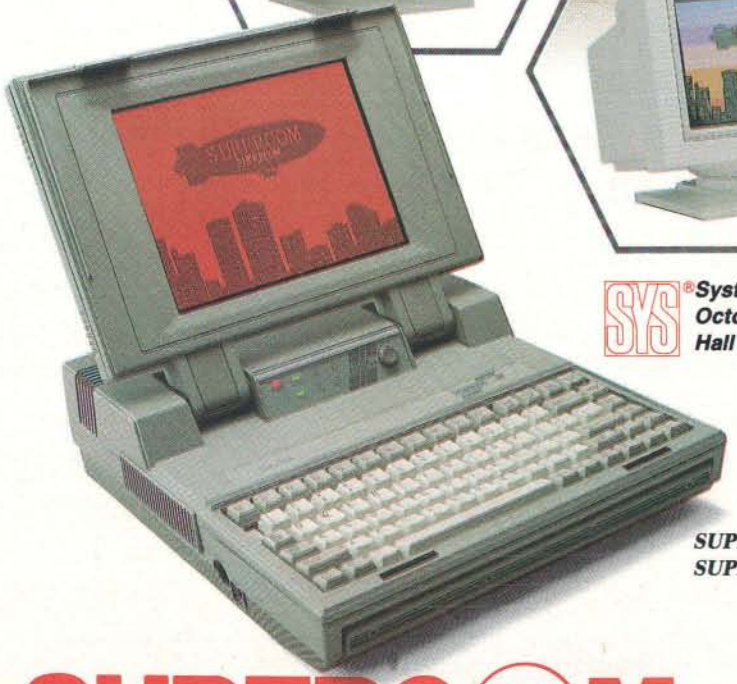
Music Publisher 2.0 requires a Mac Plus, SE, or II, two 800K-byte floppy disk drives (a hard disk drive is recommended), an Imagewriter or PostScript-compatible printer, and at least 1 megabyte of RAM.
Price: $995 Australian; $495 U.S.
Contact: Repertoire Pty. Ltd., 49A Stephens Terrace, St. Peters, South Australia 5069, 61-08-363-2600.
Inquiry 915.

continued

SUPERCOM®

WELCOME TO A WORLD OF SUPERCOM LAPTOP, SYSTEMS AND MONITORS

FCC/TUV/CSA Approval
FCC NO: HOI3DF 1400
TUV NO: R94200
CSA NO: LR 86154-1



SYS® **System 89 Munich**
October 16 - 20
Hall 14, C1D

SUPERCOM-3120E
SUPERCOM-3120C

SE-1461
14" EGA Color Monitor
Hor. Freq.: 21.85/15.75 KHz
Resolution: CGA Mode: 640×200
EGA Mode: 640×350

SV-1481
14" VGA Plus Color Monitor
Hor. Freq.: 31.5/35.2 KHz
Resolution: VGA Standard Mode: 640×480
720×400
VGA Plus Mode: 800×600

SV-1482
14" Super VGA Color Monitor
Hitachi 0.28mm Dot Pitch Tube
Hor. Freq.: 31.5/35.2/35.5 KHz
Resolution: 640×480 • 800×600 • 1024×768

SM-1421
14" Monochrome Monitor
Hor. Freq.: 18.432/15.75 KHz

SM-1411
Hor. Freq.: 18.432 KHz

SUPERCOM-3120C
80286 CPU, 6/12 or 8/16 MHz, ZERO Wait State
Fully CGA/MDA/HGA Compatible Plasma Screen, 2 Gray Scales

SUPERCOM-3120E
Fully CGA/EGA Compatible

SUPERCOM-286SN
16MHz, 80286-10, 1 MB RAM, 3.5" 1.44 MB Disk Driver, Slim Case

SUPERCOM-286LN
16MHz, 80286-10, 1 MB RAM, Baby Size Case

SUPERCOM®

SUPERTRON ELECTRIC CO., LTD.

12/F, No. 591-593, Tun Hua S. RD.,
Taipei, Taiwan, R.O.C.
Telex: 24317 SUPEROHM
Tel: (02)705-2121, 707-7047 (Rep.)
Fax: 886-2-7089936

Holland Branch:
Taiwan Trade Center, Rotterdam
Vareseweg 5, 3047 At Rotterdam,
Netherlands
Tel: (010) 4460321 Fax: (010)4625280

Store 6.4 Gigabytes of Data

A high-capacity WORM (write once, read many times) optical disk drive, the Gigadisc 6000 stores up to 3.2 gigabytes of data on each side of a 12-inch disk. It has an average access time of 100 ms, and it can sustain a data transfer rate of 1 megabyte per second in read or write mode; in write and verify mode, the rate is 400K bytes per second.

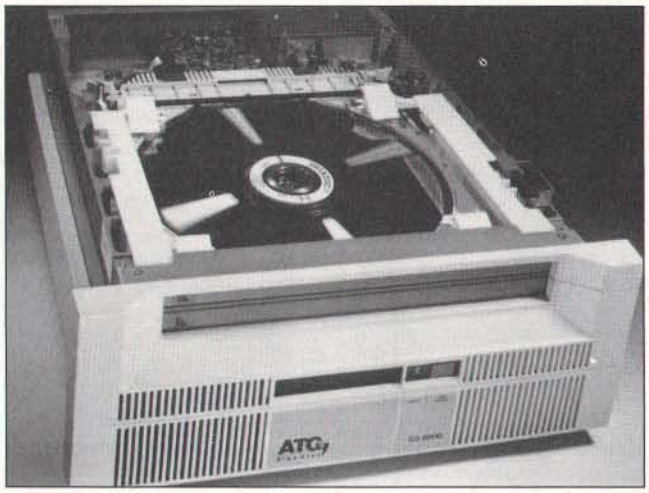
If you need more than 6.4 gigabytes of storage, you can use the Gigadisc 6000 in Cygnet Systems' 1800 series of expandable jukeboxes. You can configure this with one to five drives reading up to 141 disks. Utilizing Gigadisc 6000 drives, a Cygnet Model 1803 jukebox can provide rapid access to over 900 gigabytes of data in a floor space of less than 20 square feet.

The Gigadisc 6000 can also read disks recorded at 1 gigabyte per side on the Gigadisc 1001 and 1002 drives. In addition, it can read and write optical disks using either bubble or hole technology. It comes with a standard SCSI controller, so you can use it with most computers.

Price: 100,000 French francs.

Contact: ATG Gigadisc, Avenue General Eisenhower, B.P. 1270, 31047 Toulouse, Cedex, France, 33-61-40-70-50.

Inquiry 892.



Gigadisc 6000 lets you store up to 3.2 gigabytes of data per side on a 12-inch optical disk.

A Pocket-Size Data Logger

The TDS9090 memory unit is a pocket-size computer module that combines a self-contained control computer and the TDS9095 memory-storage unit. It gives you a battery-powered data logger

continued

The new Hardlock E-Y-E. Beauty is in the eye of the beholder ... but no hacker will get a look in.

Software protection requires a serious partner.
If you care about software protection, sooner or later you will turn to FAST Electronic. We've produced over 130,000 Hardlock devices since 1985. And sold them all. Because Hardlock is no ordinary copy protection: it's software protection through hardware. Transparent. Daisy-chainable. Uncrackable because of its unique encryption technique.

Hardlock E-Y-E – a unique chip for software protection.
Our lead is increasing. The new Hardlock E-Y-E is based on a chip developed by FAST Electronic specifically for software protection. Hardlock E-Y-E is crypto-programmable. This means you can program protection of program options. Up to 128 bytes of data can be stored in the new Hardlock E-Y-E, and using the new implementation program – HL-Crypt – you can protect your .COM and .EXE files in seconds. At no additional cost, we will supply query routines for all commonly-used compilers for your individual implementation of software protection and data encryption.

The new Hardlock E-Y-E: security in silicon

Try out the new chip.
FAST Electronic has invested half a million German Marks in making Hardlock more secure. And better value for money. It'll be worth your while to get to know us – and compare our products and prices with other systems. See for yourself! With quantity discounts, we can offer you unbeatable prices. Order a new Hardlock E-Y-E to try out on approval. Now.

FAST
Fast Electronic GmbH

Contact Mathias Vaagt at
FAST Electronic GmbH, Kaiser-Ludwig-Platz 5, D-8000 Munich 2, West Germany, Telephone 49/89/53 26 53, Fax 49/89/53 34 01

Circle 421 on Reader Service Card

POLYTRON Tools: Save Money, Save Time, Save Effort!

It's a wonder complex software ever works. The process of creating it is inherently error-prone. Our Configuration Management tools manage the process, enhance communication and coordination, and help ensure product reliability. In short, they save money, effort and time during every phase of the product lifecycle.

PVCS

The core of Configuration Management is version control. The POLYTRON Version Control System (PVCS) provides complete control over the configuration of source code, object code, tools and even documentation. Previous versions are easily retrieved at any time. The most up-to-date version is instantly available and its genesis is auditable. You always know who made a change, what the change was, when it was made, why it was made and what revisions contain the change. You can prevent unauthorized changes and coordinate revisions, special versions and upgrades — automatically.

PolyMake

PolyMake automatically invokes your compiler, linker and tools to rebuild your system when modules change. The multi-language dependency generator brings even more precision to builds.

Features include integration with PVCS and PolyLibrarian, hierarchical dependency trees, configurable paths, conditional constructs, nested include files, multiple OS compatibility and "list of files" support.

PolyDoc

PolyDoc automates the nastiest job in programming — Source Documentation. The alternative is manually gathering source documentation from obsolete specifications, wads of scribbled notes and ruminations of absent-minded programmers. With PolyDoc, programmers, project leaders, teams and entire organizations have an easy, practical way to create, share and reference project documentation. PolyDoc compiles a Project Documentation Library (PDL) that stays current with the project as it evolves. Source documentation is automatically extracted from the code and other references and organized in the PDL according to keywords the programmer has embedded in the code.

PolyLibrarian

PolyLibrarian can create object code libraries with any language that produces object modules that can be linked with MS-DOS LINK, Phoenix PLINK86 or a compatible linker. PolyLibrarian is easy to use, so libraries can be optimized for specific projects or generalized for maximum functionality.

PolyLibrarian promotes supplying modules as "black boxes" for testing and integration. Teams "publish" a library consisting of their properly compiled modules, ready to be linked with other modules. This eliminates compiler switch and procedural errors and speeds building and testing since modules are precompiled.

PolyShell

PolyShell redefines MS-DOS as an environment for programmers — its UNIX-style tools and functions are designed to aid and speed the tasks that programmers do. There is no need to modify your programming tools, languages or software. A comprehensive tutorial guides users through the internal commands and all 96 utilities. Interactive help is always available.

PolyAWK

As a programmer you are confronted with manipulations of source code, data or text that fall outside the capabilities of editor macros or common tools. For these quick and dirty jobs you need a quick and dirty tool builder. AWK is a language optimized to quickly write tools. PolyAWK is a true implementation in MS-DOS or OS/2 of NAWK.

PolyAWK permits even the new user to construct elegant tools in a few lines of code — written, debugged and working in minutes. Inherent structure and excellent string handling is the secret to AWK's concise nature and remarkable readability. When you order PolyAWK you receive a copy of "The AWK Programming Language" by Aho, Weinberger and Kernighan.

Pricing

POLYTRON products can be used independently or together, and are priced on a "Per User" basis. The price per user decreases as you add users — call for quotes. Personal PVCS for MS-DOS or Mac MPW: £85. Professional PVCS: £225. Network PVCS: Call. PolyMake for MS-DOS: £85. Network PolyMake: Call. PVCS & PolyMake are packaged together on: OS/2, SunOS, VAX/VMS, IBM AIX. Call for pricing. PolyDoc for MS-DOS: £115. PolyLibrarian for MS-DOS: £85. PolyShell for MS-DOS: £60. PolyAWK for MS-DOS: £60. PolyAWK for OS/2: £115. PolyAWK + PolyShell Combination (Save £35): £85.

To Order, Call
(0763) 73455
FAX (0763) 73460

The Software Construction Co., Ltd.
The Red House, 84 High Street,
Buntingford, Hertfordshire SG9 9DJ

POLYTRON®

High Quality Software Since 1982

Circle 452 on Reader Service Card

A Winning Combination. Now Available in VGA Color.

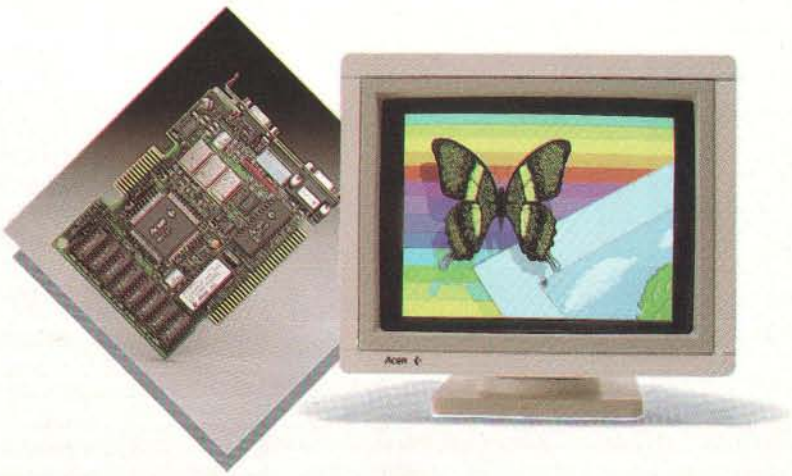
For 16 years, Fred Astair and Ginger Rogers danced their way into the world's heart. Now Acer gives you a VGA combination to dazzle your eyes and tickle your imagination: the 7015 Multiscanning Color Monitor and the 8213 VGA Display Adapter. The perfect combination to boost your sales volume.

7015 Multiscanning Color Monitor

- Supports VGA, Enhanced VGA, MCGA, EGA, CGA, Hercules and More
- Resolutions as High as 800 x 600
- Bundled With TTL and Analog Input Signal Cables

8213 VGA Display Adapter

- Uses Advanced, Space Saving SMT Technology
- Enhanced VGA Mode Offers Resolutions as High as 800 x 600 in 16 Colors
- Up to 600% Faster Than the Competition
- Both TTL and Analog Monitor Compatible



For more information on the winning combination in OEM VGA graphics, contact:

Acer Incorporated
Peripheral Business Unit
135 Chien Kuo N. Road, Sec. 2, 8 FL.
Taipei, Taiwan, R.O.C.
Phone: 886-02-501-0055
Fax: 886-02-501-2521 or 505-8414

Flexible Volume/OEM Inquiries Welcome

Acer®

The Word for Value

Circle 404 on Reader Service Card

FOR.C™ FORTRAN TO C TRANSLATOR

Delivers very READABLE, MAINTAINABLE translations from FORTRAN-77 to ANSI C!

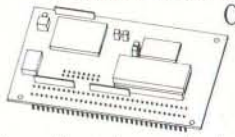
Translates to C-style functions, like fprintf(), reduces do loops and subscripts, uses innovative translation aids and supports numerous VAX F77 extensions. Includes runtime source for portability.

Available for MS-DOS and UNIX

COBALT BLUE
2940 Union Ave, Ste C, San Jose CA 95124, USA
(408) 723-0474 • FAX: (408) 377-7648

Circle 468 on Reader Service Card

FORTH INSTRUMENTATION COMPUTER



TDS 9090

A powerful control computer based on the new Hitachi 6303Y and high level language Forth. 100mm x 72mm. 30K bytes RAM, 16K dictionary RAM/PROM, 256 bytes EEPROM, 16K Forth. You can attach 64 key keyboard, LCD and I²C bus peripherals. Built in are interrupts, multitasking, time of day clock, watchdog timer, full screen editor and symbolic assembler. 32 parallel and two serial ports. Single power supply and low power 3mA OPERATIONAL mode.

1 off £194.95 including manual and non-volatile RAM.

Triangle Digital Services Ltd
100a Wood Street, London E17 3HX
Telephone 01-520-0442 Telex 262284 (quote MO775)

Circle 459 on Reader Service Card

ITALIANI !

...un estratto dal nostro catalogo:

MS Word 5 it.	**720.000**
MS Excel 2.1 it.	**720.000**
MS Quick MASM/C	**230.000**
Lotus 1-2-3 3.0 it.	**750.000**
dBASE IV it.	**1.090.000**
Turbo Pascal 5.5 it.	**240.000**
PC Tools 5.5	**125.000**
Norton Utilities 4.5	**150.000**

Quotha32

Via Accursio, 2 - 50125 Firenze
Fax. 055-22.80.674
Tel. 055-23.20.391 (r.a.)
tutto il software in italiano e di importazione a pronta consegna.

Circle 448 on Reader Service Card

that's only 100 mm long, and it weighs less than 100 grams. You can use the combined module for applications such as roadside vehicle counting, water management in reservoirs, meteorological outstations, black-box recording devices in ships and road vehicles, and heart-rate recording.

You could incorporate the memory unit alone into equipment to collect data such as ticket sales, market research, on-site measurements in engineering, statistics, and bar code readings. It has 128K bytes of battery-backed memory, a real-time clock, and 10 channels of 10-bit A/D conversion.

You can also use the control unit independently (e.g., in robot devices, remote signaling systems, and biochemical growth processes). The unit has the computer language Forth built in on ROM. It can interface with alphanumeric or graphical LCDs that have built-in HD61830 controller chips, and it has an interface for you to plug in a keyboard for initial programming.

The TDS9090 is powered by a 9-volt battery or small power supply; a separate lithium battery maintains the memory and the clock.
Price: £194.95; £90 for the supporting IBM PC software.
Contact: Triangle Digital Services Ltd., 100a Wood St., London E17 3HX, UK, 44-01-520-0422.
Inquiry 914.

Manage Your Credit Card Business on an IBM PS/2

The Card Management System (CMS) from Application Systems lets you manage a credit-card business on an IBM PS/2. It provides all the facilities you need for processing new business and new accounts, maintaining customer service, processing merchandise, producing cardholder and merchant statements, validating charge and payment data entry, reporting collections and activity, and managing plastic cards.

At the heart of CMS is the concept of the Plan, which describes the key features of the product, such as interest calculation types, transaction charges, insurance, and fees, and defines the limits within which you can vary these parameters at the account level.

The CMS database incorporates a relational data structure linking a cardholder with up to four accounts, and each account with up to 10 plastic cards. Although the cardholder number, the primary account number, and the first card number are usually the same, this is not a system requirement; replacement cards are issued with a different card number.

The Voice Authorization process informs the operator about the status of the selected account, and it also reports any other delinquent accounts belonging to the cardholder. In addition, the authorization process checks the overall cardholder credit limit and the credit limit for each individual account.

Other features include a Customer Information File (CIF) of demographic data (information is held by cardholder, not by account); multiple accounts per cardholder; multiple plans, each of which can have different interest rates and transaction fees; multiple accounts per merchant; and parameter overrides, at cardholder- and merchant-account level, to vary Plan defaults. CMS also generates comprehensive daily reports detailing all activities on the system for control and backup.

CMS runs on IBM PS/2s with 4 megabytes of RAM and OS/2 1.1; a DOS 2.1 version

continued

✔ **Linea PCdue.**
L'architettura Microchannel, PS/2 compatibile: **l'innovazione.**

Microchannel, PS/2 compatible: ***the innovation.***

✔ **Linea PCbit.**
I best seller, con oltre venticinquemila unità già vendute: **l'affidabilità.**

Our best sellers, more than twentyfive thousand of units sold: ***the reliability.***

✔ **Linea PCpro.**
L'integrazione su piastra madre dei dispositivi più avanzati: **la completezza.**

The integration on the mother board of the most advanced devices: ***the completeness.***

✔ **Linea PCbase.**
L'indispensabile per lavorare, nello spazio di una tastiera: **l'economicità.**

The minimum to work, in the space of a keyboard: ***the economy.***

✔ **Linea TSX.**
I sistemi flessibili per multiutenza e reti locali: **la competitività.**

The flexible systems for multi-user solutions and local area networks: ***the competitiveness.***

✔ **Linea PCport.**
8, 16, 32 bit, tutti portatili e a batteria: **il dinamismo.**

8, 16, 32 bit, all of them portable and battery-fed: ***the dynamism.***

Solo Unibit ha tutte queste qualità.

Qualities that only Unibit has got.

Solo Unibit , un'azienda che vi è vicina ovunque in Italia, offre una gamma di personal e minicomputer così completa e aggressiva: senza concorrenti.

Dall'architettura standard all'innovativa MCA (PS/2 compatibile), dall'MS DOS all'MS OS/2, a Xenix, a Unix: tutti i personal e i minicomputer prodotti e distribuiti da Unibit utilizzano le tecnologie più avanzate e competitive.

Altra forza di Unibit, oltre la particolare attenzione che dedica alla grande utenza, è la sua rete di Rivenditori Autorizzati selezionata e dinamica, attiva in tutta Italia, che garantisce direttamente supporto e assistenza con la sensibilità esclusiva Unibit.

Perché Unibit è una realtà tutta italiana. Spirito d'impresa, entusiasmo, creatività e grande professionalità ne fanno un'azienda unica, in competizione anche con i grandi concorrenti internazionali.

Unibit. Qualità Uniche.

UNIBIT®

Only Unibit , an enterprise present everywere in Italy, offers such a complete and aggressive personal and minicomputer range: with no competitors.

From standard architecture to innovative MCA (PS/2 compatible), from MS DOS to MS OS/2, to Xenix, to Unix: all Unibit manufactured and distributed personal and minicomputers exploit the most advanced and competitive technologies.

Unibit is an all-italian reality. An enterprising spirit, enthusiasm, creativity and a great professionalism make Unibit a unique enterprise, capable to compete with the major international competitors.

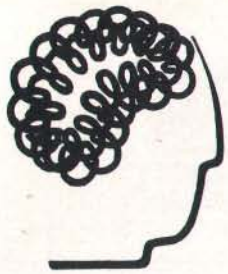
Unibit. Unique qualities.

IF YOU LIKE OUR PHILOSOPHY CONTACT US NOW. WE CAN MAKE HIGH QUALITY BUSINESS.

Unibit S.p.A. - Direzione generale (Headquarters): Roma, via di Torre Rigata 6, tel. 06.4090650 (r.a.), fax 06.4090727.
Filiale di Milano: Segrate, Milano S. Felice Centro Commerciale, tel. 02.7532003/7531071, fax 02.7532040. Filiale di Napoli: Parco San Paolo, via Cintia 35, tel. 081.7675117/7678273.

Microchannel, PS/2, MCA sono marchi registrati della International Business Machines Corp.; MS DOS, MS OS/2, Xenix sono marchi registrati della Microsoft Corp.; Unix è un marchio registrato della AT&T.

Circle 464 on Reader Service Card



Intelligent SCSI Controllers for NetWare, OS/2 & DOS

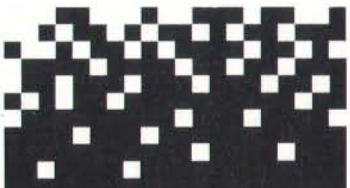
- Novell DCB compatible
- OS/2 & DOS drivers available
- 286/386 ISA & PS/2 MCA versions
- Handles any SCSI drive
- Optical CD drive support available
- Use up to 4 boards & 32 SCSI drives
- Works with 33 MHz systems
- Available now.

Dealers and Distributors wanted.

PROCOMP

PROCOMP USA, INC.
6801 Engle Road
Cleveland, OH 44130
FAX: (216) 234-2233
Phone: (216) 234-6387

Trademarks: NetWare--Novell, Inc.; OS/2--Microsoft Corp.; PS/2--IBM Corp.; PROCOMP is an MT company.



IEEE488

Technology that hits the mark

- For **IBM-PC/XT/AT/386, IBM-RT 6150, IBM-PS/2, PHILIPS :YES** and all compatibles
- For **MS-/PC-DOS, OS/2,** and **UNIX**
- Extremely fast and easy to use software
- All **HP-IB commands (ONSRQ** etc.) are implemented
- Compatible to **ASYST, AutoCad, National Instruments, CEC** etc.
- Real time error checking and bus analysing
- Supported Basic (compiled), Turbo-Basic, (Turbo-) Pascal, Modula-2, Fortran, C, Turbo-C, Assembler etc.
- Available in English, French and German
- Analysing software for instruments

ines Messtechnik Datenverarbeitung

Dealer + OEM welcome

ines GmbH
Neuenhöfer Allee 45
5000 Köln 41
West-Germany
Phone: - 49 - 2 21 - 43 86 59
Teletex: - 26 27 - 2 21 - 4237 gizkln
FAX: - 49 - 2 21 - 49 18 71

is also available that requires 640K bytes of RAM. The system supports IBM-compatible nine-track tapes for data exchange with Central Bank Clearing Centres and card-embossing machines. English and German text is available for all screens, messages, and cardholder communications; additional languages can be implemented without changing programs.
Price: From £8000 for 5000 credit cards to £20,000 for 25,000 credit cards.
Contact: Application Systems, 35 Lea Wood Rd., Fleet, Hampshire GU13 8AN, UK, 44-0252-625919.
Inquiry 905.

Form a Peripheral-Sharing Network

Up to 31 users can share access to as many as 31 printers, plotters, and modems, as well as exchange E-mail and data files, with the Systemizer Plus Modular Peripheral Access System. Each user has one of the modem-size devices on his or her desktop, and you use it to form a distributed peripheral-sharing network. Only the Systemizer Plus devices are networked, so you don't need a central control unit or server.

The system provides a modular, building-block approach to peripheral sharing that accommodates any combination of computers, printers, plotters, or modems and any combination of serial and parallel interface requirements. Systemizer Plus also provides a bridge between incompatible networks, so that computers on one LAN can share peripherals with computers on another LAN, wide-area network, private branch exchange, or 3270 link.

The Systemizer Plus Modular Peripheral Access System also adds a spooling and cache buffer capacity of up to 1 megabyte per user; front-panel push-button access to eight peripherals; support for XON/XOFF handshaking on both input and output; macro function keys for sending control-code sequences to printers; several emulation modes to facilitate buffering of plotters; a user-definable operating personality; an EEPROM for storing data translations, macros, and personality settings; and an optional print-server mode for when a Systemizer Plus is located at a remote printer (up to 1200 feet away). In this last mode, all users share its buffer, and its front panel is optimized for controlling the printer that is attached to it.
Price: $399 U.S.
Contact: B+W EDB, Tonedraget 2, 3450 Allerod, Denmark, 45-252-5752.
Inquiry 918.

Fujitsu's 25-MHz 80386 Machine

Fujitsu's FM R-70HX3 machine uses the 25-MHz 80386 chip, along with the Japanese MS OS/2 1.1 and Presentation Manager. The HX3 comes with 4 megabytes of main memory (expandable to 16 megabytes), a four-way set-associative 32K-byte cache memory, and two 5¼-inch floppy disk drives. Performance is said to be 1.6 times that of the current FM R-70HX2.
Price: 1.69 million yen with an internal 170-megabyte hard disk drive; 1.35 million yen with an 85-megabyte hard disk drive.
Contact: Fujitsu Ltd., Marunouchi Center Building, 1-6-1 Marunouchi, Chiyoda-ku, Tokyo 100, Japan, 81-03-213-4160.
Inquiry 925.

continued

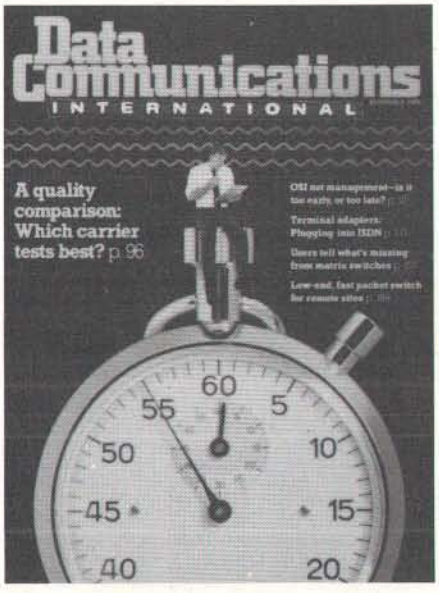
ENTER YOUR SUBSCRIPTION TO DATA COMMUNICATIONS International

If you are responsible for the use, planning, design or implementation of data and information systems...**you need Data Communications magazine!**

The leading networking magazine since 1972, DATA COMMUNICATIONS is the *only monthly publication devoted solely to networking.* It will keep you fully informed on the latest technology, equipment, services, opportunities and challenges that affect your network. No other publication delivers the timely, technical analysis that is crucial to you.

You'll see how you can *cash in on profitable new strategies and applications* for factory and office automation, distributed processing, and electronic mail. Plus, DATA COMMUNICATIONS *warns you of the dramatic changes ahead in tariffs, regulations and standards* - and what they'll mean to you and your company.

Here is a preview of what you'll be seeing:



October issue - Our editors will lay out the technical and market trends for TI in this issue.

November issue - OSI products, prospects, and services. Which vendors are offering real solutions and which are only offering lip service - Find out.

November LAN Strategies Special Issue - Includes LAN operating systems and applications, gateways, bridges, routers and cabling schemes.

December issue - A report from the field outlines how integrated network management works and doesn't work.

1990 Buyers' Guide issue - The powerful, year-round reference that provides vital product and vendor information networking decision-makers need when they are ready to buy.

Don't get left behind! Stay on top of the rapid changes in technology and discover how you can take full advantage of the latest advances with DATA COMMUNICATIONS.

Fill in and mail your subscription application **today!**

More Printers from Star Micronics

The 9-pin FR-10 and FR-15 are part of Star Micronic's Professional Series of dot-matrix printers (see July What's New International, page 88IS-30). The machines can print 300 cps in draft mode and 76 cps in near-letter-quality mode, and they offer seven NLQ fonts, one optical-character-recognition font, and one draft font.

In addition, the FR printers offer all the other features of the XB24 models, including the optional color kit.

Star Micronics also offers the LaserPrinter 8 II T, a Hewlett-Packard Series II–compatible device offering twin-bin facilities. The two standard input hoppers can each accommodate 200 sheets of A4-size paper, while an optional high-capacity feeder can house 1000 sheets.

Eight fonts are built in, and you can access additional fonts via plug-in cartridges; you can combine up to 64 fonts on one page and print in portrait and landscape orientations.

The LaserPrinter 8 II T can print 8 pages per minute, and it comes with 1 megabyte of memory, expandable to 4 megabytes. In addition to Hewlett-Packard emulation, the printer includes emulations for IBM, Epson, and Diablo printers. The LaserPrinter 8 II T also comes with both RS-232C serial and Centronics parallel interfaces.
Price: £459 for the FR-10; £599 for the FR-15; £2589 for the LaserPrinter 8 II T.
Contact: Star Micronics UK Ltd., Craven House, 40 Uxbridge Rd., Ealing, London W5 2BS, UK, 44-01-840-1800.
Inquiry 912.

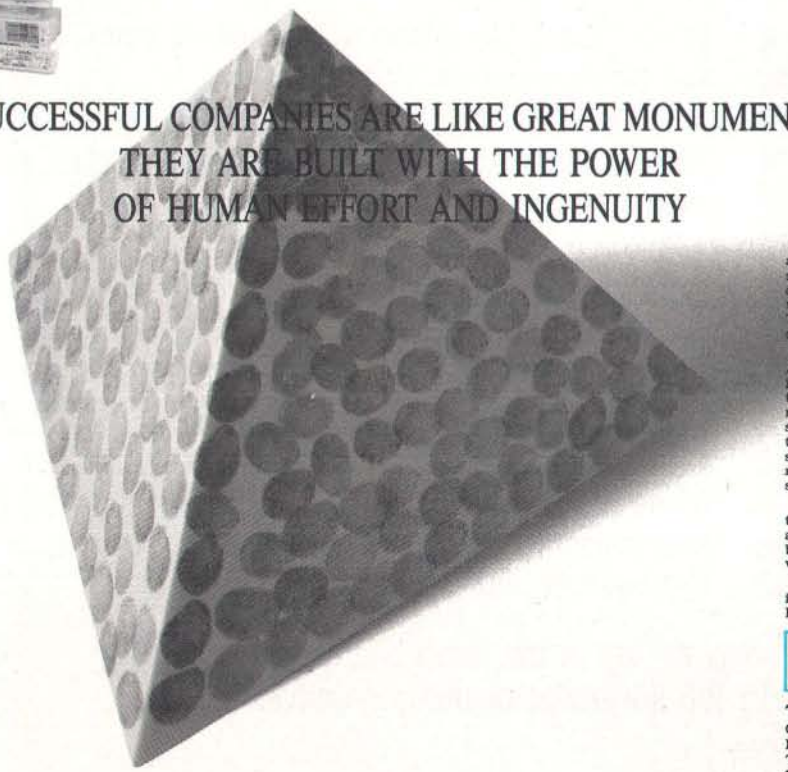
Produce Mock Industrial-Plant Diagrams

You can display a fully working mock industrial-plant diagram on an IBM XT or AT using AFE Displays' IC2X extension card. You can install up to four cards in your personal computer, which interfaces with an industrial process controller to provide instant data on the status of the plant.

Each full-size card contains an 80286 microprocessor and an 82786-based graphics processor. The IC2X operates its own EGA or RGB monitor and supports its own keyboard, permitting multitasking.

Besides graphics displays of current trends, the IC2X maintains a historical database—it stores the last 2000 trending traces and the last 10,000 alarm loggings, which you can use for analysis. EC-BASIC programming facilities cover calculations, shift reports, and data manipulation. The host computer handles printing facilities.
Price: £3850.
Contact: AFE Displays Ltd., 62 Anchorage Rd., Sutton Coldfield, West Midlands B74 4PG, UK, 44-21-355-0077.
Inquiry 897.

continued



SUCCESSFUL COMPANIES ARE LIKE GREAT MONUMENTS.
THEY ARE BUILT WITH THE POWER
OF HUMAN EFFORT AND INGENUITY

At Twinhead we are in no doubt as to where our greatest assets lie. In our personnel. It was through the efforts of all our staff that we became one of the world's leading manufacturers of add-on cards. It was through the skill of our engineers that we were the first producer of a VGA card and a PS/2 model 30 in Taiwan. The quality of our employees is the guarantee of the quality of our products.

Products like our complete range of industry standard XT's, AT's, 386 and even 486 machines, and our recently introduced laptop. In fact our PC's cover the whole line from the low end to the most powerful systems available. But in a constantly changing market, we are not about to rest on our laurels. That is why we set up an extensive ASIC design department which enabled us to raise the reliability and quality of all our systems, while at the same time dramatically reducing costs. In today's competitive market, having the capability to design from the chip to the system level gives us a major advantage.

Our extensive use of highly-automated manufacturing rivals that used by the major multinational computer manufacturers, and is a leading factor in keeping costs low and quality high. And by maintaining offices in Europe and the U.S.A. we keep in touch with the latest technological advances and market trends.

But despite the ever changing nature of the computer industry, there is one thing of which you can be sure. Like the Pyramids, we intend to be about for a long time.

Twinhead

TWINHEAD INTERNATIONAL CORP.
GLOBAL INDUSTRIAL CENTER 2ND FLOOR, 2 LANE 235,
BAO CHIAO RD., HSIN TIEN, TAIWAN R.O.C.
TEL: (886)2-914-2549 FAX: (886)2-917-2675
TELEX: 19170 TWINHEAD

Circle 463 on Reader Service Card

BREAK FREE CATCH OUR CACHE

386 motherboards have been manufactured around the world, but the power of the 80386 CPU's have been going to waste as the computer user continues to be limited by slow speeds.

Now you can break free from the chains of poor design with the AGC C386 Cache motherboard and system. Their excellently professional design and compatibility provide the speedy high performance you are looking for without sacrificing the stability you need to get your difficult jobs completed.

C386
MOTHERBOARD

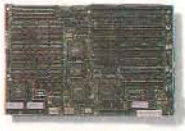
80386 25 OR 33MHz CPU OPTION, 80387 & WIETEK SOCKET.
DESIGNED WITH CHIPS™ 386 CHIP SET.
32KB CACHE MEMORY WITH INTEL™ 82385 CACHE CONTROLELR.
EXPANDABLE MEMORY WITH 8MB OR 16MB MEMORY EXPANSION CARD OPTION.
PAGE/INTERLEAVE MEMORY MODE SELECTABLE.
CACHE HIT RATIO ABOVE 95%.

P386
MOTHERBOARD

80386 20 OR 25MHZ CPU OPTION, 80287 OR 80387 CO-PROCESSOR OPTION.
DESIGNED WITH CHIPS™ 386 CHIP SET.
SIPP RAM MODULE SOCKETS ON BOARD.
EXPANDABLE TO 8MB DRAM ON BOARD WITH 8MB OR 16MB RAM CARDS AVAILABLE.
PAGE/INTERLEAVE MEMORY MODE SELECTABLE.

NESX
(P-9)
MOTHERBOARD

386SX CPU SOCKET FOR 16MHz CPU, 80387SX CO-PROCESSOR OPTION.
DESIGNED WITH CHIPS™ NEAT CHIP SET.
SIPP RAM MODULE SOCKETS ON BOARD.
EXPANDABLE TO 8MB DRAM ON BOARD.
PAGE/INTERLEAVE MEMORY MODE SELECTABLE WITH EMS 4.0 SUPPORT.



NEAT
286
MOTHERBOARD

12/16/20/24 MHz CPU OPTION, 80287 CO-PROCESSOR OPTION.
DESIGNED WITH CHIPS™ NEAT CHIP SET.
256/1MB & SIPP RAM MODULE SOCKETS ON BOARD.
EXPANDABLE TO 8MB DRAM ON BOARD.
PAGE/INTERLEAVE MEMORY MODE SELECTABLE WITH EMS 4.0 SUPPORT.

V286-12 12MHZ AT MOTHERBOARD WITH VLSI™ CHIP SET.
XT 12 MHZ MOTHERBOARD WITH V20 CPU.

*ALL ABOVE MOTHERBOARDS ARE BABY SIZE.
**BAREBONES SYSTEMS USING THE ABOVE OTHERBOARDS ARE ALSO AVAILABLE.

All trademarks are legally registered by their own respective companies and affiliates.

AGC ELECTRONICS CORP.
The Professional Manufacturer Of Personal Computers.

OFFICE: 2ND FL., NO. 481,
MIN-SHENG EAST ROAD,
TAIPEI, TAIWAN, R.O.C.
TEL: (02) 500-6695 (REP.), (02) 502-9444
TELEX: 15507 AGCELEC FAX: (02) 502-9194
CABLE: AGCTPE TAIPEI
FACTORY TEL: (02) 918-0906 (REP.)
FAX: (02) 918-5473

P9-386SX

- 80386/SX CPU
- 80387/SX Socket
- 16MHZ Zero Wait State
- EMS V4.0 DRIVER SUPPORT
- On board Memory up to 4MB
- Fully Compatible With UNIX, ZENIX, OS/2, NOVELL NETWARE
- Dealer Welcome

GMS **Galaxy Microcraft Systems Co., Ltd.**
7FL., No. 25, Lane 23, Rui-An St., Taipei, Taiwan, R.O.C.
P.O. BOX: 24-543 Taipei Tel: 886-2-7051622
Fax: 886-2-7016600 Telex: 24956 GALAXTEK

Circle 424 on Reader Service Card

"Hard to Source"

Copier and Laser Printer Parts Available

Fuser Rollers, Pressure Rollers and Picker Fingers for:

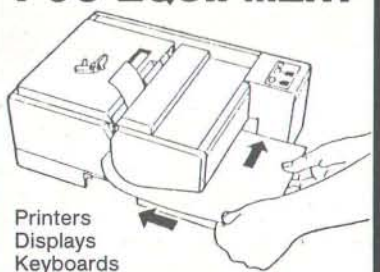
- Canon LBP-SX, LBP-CX, LBP-20 Laser Printers including Hewlett-Packard, and Apple Laser Printers
- Laser Printers using Toshiba A740 Engine and Minolta SP50B Engine

For all copiers we carry Bearings, Blades, Corona Wire, Fuser & Pressure Rollers, Picker Fingers, Photoreceptive Drums (Copiers Only), and many other parts (PRICE LISTS AVAILABLE).

WORLD WIDE COPIER PARTS, INC.
151 Forest Street
Montclair, New Jersey 07042 USA
Telephone: (201) 746-0133
Fax: (201) 746-1432
Telex: 247359-WWCP-UR

Circle 471 on Reader Service Card

POS-EQUIPMENT



Printers
Displays
Keyboards
Scanners
Drawers

Applications for MS-DOS/UNIX

dietrich *SINCE 1928*

Zähringer Staße 326
D-7800 FREIBURG/Germany
Phone 49-761-54915
FAX 49-761-56881

Circle 419 on Reader Service Card

An Optical Disk Drive

The Laserdrive Model 810 optical disk subsystem is fully DOS-compatible and provides transparent operation for existing applications software. The Model 810 is a plug-and-play WORM (write once, read many times) drive that you can use with the IBM PC and compatibles. It uses 5¼-inch removable 810-megabyte optical disk cartridges, which are exchangeable among other Laserdrive optical disk drives.

The Model 810 features full hard disk drive emulation embedded in its control unit. Ideal for archive storage of desktop publishing files, scanned images, programs, and large database files, the drive incorporates data-security and error-recovery systems to ensure the integrity of your stored data. It assures media life for a minimum of 10 years.

Internal self-diagnostics and self-calibration hardware compensate for factors such as temperature, component drift, laser-diode degradation, beam focus, and tracking error.

Two versions of the Laserdrive Model 810 are available: a single-drive unit providing 810 megabytes of storage, and a twin-drive unit providing 1620 megabytes of storage. An internal chassis version, with a controller, is also available. Other versions give direct compatibility with Macintosh II, IBM PS/2, and DEC MicroVAX II computers.
Price: £4215 for the 810-megabyte version; £6708 for the 1620-megabyte version.
Contact: Headway Computer Products, Headway House, Christy Estate, Ivy Rd., Aldershot, Hampshire GU12 4TX, UK, 44-0252-333575.
Inquiry 913.

A New Version of Freelance

Lotus Development Japan offers Freelance release 3J, a Japanese version of the company's business-graphics software package, which integrates charting, drawing, and presentation capabilities for creating professional-looking graphics and presentations.

Modifications to the original version include charting features, such as additional chart types that are specific to Japan (e.g., radar and column charts), and direct importing of data from Lotus 1-2-3 release 2J and 2.1J and from the Japanese versions of Multiplan and dBASE II and III. The program also gives you four types of kanji fonts and more than 200 new Japanese symbols and maps.

You get internal katakana-to-kanji conversion so you can input katakana to display kanji. An image utility lets Freelance accept scanner input and then converts the files from other Japanese graphics software packages into TIFF files. You can import and export files from the popular graphics packages Hanako and Kaede. The software supports more than 20 Japanese output devices.

Freelance release 3J is available for NEC's PC-9801, IBM Japan's PS/55, and Fujitsu's FM-R series of computers.
Price: 98,000 yen.
Contact: Lotus Development Japan Corp., Toranomon MF Building No.10, 3-10-11 Toranomon, Minato-ku, Tokyo 105, Japan, 81-03-436-4105.
Inquiry 917.

continued

The Perfect Pirouette
Excellence worth a front row

High performing PCs that satisfy even the most scrupulous users, are surprisingly affordable.

Investing in the Samsung 386 Micro Computer SD830, means you're not only getting a highly cost-efficient package, but you're also getting Samsung's service as a total systems vendor. Based on the floor-standing type 33 MHz 386 microprocessor, SD830 is a powerful microcomputer ideally suited for file server and other high-performance applications.

As a total systems vendor, Samsung also produces a variety of XT, AT, and LAP-TOP computers based on 10 MHz — 33 MHz. By developing state-of-the-art computers as well as sophisticated semi-conductors and peripherals, Samsung has propelled itself as one of the leaders in the integrated information industry.

- **Standard memory — 4 MB on board (8 MB — 40 MB)**
  Cashe memory — 64 KB
- **Color monitor capable of supporting DTP and Application CAD/CAM; Super VGA compatible.**
- **Dot Printer (9 pin 300 cps, 24 pin 220 cps) Laser Beam Printer (8 ppm)**

* XT and AT are registered trade marks of IBM.

SAMSUNG Electronics

Head Office:
Samsung Electronics Co., Ltd.
6-14th Fls, Ankuk Insurance Bldg.,
87, 1-ka, Ulchi-ro, Chung-ku,
Seoul, Korea.
Tel: (82-2) 771-78
Fax: (82-2) 753-3037

Overseas Address:
Samsung Electronics U.K. Ltd.
Unit 1, Hook Rise Business and
Industrial Centre 225, Hook Rise
South Surbiton, Surrey KT6 7LD,
U.K.
Tel: (44-1) 391-0168

Samsung Electronics GmbH
Daimlerstrasse 6, 6374 Steinbach/TS,
W/Germany
Tel: (49-6171) 708-200

Samsung Information Systems France
B.P. 146 Tour Maine-Montparnasse,
33 AV, DU Maine-75755,
Paris Cedex 15, France
Tel: (33-1) 4538-6836

Circle 449 on Reader Service Card

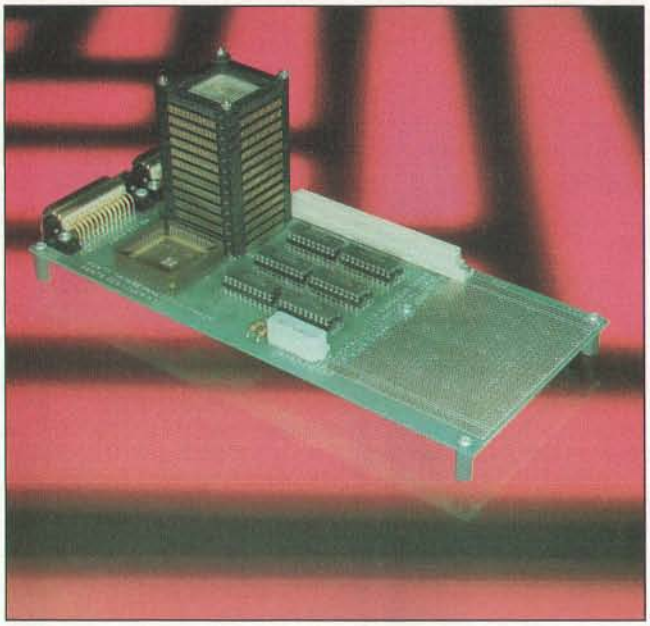
A Designer's Kit for Chiprack Systems

Dowty Interconnect offers a Designers Kit for its Chiprack interconnection system that gives you an introduction to the high-density and fast-assembly benefits of Chiprack. You can also customize the kit to provide processing power for a variety of applications.

The Designers Kit consists of an assembled stack on a motherboard and a power cable. The stack includes Philip's 68070 CMOS CPU chip, an RS-232C serial interface, an application-specific IC providing a memory interface and other processor services, 64K bytes of one-time programmable CMOS ROM for monitor software, and up to eight Chiprack carriers, each holding two 32K-byte by 8-bit CMOS static RAMs. Versions of the Designers Kit are also available with 64K, 128K, 256K, and 512K bytes. The fully configured 512K-byte stack measures 7 by 4 by 4 cm. The motherboard contains signal buffers for address and data lines, signal and power connectors, and an area for user prototyping.

The 68070 CPU is fully compatible with Motorola's 68000 microprocessor. It is a highly integrated device with an on-chip clock generator, a memory management unit, a two-channel direct-memory-access controller, a universal asynchronous receiver/transmitter serial interface, a 16-bit timer/counter, and two 16-bit match/count/capture registers, as well as Philips' I²C bus interface.

On-board software helps you develop machine code and other programs on a host computer, download them via the RS-232C serial port, run them, and manipulate them in the Chiprack system.



The Designers Kit for the Chiprack interconnection system from Dowty Interconnect consists of an assembled stack on a motherboard and a power cable.

You can prototype on the motherboard and then simply remove the stack for incorporation into your equipment. Although the stack is bolted together on the Designers Kit, another version will feature snap-together connectors for rapid assembly. An IBM PC interface card, for connection to an I²C port, and a cross-assembler are also available as options.

Price: £525 and up.

Contact: Dowty Interconnect, Knaves Beech Business Centre, Loudwater High Wycombe, Buckinghamshire HP10 9UT, UK, 44-0628-810810.

Inquiry 904.

New and Improved Tempus for the Atari ST

HiSoft has extended the features of its Tempus editor for Atari ST computers to include new commands and a full range of keyboard shortcuts and installation options. Among the new features of Tempus 2 are a fast GEM editor, three cursor modes, optional word wrap with justification, search and replace with wild cards, flexible text conversion, block commands, cross-reference generation, and optional printing of line numbers. You can also edit and compare up to four files, call other programs from within Tempus 2, and check the structure of the file. In addition, you get automatic file-save and screen-off features, a built-in calculator, undoable UNDO, a sort utility, and a customized file selector.

Tempus 2 comes with a manual containing a full reference to all the commands, plus details for configuring the editor to your own requirements.

Price: £39.95.

Contact: HiSoft, The Old School, Greenfield, Bedford MK45 5DE, UK, 44-0525-718181.

Inquiry 899.

Turn Your IBM PC into an ANSI Terminal

QuickTerm-ANSI from Glance lets you use an IBM PC as an ANSI terminal, so you can connect the computer to Xenix multiuser systems without any loss of functionality. The terminal emulator processes the Xenix control sequences and provides user-programmable function keys.

The basic functions of QuickTerm-ANSI are identical to those of the QuickTerm Emulators for VT220 and Wyse 50 terminals. The QuickTerm product family supports two RS-232C interfaces, direct memory or modem operation, and free setup of the data transmission format, including protocol selection (e.g., XON/XOFF, DTR, and RTS).

Other features include a Kermit file transfer utility, which you operate directly from the emulator; switchable screen presentation, between 24 by 80 and 24 by 132 characters; branching to DOS level; functions such as local mode, capture mode, print mode, Print Screen, and Scroll Lock; and a status line for displaying the operating condition of the emulator. There is an option that lets you operate without the status line so you can use all 25 lines of the screen.

Price: 380 Swiss francs each.

Contact: Glance Ltd., Gewerbestrasse 4, CH-8162 Steinmaur, Switzerland, 41-01-853-39-49.

Inquiry 942.

continued

The HASP Family: Software protection you can trust. Software protection you can afford.

As a software producer, you can't market your software without protecting it. Aladdin Knowledge Systems is a leading company in the field of software protection: during the last four years we have enabled hundreds of software producers in more than 30 countries to protect their software.

We, at **Aladdin**, believe that software protection is a serious business which demands a high level of knowledge and expertise in order to give you a reliable and lasting protection for your intellectual property.

Basing our research on the experience we accumulated with **HASP-II**, we are now launching two new HASP plugs designed to protect your software through the coming decade - **HASP-3 and MEMOHASP: software protection for the nineties.**

HASP-3™ connects to the parallel port* of PC/XT/AT and PS/2 computers and compatibles. HASP-3's advanced technology prevents reverse engineering, making the plug virtually un-crackable.

- **Access Password** - A unique password supplied to the software developer is needed in order to access the plug's code. The number of available codes and passwords is enormous (more than 256,000 billion!).
- **The Highest Compatibility** - The plug is transparent to the operation of the computer and the printer.
- **Full Software Support** - All the software required to link HASP-3 to all high-level languages - including the most sophisticated anti-debugging protection and a utility program to protect EXE/COM files - is supplied.
- **Daisy-chaining** - Several plugs can be connected one behind the other.
- **There is no Battery in the Plug!**

* A serial RS232 HASP is available as well.

MEMOHASP™ is the last word in software protection. In addition to all of HASP-3's advantages, **MEMOHASP's 1000 bits of read/write memory enable you to:**

- Assign a unique code to every software user.
- Control access to different software modules or different software packages.
- Distribute demos which can be activated only a certain number of times.
- Rent or lease software.
- Save passwords or other sensitive information.

Most important of all: all the above operations are performed on the PC without any special programming equipment!

For further information contact us at

ALADDIN
KNOWLEDGE
SYSTEMS LTD

130 Dizengoff St., Tel-Aviv
P.O.Box:11141 Tel-Aviv 61110, Israel
Tel: (972) 3 226286, 3 241603
Tlx: 35770/1 COIN IL Ext. JBL
Fax: (972) 3 243540

© 1985-1989 Aladdin Knowledge Systems Ltd.

Spain Format Computers S.A., Santalo 120, 08021 Barcelona, Phone: (93) 209 5344, Fax: (93) 201 5169 • **The Netherlands** Akkermans Service B.V., Valkenbergstraat 1, Eygelshoven 6471 VL, Phone; (045) 352 753, Fax: (045) 461 822 • **West Germany**, CSS GmbH, Am Westbahnhof 2, 4300 Essen 1, Phone: (0201) 707 041/42 Fax: (0201) 748 644 • **Greece**, Unibrain Ltd., Bousgou 2, Pedio Aeros, Athens 114 73, Phone: (1) 646 5195, Fax: (1) 642 3648

Circle 407 on Reader Service Card

IBM-PC BUS
Input/Output Cards

DIP-24	Opto-isolated digital input
DOP-24	Opto-isolated Darlington output
PIO-48	TTL level digital input/output
DPC-10	Pulse counter/timer/generator
DCM-16	8 Inputs, 8 Outputs, CTC
AIP-24	12 Bit ADC input
AOP-8	12 Bit DAC output
AIS-16	12 Bit isolated ADC input
TIP-8	Thermocouple input
SIO-2	RS232/422/485/20mA I/O
ST-24	Screw terminal adaptors
BXT	Backplane extenders
BP-5/11	5/11 Slot backplanes

BLUE CHIP TECHNOLOGY

Blue Chip Technology
Main Avenue, Hawarden Industrial Park
Manor Lane, Deeside CH5 3PP U.K.
Telephone: (0244) 520222
Telex: 61471 Fax: (0244)531043

Agents Wanted

Circle 411 on Reader Service Card

X Window System*

As the European centre of X expertise, IXI can help you exploit this important software standard

- Documentation
- Source Code
  Latest release of X11 on 0.25" cartridge tape and IBM PC-AT format floppies 5.25"
- Training
  Includes 4 day Programmer's Workshop
- Consultancy

Call +44 223 462131

IXI Limited

62-74 Burleigh Street, Cambridge, CB1 1OJ, England

* X Window System is a trademark of MIT

Circle 431 on Reader Service Card

NEED MEMORY?

All *WE* need is:

54 KB - WKS, 67 KB - Server

Even LESS with new Expanded-Memory-Version - EMS 4.0 (Nov. 89)! **Easynet NOS/2** is a full featured LAN operating system which is 100% NETBIOS and MS/PC-DOS 3.1 compatible and works with any Arcnet, Ethernet or Token Ring interface cards. Start with a 5 user system and easily upgrade later to a full 250 user system. Some Features are : Print-Spool-Popup with Forms Control, Directory and File Security System, Data Encryption, Unload Function, Online Help! Supports Bridges, Gateways, Shared Modems, CD-ROMs and much more! Multi-Tasking **Easynet NOS/2** is easy on memory, easy to install AND easy on your BUDGET! Availible in English and German Versions! Call now for a DEMO-System!

See us at SYSTEMS '89 - Munich, W. Germany
Hall 16, Booth D12-E11 (Canada)

GET EASYNET NOS/2 - LAN

Dealers and Distributors WANTED! - Alive!

SOFTTEK Computer, Box 9, D-3360 Osterode 14
Tel. (49) 5522/75421 Fax. (49) 5522/5112

Circle 453 on Reader Service Card

Languages for Digital Circuits

SzKI offers two high-level programming languages for describing digital circuits: OPART, a functional-description language and compiler, and TESTART, a test-description language and compiler.

You use OPART to model digital-circuit operations, logic simulation, and fault detection–test generation. OPART lets you use two types of functional descriptions: normal operation and inverse operation. You use the normal description for simulation purposes, and the inverse description for test calculation.

OPART gives you a five-value logic system (0, 1, don't care, unknown, and high-impedance value) and built-in functions for bit vectors. You can use subroutines, arbitrary vectors and arrays, and conditional and unconditional branching, as well as branching according to the actual values of variables. It includes arithmetic and logic operations that you can use to describe relations, logic expressions, and Boolean functions.

You can use a run-time system to process the object code generated by the compiler. One application of the object codes is the DIAS test-design and fault-simulation system, which is capable of processing the logic circuit you design in OPART either as an element of a logic diagram or as a self-contained module. The compiler produces lists of program text, user errors, and cross-references.

You use TESTART to describe the testing and trouble-shooting procedures of digital circuits up to the LSI and VLSI levels. TESTART programs consist of instructions that define the programmable electric and timing parameters of automatic measuring equipment.

TESTART has many of the same features as OPART, including arithmetic and logic operations that you can use to describe relations, logic expressions, Boolean functions, and built-in functions for bit vectors. Other features include complex special instructions for defining test measurements, and the use of integer, binary, character, and circuit-pin variables.

The compiler executes the compilation in three steps: the syntactic and semantic control of the source language test, generation of the intermediate code, and generation of the final object code on disk. It also generates program lists, lists of user errors, cross-reference lists, and assignment lists of interfaces.

OPART and TESTART run on the IBM XT with 256K bytes of RAM and DOS 3.2. OPART also runs on the VAX-11/730-780 or MicroVAX II computers under VMS.
Price: $3000 U.S. for OPART; $6000 U.S. for TESTART.
Contact: SzKI Computer Research and Innovation Center, Donáti 35-45, H-1251 Budapest, Hungary, 36-1-35-01-80.
Inquiry 891.

Consumption Tax Form Set for KIRI

Kanri Kogaku Labs offers its KIRI 2.0 DBMS with a set of 40 forms for consumption tax. You can use the forms with either the internal or external calculation methods.
Price: 3000 yen for current KIRI owners.
Contact: Kanrikogaku Kenkyusho Ltd., 3-3-1 Nishi-Azabu, Minato-ku, Tokyo 106, Japan, 81-03-405-5521.
Inquiry 927.

continued

NEW

A REAL KEYBOARD TERMINATOR YOU CAN FIND THIS CENTURY IS NOW PRESENTING

Our excellent reputation has encouraged us to continue our research and development to better serve computer users, now and in the future. These efforts will never cease. Contact us now for further information.

FT-100 SERIES TRACK BALL

- Matched fully with focus serial keyboards:
- Optionally connected to RS-232 or focus serial keyboards.
- Adjustable rack in the back 5-10 degrees.
- Four regal-sticked rubbles on the bottom to prevent moving.
- Attached with operation diskette.
- Legal copyright of software.
- 3 control buttons with ergonomic designed for PC/MS selection.
- Offered stand RS-232 output and 9 pin D-connector with 9-25 pin adapter.
- PC/MS mouse system switchable.

FK-5001 130KEYS PC/PS2 COMPATIBLE KEYBOARD

<10 EXTRA SURPRISE>

- Special offer of "2 sets 12 function keys" on upper and left position.
- CAPLOCK and CTRL key exchangeable.
- 8 direction arrow keys for choice to track cursor.
- 12 kinds of speed change by pressing focus + F1..F12 keys.
- Attached with a "solar calculator" and offer keyboard/calculator switch to choice function you need.
- Furnishing calendar and extra 6 kinds of the most popular function description plates for necessary. There are changeable and tilted adjustment 6 to 12 degree.
- 4 dips switch selection for "XT, enhanced XT, AT, enhanced AT/PS2".
- External phone jack cable for pc and ps2.
- Reserving a mini din socket for connecting track ball or mouse.
- Double shoot keycaps to guarantee 20 million times typing.

FK2000 series

* FK-2001 101-key US version
* FK-2002 102-key European version
* Double injection keycaps
* Customers' mold logo tabs
* With attached "Dust cover & copy holder"
* Alternating CTRL, CAPLOCK key function
* 4 dip switch: XT,EN XT, AT,EN AT/PS2
* Mechanical tactile switch with click

FK3000 series

* FK-3001 111-key US version
* FK-3002 112-key European version
* Double injection keycaps
* Customers' mold logo tabs
* With big-caps "Solar calculator"
* Alternating CTRL, CAPLOCK key function
* 4 dip switch: XT,EN XT, AT,EN AT/PS2
* Mechanical tactile switch with click

FK1000 series

* FK-1001 101-key US version
* FK-1002 102-key European version
* Double injection keycaps
* Laptop layout designed
* Size: 420(W) x 177(D)mm
* Customers mold logo tabs
* 4 dip switch: XT,EN XT, AT,EN AT/PS2
* Mechanical tactile switch

FCC Approved!

patent eingetragen

FOCUS

FOCUS ELECTRONIC CO., LTD.
Head Office
No. 120 Fu-Kung St., Shih Lin Taipei 11152, Taiwan, R.O.C.
Tel: 886-2-8826770. Fax: 886-28824377.
Telex: 26161 FOCUSKB.

U.S.A.
FOCUS ELECTRONIC CORP.
9080 Telstar Ave., #302-304 El Monte, CA 91731 U.S.A.
Tel: (818)280-0416.
Fax: (818)280-4729.

Canada
FOCUS ELECTRONIC (CANADA) INC.
#103-11511, Bridgeport Rd., Richmond (Vancouver) B.C., Canada, V6X 1T4. Tel: (604)273-8086.
Fax: (604)271-8435.

Circle 422 on Reader Service Card

Bilingual Translation Dictionaries

INK International offers a range of bilingual translation dictionaries designed for use with its TermTracer and TextTools terminology management programs (see March 1988 What's New International, pages 88A-4 and 88A-8, and July, page 88IS-28).

Together with the TermTracer and TextTools programs, the dictionaries provide instant access to technical terms and translations, as well as to contextual and usage information.

The Computer Dictionary contains more than 4600 terms with more than 6100 translations, covering computers, automation, and data communications. It is available in English to French, German, Dutch, Spanish, and Italian, and in those languages to English.

The Business and Office Dictionary contains more than 4500 terms with more than 6000 translations. It covers standard business expressions, as well as terms related to the office environment and administration. This dictionary is available in the same languages as the Computer Dictionary.

The Medical Dictionary contains 7500 terms and more than 9000 translations. It is available in all language combinations between English, French, German, and Dutch.

The Legal Dictionary contains 3400 terms with more than 5000 translations and is available in the same language combinations as the Medical Dictionary.

The Economics and Trade Dictionary covers the fields of international trade, economics, and finance, and it contains 3100 terms with 5000 translations. It is also available in all language combinations between English, French, German, and Dutch.

Price: 140 Dutch guilders each for the Computer Dictionary and the Business and Office Dictionary; 185 DFL for the Medical Dictionary; 125 DFL each for the Legal Dictionary and the Economics and Trade Dictionary.

Contact: INK International BV, Prins Hendriklaan 52, 1075 BE Amsterdam, The Netherlands, 31-20-664-6361.

Inquiry 933.

Eight Serial Channels on One Card

DSP Design's SL802 is a communications controller card with eight RS-232C serial channels. Each channel has handshaking capabilities and programmable data-transfer-rate generators that support asynchronous operation up to 38,400 bits per second.

The single Eurocard uses Zilog's 8530 serial communications controller. Serial data transfers can be interrupt-driven, using vectored or nonvectored interrupts, or performed under direct-memory-access control. You can jumper-link interrupts that you generate on-board to any one of the eight STEbus ATNRQn lines.

You can link serial cards together using the 60-way insulation displacement connector mounted on the front of each card. Software support is available in the form of source code listings for Z80-, 64180-, and 8086-compatible CPUs running under DOS or CP/M.

Price: £250.

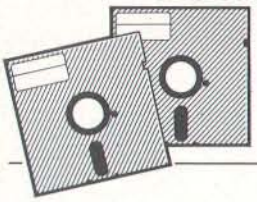
Contact: DSP Design Ltd., Unit 1, Apollo Studios, Charlton Kings Rd., London NW5 2SB, UK, 44-01-482-1773.

Inquiry 888.

continued

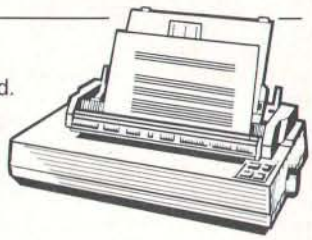
SMART PC-
06-SOFTW
CALL OR WRITE FOR EXTENSIVE
IN MOST EUROPEAN LANGUAGES

06 SOFTWARE CENTRE EUROPE
AUTHORIZED BY:



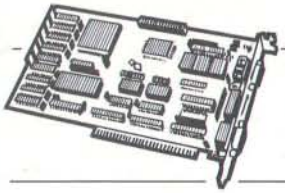
Microsoft, Lotus, WordPerfect, Ashton Tate, Computer Associates, SmartWare, Borland Int., SPSS Inc., NOVELL.

Citizen, Epson, Hewlett Packard. Oki, Hermes, Star, Seikosha, Canon, Kyocera, VISA. Matrix printers/laser printers/ plotters.



Compaq, Tandon, Tulip, Amstrad, XT/AT/286/386/Laptop.

NEC, ADI, AST, MDS. Monochrome/colour/CGA/VGA/EGA.



AST, ATI, Hercules, Paradise, Tecmar, Video 7, Intel, IDEA. Memory expansion/graphics/fax.

■ Prices incl. VAT ■ Add shipping charge from Amsterdam ■ Special discounts and credit facilities for large or corporate accounts incl. government agencies ■ Fast delivery, special courier service on request, call for price quote ■ Payments may be made by creditcard, Eurocheque, C.O.D. or by bank transfer in advance ■ All European currencies accepted, call for latest exchange rates.

YES, I would like to receive 06 Software Centre Europe's free catalogue with details on your service and other products. Please send your extensive catalogue without any obligation to:

Name: _____ male/female _____

Position: _____

Company: _____

Address: _____

Postal code/City: _____ Country: _____

Phone: _____ 34

Please send this coupon to 06-Software Centre Europe, Alpen Rondweg 102, NL-1186 EA AMSTERDAM (Amstelveen) NETHERLANDS.

Circle 401 on Reader Service Card

USERS PURCHASE AT ARE CENTRE EUROPE

CATALOGUE WITH LOW-PRICED SOFTWARE

The most complete software range with:
1. Discounts up to 50%. **2.** Prompt delivery. **3.** Expert sales advice. **4.** Test and training facilities. **5.** Hot line support. **6.** Updates at the lowest prices. **7.** Up-to-date information. **8.** Software in 10 European languages. **9.** Free PC assembly, testing and 24 hours burn-in period.

Call us today toll-free* on our international telephone lines!
06-Software Centre Europe operates toll-free* numbers in: Germany, Switzerland, United Kingdom, France, Belgium and the Netherlands. Check your local number below!

LOW-PRICED SOFTWARE IN MOST EUROPEAN LANGUAGES FOR IBM-PC, PS/2 AND APPLE MAC

PRICES INCL. VAT EXCL. SHIPPING CHARGE

JUST A SMALL SELECTION FROM OUR EXTENSIVE RANGE:

	Preis einschl. 14% MWSt. DM	Price incl. of 15% VAT GBP	Prix incl. 18,6% T.V.A. FRF
WORDPROCESSORS			
Manuscript **NL-F**	971	308	3,473
Manuscript **GB**	876	278	3,132
Manuscript **D**	1,189	377	4,251
MultiMate Advantage II **GB**	1,160	368	4,147
MultiMate Advantage II **NL-F-D**	1,239	393	4,433
Word 5.0 **GB**	740	235	2,646
Word 4.0 **NL**	957	303	3,423
Word 4.0 **F**	1,011	321	3,617
Word 4.0 **D**	1,208	383	4,319
WordPerfect 4.2 **GB-NL-F-D**	call	call	call
WordPerfect 5.0 **GB-NL-F-D**	call	call	call
WordStar 3.4 **NL-D**	1,046	332	3,742
WordStar 5.5 **GB**	1.006	319	3,599
DATABASES			
Clipper dBase III Compiler **GB**	1,399	444	5,003
Clipper dBase III Compiler **D**	2.033	645	7,272
dBase III Plus **GB-NL-F-D**	call	call	call
dBase IV MS/DOS **GB-NL-F-D**	call	call	call
dBase IV Developers Edition **GB-NL-F-D**	call	call	call
DataBase 4.0 **GB**	2,192	695	7,839
Paradox 3.0 **GB**	1,197	380	4,281
Paradox 3.0 **D**	1,805	572	6,455
Paradox 386 **GB**	1,470	466	5,255
Paradox 386 **D**	1,805	572	6,455
RapidFile **GB-NL-F-D**	618	196	2,209
Reflex **GB**	409	130	1,464
Reflex **D**	425	135	1,521
SPREADSHEETS			
Excel **GB**	815	258	2,913
Excel **NL**	1,052	334	3,762
Excel **F**	1,127	357	4,030
Excel **D**	1,208	383	4,319
Lotus 1-2-3 v.2.2 **GB-NL-F-D**	call	call	call
Lotus 1-2-3 v.3.0 **GB-NL-F-D**	call	call	call
Multiplan **GB**	319	101	1,142
Multiplan **NL**	414	131	1,479
Multiplan **F**	631	200	2,258
Multiplan **D**	700	222	2,502
Quattro **GB**	424	134	1,516
Quattro **D**	568	180	2,030
SuperCalc 5 **GB**	745	236	2,665
SuperCalc 5 **D**	1,521	482	5,438
INTEGRATED PACKAGES			
WordPerfect Executive **GB**	424	134	1,516
WordPerfect Executive **D**	682	216	2,438
Framework III **GB**	1,471	466	5,259
Framework III **NL**	1,550	492	5,545
Framework III **F-D**	1,757	557	6,282
Symphony 2.0 **GB**	1,219	386	4,359
Symphony 2.0 **NL-F**	1,321	419	4,725
Symphony 2.0 **D**	1,629	516	5,825
Q & A **GB**	611	194	2,187
Q & A **NL-D**	1,239	393	4,433
Works **GB**	237	75	849
Works **NL**	373	118	1,334
Works **F-D**	448	142	1,602
LANGUAGES AND PROGRAMMING TOOLS			
C Asynch Manager **GB**	411	130	1,471
C Compiler 5.1 **GB**	740	235	2,646
C Tools Plus **GB**	317	101	1,134
Macro Assembler 5.1 **GB**	245	78	875
Quick Basic Compiler 4.5 **GB**	163	52	582
Quick Basic Compiler 4.0 **F**	224	71	801
Quick C Compiler **GB**	163	52	582
Quick C Compiler **F-D**	224	71	801
Turbo Basic **GB**	186	59	663
Turbo Basic **D**	258	82	922
Turbo C Compiler 2.0 **GB**	268	85	960
Turbo C Compiler 2.0 **D**	356	113	1,272
Turbo Pascal **NL**	268	85	960
Turbo Pascal **D**	356	113	1,272
Turbo C Professional **GB**	428	136	1,531
Turbo C Professional **D**	554	176	1,982
Turbo Power Tools Plus **GB**	305	97	1,090
Turbo C Tools **GB**	305	97	1,090
Windows 286 **GB**	163	52	582
Windows 286 **NL**	210	67	752
Windows 286 **F-D**	339	108	1,214
Windows 386 **GB**	319	101	1,142
Windows 386 **NL**	415	131	1,483
Windows 386 **D**	568	180	2,030
MISCELLANEOUS			
Carbon Copy Plus **GB**	329	104	1,175
Chart **GB-F**	645	204	2,305
Chart **D**	932	296	3,334
Disk Optimizer **GB**	154	49	552
FastBack Plus **GB**	307	97	1,097
Freelance Plus 3.0 **GB**	971	308	3,473
Freelance Plus 3.0 **F**	1.028	326	3,678
Freelance Plus 3.0 **D**	1,279	405	4,574
Harvard Graphics **GB-NL**	906	287	3,239
Harvard Graphics **D**	1,102	349	3,940
Magellan 1.0 **GB**	362	115	1,293
Magellan 1.0 **F-D**	306	97	1,093
Norton Editor **GB**	115	36	411
Norton Commander 2.0 **GB**	127	40	456
Norton Utilities **GB**	140	44	500
Pagemaker 3.0 **GB**	1,964	623	7,023
PC Tools Deluxe 5.5 **GB**	233	74	834
SPSS/PC+ Base System **GB**	2,258	716	8,076
Ventura 2.0 Basic Edition **GB-NL-D**	call	call	call
MAC SOFTWARE	call	call	call
XENIX SOFTWARE	call	call	call

prices subject to change without notice, call for current prices

CALL US TODAY TOLL-FREE*ON OUR INTERNATIONAL TELEPHONE LINES!

D	UK	CH	F	NL	B
* Rufen Sie uns an zum Ortstarif:	Free Phone:	* Rufen Sie uns an zum Ortstarif:	Numéro Vert:	Bel Gratis:	Bel Gratis/ Numéro Vert:
0130-811466	0800-898438	04650-5850	19-05906177	06-0-228800	11-8206

Our showroom with the largest selection from hundreds of software and hardware products.

06 SOFTWARE CENTRE EUROPE®

Alpen Rondweg 102 NL-1186 EA AMSTERDAM (Amstelveen) NETHERLANDS
Tel.: (31)20-434321 - FAX: (31)20-473032 - Telex: (044)11938 SWARE NL
Branches also in Düsseldorf and London.

Circle 402 on Reader Service Card

Upcoming International Events

International Electronics Fair

The First International Electronics Fair is set for October 16–19 in Hong Kong at the new Hong Kong Convention and Exhibition Center.

About 350 companies will be exhibiting consumer products such as audio equipment, TV sets, household electrical appliances, and toys and games. Other products, such as data processing and telecommunications equipment, personal computers, computer peripherals, printers, photocopiers, and fax machines, will also be exhibited.

Contact: Hong Kong Trade Development Council, 673 Fifth Ave., New York, NY 10022, U.S.A., (212) 838-8688.

Inquiry 907.

Image Processing '89

Scheduled for October 10–12 at the Wembley Exhibition Center, Image Processing '89 is an exhibition and conference concentrating exclusively on image processing. Among the companies exhibiting are Wang, Ramtek, Pulnix, Intergraph, Joyce-Loebl, Kontron, Synoptics, and Ambitron.

Contact: Blenheim Online Ltd., Blenheim House, Ash Hill Dr., Pinner, Middlesex HA5 2AE, UK, 44-01-868-4466.

Inquiry 908.

Imagica '89

The latest in computer graphics and CAD/CAM research developments, new applications, technological breakthroughs, and industrial innovations will be featured at Imagica '89 on October 24–26 in Lyon, France. This fifth international computer graphics show and symposium is a forum for discussions, demonstrations, and workshops on CAD and manufacturing techniques and systems.

Imagica '89 is where graphics image designers and industrial users can meet to propose real-life solutions to users' problems.

Contact: Chambre de Commerce et d'Industrie de Lyon, 3, place de la Bourse, 69289 Lyon Cedex 02, France, 33-78-38-10-10.

Inquiry 910.

InfoSystem '89

InfoSystem '89, the third International Exhibition of Information Systems, will be held November 1–5. Exhibits will include computers, peripheral equipment, computer manufacturing components, supplies, telecommunications, office machines, software, security and safety products for information systems, and office automation.

Contact: HELEXPO, Thessaloniki, 154, Egnatia Str., 546 36 Thessaloniki, Greece, 30-031-239-221.

Inquiry 909.

continued

Computers For The Blind

Talking computers give blind and visually impaired people access to electronic information. The question is how and how much?

The answers can be found in "The Second Beginner's Guide to Personal Computers for the Blind and Visually Impaired" published by the National Braille Press. This comprehensive book contains a Buyer's Guide to talking microcomputers and large print display processors. More importantly it includes reviews, written by blind users, of software that works with speech.

This invaluable resource book offers details on training programs in computer applications for the blind, and other useful information on how to buy and use special equipment.

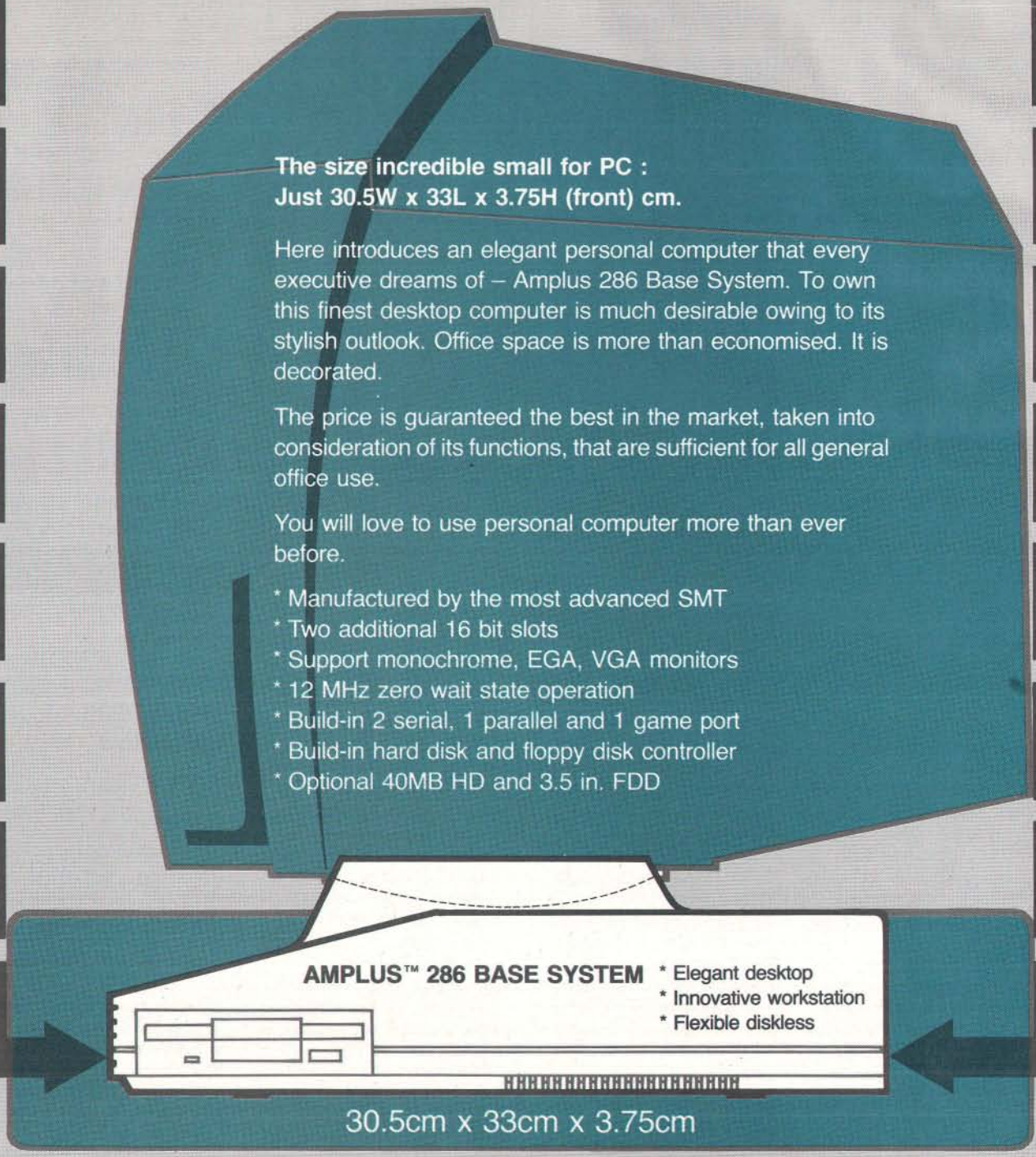
Send orders to:

National Braille Press Inc.
88 St. Stephen Street
Boston, MA 02115
(617) 266-6160

$12.95 for braille or cassette, $14.95 for print. ($3 extra for UPS shipping)

NBP is a nonprofit braille printing and publishing house.

Can You See It?



The size incredible small for PC :
Just 30.5W x 33L x 3.75H (front) cm.

Here introduces an elegant personal computer that every executive dreams of – Amplus 286 Base System. To own this finest desktop computer is much desirable owing to its stylish outlook. Office space is more than economised. It is decorated.

The price is guaranteed the best in the market, taken into consideration of its functions, that are sufficient for all general office use.

You will love to use personal computer more than ever before.

* Manufactured by the most advanced SMT
* Two additional 16 bit slots
* Support monochrome, EGA, VGA monitors
* 12 MHz zero wait state operation
* Build-in 2 serial, 1 parallel and 1 game port
* Build-in hard disk and floppy disk controller
* Optional 40MB HD and 3.5 in. FDD

AMPLUS™ 286 BASE SYSTEM

* Elegant desktop
* Innovative workstation
* Flexible diskless

30.5cm x 33cm x 3.75cm

ABC–Building Blocks For Your Computers

ABC

ABC Computer Co. Ltd.
Headquarters & Manufacturer:
Basement 66, Golden Shopping Centre,
148 Fuk Wah Street, Shamshuipo,
Kowloon, Hong Kong.
Tel: 852-3-7290238
Fax: 852-3-879279
Telex: 52178 ABCTC HX
Cable: ABCTDGCO HK

ABC Computer (U.S.A.) Corp.
U.S. Office:
2531 237th Street, Suite 122,
Torrance, California, 90505,
U.S.A.
Tel: 213-325-4005
Fax: 213-325-6369

ABC Computer (S) Pte. Ltd.
Singapore Office:
1, Rochor Canal Road,
#05-28, Sim Lim Square,
Singapore 0718
Tel: 65-3387228
Fax: 65-3368643

See us at R8211, R8215
COMDEX/Fall '89
November 13-17, 1989
Riviera Hotel
Las Vegas, Nevada

See us at Booth 4074 Hall 4
SINGAPORE INFORMATICS '89
The IT event of the year
December 7-10, 1989
World Trade Centre
Singapore

Circle 403 on Reader Service Card

Analyze and Display Surface Profiles

The Nanosurf 488 profilometer from SAS Technologies not only analyzes but displays surface profiles in two and three dimensions. The system lets you visualize microscopic surface roughness so you can see the vulnerable zone exposed to corrosion, contamination, and wear, as well as the source of contact, adherence, and lubrication problems.

For three-dimensional profilometry, you place the surface of a sample on a base plate fixed to a pair of stepping motors. These motors move in the same plane along two perpendicular directions, x and y, under a fixed sensor. The system then scans a zone of the sample surface along a series of parallel lines.

All the system's components are connected to and controlled by an IBM AT. The computer controls the synchronization of the motor displacement and handles data acquisition, A/D conversion, and data processing, including topographic display and statistical characterization of the surface.

The software, called Nano88, gives you a multitude of possibilities and functions for 2-D and 3-D analysis, such as rapid acquisitions, multidirectional viewing, contour mapping, zoom display, surface characterization, least-square plane-surface smoothing, and high- and low-pass numerical filtering.

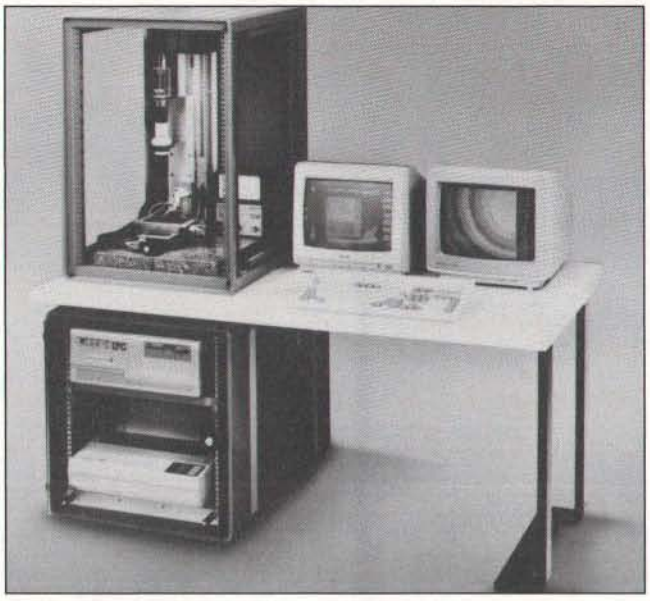
Since the Nanosurf 488 system is basically independent of the sensor, you can use it to convert an existing 2-D system into a 3-D one, with a visualization axis ranging between 30 and 75 degrees. The optional charge-coupled-device camera lets you locate and identify up to 16 zones and enlarge them on the color video screen. You then automatically acquire 3-D profiles of those same zones. The system provides vertical resolution of up to 10 nm, while the minimum horizontal resolution step can be as fine as 100 nm with the optional high-resolution motor.

The Nano88 software runs on the IBM AT with 1 megabyte of RAM, DOS 3.3, a 40-megabyte hard disk drive, and an EGA color monitor. SAS Technologies offers Nanosurf 488 as a turnkey 3-D system, or the company can transform your existing 2-D profilometer into a 3-D system.

Price: 340,000 to 427,000 French francs.

Contact: SAS Technologies, Technoparc, rue du Cristal, 45072 Orléans Cedex 2, France, 33-38-76-03-03.

Inquiry 934.



You can analyze and display surface profiles in two and three dimensions with Nanosurf 488.

A Portable Data Terminal

Traveling personnel will appreciate the Vision-100 portable data terminal from Ranger Computers. The terminal is based on the Z88 portable computer and emulates an extensive subset of commands from the industry-standard VT100 terminal. For example, you can use the terminal to access your company's central computer systems from the field and interrogate computer-based equipment, such as traffic-light controllers and telephone exchanges in the field.

The terminal has a pixel-map feature that displays a miniature rendition of the full 25-line page on the right-hand side of the screen. This pixel map lets you instantly see the overall screen display and the position of the terminal's eight-line LCD window. Special software ensures that the window always displays the part of the screen containing the cursor, while letting you flip the window to other areas.

For data transfer applications, the emulator lets you transmit files prepared using the Z88's built-in word processing software. You can also capture information on the screen for later off-line use. The terminal supports data transfer speeds of up to 9600 bps over the RS-232C serial interface.

Vision-100 has a full-size keyboard and operates from its own internal batteries. It weighs only 21 pounds and is the size of an A4 notebook. To complete the package, a battery-operated modem and a range of connecting cables are also available.

Price: £375 for the terminal and the software; £175 for the software alone.

Contact: Ranger Computers Ltd., The Innovation Centre, Boughton Green Rd., Moulton Park, Northampton NN2 7AH, UK, 44-0604-791064.

Inquiry 935.

Virtual 8086–Mode EMS Driver

IO Data's IOS-10/386 device driver for 80386 and 80386SX machines offers EMS 4.0, bank memory specification, and bank switching for system memory over 1 megabyte. The company ported the DOS environment to the virtual 8086 mode and used a paging mechanism to change memory mapping for high-speed access on a par with bank memory boards. The IOS-10/386 will also offer conventional functions such as a disk cache, a RAM disk, and bank drivers.

Price: 6,000 to 8,000 yen for the NEC PC-9801 series 80386 and 80386SX machines and the PC-386 series.

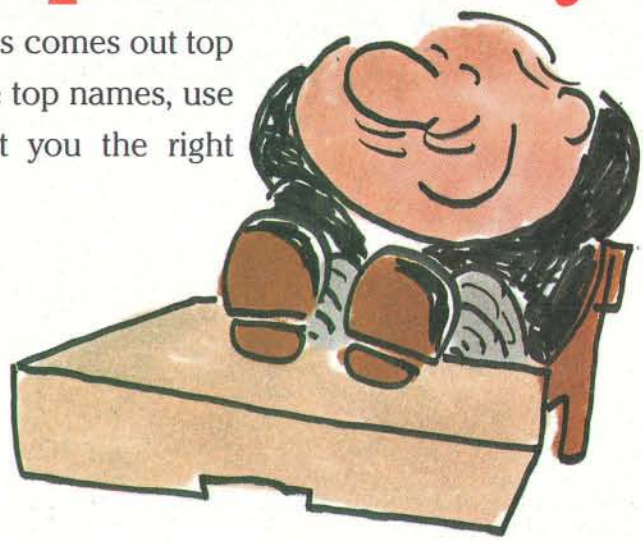
Contact: IO Data Equipment, 1-5-41 Honmachi, Eki-Nishi, Kanazawa 920, Japan, 81-0762-21-4812.

Inquiry 924.

continued

Choose Mayfair. For price, delivery and dependability.

For price, quality and service, Mayfair Micros comes out top every time. When you need PC systems from the top names, use our experience and our buying power to get you the right products – fast.



THE LATEST TECHNOLOGY FROM OLIVETTI AT THE VERY BEST PRICES.

Olivetti's new range of micros available from Mayfair, the leading Olivetti dealer.

Olivetti M280

Desktop	£1099	20MB Hard Disk	£1549
Dual 1.44MB Floppy Disk	£1199	40MB Hard Disk	£1649

Olivetti M300

1MB 40MB Hard Disk	£2099	1MB 100MB Hard Disk	£2449
2MB 40MB Hard Disk	£2335	2MB 100MB Hard Disk	£2585

Olivetti M380

80386 Processor, 16, 20 or 25Mhz. Memory expandable to 48MB (64MB on XP5 and XP7). Intel 82385 32K cache memory on XP4 and XP7. UP to 4 32 bit slots. Optical disk options.

M380/C	16Mhz 1MB RAM 62MB (40ms) Disk	£2395
XP1	20Mhz 1MB RAM 80MB (20ms) Disk	£3249
XP3	20Mhz 2MB RAM 135MB (23ms) Disk	£3749
XP5	20Mhz 4MB RAM 135MB (23ms) Disk	£4549
XP5	20Mhz 4MB RAM 300MB (20ms) Disk	£5395
XP4	25Mhz 4MB RAM 135MB (23ms) Disk	£5049
XP7	25Mhz 4MB RAM 135MB (23ms) Disk	£5395
XP7	25Mhz 4MB RAM 300MB (20ms) Disk	£6295
XP9	33Mhz 4MB RAM 135MB (20ms) Disk	£5895
XP9	33Mhz 4MB RAM 300MB (20ms) Disk	£7095

Olivetti P500

16Mhz 80386sx Processor. 1MB RAM expandable to 4MB on main board. Micro Channel Architecture bus.

1MB RAM 40MB (28ms) Disk	£2049	2MB RAM 40MB (28ms) Disk	£2149
2MB RAM 80MB (18ms) Disk	£2449		

All standard configurations include 102 keyboard floppy disk drive, parallel and serial ports, MS:DOS and VGA monochrome display. For VGA colour display add £275.

SYSTEMS CAPABILITY.

As an Authorised IBM Dealer, we are pleased to advise you on the latest models in the PS/2 range, under DOS or OS/2, and provide competitive tailored systems for all your requirements.

We also offer expert advice and installation on Local Area Networks using IBM Token Ring and Novell Netware on conventional or fibre optic systems, and multiuser systems based on the new SCO Unix System V/386.

Our specialist CAD team share extensive experience in 2D drafting and 3D modelling. We supply complete turnkey systems based on high performance personal workstations running the AutoCAD range of software.

For further details please call our Systems Division on: 01-874 9959.

NETWORK SOFTWARE

dBase IV LAN (5 users)	645
Harvard Graphics LAN	949
Lotus 123 Networker	799
Paradox 3 LAN	599
Wordperfect 5 Server	275
Wordperfect 5 User	75

LASER PRINTERS

Brother HL8	1549
Brother HL/8QS	3099
Epson GQ5000	1269
HP Laserjet II	1399
HP Laserjet IID	2099
IMB RAM Upgrade	309
25 in 1 Font Cartridge	335
Qume ScripTen	3095

PRINTERS

Epson – call for new range prices	
HP Deskjet Plus	635
HP Quietjet Plus	475
HP Ruggedwriter	1029
HP Paintjet	795

DISK DRIVES

Control Data 90MB (18ms) SCSI	695
Control Data 170MB (15ms) ESDI	1249
Miniscribe 115MB (17ms) SCSI	815
Miniscribe 155MB (17ms) SCSI	945
Miniscribe 335MB (16ms) ESDI	1125

GRAPHICS BOARDS

Hercules VGA	160
Orchid Prodesigner	259
Orchid Prodesigner Plus	259
Video 7 VGA	199
Video 7 Fastwrite VGA	260

DTP DISPLAYS

MDS Genius 15"	599
NEC Monograph 16"	959
Wyse 7190 A3	1195

MEMORY BOARDS

AST Rampage/2 2MB	565
Orchid RamQuest XT/AT 2MB	749

MONITORS

Hitachi Auto 480 VGA	350
Hitachi Hi Scan 20	1750
NEC Multisync 2A	385
NEC Multisync 3D	495
NEC Multisync XL	1545

PS/2 MEMORY BOARDS

Orchid RamQuest IIz 2MB	589
Orchid RamQuest Extra 16/32 2MB	775

SOFTWARE

AMI WP	145
Concorde	475
Crosstalk 4	95
dBase IV	349
Designer	309
Excel	260
Framework 3	349
Harvard Graphics	249
Lotus 123 R3	259
Symphony 2	369
Agenda	219
Freelance Plus 3	269
Magellan	79
Pagemaker 3	475
Q & A 3	185
R:Base	340
Smartware II	359
Supercalc 5	199
Ventura 2	549
Wordperfect 5	219
Wordstar Prof 5	219
MS Word 5	249

MAYFAIR MICROS

Blenheim House, Podmore Road, Wandsworth, London SW18 1AJ.

01-874 6474

All prices exc. VAT and are correct at time of going to press.

IBM PS/2 and OS/2 are trade marks of International Business Machines Corporation.

A VMEbus Automation Module for the IBM AT

Philips has added the new PX4010, an IBM AT–compatible module based on a 10-MHz 80286 CPU, to its VMEbus range of automation modules. The module offers full IBM functionality within the VMEbus environment and lets you use most current IBM PC operating systems, including DOS, OS/2, and Xenix.

The PX4010 has a stand-alone configuration that includes 1.64 megabytes of system RAM; a graphics adapter for CGA, EGA, and Hercules standards; an on-board controller for floppy and hard disk drives; plus a keyboard interface, a real-time clock, a Centronics parallel port, and two RS-232C/RS-422 serial ports. The module also incorporates an IBM XT system bus that lets you connect standard IBM PC extension cards to meet specific requirements, such as those for communications and special device drivers.

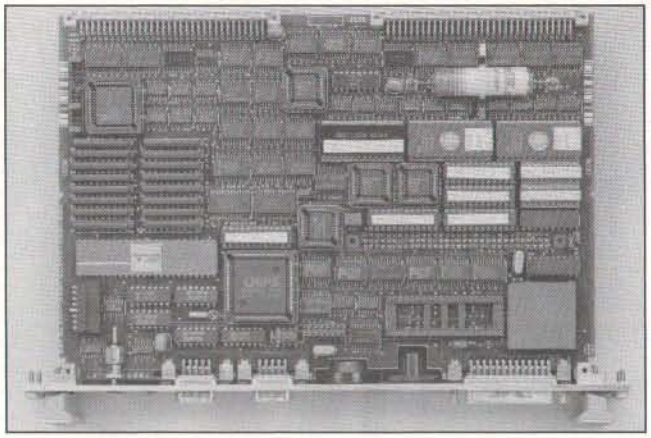
Price: 7400 Dutch florins; $3360 U.S.

Contact: Philips Industrial & Electro-acoustic Systems Division, I&E Press Office, Christa Horrocks, Building HKF, 5600 MD Eindhoven, The Netherlands, 31-40-788620.

Inquiry 898.

Create a Multiuser DOS Graphics System

The VPC Multiuser Graphics System is a combination hardware and software multistation DOS system.



Philips' PX4010, an IBM AT module, adds personal computer functionality to VMEbus systems.

A multicontroller card supports either two EGA-type 2000 or four Hercules graphics card–type 1000 monitors. To help prevent any communications bottlenecks, the data-entry point is connected to the controller through 13 twisted-pair video lines. Hardware drivers amplify the video signal, so you can use cables up to 90 meters long.

The station controller is housed in a box measuring 16 by 12 cm. At the entry points, it divides the signals into the video, keyboard, and communications ports and passes them on to the relevant outputs. The system supports up to eight screens with each graphics controller physically connected to the system bus, which eliminates delays due to signal conversion. VPC retains standard interface connections so you can operate 80386 host computers, monitors, keyboards, and graphics I/O devices.

The DOS operating system remains unchanged. However, to help you establish a multistation system, VPC contains a special management program that divides the main memory into areas. The program then allots these areas to individual stations or virtual machines (VMs). Each VM has its own DOS environment and, as such, is an independent computer; you can even boot it separately without affecting the other stations.

VPC also has a timesharing system, called the System Resource Monitor, that constantly monitors software activities. As soon as one job is processed, it switches the processor onto the next one. The fileshare subsystem carries out access and file management for all disks independently, which guarantees free access to all unprotected data. The Password Protection System lets each user protect individual files or whole areas (e.g., directories) from unauthorized access.

VPC runs on the IBM AT or an 80386 computer with at least 3 megabytes of RAM, any version of DOS, one 1.2-megabyte 5¼-inch floppy disk drive, a hard disk drive, and a Hercules graphics card- or EGA-compatible monitor.

Price: 1700 deutsche marks for the VM/386 Multiuser Software package; 3802 DM for an EGA Set for one host and one remote station; 4492 DM for an EGA Set with two remote stations; 4922 DM for an MDA Set with four remote stations.

Contact: I.E.S. GmbH, Industrie Electronic & Service, Spitzwegstrasse 10, D-8012 Ottobrunn, West Germany, 49-89-604063.

Inquiry 930.

A Hand-Held Scanner for the IBM PC and Mac

You can scan photographs, logos, drawings, diagrams, and brochures into your IBM PC or PS/2 or Mac Plus, SE, II, or IIx with ScanMan, a hand-held scanner from Logitek (see "Handy Scanners," June BYTE). The operating software lets you edit all or part of the images, as well as rotate, copy, cut, move, flip, and resize them. ScanMan offers you precise variable resolutions, including 100, 200, quasi-300, and quasi-400 dpi, with gray scaling and contrast control. You can save your scanned images in TIFF, compressed TIFF, PICT, and MacPaint formats.

Logitek also offers a new mouse that is available in two versions: a serial IBM PS/2 version and a Bus version. You can plug the IBM PS/2 version directly into an RS-232C serial port or a dedicated mouse port, while the Bus version includes a half-size Bus card for the IBM PC and compatibles.

Both versions offer a new ergonomically designed case and an improved resolution of 320 dpi. The new MouseWare utilities software features a mouse-based, menu-driven, DOS management program called Pop-Up DOS; a ballistic driver that you can use with most popular programs; and Mouse 203, a menu shell that helps you become more productive with Lotus 1-2-3.

Price: £199 for the IBM PC version of ScanMan; £239 for the PS/2 version; £345 for the Mac version; £95 for either version of the mouse.

Contact: Logitek Plc., Markham Point, 1a Stoke Rd., Slough, Berkshire SL2 5BN, UK, 44-0753-824707.

Inquiry 893.

continued

ADA COMPILERS

IntegrAda - The first Ada compiler with an easy to use Turbo-like environment.

AdaVantage Dev Kit v2.2	PC-DOS	£1345
AdaVantage Prof Dev Kit	PC-DOS	£2170
IntegrAda	PC-DOS	£ 645
Janus Ada C-Pack	PC-DOS	£ 115
Janus Ada ED-Pack v2.0.2	MS-DOS	£ 375

PASCAL LANGUAGE

Quick Pascal and Turbo Pascal V5.5 offer Object Oriented features.

Pro Pascal for OS/2	OS/2	£265
MS Pascal v4.0	OS/2&PC-DOS	£170
MS Quick Pascal	PC-DOS	£ 60
ALICE Pascal Intrprtr.	PC-DOS	£ 80
Dr Pascal Interpreter	MS-DOS	£ 39
Metaware Prof.Pascal	MS-DOS	£420
Metaware Prof.Pas/386	MS-DOS	£635
Oregon Pascal-2	MS-DOS	£295
Prospero Pascal v3.17	MS-DOS	£240
Prospero Pascal for GEM	MS-DOS	£ 85
Prospero PC Pascal	PC-DOS	£ 85
SVS Pascal 386	PC-DOS	£570
Turbo-Pascal v5.5	PC-DOS	£ 79
Pecan P-Sys w.UCSD Pas.	IBM-PC	£120
Pecan P-Sys Pascal Prof.	IBM-PC	£210
Metaware Prof.Pascal	Flexos	£420
Pro-Pascal v2.14	CP/M-86	£240
Pascal MT+ v5.6	CP/M-80	£ 99
Pro-Pascal v2.18	CP/M-80	£240
MCC Pascal	ATARI ST	£ 75
Pecan P-Sys w.UCSD Pas	ATARI ST	£120
Pecan P-Sys w.UCSD Pas	APPLE][	£ 80

THE C LANGUAGE

The new V7 of Watcom C is now in stock - the only C compiler for DOS which conforms to the latest draft ANSI standard. The new V6 of Lattice C with global optimiser should be in stock when this add appears.

C COMPILERS

Avocet C	PC-DOS	£210
Aztec C86 Professional	MS-DOS	£120
Aztec C86 Developer	MS-DOS	£175
Aztec C86 Commercial	MS-DOS	£290
CI C86 Plus v1.3	MS-DOS	£290
De Smet C Programmer	MS-DOS	£ 95
De Smet C Professional	MS-DOS	£165
ECO-C88 V4.0	MS-DOS	£ 70
HIGH C (Metaware) v1.5	MS-DOS	£420
HIGH C 386 v1.5	MS-DOS	£635
Hi-Tech C	MS-DOS	£135
Lattice C v3.4	OS/2&MS-DOS	£180
Mark Williams LETS C v4	MS-DOS	£ 60
Microsoft C v5.1	OS/2&PC-DOS	£250
Microsoft Quick C v2	PC-DOS	£ 60
MIX C	MS-DOS	£ 20
MIX Power C & lib s'ce	PC-DOS	£ 29
Turbo C v2	PC-DOS	£ 79
Turbo C Professional v2	MS-DOS	£160
Watcom Express C v7	PC-DOS	£ 65
Watcom v7 opt comp + tls	PC-DOS	£250
Zortech C v3	PC-DOS	£ 45
Zortech C++	PC-DOS	£ 90
Aztec C86 Developer	CP/M-86	£245
Aztec C86 Personal	CP/M-86	£140
CI Optimizing C86	CP/M-86	£225
De Smet C Programmer	CP/M-86	£125
Hi-Tech C	CP/M-86	£135
Lattice C	CDOS	£395
HIGH C (Metaware)	Flex OS 286	£420
Avocet C	CP/M-80	£210
Aztec C Personal 1.06D	CP/M-80	£120
Aztec Commercial 1.06D	CP/M-80	£200
BDS C 1.60	Z80 + CP/M-80	£ 65
Eco-C w. Lib s'ce	Z80 + CP/M-80	£ 60
Hi-Tech C	Z80 + CP/M-80	£ 99
Mix C	Z80 + CP/M-80	£ 35
Toolworks C/80 v3.1	CP/M-80	£ 45
Aztec C65 V1.05	Apple DOS	£200
Aztec C65 V3.20	Apple PRO-DOS	£245
Aztec C68K MPW C	MACINTOSH	£110
Aztec C68K C	MACINTOSH	£ 75
Aztec C68K/AM Developer	AMIGA	£175
Aztec C68K/AM Prof'snl	AMIGA	£120
Aztec C68K/ST Developer	ATARI	£175
Aztec C68K/ST Prof'snl	ATARI	£120
Hi-Tech C	ATARI	£ 99
Lattice C	ATARI	£ 85
Mark Williams C v2	ATARI	£110
Laser C	ATARI	£135
Prospero C	ATARI	£105

C CROSS COMPILERS

We supply 2500AD, Avocet, Aztec, Lattice, IAR and HI-Tech Cross Compilers hosted on MS-DOS and targeted on Z80, 6502, 6801, 68HC11, 6301, 6809, 7811, 8051, 8096, 68000 & 68020. Please call for information or advice.

C INTERPRETERS

Instant C/16M supports large programs on 286/386 machines.

C-terp V3.0X	PC-DOS	£155
Interactive C	PC-DOS	£195
Introducing C	PC-DOS	£ 85
Living C Plus	PC-DOS	£135
Instant-C v3	PC-DOS	£380
Instant-C/16M	PC-DOS	£680
RUN/C Professional	MS-DOS	£110

PRICES & DELIVERY

Prices do not include VAT or other local taxes but do include delivery in UK and Europe. Please check prices at time of order, ads are prepared some weeks before publication.

This page lists some of our products. Call us for a complete pricelist.

Order by phone with your credit card.

C LIBRARIES

Microsoft OS/2 Presentation Manager Toolkit is now in stock.

DATABASE

Btrieve	OS/2	£400
Btrieve v5	MS-DOS	£170
Btrieve/Network	MS-DOS	£400
XQL	PC-DOS	£540
C/Database T'lchest sce	PC-DOS	£ 29
CBTREE (source any C)		£135
C-Index/Plus (source any C)		£175
C-ISAM (L,MS)	MS-DOS	£220
C-tree (source any C)		£225
Essential Btree (s'ce)	PC-DOS	£120
R-tree	MS-DOS	£165
db-VISTA III s'gle user	PC-DOS	£575
db-Query v2 s'gle user	PC-DOS	£575
db-FILE (most C's) s'gle	MS-DOS	£325
db-RETRIEVE single-user	MS-DOS	£325
Lattice dBCIII (L,MS)	MS-DOS	£165
Lattice dBCIII+ (L,MS)	MS-DOS	£385
SftFcus Btree&Isam (sce any C)		£ 80
Virtual Memory File Man.	PC-DOS	£150

GRAPHICS

Enhanced Graphics Tlkt	PC-DOS	£170
Essential Graphics v2	PC-DOS	£175
GFX Graphics	PC-DOS	£ 75
GraphiC v5 (CI,L,DS,MS)	PC-DOS	£290
GSS Kernel system	PC-DOS	£350
GSS Lattice Binding	PC-DOS	£110
GSS Graph Dev Toolkit	PC-DOS	£350
GSS Graphic Plotting sys	PC-DOS	£245
GSX Prog.Toolkit (DR)	PC-DOS	£270
HALO '88 (MSC5,LAT,TC)	PC-DOS	£230
HGraph (MSC)	PC-DOS	£ 80
Ingraf (MSC)	PC-DOS	£175
MetaWINDOWS (CI,L,MS,T)	PC-DOS	£145
MetaWINDOWS Plus	PC-DOS	£190
MetaWINDOWS Premium	PC-DOS	£315
Turbo WINDOWS/C (Turbo)	PC-DOS	£ 75
Quick Windows/C (QC)	PC-DOS	£ 75

SCREEN & WINDOWS

Vitamin C (MS5.1)	OS/2&PC-DOS	£240
Blaise Power Scrn (MS&TC)	PC-DOS	£ 85
Blaise View Mngr. (s'ce)	PC-DOS	£245
Curses Screen Mngr. (L)	PC-DOS	£130
Entelekon Windows (s'ce)	PC-DOS	£105
Multi-windows (MS,L)	PC-DOS	£220
Panel Plus II (source)	PC-DOS	£270
Vitamin C (source)	PC-DOS	£165
Vermont Views (MSC,TC)	PC-DOS	£275
Greenleaf Datawindow	PC-DOS	£145
Greenleaf Makeform	PC-DOS	£ 60
C-Scape v3 (MS,L,TC)	PC-DOS	£330
Zortech Windows (ZC++ZC3)	PC-DOS	£ 39

GENERAL FUNCTIONS

C+0 Class Lib (MS,TC)	PC-DOS	£155
C+0 Cl's Lb (MS) WINDOWS&	PC-DOS	£155
C/Utilities T'chest sce	PC-DOS	£ 39
CQL (CTREE,BTRIEVE) s'ce	PC-DOS	£270
C-Worthy Int.Lib (L,MS)	MS-DOS	£175
D-Tree (source)	PC-DOS	£345
Greenleaf Functions s'ce	PC-DOS	£ 95
G'leaf Super Functions	PC-DOS	£130
G'leaf Business Mathlib	PC-DOS	£150
Smorgasbord C-food	PC-DOS	£ 65
Blaise T'ls plus/5.0 (MS)	PC-DOS	£ 85
Blaise Turbo C Tools v2	PC-DOS	£105
ESI Utility Lib (source)	PC-DOS	£110
Entelekon Funct (source)	PC-DOS	£105
Phoenix Pforce (source)	PC-DOS	£230
Pro-C & Workbench	PC-DOS	£595
Security Library object	MS-DOS	£110
Resident-C (MS,L) (s'ce)	PC-DOS	£120
The Heap Expander (MS&TC)	PC-DOS	£ 65
Zortech Supertext	PC-DOS	£ 39

COMMS LIBRARIES

Blaise C Asynch (source)	PC-DOS	£105
Essential Comms (L,MS,T)	PC-DOS	£120
Greenleaf Comms (source)	PC-DOS	£110
Multi Comms (L,MS)	PC-DOS	£165
Zortech Comms (QC&TC)	PC-DOS	£ 65
Zortech Comms (ZC++&ZC3)	PC-DOS	£ 65

SCIENTIFIC LIBRARIES

Wiley Scientif.Lib.v2	ANY C	£155
Mathpak 87 (L,MS)	MS-DOS	£ 80

PROGRAMMERS UTILITIES

PC-Lint	OS/2,MS-DOS	£ 85
C-Documentor	PC-DOS	£195
C-Scan	PC-DOS	£195
C Toolset	MS-DOS	£ 90
Clear+ for C	PC-DOS	£165
Lattice Comp Companion	MS-DOS	£ 65

REAL TIME & MULTI-TASKING TOOLS

Concurrent C (PC/MPX) sce	MS-DOS	£ 60
Multi C (L,MS,CI)	PC-DOS	£165
Op.Sys.T'box (MS) s'ce	PC-DOS	£ 65
Timeslicer v3.01 (L)	PC-DOS	£175
Timeslicer v5 (MS)	PC-DOS	£175
Over-C (L,MS)	PC-DOS	£225

PROGRAMMING TOOLS

Ada Compilers	Algol Compilers
Assemblers & Libs	AWK
Basic Compilers	Basic Interpreters
Basic Utilities	Basic Libraries
BCPL Compilers	C Compilers
C Interpreters	C Libraries
C Utilities	Cobol Compilers
Comms.Libraries	Cross Assemblers
Database Libs.	Debuggers
Dis-assemblers	Editors
Engineers Libs.	Expert Systems
Forth	Fortran Compilers
Fortran Libraries	Graphics Libraries
Icon	Linkers/Locaters
Lisp	Modula-2
Nial Interpreters	OPS 5
Pascal Compilers	Pascal Libraries
Prolog	Rexx
Risc	Screen Libraries
Smalltalk	Snobol

We stock many items for which there is no space in these advertisements.

CROSS ASSEMBLERS

We supply cross-assemblers by Avocet, 2500AD,IAR Systems and Pecan hosted on MS-DOS, CP/M-86 and CP/M-80 with over 30 target processors. In total over 200 products with no space to list them here. We hold some stock but you should allow 10-14 days for delivery. Please call for information or advice.

DISK COPYING SERVICE

We can copy files to and from 600 disk formats including CP/M, CP/M-86, MS- DOS, PC-DOS, ISIS, APPLE, SIRIUS, BBC, TORCH, APRICOT, HP-150, TRSDOS, DEC RT- 11, IBM BEF, ATARI ST, AMSTRAD, MACINTOSH.

Our charge is £10.00 + disk + VAT with discounts on small quantities and disks are normally despatched within 24hrs of receipt. For more information call us.

GREY MATTER

4 Prigg Meadow, Ashburton, Devon TQ13 7DF.

TEL. (0364) 53499

GREY MATTER
4 Prigg Meadow, Ashburton, Devon TQ13 7DF.
TEL. (0364) 53499
GREY MATTER
4 Prigg Meadow, Ashburton, Devon TQ13 7DF.
TEL. (0364) 53499

Circle 427 on Reader Service Card

A Dual-Bus I/O Card with 80 Parallel Lines

Arcom Control Systems has added the VSP80 parallel I/O board for the VMEbus to its series of dual-bus boards (see July What's New International, page 88IS-42). The board provides 80 parallel I/O lines and features an interface that lets you plug in a single Eurocard STEbus CPU to add local intelligence during initial system configuration or as upgrades become necessary. According to the company, the resulting parallel-processing architecture increases system throughput without adversely affecting bus-traffic levels.

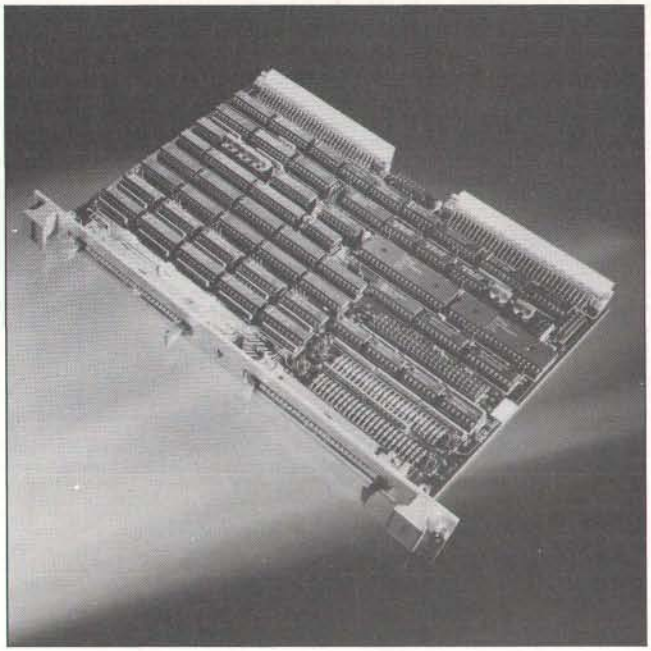
A mailbox system, utilizing two 16-bit-wide data latches, regulates control-passing between the two buses; you can configure the latches to cause interrupts when the latches are written to. You can choose among a range of plug-in signal-conditioning modules, including optoisolators, solid-state relays, and high-power drivers. Arcom also offers an interface module to the Opto-22 I/O scheme.

You can set all 80 I/O lines as input or output and have them deactivate automatically at reset; 40 of them are bit-programmable, while the other 40 are jumper-controlled. In addition, two on-board 8530 counter/timer/parallel I/O devices provide features such as six counter-timers, change-of-state and interrupt inputs, and pattern recognition.

Price: £438.

Contact: Arcom Control Systems Ltd., Units 8–10, Clifton Rd., Cambridge CB1 4WH, UK, 44-0223-411200.

Inquiry 889.



The VSP80 card for the VMEbus features 80 parallel I/O lines and an interface for a single Eurocard STEbus CPU.

Financial Portfolio Management Software

If you are an active investment manager concerned about competition from index trackers, Computer Design offers a software program, designed for use in conjunction with the company's Financial Portfolio Management (FPM) system, that gives you an alternative to index tracking.

Investment Manager Beats Index Trackers (IM-BIT) lets you record guidelines for 1000 or more clients. It goes through your client profiles in minutes; informs you about underinvestments and overinvestments client by client, sector by sector, and currency by currency; and helps you make adjustments to restore a portfolio to its guidelines—you decide what to buy and sell, and IM-BIT determines the amounts for each client.

The FPM system is designed to automate dealing, cash management, portfolio valuation, performance measurement, accounting, and management reporting functions related to investment management. The system contains integrated facilities for equities, unit trusts, bonds, money market instruments, traded options, commodities, and financial futures.

Features of the system include a relational database for funds (clients) and securities with on-line search, update, and report facilities; a report generator; and a historical database.

FPM and the IM-BIT module run on IBM ATs under DOS 3.0, as well as on networks, multiuser systems, and turnkey systems under DEC VMS, AIX, SCO Xenix, and Unix.

Price: £1500 for the IM-BIT module; £3500 for the base FPM module; £750 to £2500 for other FPM modules.

Contact: Computer Design, 10–12 Exhibition Rd., South Kensington, London SW7 2HF, UK, 44-01-589-7331.

Inquiry 940.

Organize Your Hard Disk

Disc Director is a new class of utility program that will forever change the way you organize your hard disk, according to International Data Security. The program eliminates problems such as lost files, unknown directories, and illogical tree structures, even on mature hard disk drives.

The menu-driven program eliminates wasted disk space by finding unused duplicate files, empty and inefficient directories, and orphan files. It is specifically designed to help you analyze, plan, and implement a strategy of hard disk reorganization and to turn a disorganized, hard-to-use tree structure into a streamlined, logical tree in moments.

In addition to helping you reorganize your tree structures, Disc Director helps eliminate wasted space. Features such as Find All Duplicate Files and Show Me Inefficient Directories help you reclaim hard disk space. In the case of Find Duplicates, the program places the output of a search into a phantom directory, which acts as a virtual directory that points to files wherever they exist on the hard disk. When you combine this with the full range of file options (e.g., browse, copy, move, erase, and wipe), you can eliminate unneeded duplicates and keep only the files that are useful. Disc Director also lets you attach comments up to 78 characters long to directories, files, and drives.

Disc Director requires an IBM PC with 512K bytes of RAM, DOS 2.0, a hard disk drive, and a graphics adapter.

Price: £89.

Contact: International Data Security Pty. Ltd., 37-41 Gower St., London WC1E 6HH, UK, 44-01-436-2244.

Inquiry 939.

Get A Copam System "Tailored" To Fit All Your Needs!

SYSTEM 386V/33
With 33 MHz processing speed and 32 KB cache memory, Copam's SYSTEM 386V/33 offers you an fastest advanced, speed performing 32-bit system. This amazing model is for those users which expect high-performance and satisfaction in a versatile tower.

SYSTEM 286M
The SYSTEM 286M's all-in-one mainboard has built-in features such as 4 MB of RAM, CGA/MONO, 2 FDDs/1 HDD, SERIAL/PARALLEL ports and so much more. It remains conveniently simple for any type of user.

SYSTEM 386SX, PS/2 Models 60 and 80 are also offered.
Contact one of the offices listed below to more details.

■ Beta Computer Systems Aps
Frichsvej 40
DK-8600 Silkeborg, Denmark
Tel: (45) 6826100
Fax: (45) 6800222

■ Clone AG
P.O. Box 105
CH-5400 Ennetbaden
Switzerland
Tel: (41) 56 21 26 66
Fax: (41) 56 22 08 46

■ Copam Elec. Europe GmbH
Heerdter Landstrasse 193
4000 Dusseldorf 11
West Germany
Tel: (211) 501158, 507038
Fax: (211) 503591

■ Copam France
Centre d'Affaires La Boursidière
Bâtiment, Champagne R.N. 186 92357
LE PLESSIS ROBINSON Cedex, France
Tel: (331) 46 30 34 34
Fax: (331) 46 30 11 20

■ Copam Elec. Singapore
#06-03 Duma House
No. 2 Alexandra Road
Singapore 0315
Tel: (65) 2739966
Fax: (65) 2735044

■ Copam U.S.A., Inc.
45875 Northport Loop East
Fremont, CA 94538
U.S.A.
Tel: (415) 6238911
Fax: (415) 6238551

■ Cotronic Computer Electronic
DR. Heschl-Weg 6.
A-8054 Graz. Austria
Tel: 316 294988
Tlx: 311860 CONTR A

■ Datavarehuset AS
Prof. Birkelandsvei 26
1081 Oslo, 10, Norway
Tel: (47) 2 321025
Fax: (47) 2 327084

■ IMP-Data AB
Box 19137, S-104 32
Stockholm, Sweden
Tel: (46) 8317710
Fax: (46) 8342822

■ Jen Electronica S. R.L.
Zona Industriale Enrico Fermi
62010 Montelupone (MC), Italy
Tel: (0733) 586423
Fax: (0733) 586980

■ OY Genine AB IMP-Date
Yliopistonkatu 37
SF-20100 Turku, Finland
Tel: 35 (821) 335700
Fax: 35 (821) 516340

■ Simac Data B.V.
High Tech Park, 5503 HP
Veldhoven, Netherlands
Tel: (040) 582933/582654
Fax: (040) 582707

COPAM®

COPAM ELECTRONICS CORP.

5/F, 125 Nanking E. Road
Sec. 5, Taipei, Taiwan, R.O.C.
Tel: (02) 7640736
Fax: (02) 7695500

COPAM, SYSTEM 286M, SYSTEM 386V/33, SYSTEM 386SX, PS/2, CGA, MONO are registered trademarks.

BACK ISSUES FOR SALE

BYTE
Limited Quantities — Order Now!

	1986	1987	1988	1989
January	■			
February	■			
March	■			
April				
May				
June	■			
July				
August	■			
September				
October				■
November	■			■
December	■			■
Inside the IBM PCs		■		■
Applications Software Today	■		■	■

Available Issues ☐

Rates (postage and handling included):

Holland	**Dfl 18.00**
United Kingdom	**£ 5.25**
West Germany	**DM 16.50**
Switzerland	**SwFr 13.50**
France	**FFr 54.50**
Sweden	**SEK 56.50**

No other currencies will be accepted other than those mentioned above.

Please indicate which issues you would like by checking (√) the boxes.

Send requests with payments to:

BYTE Back Issues
c/o Dynamics Graphics International
P.O. Box 25, AA Maarn
The Netherlands

☐ Check enclosed.

Charge: ☐ MasterCard ☐ Eurocard ☐ American Express

Name _____

Address _____

Postcode _____ City _____

Country _____

Card # _____

Exp. Date _____

All orders must be prepaid. Pay only in the currencies given.
Please allow twelve weeks delivery by surface mail.

BYTE McGraw-Hill

SCANDEC GIVES YOU SOLUTIONS

Unique Features Unique Economy

REQUIREMENT: ELIMINATE MANUAL PRINTER SETUP

SOLUTION: SCANSHARE®

Intelligent printer controller/sharer and string conversion, with setup for each input port (4 parallel inputs) from a dedicated control serial port connected to a PC.

REQUIREMENT: UNIVERSAL NETWORK COAX CONNECTION

SOLUTION: SCANANIO®

Arcnet interface with controller for connection of 2 printers to a standard Arcnet Coax. Support both Star and Bus (jumper). 100% compatible with SMC (Standard Micro System Corp.), PC 120 and PC 220.

REQUIREMENT: LAP TOP ARCNET

SOLUTION: SCANARCNET®

PC Arcnet interface with very low power, 0.5W, for extended use when using battery. Supports both Star and Bus (jumper). 100% compatible with SMC (Standard Micro System Corp.), PC 120 and PC 220.

REQUIREMENT: LOGOS AND HIGH CAPACITY ELECTRONIC FORMS

From: **$1150 U.S.**

SOLUTION: SCAN LOGO® AND SCANFORM®

Built-in printer share for Canon II and H-P II models with SX engines. Easy access to prewritten overlays and logos, using a fontcartridge with burn-in logos, on a swapable memorycard (the size of a standard credit card).

REQUIREMENT: INTELLIGENT CHANGING OF I/O

SOLUTION: SCANSIPO®

An intelligent serial to parallel or reverse converter, strapable baud, parity, bits, protocol (on serial), and strapable (3 kinds of timing for parallel output). Can be expanded with up to 32k of buffer).

DEALERS

are invited to join in distribution of these products in their own markets. Please write or FAX, the listed numbers, for documentation and dealer prices.
SCANDEC TRIBUTOR GUARANTEES ITS PROPRIETARY PRODUCTS FOR 5 YEARS.

REQUIREMENT: TRAINABLE OCR SOFTWARE

SOLUTION: SPOT 3.0

Fast, accurate, low cost OCR software, that trains an MS DOS PC to recognise all printed fonts. Reads 35 cps with 16 MHz AT and 65 cps with 25 MHz AT. Supports major scanners.

$1095 U.S.

SPOT is a trademark of Flagstaff Engr.

SCANDEC TRIBUTOR A/S and its sister company Scandec Tributor (USA) Inc are successfull developers of Laser Printer Interface devices. Through our customers in Scandinavia we have been encouraged to offer our proprietary products to other reseller companies, worldwide.

SCANDEC TRIBUTOR

Sam Eydes vei 1B,
P.Box 71, 1412 Sofiemyr, Norway
Telefax: + 47 2 80 59 59,
Telex: 74 840 scand. n

® Designed and produced by SCANDEC UDVIKLING in Denmark.

QUALITY REKLAME

BYTE Subscriber Services Available

Your BYTE subscription brings you a complete diet of the latest in microcomputer technology every 30 days. The kind of broad-based objective coverage you've read in this issue. To ensure that you receive the best possible service during the term of your subscription, we have listed below a wealth of services, available to you as a BYTE subscriber.

BONUSES

- ***Annual Separate Issues:*** In addition to BYTE's 12 monthly issues, subscribers also receive our annual IBM PC issue free of charge, as well as any other annual issues BYTE may produce.
- ***Reader Service:*** For information on products advertised in BYTE, circle the numbers on the Reader Service Card enclosed in each issue that correspond to the numbers for the advertisers you select. Drop in the mail and we'll get your inquiries to the advertisers.
- ***Subscription Service:*** If you have a problem with, or a question about your subscription, you may contact us at the following addresses.

Europe:
BYTE Subscriptions
McGraw-Hill House
Maidenhead, Berkshire
England SL6 2QL

Outside Europe:
BYTE Customer Service
Department
Box 6821
Hancock, NH 03449 U.S.A.

Mail us the details along with the name, address and postal codes of the subscription. If the problem involves a payment, please include a copy of the credit card statement or front and back of your cancelled check. For information regarding back issues and editorial indicies, write to the following address:

BYTE Customer Service
Department
Box 328
Hancock, NH 03449 U.S.A.

PAID SERVICES

- ***BIX:*** BYTE's Information Exchange puts you on-line 24 hours a day with your peers via computer conferencing and electronic mail. All you need is a microcomputer, a modem and a password. See the BIX ad (refer to Index for page) in this issue of BYTE for cost information on foreign registration and usage.
- ***Program Listings:*** Listings of programs that accompany BYTE articles are now available on BIX, on disks or in quarterly printed supplements (see reply cards in this issue for cost information).
- ***Microform:*** BYTE is available in microform from University Microfilm International in the U.S. and Europe. See Contents page for cost information.

DISCOUNTS

- Group discounts available for one-year subscriptions. For details write to the following address:

BYTE Group Subscriptions
P.O. Box 555
Hightstown, NJ 08520 U.S.A.

Be on the leading edge of micro technology. Subscribe to BYTE magazine and in addition benefit from all the aforementioned services. Complete and mail in a subscription card from the adjacent page.

BYTE McGraw Hill

Order your BYTE subscription with one of the convenient order cards in this issue or through a McGraw-Hill representative or magazine agency listed below:

McGraw-Hill Representatives:

France:
McGraw-Hill
18 Rue Des Cordonniers
78600 Maisons Lafitte
1-39-62-57-79

Italy:
McGraw-Hill/Ceti
Lungo Po Antonelli 205
10153 Torino
11-8999023

Netherlands:
McGraw-Hill Benelux
Waaldijk 8
5327 AC Hurwenen
Netherlands
04182-1553

Scandinavia:
McGraw-Hill
Holm Marketing
Granstuevej 13
DK-2840 Holte
Denmark
2-422-806

Spain:
McGraw-Hill De Espana
Santa Beatriz 4
28038 Madrid
1-433-8777

Turkey:
McGraw-Hill
Halitaga Kad Eksioglu Ishani
Kad 4 No 101 Kadikoy
Istanbul
11-337-8145

United Kingdom:
Circulation Field Sales
McGraw-Hill
McGraw-Hill House
Maidenhead, Berkshire SL6 2QL
England
0628-23431

Austria/Switzerland/West Germany:
McGraw-Hill
Postfach 40 02 69
D-8000 Munchen 40
West Germany
89-525847

Agencies:

Austria:
Minerva
Postfach 367
A-1001 Vienna

Belgium:
Office International Periodiques
Avenue Louise 485
B-1050 Brussels

Denmark:
Harck & Gjellerup Booksellers
G.E.C. Gad Norreport
31-33 Fiolstraede
DK-1171 Copenhagen K

United Kingdom:
Blackwells Periodicals
PO Box 40
Hythe Bridge Street
Oxford OX1 2EU

Finland:
Akateeminen Kirjakauppa
PO Box 128
SF-00101 Helsinki 10

France:
Dawson France
Rue De La Prairie
91121 Palaiseau Cedex

Greece:
A. Atzemiam & Co
9 Amerikis Street
Athens 10672

Italy:
D.E.A.
28 Via Lima
00198 Rome

Netherlands:
Faxon Europe
2 Voorburgwal 60
Box 197
1012 SC Amsterdam

Norway:
Narvesen As Subscriptions
Boks 6125
Etterstad, Oslo 6

Portugal:
Fernando Machado & Co
15 Rua Das Carmelitas
4000 Porto

Spain:
Diaz De Santos Sa
Liberia Cientificio Tecnica
Calle De Lagasca 95/PO Box 6.050
Madrid 6

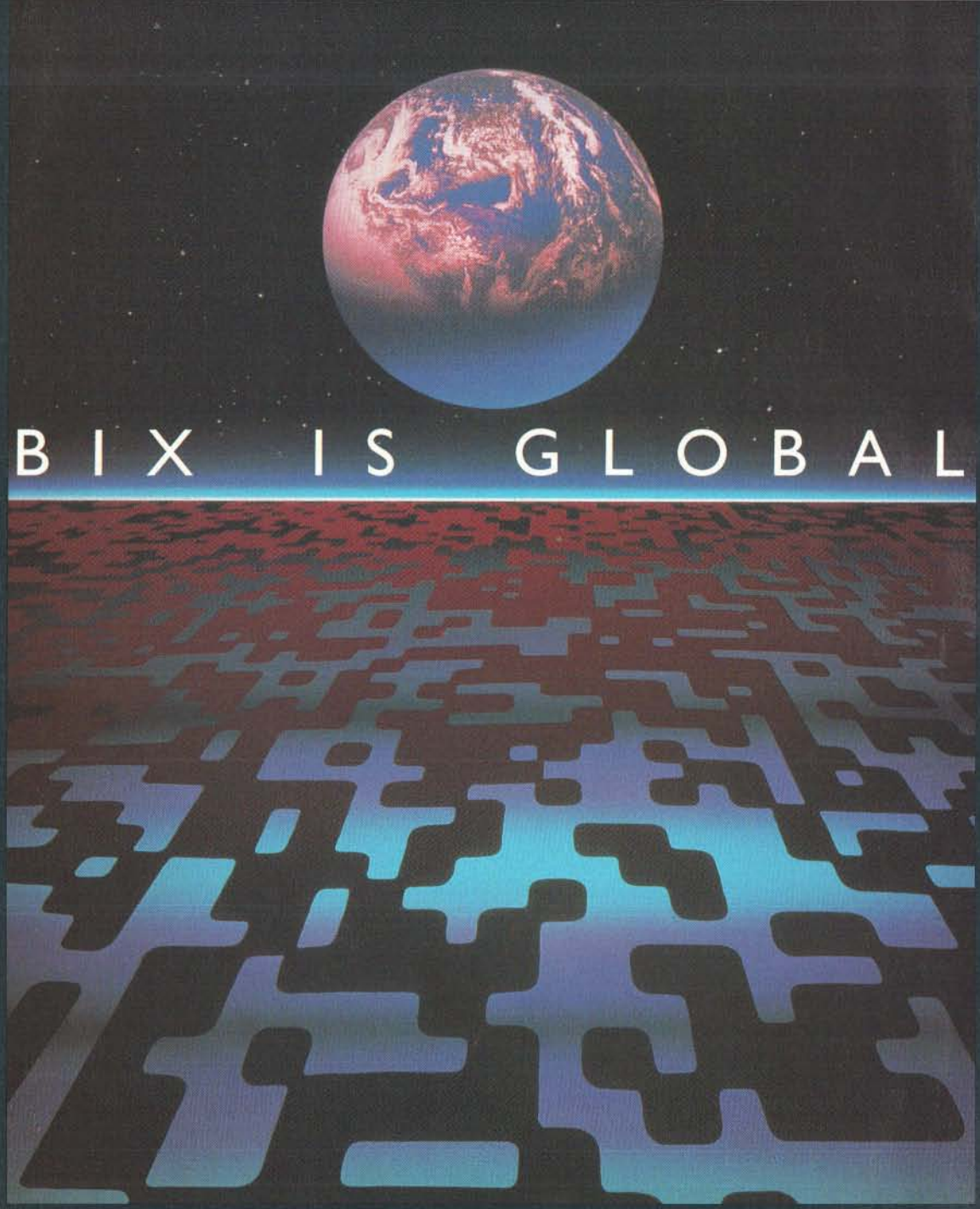
Sweden:
Esselte Tidskriftscentralen
PO Box 45150
5-10430 Stockholm

Switzerland:
Hans Huber
Langgasstrasse 76 & Marktgasse 9
3000 Bern 9

Turkey:
Caglayan Kitabevi
Beyoglu Takaoliyan Ust Pasaj
7-8-9-21 Istanbul

West Germany:
Kunst & Wissen
Willhelmstrasse 4
Postfach 46
D-7000 Stuttgart 1

Yugoslavia:
Cankarjeva Zalozba
Postni Predai 201
61001 Ljubljana



BIX is BYTE's Information Exchange, a worldwide computer conferencing system devoted to the exchange of microcomputer information.

When you use BIX, you leap borders of geography and time to exchange information, opinions and ideas with a "living database" of the world's most knowledgeable microcomputer users.

BIX covers the world.
Our *Microbytes* news service, backed by BYTE and McGraw-Hill, provides worldwide daily news coverage of major events in the microcomputer industry plus listings of thousands of new products from vendors around the globe. Scores of companies now use BIX to provide technical support for their hardware and software products worldwide.

BIX saves you time.
BIX resources help you get the micro-related information you need right away, regardless of your location. BIX electronic mail lets you send private messages to other BIX users worldwide. For more information on how to join and use BIX from your country, read the BIX message in this issue (see Advertiser Index for page number), or contact us today.

BIX
BYTE INFORMATION EXCHANGE

One Phoenix Mill Lane
Peterborough, NH 03458 USA
(603) 924-7681 (Our overseas helpline number)
8:30 AM–11:00 PM
Eastern Time
(–5 GMT) Weekdays

Circle 410 on Reader Service Card

Flag Down 113,000 International Product Specifiers—75,500 in Europe—for Just Pennies Per Contact!

BYTE's International Section reaches over 113,000 BYTE paid readers outside of North America. 75,500 of these influential readers are located in Europe. What's more, 89% of the European readers are directly involved in their companies' plans to purchase personal computers and related products. And, BYTE's monthly International Section has built-in direct response capabilities.

Three Cents Per Contact!

The adjacent International Direct Response Postcards provide a vehicle that encourages your prospects to respond to you. All replies are sent directly to your company. The cost to you is less than three cents per contact!

In addition to the international postcards are Reader Service Cards. They generate pre-qualified sales leads for your ads and new products. These leads are collected in our processing center in Birmingham, England, so you'll get them as quickly as possible, all at no cost to you.

Are You Ready For 1992?

In 1987, the European personal computer market grew by *66% to over 10 billion dollars*. By 1992, trade restrictions will be removed within the European community resulting in unprecedented activity and expansion within the pan-European marketplace. BYTE's International Section presents the perfect opportunity to sell your products to the most important computer decision makers across Europe.

Low Advertising Costs

Advertise in BYTE's International Section for as low as $550 for a one-time 5.1 cm x 7.6 cm ad...to $3,890 for a one-time full page ad (that's only five cents per contact!).

For more information call Frank Tanis, European Sales Manager in The Netherlands at 340-249496 or Karen Lennie and Roz Weyman (German-speaking) in the U.K. at 01-493-1451. Reach the product specifiers that only BYTE can attract.

Readers! Use these Postcards for Fast Response

Just fill out the adjacent postcards of interest to you, affix postage and place in the mail. Or, for even faster response, call the companies directly through the telephone numbers indicated on each card.

BYTE

SHORT TAKES

BYTE editors' hands-on views of new and developing products

PageMaker for OS/2 Presentation Manager

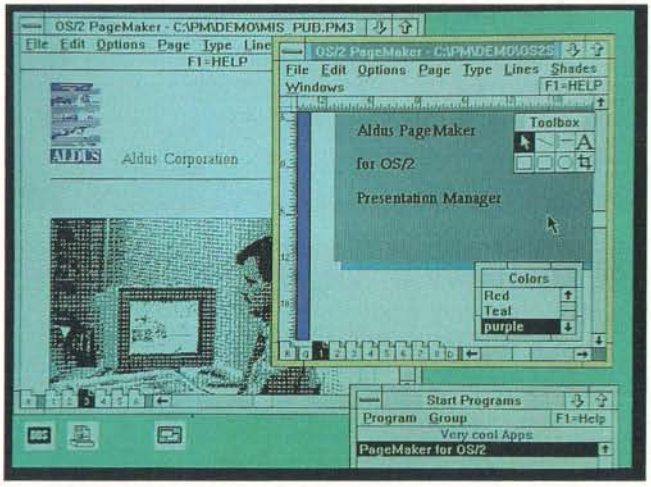
Think C 4.0

DeskWriter

HyperAccess/5

DOS Mounter

hyperStore-816 and SmartCache PM3011



OS/2 Puts Desktop Publishing in the Fast Lane

Imagine a desktop publishing (DTP) package with the power of PageMaker 3.0 and the added ability to handle multiple documents simultaneously. If that sounds like a dream come true, how about a product that runs faster than PageMaker 3.0 yet can share files with it? **PageMaker for OS/2 Presentation Manager** can do all that and more.

It may be that for DTP software users OS/2 has found a raison d'être. PageMaker has always been an excellent package, holding a position as one of the two most popular DTP packages for the IBM PC. But I've always thought that it would benefit from a bit more speed, a little less disk swapping, and better font control.

OS/2 provides facilities for managing much more memory than the maximum of 640K bytes handled by DOS. Thus, this version of PageMaker has more memory to use, so it runs much faster than its DOS cousin. Multiple document windows let PageMaker for OS/2 easily transfer graphics elements from document to document. The DOS version has been unable to do this since the conversion from PageMaker 1.0 to 3.0.

OS/2 also fixes something about Windows 2.10 that has always bugged me—the screen fonts. Under Windows, the imprecise font display made it difficult to tell how the printed document would look. You had to trust that PageMaker knew more than it could show you on-screen. I was pleasantly surprised to see how terrific the Presentation Manager fonts looked by comparison. Perhaps I've just never installed Windows fonts correctly, but if that's true, I'm not alone.

Multitasking isn't wasted on PageMaker, either. If you've used PageMaker 3.0, you know what a godsend autoflow was. The ability to automatically run text from one column to another and from one page to another got rid of one of PageMaker 1.0's biggest limitations. But it wasn't the fastest function, and it tied up the computer for a fair amount of time on long text.

Multitasking OS/2 lets the new PageMaker autoflow one document while you work on another. I tested it with a lengthy piece of text and found that I could work smoothly on a second document while the first was still processing.

To make full use of PageMaker for OS/2 right now, you'll have to run under both DOS and OS/2, at least until paint, scanning, and text-editing packages are available for OS/2. This may sound like déjà vu to those of you who remember how frustrating PageMaker was in the early days of version 1.0, when few programs were compatible with Windows.

So, again we must wait. But when the programs are available, PageMaker for OS/2 may be a good enough reason to consider buying OS/2. If you're already running OS/2 and don't have a DTP program, you'll want to give this package a serious look. □

—Howard Eglowstein

THE FACTS

PageMaker for OS/2 Presentation Manager
$795

Requirements:
IBM PS/2 Model 70, Model 80, or other 80386 system with a 40-megabyte hard disk drive; 4 to 6 megabytes of extended memory; an EGA, VGA, or high-resolution color monitor and adapter card; an OS/2-compatible pointing device; and a PostScript- or OS/2-compatible printer.

Aldus Corp.
411 First Ave. S,
Suite 200
Seattle, WA 98104
(206) 622-5500
Inquiry 1002.

Think C Goes OOP

Like fine wine, some Macintosh software gets better with age. So it is with Symantec's C compiler, **Think C**, now upgraded to version 4.0. It uses an integrated development environment that contains an editor, a compiler, and a linker combined in a single application for fast code development. Under MultiFinder, a source debugger lets you step through source code, set breakpoints, and examine the contents of variables, arrays, and structures. So what's new this time around?

First, the compiler and C libraries now conform to the ANSI standard. Second, the compiler can generate multisegmented code resources (a capability that had been previously limited to applications, drivers, and desk accessories). Third, the compiler's in-line assembler has been

continued

rewritten: The assembly language syntax has been relaxed to support 68020/68030 addressing modes and instructions. The compiler supports the 68881/68882 FPU, but the 68851 paged-memory-management-unit and 68030 MMU instructions are not supported. Last but not least, Think C now supports object-oriented programming (OOP) in language extensions called Object C.

Object C's syntax is loosely based on C++. As with C++, you implement objects by first declaring a *class*. In Object C, these declarations are extensions of `struct` declarations. You allocate or remove objects from memory by using the `new()` and `delete()` functions, respectively. Object C's message dispatcher supports polymorphism; that is, during execution, the dispatcher determines the class of the method that the message is going to (also called run-time binding). This allows you the flexibility to write methods within your program that will override existing methods within a class.

Run-time binding exacts a performance penalty, but the Think C linker looks for ways to overcome this. It evaluates your code, and if a particular method is monomorphic (i.e., it doesn't override another class and is itself not overridden), it generates a direct call to the method, rather than routing it through the dispatcher. A set of class libraries that let you easily use Mac windows, handle the menu bar, and process events is also provided.

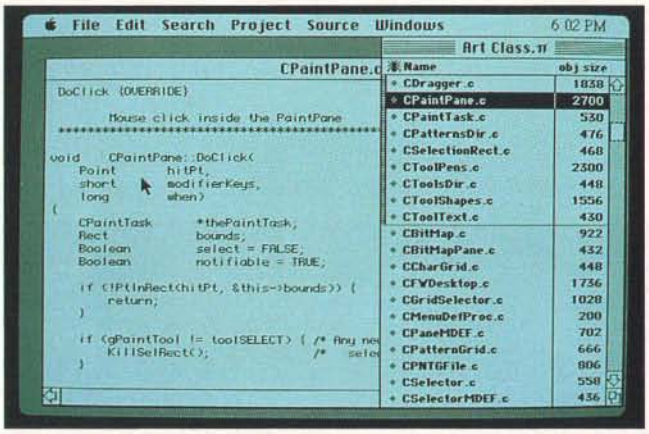
The big advantage of Object C is that you can trace through it using the Think C source debugger. You can actually watch the thread of execution pass through objects and see instance variables modified. Two new sample programs (besides the usual application and desk accessory files) are provided: a paint application written in Object C and an object-oriented cdev. Normally, you can use only the source debugger to debug applications, but Symantec also supplies a special application shell that lets you debug a cdev. The preliminary documentation covers only the Unix libraries and Object C extensions. A list of Mac Toolbox calls with the appropriate Think C arguments would be helpful.

I used a prerelease version of the compiler to complete two works in progress. The first was an application that makes extensive use of AppleTalk. The second was an FKEY that output two characters to the Mac's printer port to disengage a smart serial switch I was using to share an Apple ImageWriter with a Mac and a PC.

I had no trouble making the switch to the new compiler and experienced no problems completing the programs. Compiling and linking were snappy, as in version 3.0. I also traced program flow with the source debugger, with both the sample cdev and the object-oriented paint application.

If you already own Think C, it's time to upgrade. If you want a low-cost, fast C development package for the Mac with object-oriented extensions, look no further. Think C continues its reputation as a high-quality product, and its class libraries and source debugger can shed light on how objects *really* work. □

—Tom Thompson



THE FACTS

Think C 4.0
$249; upgrade, $69

Requirements:
Mac with 1 megabyte of RAM (2 megabytes and MultiFinder are required to run the source debugger) and System 6.0.2 or higher; a hard disk drive is recommended.

Symantec Corp.
135 South Rd.
Bedford, MA 01730
(617) 275-4800
Inquiry 1003.

An Ink-Jet Printer for the Mac

Macintosh users now have an ink-jet printer to call their own. The **DeskWriter** from Hewlett-Packard is the new Mac printer that's based on DeskJet technology.

Using a relatively simple paper path, ink is deposited at a rate of 300 dots per inch from a disposable ink cartridge. The cartridges are priced at a reasonable $18.95. However, if they last only as long as those in the DeskJet Plus, you'd better buy a handful.

You can increase the print speed up to 50 percent with the draft-quality mode, which prints at 150 dpi.

This 15-pound printer is powered by an external power supply from an AC outlet. To hook it up, you'll need an M0197 Apple male-mini-8-to-male-mini-8 cord, which you connect to the serial port of your Mac.

The printer uses QuickDraw to do its imaging and has a driver from Palomar Software. You can scale the fonts from 4 to 250 points without having to install fonts for each point size. While this is similar to the printing mechanism envisioned in Apple's forthcoming System 7.0, it remains to be seen what effect the release of System 7.0 will have on the printer driver. It will probably be minimal, since the overall design appears to conform to Apple guidelines.

continued

THE FACTS

DeskWriter
$1195

Requirements:
Mac Plus, SE, or II with a hard disk drive for font storage and a standard peripheral/8 cable.

Hewlett-Packard Co.
19310 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
Inquiry 1004.

Embedded systems designers have already used **CrossCode C** *in over 413 different applications.*

CrossCode C has twelve important features to help you program your 68000-based ROMable applications

It's the one 68000 C compiler that's tailor-made for embedded systems development

CrossCode C is designed specifically to help you write ROMable code for all members of the Motorola 68000 family. It comes with these twelve special features to help you get your code into ROM:

1. A 100% ROMable Compiler: CrossCode C splits its output into five memory sections for easy placement into ROM or RAM at link time.

2. Integrated C and Assembler: You can write your code in any combination of C and assembly language.

3. Readable Assembly Language Output: The compiler generates assembly language code *with your C language source code embedded as comments*, so you can see each statement's compiled output.

4. Optimized Code: CrossCode C uses minimum required precision when evaluating expressions. It also "folds" constants at compilation time, converts multiplications to shifts when possible, and eliminates superfluous branches.

5. Custom Optimization: You can optimize compiler output for your application because *you* control the sizes of C types, including pointers, *floats*, and all integral types.

6. Register Optimization: Ten registers are reserved for your register variables, and there's an option to automatically declare all stack variables as *register*, so you can instantly optimize programs that were written without registers in mind.

7. C Library Source: An extensive C library containing over 47 C functions is provided in source form.

8. No Limitations: No matter how large your program is, **CrossCode C** will compile it. There are no limits on the number of symbols in your program, the size of your input file, or the size of a C function.

9. 68030 Support: If you're using the 68030, **CrossCode C** will use its extra instructions and addressing modes.

10. Floating Point Support: If you're using the 68881, the compiler performs floating point operations through the coprocessor, and floating point register variables are stored in 68881 registers.

11. Position Independence: Both position independent code and data can be generated if needed.

12. ANSI Standards: CrossCode C tracks the ANSI C standard, so *your* code will always be standard, too.

There's More

CrossCode C comes with an assembler, a linker, and a tool to help you prepare your object code for transmission to PROM programmers and emulators. And there's another special tool that gives you symbolic debugging support by helping you to prepare symbol tables for virtually all types of emulators.

CrossCode C is available under MS-DOS for just $1595, and it runs on all IBM PCs and compatibles (640K memory and hard disk are required). Also available under UNIX, XENIX, and VMS.

CALL TODAY for more information:

1-800-448-7733
(ask for extension **2003**)

Outside the United States, please dial

PHONE: **1-312-971-8170**
FAX: **1-312-971-8513**

SOFTWARE DEVELOPMENT SYSTEMS, INC.
DEPARTMENT 23
4248 BELLE AIRE LANE
DOWNERS GROVE, ILLINOIS 60515 USA

CrossCode™ is a trademark of SOFTWARE DEVELOPMENT SYSTEMS, INC. MS-DOS® is a registered trademark of Microsoft. UNIX® is a registered trademark of AT&T. XENIX® is a registered trademark of Microsoft.

We had no trouble using the DeskWriter with most Mac programs. Programs that provide PostScript output, however, aren't compatible. These exceptions are well documented in the manual.

The DeskWriter comes with four fonts: Courier, Times, Helvetica, and Symbol. We thought the quality of the printing was remarkable and found that we could create documents that look identical to LaserWriter output. We uploaded some bit-map fonts, which also produced an extremely crisp page.

For $200 less than a dot-matrix ImageWriter LQ, you get ink-jet quality. While the DeskWriter is not networkable, it appears to be ideal for low-quantity (fewer than 50 documents a day), high-quality personal printing. □

—Anne Fischer Lent and Laurence H. Loeb

Communications Get Hyper

Hilgraeve's **HyperAccess/5**, the newest version of its venerable communications program for the IBM PC, is overflowing with every communications feature you can imagine.

Although adding feature after feature to a package isn't unusual these days, I'm a purist. I like my communications software to do a few simple things well, like logging onto a system and doing file transfers. So I found HyperAccess/5 to be a bit overdone, with a confusing user interface that stubbornly told me it was connected to BIX before it even dialed the number. I finally found out what I was doing wrong, but the beta software I was using continued to blow up at unexpected times.

However, some of its features did grow on me. HyperAccess/5 let me set up a simple command-line method to access the systems I use most often, but I first had to wade through a myriad of screens and help files and also read the manual to figure it out. And although they're common in communications software these days, the package's "smart" method of automatically learning log-ons and its ability to scroll back through a session are handy indeed.

But HyperAccess/5's most noteworthy features are its ability to be highly customized to a wide variety of terminal emulations and modems. And somehow, the package's designers have managed to make it perhaps the most well-behaved software around. It runs fine under Microsoft Windows. Also, HyperAccess/5 adds OS/2 support, becoming the first communications program to run under Presentation Manager.

Then there are the built-in editor, extensive BBS capabilities (even call-back), and time-triggered calling. About the only thing that I found to be missing was background operation (except under OS/2). If you want simple and inexpensive communications, make another choice. But if you are willing to ascend its steep learning curve, HyperAccess/5 can open new horizons. □

—Stan Miastkowski

THE FACTS

HyperAccess/5
$199

Requirements:
IBM PC, AT, PS/2, or compatible running OS/2 1.0 or higher (or DOS 2.0 or higher) with 384K bytes of RAM.

Hilgraeve
Genesis Center
111 Conant Ave., Suite A
Monroe, MI 48161
(800) 826-2760
Inquiry 1005.

Swapping DOS to Mac the Convenient Way

One of the greatest things Apple has ever done is to come up with the FDHD (for floppy disk high-density) unit. This terrific device with the terrible moniker hooks to a Macintosh and lets it read and write 3½-inch floppy disks from a DOS machine. For those of us who use both a Mac and a DOS computer and who work at a place where disks from either type of system might come our way, this product is an essential piece of hardware.

Now Dayna Communications has come up with an essential piece of software for anyone who has an FDHD unit. **DOS Mounter** is a utility program that lets the FDHD unit access DOS disks without having to use the Apple File Exchange (i.e., a file converter that lets the Mac work with alien formats). DOS Mounter causes a foreign disk to appear on the Desktop as a Mac disk; you can work with the files on the disk as if they came from a Mac.

After I installed DOS Mounter in the System folder of a Mac IIcx, I tried opening some PageMaker files created on a Compaq computer. No problem. Not only did the files open intact, but all the formats and styles translated properly. I also checked out some files from PC versions of Excel and Microsoft Word. No problem. Dayna, though, warns that not all files will be so thoroughly maintained. I'd recommend knowing your applications'

continued

We think programmers need more drive.

Get the tools you need to enter the CD-ROM age. Microsoft Programmer's Library Software plus a Denon CD-ROM Drive—for under $1,000.

Call Microsoft direct at (800) 227-4679 now for complete details on the bundled bargain of the year: Microsoft *Programmer's Library* with 72 reference manuals and guides—over 278 MB of data on a single compact disc. Plus 3-user OPTI-NET™ software, including 2 additional user licenses (a $130 savings). And Denon's SCSI CD-ROM drive system, complete with interface card and cables… all for just $949.

> *"If you do much programming and your time is worth anything at all, get a CD-ROM reader and Microsoft's Programmer's Library. You won't regret it. Highly recommended."*
>
> —*Jerry Pournelle,* Byte Magazine, *Sept. 1989*

With accelerating hardware and software development by leading companies like IBM, Intel, Lotus and Microsoft, CD-ROM is fast becoming a standard peripheral of the 90's. Utilizing CD-ROM technology, Microsoft Programmer's Library helps you work faster…and smarter. Over 100,000 hypertext links streamline your search time, giving you instant access to all documentation on networks, hardware, OS/2, Windows™ and MS-DOS® environments, C, Macro Assembler, Pascal, FORTRAN and BASIC. And the latest versions of 72 essential reference texts, with regular updates available from Microsoft. You'll also have 26 MB of indexed code you can actually cut-and-paste right into your text editor.

The Denon CD-ROM drive—with its advanced servo-circuitry, high reliability, multimode flexibility and access time of 400 ms.—dramatically cuts manual search time and downtime. And when you really want to switch modes, the built-in speaker and jacks let you play your favorite audio CDs. So you can *listen* to a keyboard for a change. But if you just can't stop programming, Microsoft audio software turns your CD drive into a programmable audio CD player. Order now and this special music program (a $99 value) is *yours free*… while supplies last.

15-Day Money-Back Guarantee. Order direct from Microsoft today and get Microsoft Programmer's Library complete with the Denon CD-ROM Drive (IBM® AT® version) and Microsoft's audio program for just $949.

Call now and save $799!
(800) 227-4679

Microsoft®
Making it all make sense™

©1989 Microsoft Corporation. All rights reserved. MS-DOS, Windows and the Microsoft logo are registered trademarks and *Making it all make sense* is a trademark of the Microsoft Corporation. IBM and AT are registered trademarks of International Business Machines Corporation. OPTI-NET is a trademark of On Line Computer Systems Inc. Offer expires December 31, 1989.

C for the 8051 Compare:

Benchmark Results —Sample program: Eratosthenese sieve Program from BYTE (1/83) expanded with I/O and interrupt handling.

	Archimedes ICC51 v2.20A	MCC51 v1.2	FRANKLIN C51 v2.1
Compilation time	12 sec ✓	18 sec	17 sec
Linkage time	29 sec	9 sec	6 sec ✓
Execution time	11.45 sec	9.00 sec	0.88 sec ✓
Total code size	5318 bytes	3798	1726 ✓
Sieve module size	736	1021	541 ✓

Call now for your free DEMO disk.

FRANKLIN SOFTWARE, INC.

888 Saratoga Ave. #2 • San Jose, CA 95129
(408) 296-8051 • FAX (408) 296-8061

Europe A: (0222) 25 36 26 **B:** (010) 22 34 55 **CH:** (032) 41 01 11 **D:** KEIL (089) 46 50 57 **DK:** (02) 65 82 00 **F:** (1) 64 07 85 64 **GB:** (0962) 73 31 40 **NL:** (01858) 16133 **S:** (040) 92 24 25 **Far East: Aust:** (61) 04 65 41 873 **R.O.C.:** (02) 76 40 2156 **N.Z.** (64) 04 694 129 (fax).

NEW FOR TURBO C PROGRAMMERS

Three Serious Tools
to maximize your time.

Your time is valuable! Now you can reduce your programming time like you never imagined, using The Working Toolbox Software program by Be Aware Inc. Our program comes with an extensive 310 page, easy-to-use manual that is loaded with examples. Also included is a 30-day money back guarantee. Here are some of the features of these three great timesaving tools.

THE WORKING TOOLBOX

THE WORKING ISAM
- Stores data in B+ Trees.
- Maximum of 256 indexes.
- RAM buffers for high speed.
- 6 types of indexes available.
- Multi-field indexing.
- All indexes stored in one file.
- Automatic Recovery.
- FREE SOURCE CODE

THE WORKING SCREEN PAINTER
- Friendly interactive environment.
- Data entry and display.
- Box & line drawing supported.
- Multi color screens at a glance!
- SUPER FAST SCREENS
- Writes C source code ready to be compiled under any memory model.

THE HANDY LIBRARY
- Great functions for easier programming and professional results.
- Intelligent data entry and display.
- Overlapping windows
- Pop Up, Pull down and bar menus with one function call!
- All memory models supported.
- Date conversion functions.

Don't waste any more time, order now! Special introductory price of $179.99 plus S & H. Call (our toll-free number) or fax your order.

Be Aware Inc.

5197 N.W. 15th St., Suite 120, Margate, FL 33063

No Royalties! ORDER NOW ONLY $179.99
1 800-423-1611 or 305-970-0372
or FAX 305-735-3459

Turbo C is a registered trademark of Borland International.

capabilities for saving files to certain formats before investing in an FDHD unit or DOS Mounter.

The package comes with an "extension mapping" feature that lets you open a DOS file by just double-clicking on the file's icon instead of having to first call up the application. This feature basically links DOS file extensions with Mac applications, like DBF with dBASE Mac.

The program's extension table is set up for common programs like dBASE, Excel, and PageMaker. You can customize this table in a window that's similar to the Font/DA Mover. Extension mapping doesn't eliminate the need for file translation when working with incompatible files or programs. Mapping a DOS file to an incompatible Mac program will result in either the program not starting up or the file containing weird characters.

DOS Mounter cannot initialize or erase DOS disks. For that you need the Apple File Exchange 1.1.1, which comes with DOS Mounter. You're supposed to be able to initialize disks in either 720K-byte or 1.44-megabyte formats, but the version that I worked with didn't have a button for the higher density.

I took some disks formatted in the FDHD unit and tried using them with several different DOS computers. I thought that my skepticism was justified when a certain PC clone wouldn't have anything to do with one of the Macintosh-born disks, but it turned out that the clone had some bad parts and wouldn't even accept true-blue disks.

If you're a Mac user who's frequently working with data files from a DOS computer and you like convenience, you need an Apple FDHD unit. And if you need an FDHD unit for your Mac, you probably also need the DOS Mounter software. □

—D. Barker

THE FACTS

DOS Mounter
$89.95

Requirements:
Mac with an FDHD unit and System 6.0.2 or higher.

Dayna Communications
50 South Main, Suite 530
Salt Lake City, UT 84144
(801) 531-0600
Inquiry 1006.

Cold Cache for Your Hard Disk

Caching disk controllers, which use dedicated RAM to store most-often-used data for virtually immediate access, have been available for several years. But the last few months have seen the arrival of a new generation of "smart" caching controllers that put a big dent in the hard disk drive data transfer bottleneck.

Two such controllers are **hyperStore-816** from Perceptive Solutions and **SmartCache PM3011** from Distributed Processing Technology (DPT). Starting with a 10-MHz IBM PC AT clone, I used both controllers with a Seagate ST577R 64-megabyte run-length-limited (RLL) hard disk drive. The results were impressive.

Of the two, the hyperStore-816 has the more radical design. It's a full-length single-slot caching controller that includes a custom hard disk drive BIOS and its own operating system controlling a dedicated Zilog Z80280 microprocessor. Cache RAM is neatly packaged in single in-line memory modules. Although

continued

THE $49 DISK SPACE SOLUTION — PACK MAGIC!

GUARANTEED.

Whether you're a hard disk user who is quickly running out of space, or a software developer whose program no longer fits on a single disk, PACK MAGIC is for you. PACK MAGIC works hard to solve these common disk space problems:

PROBLEM: You never dreamed it would happen, but your hard disk is now fast running out of room.
SOLUTION: Use PACK MAGIC to quickly compress directories when you're not using them. (They'll usually shrink by more than 50%!) When you're ready to use them, PACK MAGIC's rocket-fast algorithm expands any directory in record time.

The following savings are possible with PACK MAGIC:

Disk Size	Space Before PACK MAGIC	Space After PACK MAGIC
20 Megabytes	*4 Megabytes*	*12 Megabytes*
40 Megabytes	*5 Megabytes*	*23 Megabytes*

It's like getting a bigger hard disk!

PROBLEM: Backing up your hard disk takes forever, so you do it far less often than you should.
SOLUTION: Use PACK MAGIC to compress your directories before backing up. You'll cut the time and number of disks needed to back up by half or more.

PROBLEM: You'd like to reduce the amount of space occupied by the programs you use frequently, or you're a software developer and your program is too large to operate on a 360K floppy disk.
SOLUTION: Also use PACK MAGIC to compress your active program files (.com and .exe files). The average reduction for program files is 22%! Your programs will continue to function normally, but will occupy less disk space.

PACK MAGIC is easy-to-use, comes with a menu-driven interface, on-line help, free technical support and a printed manual.

Try PACK MAGIC for 30 days--if you're not completely satisfied, return it for a full refund *(excluding shipping).*

For Same Day Shipping

VISA, MASTERCARD & C.O.D. ORDERS CALL

1-800-223-6925

In Canada call: 319-395-7300
Mon.-Fri. 8:30 a.m. to 5:00 p.m. CST
FAX: 319-395-0217
Or send check or money order payable to Parsons Technology.

Parsons Technology®
Dept.
375 Collins Road NE
Cedar Rapids, Iowa 52402

PACK MAGIC
$49 + $5 shipping
NOT COPY PROTECTED
INCLUDES PRINTED MANUAL

NAME _____
ADDRESS _____
CITY _____
STATE/ZIP _____ PHONE _____
CHECK ☐ MONEY ORDER ☐ VISA ☐ MASTERCARD ☐
CARD # _____ EXP. DATE _____

PACK MAGIC requires an IBM*/Tandy*/Compaq* or compatible computer, 384K or more RAM and DOS 2.0 or higher. Add $5 shipping/handling—$10 outside North America. Iowa residents, please add 4% sales tax.

*IBM, Tandy and Compaq are registered trademarks of International Business Machines Corp, Tandy Corp., and Compaq Computer Corp. respectively.

Circle 272 on Reader Service Card

NEW! REAL-TIME MONITORING & CONTROL

MENU-DRIVEN, EASY-TO-USE STAND-ALONE COMPUTER

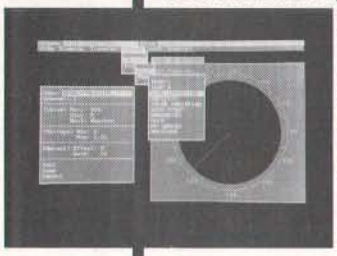
The *stand-alone* SOLUS™ computer connects to an IBM PC's RS-232 port, and provides 36 digital/analog I/O channels.

Menu-driven operation and a large graphics library make it easy to create monitoring and control applications. Use modems to remote locations. And daisychain up to 256 SOLUS computers.

For details or to order, call toll-free.

(800) 247-5712

In Oregon (503) 635-3966



Only **$895**

VISA/MC/AMEX accepted. Software additional.

SOLUS™

PERSONAL CONTROL COMPUTER™

TMI, inc.
4000 Kruse Way Place, 2-120
Lake Oswego, OR 97035
FAX (503) 635-3004

Introducing
Smallest 80386 based
PC Compatible
Single Board Computer

Now Available **DR DOS®**

Only 4" x 6"

Quark/PC® II

- EGA® Video/Color LCD Controller
- SCSI Hard Disk Control • Floppy Disk Control
- Up to 4 Mbytes Memory and much more. . . .

To order or enquire call us today.
Megatel Computer Corporation
(416) 245-2953 FAX (416) 245-6505
125 Wendell Ave., Weston, Ontario M9N 3K9

REPS: Italy 39 331 256 524 · Austria 43 222 587 6475 · W. Germany 49 6074 98031 · Finland 358 0757 1711 · U.K. 44 959 71011 · Sweden 46 40 78 078 · Netherlands 31 838 529 505 · Norway 47 986 9970 · Australia 61 03 568 0988 · Denmark 45 244 0488

Trademarks: Quark - F. + K. Mfg. Co. DRDOS - Digital Research Ltd. EGA - IBM Corp.

megatel

512K bytes is standard, the unit I tested was packed with the maximum of four 1-megabyte SIMMs.

Perceptive Solutions puts its standard floppy disk drive controller and the hard disk drive interface modules on small daughterboards that are mounted to the main hyperStore-816 board. This perceptive design lets you easily change the hard disk drive interface (RLL, modified frequency modulation, ESDI, or SCSI) should you upgrade your hard disk drive.

DPT's SmartCache has a Motorola 68000 microprocessor and uses a more conventional design, with the (optional) floppy disk drive controller and hard disk drive interface integrated onto a single board. This can be a real pain if you change to a drive with a different interface, requiring you to buy an entire new controller. If you want to use a larger cache than the standard 512K bytes, you also need to add a second full-size board. DPT uses standard 1-megabit chips; the board can hold up to 12 megabytes.

After making a full backup of my drive, I found both boards easy to install.

After DOS partitioning and formatting the drives, I immediately booted and used the system in the normal manner. The increase in performance was dramatic. Objective benchmarking of these boards is almost impossible, because the jealously guarded proprietary algorithms "watched" how I worked and became progressively faster as I used them. Both companies claim an effective disk-access time of about 0.5 ms, and I have to agree. What this means in real-world terms is that most applications run eight to 12 times faster.

Although both boards gave me similar results, each had idiosyncrasies. I liked the compact design and easy expandability of the hyperStore-816, but the unit I tested worked only with vanilla DOS. (The company says that drivers for Unix, OS/2, and Novell NetWare are on the way.) SmartCache works with all operating systems, but the necessity of using a second slot for additional cache memory is inconvenient. In addition, my SmartCache ran very hot, although the company assured me that it was normal. Although fully configured caching controllers are not inexpensive, I found that the real speed they added to my system is a better investment than a faster microprocessor. ■

—Stan Miastkowski

THE FACTS

hyperStore-816
$1195 (with 512K bytes)

Requirements:
IBM AT or compatible.

Perceptive Solutions, Inc.
1509 Falcon St.,
Suite 104
DeSoto, TX 75115
(800) 343-0903
Inquiry 1007.

SmartCache PM3011
$1150 (with 512K bytes)

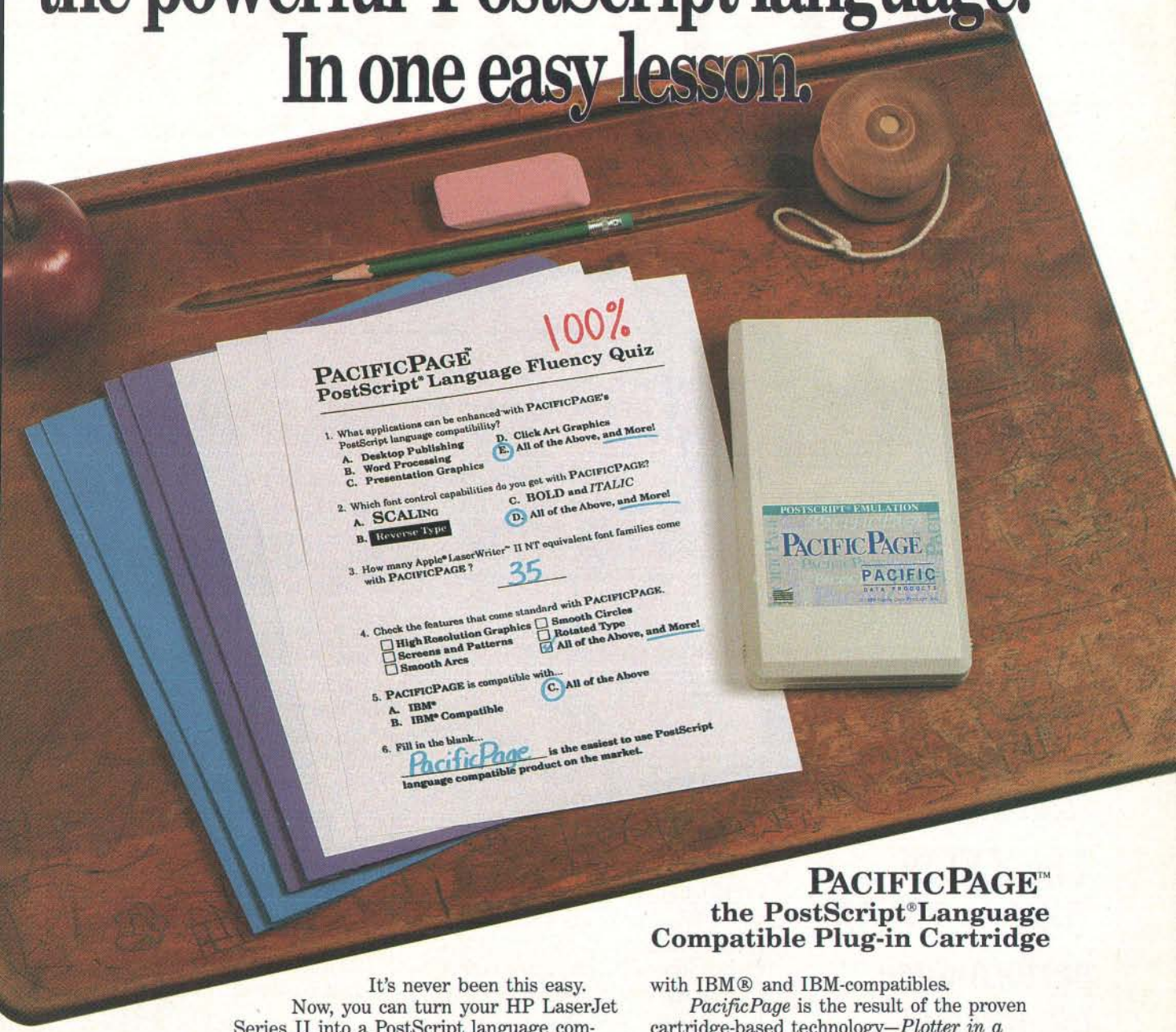
Requirements:
IBM AT or compatible.

Options:
Floppy disk support, $80; mirroring option, $800; BIOS expander chip set, $50.

Distributed Processing Technology
132 Candace Dr.
P.O. Box 1864
Maitland, FL 32751
(407) 830-5522
Inquiry 1008.

 Circle 170 on Reader Service Card

Teach your HP LaserJet Series II® the powerful PostScript® language. In one easy lesson.



PACIFICPAGE™
the PostScript® Language Compatible Plug-in Cartridge

It's never been this easy.

Now, you can turn your HP LaserJet Series II into a PostScript language compatible printer simply by plugging in Pacific Data Products' *PacificPage* cartridge. That's all. No other add-ins, software or cables are required.

Immediately start printing PostScript language output from Ventura Publisher®, Aldus PageMaker®, WordPerfect 5.0®, Microsoft Word® as well as many other graphics and business application software packages. And *PacificPage* is compatible with IBM® and IBM-compatibles.

PacificPage is the result of the proven cartridge-based technology—*Plotter in a Cartridge*™, *25 Cartridges in One!*™—from Pacific Data Products and the innovative PostScript emulation skills of Phoenix Technologies, Ltd.

Authorized Dealer:

DATALINK NORTHWEST
All font cartridges carry lifetime warranty

14430 18th Ave. SW
Seattle, WA 98166
(206) 244-2355
1-800-544-1720

PACIFIC DATA PRODUCTS

6404 Nancy Ridge Dr., San Diego, CA 92121 •(619)552-0880 FAX (619)552-0889• *PacificPage*, *25 Cartridges in One!*, and *Plotter in a Cartridge* are trademarks of Pacific Data Products, Inc. PostScript is a registered trademark of Adobe Systems Inc. PhoenixPage is a registered trademark of Phoenix Technologies, Ltd. Copyright 1987, 1988 Phoenix Technologies Ltd. All other company and product names are trademarks of the company or manufacturer respectively. Copyright 1989 Pacific Data Products, Inc.

PhoenixPage

Circle 199 on Reader Service Card (DEALERS: 200)

ZEOS® 386SX

ZEOS Smashes the '386

Your best reason yet to move up to a '386. Now you can own a complete ZEOS '386SX 16MHz hard drive system for *less* than comparable '286 systems.

The ZEOS '386SX. ZEOS performance, quality and support. ZEOS value. The Choice is Clear.

If you plan to buy a 16- or 20MHz 286 machine, think again.

A fundamental change in computing is about to take place. Systems based on the 80286 processor will be replaced by systems based on the 80386SX.

As America's premier manufacturer of 80386 based systems, we've designed the new ZEOS 386SX to provide everyone with a window to the future. A future of '386 speed and performance at a fraction of what you would expect to pay.

And ZEOS knows '386 systems better than anyone. After all, PC Magazine chose ZEOS above 57 other companies for *"For Overall Excellence"* in their recent '386 Blockbuster issue.

The new ZEOS 386SX simply runs circles around '286 based machines. PC magazine noted that the ZEOS 16MHz 386SX compares "favorably with the 20MHz '286 machines reviewed in 'The 80286: Unsafe at Higher Speeds?'" (PC Magazine, December 27, 1988).

So forget those 16- and 20MHz '286 machines forever. The ZEOS '386SX-16 "blows 'em right out of the water." As PC Magazine says, "386SX-based machines are the right choice..." and the new ZEOS 386SX is the right choice for you.

30 Day Absolute Satisfaction Guarantee. One Full Year Limited Warranty.

If a company believes in their product, they should stand Rock Solid behind it. That's why your new ZEOS 386SX hard drive system includes our famous 30 Day Absolute Satisfaction *Money Back* Guarantee, One Full Year Limited Warranty and Express Parts Replacement Policy.

24 Hour a Day Sales and Toll Free Technical Support!

And talk about service! ZEOS is the only computer company in America standing by ready to help you *Toll Free, 24 hours a day, 365 days a year.* Nobody supports their customers like ZEOS!

Order your new ZEOS 386SX now with confidence. Your choice of ZEOS quality and performance is *Guaranteed.* Order now by calling 800-423-5891.

All prices and specifications are subject to change without notice. Please call for current pricing and warranty details.

Only $1695.
Price Barrier!

The New ZEOS 386SX Hard Drive System. Below '286 Prices!

Only $1,695

The future is now!

Why be left behind with yesterday's '286 technology? This fast new ZEOS 386SX system is your high performance ticket to '386 computing power. It's actually faster and yet less expensive than comparable '286 systems.

- *80386SX-16 CPU, 8/16MHz Dual Speed Keyboard Selectable. Reset/Turbo Buttons.*
- *512K DRAM, expandable to a System Total of 16MB.*
- *Shadow RAM and EMS capability.*
- *Fast 32MB Seagate 138R Hard Drive with autopark, 1.2MB Teac floppy drive.*
- *Ultra high speed Hard/Floppy controller. 1:1 interleave, High Speed transfer.*
- *Genuine Hercules® brand graphics controller. High-Res Amber Display with Tilt/Swivel.*
- *ZEOS/RS Enhanced Tactile/Click keyboard.*
- *2 High Speed Serial Ports plus one Parallel and one Game Port.*
- *6-16, 2-8 bit expansion slots. 80387SX support.*
- *Rugged ZEOS space saver case. Security lock and LED indicators.*
- *Includes ZEOS 24 Hour a Day Toll Free Technical Support and Customer Satisfaction package.*

ZEOS® INTERNATIONAL, LTD.

Order Now Toll Free

800-423-5891

FAX Orders Dial: 612-633-1325
In Minnesota Call: 612-633-4591
MasterCard, VISA, ZCARD, COD
Open 24 Hours a day, 365 Days a year.

ZEOS is a publicly traded company; MPLS/St. Paul Local OTC. ©1989 ZEOS International, Ltd., 530 5th Avenue, N.W., St. Paul, MN 55112.

Circle 296 on Reader Service Card

ZEOS '386 Systems "For Overall Excellence..."

PC Magazine, May 30, 1989

Complete ZEOS 20MHz '386 System. 80MB SCSI Drive!

Only $2995

16MHz systems from $2295!

The standard by which others are measured! Featuring 64K CACHE (twice that of most competitors) providing Zero-Wait State performance vastly superior to page/interleave memory schemes. Incredible Value.

- *High speed Zero-Wait 64K read and write-back SRAM CACHE. The fastest method known.*
- *Genuine 32-bit Intel 80386-20MHz CPU.*
- *1MB of Zero-Wait DRAM Expandable to 16MB.*
- *Fast 80MB, 28ms SCSI Seagate Hard Drive, Teac® 1.2MB Floppy Drive.*
- *High speed HDD/FDD SCSI Host Adaptor with Software.*
- *Genuine Hercules® brand graphics controller. High-Res Amber Display with Tilt/Swivel.*

Performance Comparisons using PC Labs Benchmark Series Release 4:

	80386 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 386/16 Desktop	3.58	13.62	0.58
ZEOS 386/20 Desktop	2.87	10.82	0.38
IBM PS/2 Model 70-E61	4.08	16.04	0.75
Compaq Deskpro 386/16	4.12	15.47	0.75

- *101 Key ZEOS Tactile/Click keyboard.*
- *2 High Speed Serial Ports plus one Parallel and one Game port.*
- *1-32, 6-16 and 1-8 bit slots.*
- *80387 math coprocessor support.*
- *Rugged ZEOS 5-bay case. Including Security Lock and LED indicators.*
- *Includes ZEOS 24 Hour a Day Toll Free Technical Support and Customer Satisfaction package.*

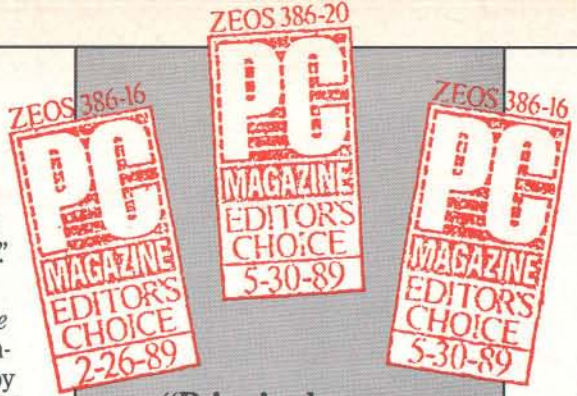
Options Galore: Including 14" VGA, add only $595. And an incredible selection of hard drives: SCSI, RLL, ESDI or MFM and virtually any other add-on you could want!

Order Now Toll Free

800-423-5891

FAX Orders Dial: 612-633-1325
In Minnesota Call: 612-633-4591
MasterCard, VISA, ZCARD, COD
Open 24 Hours a day, 365 Days a year.

All prices and specifications are subject to change without notice. Please call for current pricing and warranty details. ZEOS is a publicly traded company; MPLS/St. Paul Local OTC.



"Out of 104 machines from 58 companies... For overall excellence we selected ZEOS International's 386-16 and 386-20." *PC Magazine, May 30, 1989*

The Editors of *PC Magazine* came to this conclusion after investing "25,000 hours of work by 60 people testing and reviewing 104 '386 PCs." The review was thorough and their conclusion specific. Simply, that out of all the manufacturers in the world, ZEOS offers you the very best '386 Value.

In *all* areas, ZEOS machines are top performers. With uncompromising attention to quality and detail throughout. Not only do ZEOS systems themselves afford you the very best *Values* in computing today, they're backed up by the strongest after sales support in the industry.

At ZEOS we feel that if a company believes in its products it should stand Rock Solid behind them.

That's why ZEOS offers *Toll Free Technical Support 24 Hours a day, seven days a week, 365 days a year!* At ZEOS, we believe in standing by our customers whenever they need us.

Then add our 30 Day Absolute Satisfaction *Money Back* Guarantee, One Full Year Limited Warranty and Express Parts Replacement Policy. You've got the best.

And when you order your ZEOS '386 you can have your pick from the industry's broadest selection of options. As *PC Magazine* said, ZEOS offers "more options than even the most configuration hungry hound could possibly need."

Quality, Performance, Reliability and Support. *Overall Excellence.* That's why ZEOS is PC Magazine's *#1* choice. And that's why ZEOS is *your best choice as well.* So pick out that dream machine today and order it now with confidence. Your choice of ZEOS excellence is Guaranteed. Order now by calling 800-423-5891.

"Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road. Things like quality of construction, reliability, expandability, and ease of service."

PC Magazine, On "What Makes an Editor's Choice"

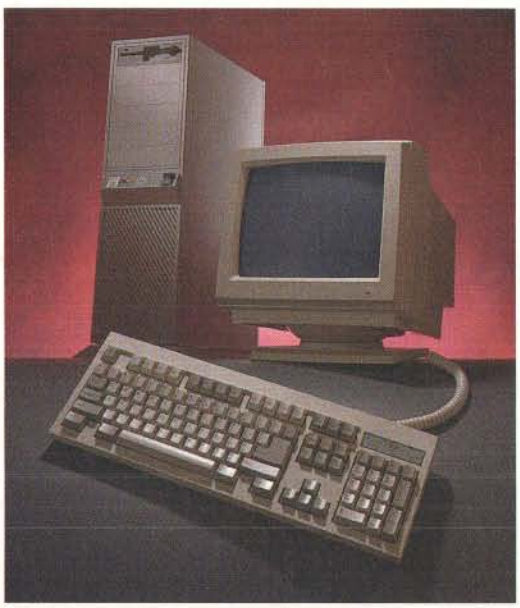
Complete 25MHz '386 Vertical System. 80MB SCSI Drive!

Only $3995

Complete 33MHz systems only $4995!

ZEOS 25MHz and 33MHz 80386 systems are the fastest, most advanced available anywhere. Government Computer News calls the ZEOS '386-33 "arguably the fastest MS-DOS and OS/2 micro in the world." Review after review, these ZEOS systems are selected as the best price/performance buys. A power user's dream!

- *Ultra High speed Zero-Wait 64K SRAM CACHE.*
- *Genuine 32-bit Intel '386-25 or 33MHz CPU.*
- *1MB of Zero-Wait DRAM Expandable to 16MB.*
- *Fast 80MB, 28ms SCSI Seagate Hard Drive, Teac® 1.2MB Floppy Drive.*
- *High speed HDD/FDD SCSI Host Adaptor with Software.*



Performance Comparisons using PC Labs Benchmark Series Release 4:

	80386 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 386/25 Desktop	2.29	8.37	0.33
ZEOS 386/33 Desktop	1.67	6.43	0.27
IBM PS/2 Model A	2.27	8.33	0.60
Compaq Deskpro 386/25	2.36	8.59	0.37

- *Genuine Hercules® brand graphics controller. High-Res Amber Display with Tilt/Swivel.*
- *BIOS and Video Shadow RAM plus EMS support.*
- *ZEOS Tactile/Click keyboard.*
- *2 High Speed Serial Ports plus one Parallel and one Game port.*
- *1-32, 6-16 and 1-8 bit slots.*
- *80387 math coprocessor support.*
- *Rugged ZEOS 5-bay case. Security Lock, LED indicators.*
- *Includes ZEOS 24 Hour a Day Toll Free Technical Support.*

Many options available: Including 14" VGA, add only $595. Plus a large selection of SCSI, RLL, ESDI or MFM hard drives and more.

Order Now Toll Free

800-423-5891

ZEOS® INTERNATIONAL, LTD.

©1989 ZEOS International, Ltd., 530 5th Avenue, N.W., St. Paul, MN 55112. All product and company names are trademarks or registered trademarks of their respective holders.

Comput

*Right Now. Guaranteed!**

Yes, we can ship your new ZEOS® '286 or '386 today! We've built up an extra supply of the hottest selling computers in America. The celebrated ZEOS 286-12 and PC Magazine's Editor's Choice—the ultra fast ZEOS 386-16.

Take your pick now for immediate delivery. These are both *complete,* genuine ZEOS Zero-Wait state systems. Both include an ultra-fast Seagate hard drive and all the other goodies. And they're ready to ship. *Right Now.*

Here's how it works. We have these extra systems pre-built and ready to ship. They include both High Resolution Monochrome and VGA systems. While supplies last, we will ship either of these systems to you *the day you order* subject to these conditions:

1. Your order must be received by 1PM Central Time.
2. Credit Cards are subject to credit card authorization.
3. Orders must be for our standard 286-12MHz system or 386-16MHz system, either monochrome or VGA. Any other systems or upgrades are custom built and will take slightly longer.

**Our Guarantee to You:*

If we fail to ship your system under the conditions outlined, we will ship it *at our expense* as soon as it is ready. All systems are fully burned in and tested. Each system includes our 30 day Money Back Guarantee and One Full Year Limited Warranty. *Toll Free* technical support and Express Parts Replacement are included too!

This offer is good only as long as these pre-built

Complete ZEOS 12MHz '286 with 32MB Hard Drive!

Only $1,395

For VGA color add $595

FREE Shareware Disks Too!
25 Software Programs Included

Every system will include 5 ready to run Shareware programs on free *disks. Included are programs for Word Processing, Spread Sheets, Educational, Financial, Business, Games and more. With Shareware you can try the programs first before you register them with the author. What a great idea!*

Standard Features Include:

- *80286-12 CPU, 6/12MHz Dual Speed keyboard/hardware selectable. Reset and Turbo buttons right up front.*
- Zero-Wait *State DRAM, 512K expandable to 4MB on the mother board (16MB System Total). EMS Capability on board.*

Performance Comparisons using PC Labs Benchmark Series Release 4:

	80286 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 286/12 Desktop	4.78	18.84	0.72
IBM PC AT (8MHz)	8.96	35.60	1.32
IBM PS/2 Model 50	7.20	28.34	1.05

- *Fast 32MB Seagate 138R Hard Drive with auto-park, 1.2MB Floppy Drive.*
- Ultra high speed *Hard/Floppy controller. 1:1 interleave, 800 KB/sec transfer rate.*
- *Genuine Hercules® (Yes, Hercules!) Brand graphics card. High-Res Amber Display with Tilt/Swivel Base.*
- *ZEOS Enhanced 101 Key Keyboard with our Pleasant Tactile/Click Feel.*
- *Serial and Parallel Printer Ports.*
- *Clock/Calendar with Battery Backup.*
- *6-16 and 2-8 bit expansion slots.*
- *80287 support, up to 12 MHz.*
- *Heavy Duty Case Complete with Security Lock and LED indicators.*

Order Now Toll Free

800-423-5891

All prices and specifications are subject to change without notice. Please call for current pricing and warranty details. COD orders may require an advance deposit. PS/2 and AT are trademarks of IBM Corporation.

ers Now!℠

systems remain in stock; please give us a call to verify availability. This offer does not apply to other ZEOS systems or custom configurations.

Immediate shipment is only part of the story.

ZEOS builds Rock Solid computers. That's why we offer you our 30 Day Money Back Guarantee, Toll Free technical support and Full One Year Limited Warranty. Compare that to the others. Then compare performance.

Performance is what ZEOS is all about. If you're buying a computer you may as well buy the fastest. The ZEOS 286-12 is *the fastest* in its class. It features true Zero-Wait state operation with speeds close to many 386 systems!

Or select the ZEOS 386-16. The Editors of *PC Magazine* did. In fact they selected the ZEOS '386 *as Editor's Choice.* And is it ever a screamer. As *PC Magazine* said, "This ZEOS 386-16 blows away every other computer...." Another *PC Magazine* editor said "Don't pass up the ZEOS...solid construction, flexible design and escape-velocity performance make it a top flight choice."

PC Resource Magazine put it this way "ZEOS ...provides quality comparable with the IBM or Compaq and does so for about 70% of the cost." *Personal Computing* simply says "The best value we've come across so far."

We couldn't have said it better ourselves.

And these are the machines that we have ready to ship to you *right now.* Rock solid block buster ZEOS machines with quality and performance that is, in a word, *Guaranteed.* Order now by calling 800-423-5891.

Complete ZEOS 16MHz '386 with 80MB 28ms SCSI Drive!

Only $2,495

For VGA color add $595

ZEOS 386-16 PC MAGAZINE EDITOR'S CHOICE 2-26-89

Standard Features Include:

- *Genuine 32-bit Intel 80386-16MHz CPU.*
- *High speed* Zero-Wait *64K SRAM CACHE.*
- *1MB of Zero-Wait DRAM Expandable to 16MB system total.*
- *Fast 80MB, 28ms SCSI Seagate Hard Drive, 1.2MB Floppy Drive.*
- *Ultra high speed Hard/Floppy SCSI controller.*
- *Genuine Hercules® Brand graphics card. High-Res Amber Display with Tilt/Swivel Base.*

Performance Comparisons using PC Labs Benchmark Series Release 4:

	80386 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 386/16 Desktop	3.58	13.62	0.58
IBM PS/2 Model 70-E61	4.11	16.14	0.77
Compaq Deskpro 386/16	4.12	15.47	0.75

- *101 Key ZEOS Tactile/Click keyboard.*
- *High speed Serial and Parallel Ports.*
- *1-32, 5-16 and 2-8 bit slots.*
- *80387 math co-processor support.*
- *ZEOS 5-bay case with security lock and LED indicators.*

Order Now Toll Free

800-423-5891

FAX Orders Dial: 612-633-1325
In Minnesota Call: 612-633-4591
MasterCard, VISA and COD
Open days, evenings and weekends
Se habla Español.
ZEOS International, Ltd.
530 5th Avenue, N.W.
St. Paul, MN 55112 USA

ZEOS® INTERNATIONAL, LTD.

Deskpro is a trademark of Compaq Computer Corporation. Corporate leasing plans are available. ZEOS is a publicly traded company; MPLS/St. Paul Local OTC. © 1989 ZEOS International, Ltd.

Circle 298 on Reader Service Card

10 Good Reasons To Buy From ZEOS®

NEWS FLASH!
ZEOS International Announces 24 Hour a Day Toll Free Technical Support!

Effective July 15, 1989, ZEOS makes industry history by launching 24 Hour a day, Toll Free Technical and Sales Support.

That's right, ZEOS is now open to serve our customers 24 Hours a day, 365 days a year! There is no other computer company in the world so dedicated to its customers. Now, no matter what time you need help, ZEOS will be there. Day or night. Toll Free.

During the day there are perhaps thousands of computer companies ready to sell you a computer. Many offer technical support if you are willing to pay for the call. And when they get tired, they turn off the lights and go home. Unfortunately, that may be just when you need their help.

At ZEOS, we never sleep. Because somewhere out there, there might just be a customer who needs us. Even at 3:30 A.M.

It's comforting to know. As night encompasses your home or your office, your research lab or your classroom, away in St. Paul sits a small group of very qualified and dedicated people. They're camped there, around the telephone. Just waiting for that small chance. The chance that you might be the one tonight who needs their help.

Across the vast expanse of North America, whether you're in Newfoundland or Hawaii, Florida or Alaska, or anywhere in between—ZEOS is there for you. Any time of the day or night. Any hour or day of the year. We're waiting to help. And you don't even have to pay for the call.

Reason #1

"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are bench mark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but three times thus far in 1989. And "Overall Excellence" are the very words *PC Magazine* used in comparing ZEOS systems to all others.

All prices and specifications are subject to change without notice. Please call for current pricing and warranty details. ZEOS is a publicly traded company; MPLS/St. Paul Local OTC.

Reason #2

Dazzling Performance.

In their February 28th '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer . . . a smart choice" is what they said. And in a recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and 'OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS . . . provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent." *Personal Computing* said, "ZEOS . . . is the best value we've come across . . . its performance is right up there with the slickest, most expensive PCs you can buy."

Reason #5

Warranties and Guarantees.

ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

Reason #6

24 Hour Toll Free Technical and Sales Support.

At ZEOS, the customer is #1. That's why we're open around the clock. For *your* convenience. If you buy a product from us we feel we should be there to help, 24 Hours a day. Our Help Lines are Toll Free too. Because you shouldn't have to pay for the call.

Reason #7

Experience.

Almost unique in the mail order computer industry, ZEOS maintains its own chip level Research and Development staff. In addition to Systems Manufacturing facility.

ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8

A Sterling Reputation.

In magazine after magazine and review after review ZEOS systems are sighted for *Overall Excellence*, for *Excellent Value*, as the *Right Choice* and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The system and the support. That means more to us than anything.

Reason #9

Easy to Buy.

ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

And now the ZCARD! It's your very own ZEOS Credit Card and you can apply today. With the ZCARD you can charge your ZEOS purchases and pay in easy monthly installments. It's just like a Bank Card. *Fill out and mail your ZCARD application now!*

Reason #10

You're Going to be Very Satisfied.

When it comes right down to it, you're going to be very satisfied with your new ZEOS system. Our goal is your complete satisfaction. And that's our commitment to you. To quality. To performance. To reliability and support. To *Value*. We don't just say it, we *Guarantee it!*

ZEOS® INTERNATIONAL, LTD.

Order Now Toll Free

800-423-5891

FAX Orders Dial: 612-633-1325
In Minnesota Call: 612-633-4591
MasterCard, VISA, ZCARD and COD
Open 24 Hours a day, 365 Days a year.

© 1989 ZEOS International, Ltd., 530 5th Avenue, N.W., St. Paul, MN 55112. All product and company names are trademarks or registered trademarks of their respective holders.

FIRST IMPRESSIONS ■ Tom Thompson and Frank Hayes

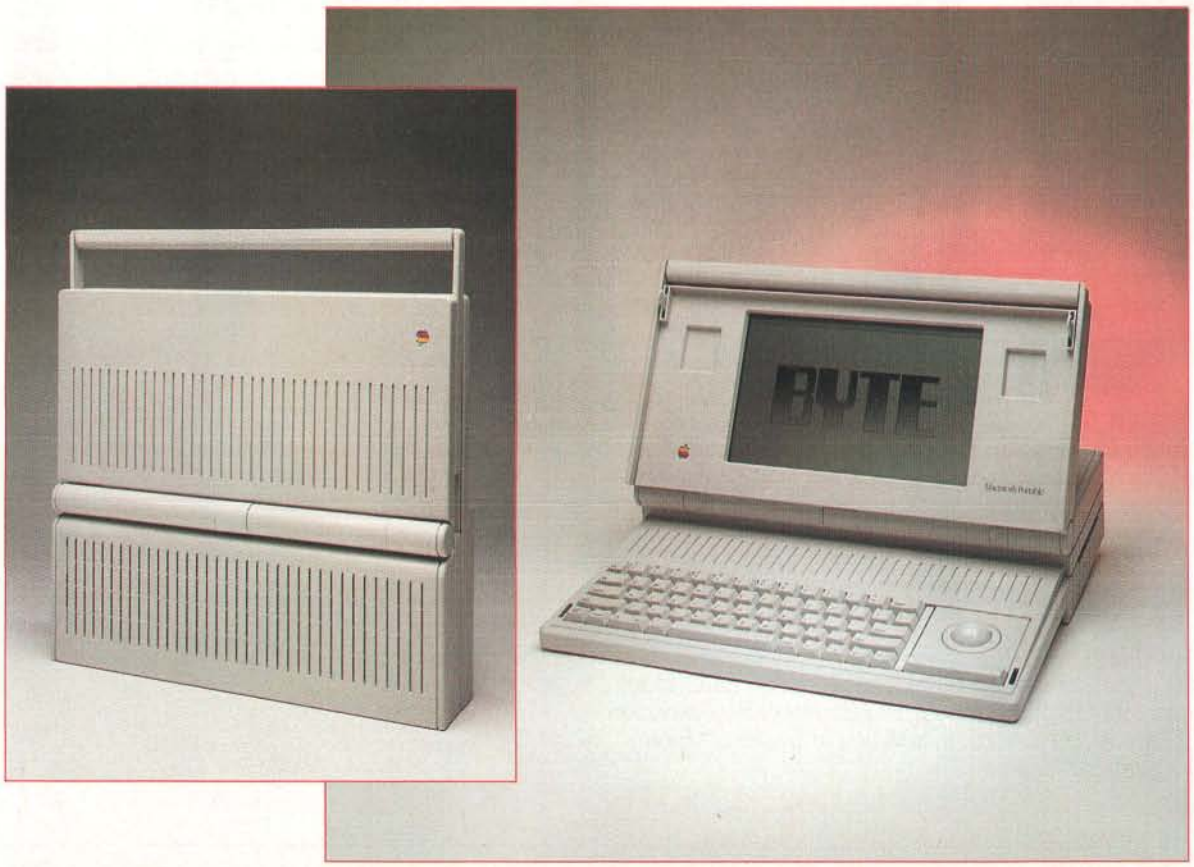
The Portable and

Apple introduces a portable Macintosh line and its newest high-performance modular Macintosh

Apple has finally entered the portable computer sweepstakes with its introduction of the Macintosh Portable, a hefty wedge of computing power that's all Macintosh. At the same time, Apple announced the most powerful Macintosh ever: a high-speed muscle machine called the Mac IIci that rewrites the rules on limits to the Macintosh computer.

The long-awaited Macintosh Portable isn't a laptop—measuring nearly a foot and a half on each side and weighing in at roughly 16 pounds, it won't fit comfortably on your lap. But the Portable still lives up to its name: It can operate for up to a full working day away from a power outlet, its razor-sharp reflective LCD screen sports more pixels than the Mac SE's screen, and it includes a built-in trackball that replaces the mouse. It's a fully functional Macintosh, using a 16-MHz 68000 processor and enhanced Mac SE ROMs.

The high-powered Mac IIci looks like the twin of its six-month-old cousin, the Mac IIcx. But a closer look reveals a video connector on the back, hinting at the changes inside. Internally, the Mac IIci has been completely redesigned, using a 25-MHz 68030 processor, a much improved memory subsystem with faster memory, and a slot for a memory cache board.



the Powerful

Mac Portable: An Outside Tour

With its tilt-up display stowed, the Portable resembles a wedge 15¼ inches wide by 14 5/16 inches deep that's taller at the back (about 4 inches high) than at the front (about 2 inches high). Its outer shell is made of high-impact platinum-gray plastic.

The Portable comes out of the box packed in its carrying case. If the unit has a hard disk drive, the system software is preinstalled. A built-in handle running the width of the wedge's shorter end pops out to make carrying the computer easier. To open the unit, you push the handle back into the wedge's body until the top of the case unlatches. The hinged case-top contains the display, and it uncovers a full-size keyboard with 63 keys. The hinge has a friction clutch so that you can adjust the display to any angle.

To the right of the keyboard is a miniature (1⅓-inch-diameter) trackball that replaces the mouse as the pointing device. Beneath it is a large button that serves as a mouse button. For the purists, a single Apple Desktop Bus (ADB) port at the rear allows use of a low-power mouse.

All other Macs have two ADB ports (except the Mac Plus, which doesn't use the ADB for its mouse/keyboard connections), but since the Portable's keyboard and trackball use internal ADB connections, the missing second ADB port isn't a problem. You can use a conventional ADB mouse, but it consumes more power and will shorten the Portable's operating time. If you're using an external mouse, you can replace the trackball with a numeric keypad.

Apple has a knack for handling fine details, and one place where this shows is in the trackball/keyboard design. Both the keyboard and the trackball can be popped out of the chassis and swapped so that the trackball is to the left of the keyboard, making it more convenient for left-handed users. (See photo 1.)

A 1.4-megabyte 3½-inch FDHD "SuperDrive" reads Mac, Apple II, or DOS-compatible 3½-inch floppy disks. The FDHD is located toward the back of the Portable, on the right side. At the rear are the usual I/O ports and several new connectors: a video port, an RJ-11 connector for an optional internal modem, and a battery charger connector. The external battery charger can operate in the 70- to 270-volt range and can handle frequencies of 40 to 70 Hz. This makes the battery charger usable anywhere in the world, provided you have a connector for the wall outlet conductors.

The Portable's display is a 9⅘-inch-diagonal flat-panel screen that uses a reflective, active-matrix, LCD technology to provide a 640- by 400-pixel black-and-white display in which every pixel is controlled by a separate transistor. By comparison, compact Macs have a 9-inch-diagonal screen with a 512- by 342-pixel display, and modular Macs using a Macintosh II video board have a 12- or 13-inch-diagonal screen (depending on the monitor type) with a 640- by 480-pixel display.

The Portable is the first computer to use the active-matrix LCD. This technology provides the high contrast and high response speed required to display the mouse pointer in real time. Two other significant advantages of this

continued

display are its low power consumption and wide viewing angle. The video port supplies only LCD signals; an optional adapter converts these signals into analog signals for a Mac monochrome monitor or into National Television System Committee, PAL, or Séquentiel à Mémoire (SECAM) video signals.

You switch on the Portable by hitting any key on the keyboard. It has no cooling fan since it consumes so little power (1 watt without a hard disk drive and 3 W on average when the hard disk drive is running).

Mac Portable: The Inside Tour

The Macintosh Portable's ancestry can be traced to the Mac SE. However, the two computers differ as markedly on the inside as they do on the outside. Interestingly, the Portable's designers have packed more functions and slots into the smaller system.

Photo 2 shows the Portable motherboard. Its heart is a low-power CMOS 68000 processor beating at 15.67 MHz—twice the speed of the Mac SE. The 256K bytes of ROM contain enhanced Mac SE firmware that incorporates bug fixes to existing Mac SE ROMs, the LCD driver, and new functions that manage the Portable's power use. Sound generation is much improved because the Portable uses the same Apple Sound Chip (ASC) found in the Mac II to generate stereo sound.

The system comes equipped with 1 megabyte of 100-nanosecond static RAM (SRAM). A 50-pin RAM expansion slot lets you expand system RAM via a 1-megabyte RAM board, for a total of 2 megabytes. When higher-density RAM becomes available, future RAM boards will expand the Portable's maximum memory to 9 megabytes. A 50-pin ROM expansion slot either provides for a possible ROM upgrade (by moving the appropriate jumper—the Portable addresses the ROM slot rather than on-board firmware at boot-up) or allows a vendor to install up to 4 megabytes of embedded software. This latter capability would be useful, for example, to salespeople who need custom software to access on-line databases or to process forms.

Like the Mac SE, the Portable also contains a Processor Direct Slot that provides unbuffered CPU signals for use by hardware expansion boards. Although this slot uses the same 96-pin Euro-DIN connector as the Mac SE, it's incompatible electrically because of differences in the processor speed, power consumption, and additional control signals. The Portable, unlike the Mac SE, has no external access port for the PDS.

As if enough hardware wasn't packed in there already, the Portable also has a slot for an optional 2400-bps modem board and room for an optional one-third-height 40-megabyte 3½-inch SCSI hard disk drive. (See photo 3.)

Photo 1: *The keyboard and the trackball can be removed and swapped to accommodate left-handed users. Mouse users can replace the trackball with a keypad.*

Conserving Energy

To get the most out of the system, you need a reliable power source. A 2-pound, 6-V, lead-acid gel battery supplies the Portable's 5-V power. Apple chose lead-acid batteries over other battery technologies for several reasons. First, the technology is a proven one. Second, the battery voltage varies slightly as it is discharged. This gives a rough indication of the battery's remaining power—unlike a nickel-cadmium battery, whose voltage drops only when its power is nearly exhausted. Third, a lead-acid battery can be completely recharged from any level of discharge, while a nickel-cadmium battery must be discharged completely before it can be fully recharged.

Wherever possible, Apple used low-power CMOS components in the Portable. Since a CMOS version of the 68030 processor was not available, that processor was not used; it would have consumed far too much power. The main memory's SRAM eliminates the need for memory refresh circuitry. The reflective LCD uses little power, and none is spent backlighting the screen. The Portable's SCSI hard disk drive was selected for low power consumption and its ability to be switched on and off frequently.

However, even these measures aren't enough. The Portable uses a dedicated processor termed a "power manager" (not to be confused with the software Managers present in the Mac ROMs) that actively regulates power in the computer. The power manager is a Mitsubishi 50753 processor, and it primarily provides "hooks" that the System software can use to switch various subsystems on or off as needed. The power manager accomplishes this by either disabling the clock signals to various components (e.g., the Standard Wozniak Integrated Machine [SWIM] chip and the serial communications controller [SCC] chip) or switching off the power to the hard disk drive.

If a certain subsystem is inactive for a predetermined amount of time, the power manager shuts it off. Likewise, if application software is going to write to an inactive device (say, the hard disk drive or the serial port), the device driver turns the subsystem on. The power manager also takes over the duties of parameter RAM, manages the real-time clock, and serves as an ADB transceiver. It also monitors the battery voltage.

The Portable operates in several modes, each using a different amount of power. In the *active mode*, the Portable operates at 16 MHz and uses the most

power. If the system sits idle (i.e., no user activity and no I/O in progress) for more than 15 seconds, the Portable enters a power-saving *rest mode*. In this mode, additional wait states (64 per bus cycle) are added to each RAM or ROM access. This slows the Portable's effective speed to 1 MHz and reduces the power consumption of the processor and memory subsystem by 20 percent.

If the Portable continues to remain idle for over several minutes (the exact interval is user-selectable from a Control Panel cdev), it enters a low-power *sleep mode*. To enter this mode, the power manager first saves the state of the 68000 processor and certain system variables. Then the CPU, display, and many of the peripheral subsystems are turned off. Finally, the power manager switches itself off by disabling its own 3.9-MHz clock. The SRAM and video memory remain powered, preserving their contents. Also, portions of the modem board and several chips (i.e., the Versatile Interface Adapter, the SCC, and the keyboard processor) remain powered.

A clock signal reactivates the power manager every sixtieth of a second, and it evaluates the situation to see if the Portable should "awake" into active mode. Several conditions can terminate the sleep mode. One is hitting a key; this closes a gate that a keyboard processor detects, and it in turn notifies the power manager. Since the ADB circuits are inactive in the sleep mode, moving the trackball or clicking the mouse button will not awaken the system.

By saving the system's state and preserving main memory, these actions "freeze" the state of a running application when the Portable enters sleep mode. When the power manager restores the Portable to active mode, the application resumes from the point at which it stopped.

In another example of Apple's attention to detail, you can also set a predetermined wake-up time for the power manager. This way you can set the Portable to wake up at night and have a suspended telecommunications application start executing a script to log onto an on-line information service. Better still, the modem board's ring-detect circuitry remains powered, so that an incoming call to the Portable's modem can wake up the system, and it can resume running, say, an application to receive E-mail or a report.

The Portable presents you with several alert boxes as the battery's power diminishes. The first alert box appears when

continued

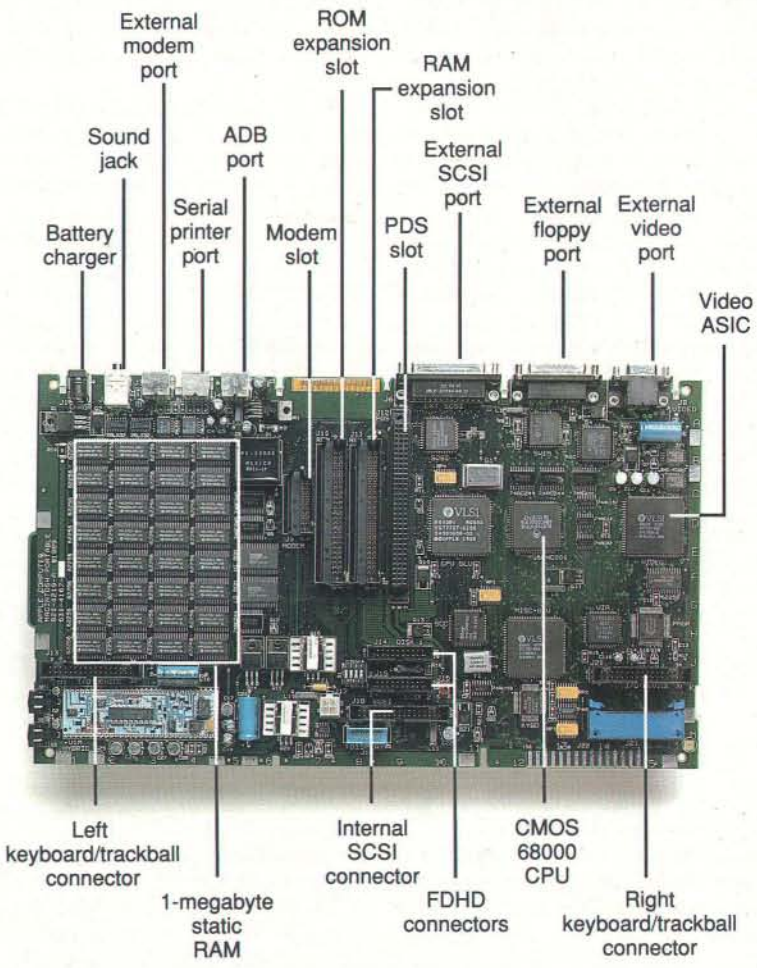


Photo 2: *The Mac Portable motherboard. It uses CMOS components to reduce power consumption. The 68000 CPU runs at 15.67 MHz, twice the rate of a Mac SE.*

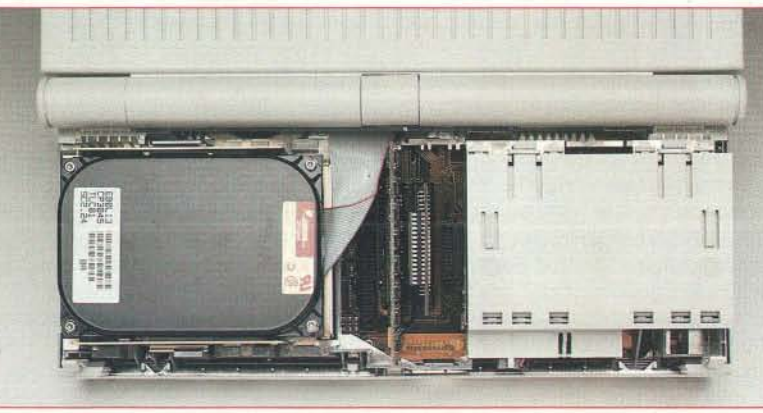


Photo 3: *Inside the Portable. At left is an optional 40-megabyte SCSI hard disk drive; in the center are RAM/ROM expansion slots; to the right is the battery housing.*

there is roughly an hour of battery life left (the exact interval depends on the Portable's configuration and usage). It tells you that you are running on reserve power and warns you to recharge the battery. The second and third alert boxes appear when the battery is at 50 percent and 25 percent of this reserve capacity. When the power level becomes critical, the Portable automatically puts itself into sleep mode. The battery preserves the state of the machine and memory for about four days thereafter. You can run the Portable while recharging the battery, or, if you need to swap batteries, a conventional 9-V battery energizes the system long enough for you to make the exchange.

Software Considerations

The Portable runs System 6.0.4, which is required to deal with the new hardware in the computer. A `Portable` cdev lets you adjust the LCD's contrast, time-out intervals for entering the sleep mode and switching off the hard disk drive, wake-up time, and whether to use the internal modem or an external modem via the serial port. You can also set the size of a RAM disk so you can operate out of RAM rather than use a power-hungry hard disk drive. As a safeguard, the rest mode can also be disabled.

The Finder's Special menu has a new item: `Sleep`. On the Portable, only minor differences exist between `Shut Down` and `Sleep`. Both power down the computer, but `Shut Down` closes all active applications while `Sleep` only suspends them.

Naturally, there are the usual concerns about software compatibility with this new Macintosh. Anything that addresses the serial ports directly (some MIDI applications) or the ADB hardware will break, since that particular I/O subsystem might be switched off. Applications should use either the appropriate traps or the serial drivers, so that the Mac OS can switch the subsystem's power back on before performing the operation. Sound generation is a problem because in many cases the old sound drivers were accessed directly. The Mac OS monitors the ASC for accesses and powers on the chip as required. Newer applications should use the Sound Manager whenever possible.

Applications that perform lengthy calculations must take precautions to prevent the Portable from entering the rest mode and lengthening the process—a distinct possibility if the operation takes more than 15 seconds. This problem has an easy fix: The Portable won't enter rest mode if the mouse pointer is a stopwatch icon, normally indicating a time-consuming process. Most applications already use either the watch or the MPW "beach ball" to indicate that the application is busy, so this shouldn't be a problem.

Finally, software designers should beef up their error checking, since the user can put the Portable into sleep mode at any time and the rest mode can produce significant delays. Both actions can produce new and unanticipated errors.

The Mac IIci

The Mac IIci is Apple's newest high-performance member of the modular Macintosh line. The Mac IIci's outside looks almost identical to that of the Mac IIcx, down to the same compact case, but it has a faster CPU and a completely redesigned motherboard.

The Mac IIci goes a long way toward using all the features of the 68030 processor.

Like the Mac IIcx, the Mac IIci uses a Motorola 68030 processor and a 68882 FPU, three NuBus slots, and a 3½-inch FDHD drive. It also has the IIcx's collection of I/O ports: two ADB connectors, a DB-25 SCSI connector, an external floppy disk drive connector, two mini-DIN-8 serial ports, and a stereo sound connector.

But here the resemblance ends. The Mac IIci's CPU and FPU are clocked at 25 MHz rather than 16 MHz—a 56 percent jump in clock speed. The Mac IIci's memory subsystem is beefed up in several ways. First, the memory itself is faster, using 80-ns fast-paged DRAM instead of the IIcx's 120-ns DRAM. A special slot for memory-cache boards provides direct memory caching. For the first time, memory parity-checking is also an option. Using 4-megabit-density RAM mounted in single in-line memory modules (SIMMs), you can expand the Mac IIci's memory to 32 megabytes.

The Mac IIci also has an on-board video subsystem that generates monochrome or color signals through a standard DB-15 video port on the computer's back, and user-selectable screen depths of 1 (black-and-white), 2, 4, or 8 bits (gray scales or 256 colors). The maximum screen depth is 4 or 8 bits, as determined by the monitor type.

Last, but certainly not least, the Mac IIci now has new 512K-byte ROMs for system firmware, as opposed to the Mac IIcx's 256K-byte ROMs.

Engineered for High Performance

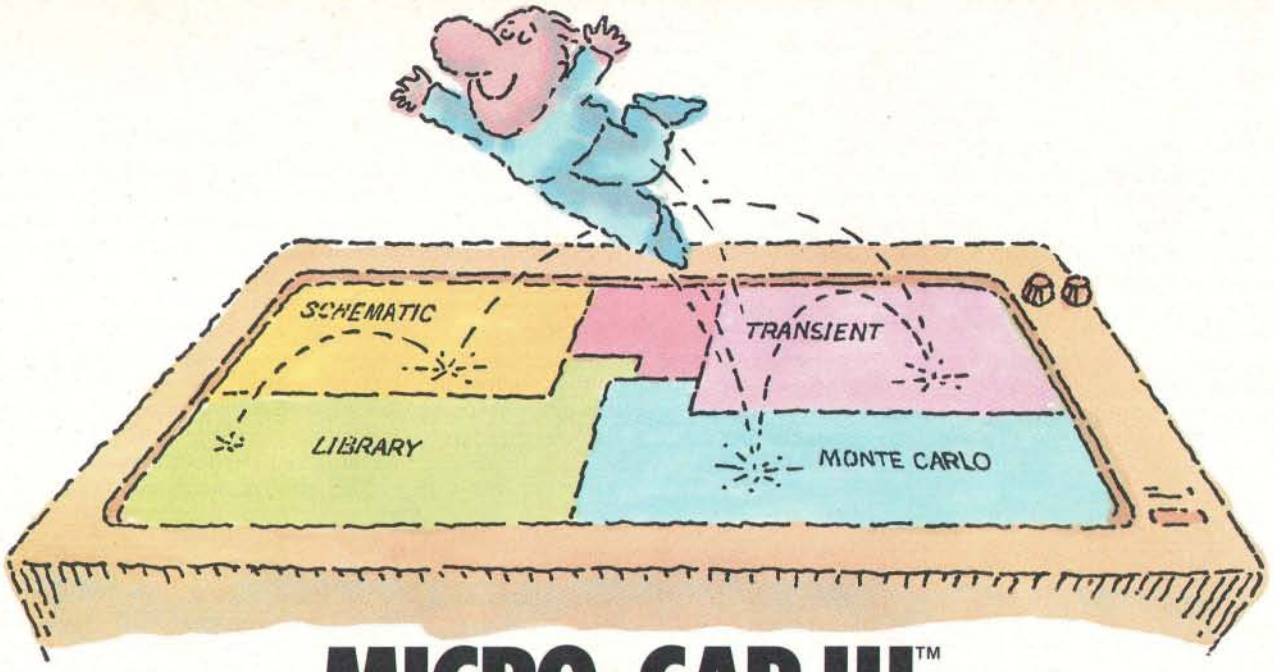
The real star of the show is the Mac IIci's new, faster processing core (see photo 4). The 25-MHz 68030 and 68882 and the 80-ns memory mean that software runs faster. But the supporting cast is critical, too: You can't just drop a faster processor and memory into any computer, least of all a Macintosh. Unless you're planning to redesign every peripheral in the system, the other timing functions—such as those for the serial ports, the FDHD controller chip, and the ADB controller—must remain the same.

The Mac IIci's design team elegantly solved the problem by decoupling the processor and memory clock speeds from the clock speed of the I/O subsystems. Earlier members of the Mac II family used a single oscillator to generate a clock signal that was then divided into signals for the CPU and other subsystems. (A separate oscillator generates the 10-MHz NuBus clock.) Attempting to boost the clock speed of this type of design triggers a cascade of modifications. Therefore, the Mac IIci uses a separate oscillator for the CPU and memory, another for the various I/O subsystems, and still another set of oscillators for running the on-board video. As a result, future Macs will be able to run still faster processors without major revisions to the overall design.

The Mac IIx and IIcx failed to use all the features of the 68030 processor. The IIci goes a long way toward filling that gap. First, it uses the 68030's burst access mode, which allows the CPU to read 16 bytes of data at a time in about half the clock cycles. The result is another 10 percent improvement in performance.

Along with faster DRAM, the Mac IIci also includes a 120-pin connector for a user-installed direct memory cache board. In a direct memory cache, cache memory is a simple mirror image of a section of memory (unlike the more complex *set-associative* caching systems commonly used on PC-compatible machines). As a result, the Mac IIci's cache may have a somewhat lower "hit rate" (i.e., how often the required data is actually in the cache; on a "cache miss," the

continued

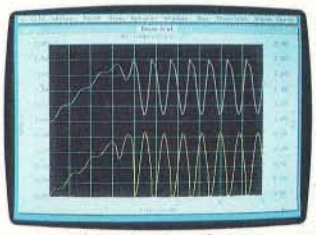


MICRO-CAP III.™
THIRD-GENERATION INTERACTIVE CIRCUIT ANALYSIS. MORE POWER. MORE SPEED. LESS WORK.

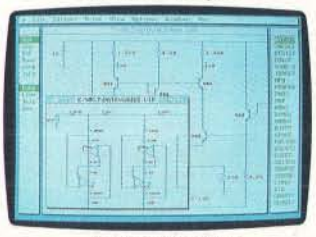
MICRO-CAP III,™ the third generation of the top selling IBM® PC-based interactive CAE tool, adds even more accuracy, speed, and simplicity to circuit design and simulation.

The program's window-based operation and schematic editor make circuit creation a breeze. And super-fast SPICE-like routines mean quick AC, DC, Fourier and transient analysis — right from schematics. You can combine simulations of digital and analog circuits via integrated switch models and macros. And, using stepped component values, rapidly generate multiple plots to fine-tune your circuits.

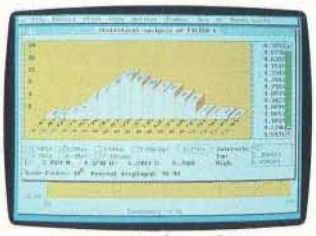
We've added routines for noise, impedance and conductance — even Monte Carlo routines for statistical analysis of production yield. Plus algebraic formula parsers for plotting almost any desired function.



Transient analysis



Schematic editor



Monte Carlo analysis

Modeling power leaps upward as well, to Gummel-Poon BJT and Level 3 MOS — supported, of course, by a built-in Parameter Estimation Program and extended standard parts library.

There's support for Hercules,® CGA, MCGA, EGA and VGA displays. Output for laser plotters and printers. And a lot more.

The cost? Just $1495. Evaluation versions are only $150.

Naturally, you'll want to call or write for a free brochure and demo disk.

spectrum

1021 S. Wolfe Road,
Sunnyvale, CA 94086
(408) 738-4387

MICRO-CAP III is a registered trademark of Spectrum Software.
Hercules is a registered trademark of Hercules Computer Technology.
IBM is a registered trademark of International Business Machines, Inc.

Circle 258 on Reader Service Card

CPU must wait a little longer while the data is fetched from main memory).

Apple is working on its own direct-memory cache board, but it won't be available until next year. Apple claims that the Mac IIci normally operates 45 percent faster than a Mac IIcx, and with a cache board, up to 55 percent faster.

Built-in Video

Perhaps the most unique feature of the Mac IIci is the video subsystem built onto the motherboard. It supports a 640- by 480-pixel display that can be 1, 2, 4, or 8 bits deep and is functionally equivalent to a Macintosh II video board. It also supports Apple's Portrait Display monitor with a 640- by 870-pixel display at screen depths of 1, 2, or 4 bits, which ordinarily would require yet another NuBus video board to use.

No special installation is required to use the video: You simply plug an Apple monitor into the Mac IIci's video socket and start the computer. The Mac IIci automatically configures the system to drive the monitor. The Start Manager (software used to run hardware diagnostics, initialize the system, boot from a start-up drive, and then launch the Finder) examines three lines on the video connector. If a monitor is attached, certain combinations of these lines will be grounded, and the Start Manager knows to use the on-board video subsystem. The grounding pattern identifies the type of monitor connected to the system.

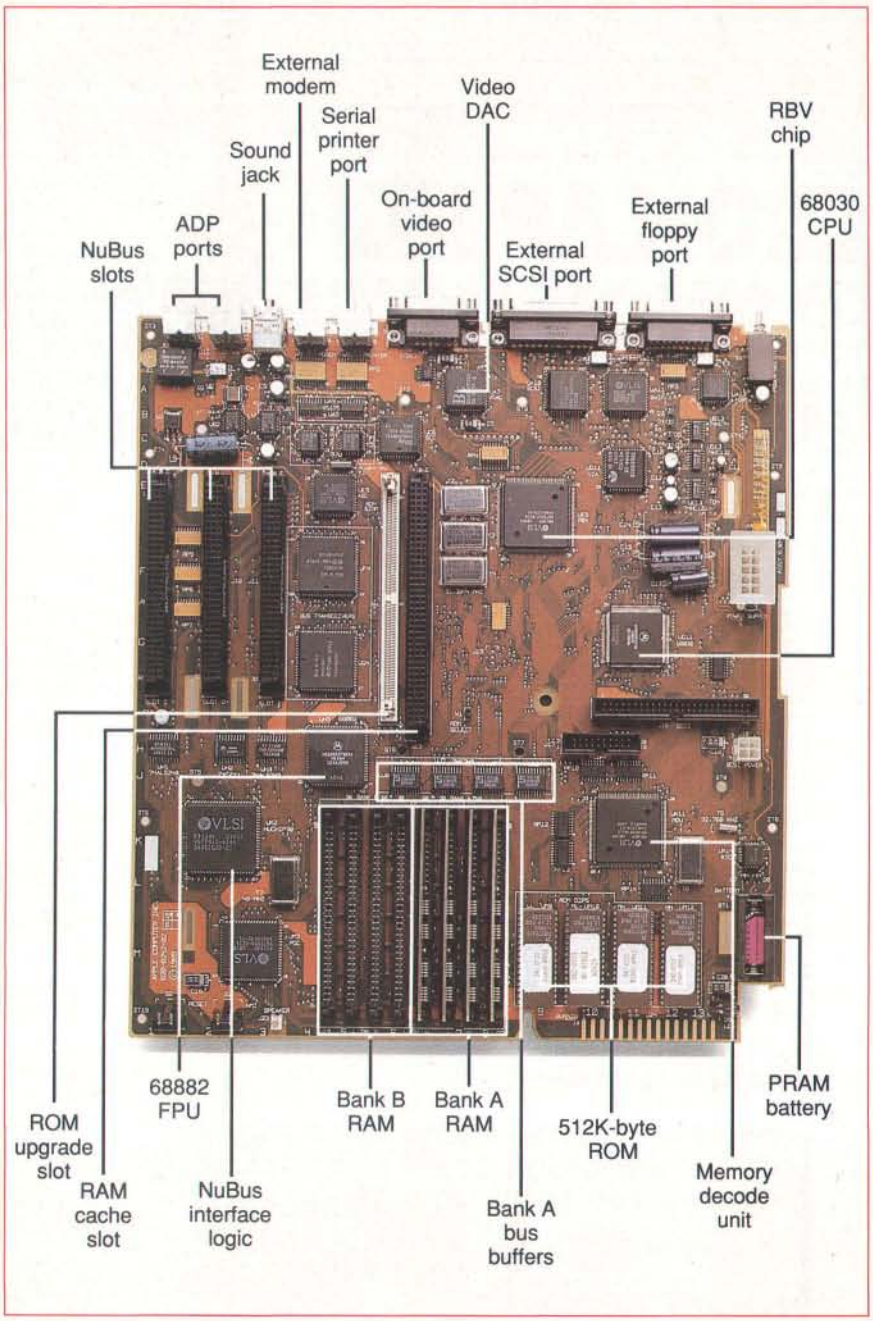


Photo 4: *The Mac IIci motherboard. The various application-specific ICs reduce the board's component count and thus improve its reliability.*

This built-in video accomplishes two purposes. First, it means a price reduction, since—unlike the rest of the Mac II family—it's no longer necessary to buy a video board to use the Mac IIci. Second, this frees up one of the three NuBus slots that the video board normally occupied. The Mac IIci still supports NuBus video boards if your application requires it (e.g., for 24-bit color) or if you add a second monitor.

The Mac IIci's built-in video provides a significant jump in video performance. This is because a section of ordinary system RAM, rather than video RAM on a NuBus board, is used for the video frame buffer. The 68030 can put video information directly into memory at full speed, rather than sending it through the somewhat slower NuBus. Two new custom application-specific ICs make this all possible: a Memory Decode Unit and a RAM-Based Video chip. The RBV maintains the display by supplying raster data from a first-in/first-out queue to the digital-to-analog converter that drives the monitor. When the FIFO is half empty, it requests more data from the MDU. The MDU uses a bus buffer to lock access to bank A of main memory and then performs a direct-memory-access (DMA) burst read of 32 bytes from the frame buffer into the RBV's FIFO.

There is a catch, though. While the MDU chip is grabbing video data, the CPU is locked out of memory bank A for 800 ns at a time. How often this occurs depends on the screen depth; since a deeper screen means that there is more data to read, bank A will be locked longer. This memory contention can reduce performance by 8 percent. With a cache card installed, of course, the performance penalty would be much less.

Fortunately, the Mac IIci's design holds a partial solution. In previous Mac II designs, memory had to be contiguous. This meant that higher-density SIMMs had to be installed in bank A first, and then in bank B. In the Mac IIci, the same MDU that assists the on-board

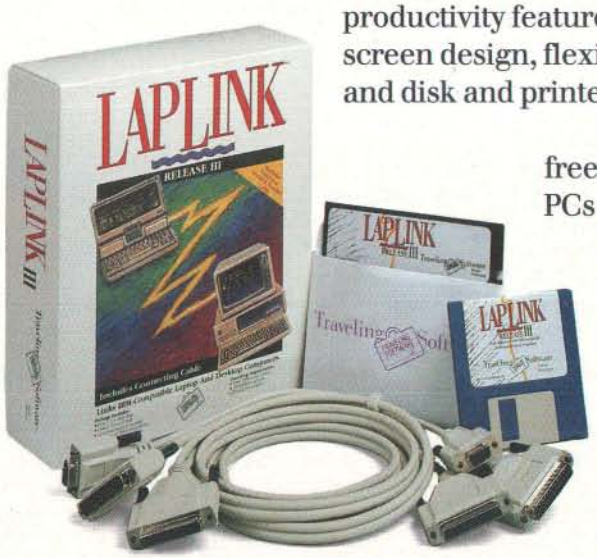
continued

"Xerox this memo."
"FedEx this proposal."
"LapLink these files."

When something becomes a standard, using it becomes second nature. That's true about LapLink. It's so effective that it has become the most popular laptop-to-desktop and desktop-to-desktop file transfer program ever.

And now Release III improves on the original with added power—while preserving the simple design that has made LapLink the choice of more major corporations.

LapLink III offers both serial and parallel file transfer, and you can take advantage of parallel transfer speeds of 500,000 baud or higher. It comes with a "six headed" universal cable that provides you with everything you need to use both serial and parallel modes.



And LapLink III will even install itself automatically on a remote computer.

That's in addition to ease-of-use and productivity features like our popular split screen design, flexible transfer options, and disk and printer sharing.

For the same fast, error-free file transfers between PCs and Macintoshes, get LapLink Mac. And for more information about any Traveling Software product, call us at **(800) 662-2652.**

LapLink III. The standard in file transfer software.

Suggested Retail Price $139.95

LAPLINK III

TRAVELING SOFTWARE

Traveling Software, Inc.
18702 North Creek Parkway, Bothell, WA 98011
(206) 483-8088

Traveling Software Europe
Lords Court, St Leonards Road, Windsor
Berks, SL4 3DB, England
(44) 0753 831855

LapLink is a reg. trademark of Traveling Software, Inc., Xerox is a reg. trademark of Xerox Corporation, FedEx is a reg. trademark of Federal Express Corporation. © 1989 Traveling Software, Inc. All Rights Reserved

Circle 279 on Reader Service Card

video also performs the physical address mapping for all the RAM, ROM, and I/O peripherals. The 68030's memory management unit then maps the physical addresses supplied by the MDU into a contiguous set of logical addresses. Simply put, the MDU/MMU address translations effectively "knit" noncontiguous physical memory into what appears to be contiguous memory to the Mac OS. Since the Mac IIci's memory is no longer required to be contiguous, it's possible to place the higher-density SIMMs in memory bank B without filling up bank A first. As a result, you can install a large complement of memory (up to 16 megabytes) that will never be hit by video subsystem lockouts.

How you use the Mac IIci can also sidestep the problem. When you use the Finder, important system globals used by applications are loaded into bank A, so there's a decrease in performance. If you use MultiFinder, it loads an application and these globals into bank B first.

When all the factors are considered, Apple claims that the on-board video still outruns NuBus video at screen depths of 1, 2, and 4 bits; with a cache board installed, it can even outrun NuBus at the 8-bit screen depth.

Another problem with on-board video is that the frame buffer's memory consumes system RAM. A 640- by 480-pixel display that's 1 bit deep requires a reasonable 64K bytes of RAM (actually only 38K bytes, but for performance reasons, RAM is allocated in 32K-byte blocks). When the same display is 8 bits deep, however, it requires 320K bytes of RAM. For a basic Mac IIci system with 1 megabyte of RAM, that's a huge percentage of available memory.

Exactly how much system memory the on-board video system uses depends on the amount of RAM available. With a 1-megabyte system, the Mac IIci defaults to the 1-bit-deep black-and-white display. You can override this by using the `Monitors` cdev, which is enhanced in System 6.0.4 so that you can adjust the size of the Mac IIci's frame buffer. With 2 megabytes or more, the Mac IIci defaults to the 8-bit-deep display. With a NuBus video card installed, of course, you eliminate the problems of memory lockout and frame buffer size entirely, but at the expense of using a NuBus slot.

New and Improved ROMs

The Mac IIci ROMs include significant changes from the Mac IIcx ROMs. To begin with, 32-Bit QuickDraw and patches to existing Mac II routines are now incorporated into the firmware (32-Bit QuickDraw lives as a RAM patch on the other Mac II-family computers). New additions to the ROM code include the driver for the on-board video, an enhanced Script Manager, a revised Slot Manager that better deals with NuBus master boards, and virtual memory support.

These ROMs were optimized for the 68030's architecture by arranging the code so that all the Mac Toolbox routines start at 16-byte boundaries. This arrangement matches the organization of the 68030's instruction cache and thus takes full advantage of the code cache's operation by ensuring that its 16-byte buffers remain filled. Since much of what a Macintosh does is accomplished by Toolbox routines, this provides an overall improvement in performance.

Using the Mac IIci is like being strapped into a rocket sled.

But perhaps the most important change to these ROMs is that the code is "32-bit clean" (i.e., it can fully use the 68030's 32-bit address space). Until now, the Mac OS has been hampered by the 24-bit addressing limitations built into QuickDraw and the Memory Manager—a legacy of the 68000's 24-bit address space. 32-Bit QuickDraw fixes the addressing problems with QuickDraw, and a new 32-bit Memory Manager, using a new master pointer structure, is embedded in the Mac IIci ROMs. However, until System 7.0 arrives, the older 24-bit Memory Manager, which is also embedded in ROM, will be used to provide compatibility with the existing software base.

What applications software might break on the Mac IIci? Those applications that rely on physical addresses (e.g., expecting Toolbox routines at specific addresses) will break. Also, any application that happened to work because of "memory wrapping" will now break. For example, an application might accidentally dereference an NIL window pointer. On other Macintoshes, this out-of-range memory reference truncates to a 24-bit address within physical memory, and unless an existing data structure gets corrupted, the window happens to work. However, the Mac IIci's MDU won't truncate the address but instead maps it to a physical 32-bit address. The 68030's MMU then attempts to access this nonsense address and signals a bus error.

Complex color applications should use the logical graphics device, `gDevice`, so that the Mac IIci can route the display to its on-board video subsystem. As usual, applications that follow the Apple software guidelines should work fine.

Observations

We had a chance to examine preliminary versions of both machines in late July and obtain some benchmark timings. Since we only had a few hours to examine a Mac Portable running a beta version of System 6.0.4, we can't comment on its expected battery life. But we determined that the Mac Portable is, without a doubt, a fully functional Mac. It ran popular software easily under MultiFinder, and the trackball was easy to use.

The bad news is that the Mac Portable's dimensions and weight place it in the "luggable" category, and you're certainly not going to rest it on your lap. Although you can carry it onto a plane, you won't be able to use it comfortably in-flight. Furthermore, it won't fit under some plane seats. On a Boeing 727, for example, the Portable in its carrying case would fit easily under the first-class and middle coach seats, tightly under coach window seats, and not at all under coach aisle seats. Clearly, though the Mac Portable is portable, its size and weight are its biggest disappointments.

The good news is that even without backlighting, the Mac Portable's active-matrix LCD is crisp and sharp, with excellent contrast. Although the tilt of the display is adjustable, we didn't bother with it because of the display's huge viewing angle.

The display is also exceptionally fast. The mouse pointer is always clearly visible on the screen: There's no blurring, no disappearing act. It's far and away the finest LCD screen we've ever seen, with or without backlighting, and it's better than most portable displays, period. Even if you don't plan to buy the computer, stop in to check out the display.

If you're used to a 68000-based Mac and have had the opportunity to try a 68030-based Mac, you may have compared the feeling to driving a sports car for the first time. Using the Mac IIci is like being strapped into a rocket sled: It's *fast*. For the first time, it is practical to

continued

Works with HP® LaserJet™ Series II

The BigBin 1000. Because 200 sheets is not enough.

BigBin.™ 1000-sheet capacity for Apple® LaserWriter® IISC, LaserWriter IINT, and LaserWriter IINTX

The BigBin is a motorized paper tray that replaces your LaserWriter II's old 200-sheet paper tray to give you 1,000 sheets of paper. That means you can print bigger jobs unattended. Satisfy the paper-hungry needs of a Macintosh® network. And spend less time refilling paper.

Sizable advantages BigBin lets you load 1,000 sheets of letter-size paper. All at once. You can even add a kit that handles legal-size.

Simple addition BigBin is a simple addition to your computer system. Just replace your printer's paper tray with BigBin and plug it into the wall. It's fully approved by Apple Computer for use with Apple LaserWriter IISC, LaserWriter IINT, and LaserWriter IINTX. And BigBin is covered by a limited 90-day warranty.

Despite the big name, BigBin needs only about a foot of space in front of your printer, and it weighs in at only 14 pounds.

To make the connection BigBin is available exclusively through authorized Laser Connection™ dealers. For more information on how BigBin can maximize your paper handling, call Laser Connection at **1-800-523-2696** for the dealer nearest you.

And be sure to ask for a free copy of *The Sourcebook*™—our exclusive catalog filled with the latest laser printer products and enhancements.

LASER CONNECTION™

A QMS® Company

The following are trademarks of their respective companies: BigBin, The Sourcebook, Laser Connection of QMS, Inc.; Apple, LaserWriter, Macintosh of Apple Computer, Inc.

©1989 QMS, Inc.

Table 1: *On the BYTE Small-C benchmarks, the Mac Portable was roughly twice as fast as a Mac SE, and the Mac IIci was roughly 60 percent faster than a Mac IIcx. Disk I/O and floating-point performance were not measured. See text for details.*

PRELIMINARY BYTE BENCHMARK RESULTS

Text	Mac SE	Mac Portable	Mac IIcx	Mac IIci
Matrix	67.1	34.2	16.2	10.5
String move				
Byte-wide	374.5	174.9	82.7	51.8
Word-wide	186.7	87.4	42.1	26.6
Doubleword-wide	92.4	59.9	22.9	14.5
Sieve	170.2	84.1	31.4	19.8
Sort	154.2	76.3	29.7	19.4
Graphics				
Slow test	84.4	57.2	52.5	19.0
QuickDraw	1.1	0.7	0.3	0.2
Text				
TextEdit	15.1	9.9	4.6	2.8
DrawString	3.8	3.2	1.6	0.8

Notes
1. All times are in seconds.
2. Both systems ran the Finder.
3. The rest mode was disabled on the Mac Portable while running the benchmark tests.
4. The Mac IIci was set to 1-bit mode and had no cache board installed.

scroll through a document in 1-bit mode rather than having to page through it.

Performance and Pricing

We ran our BYTE Small-C benchmarks on the two computers to measure their performance. These results are preliminary, of course, but they do give a rough indication of the machines' capabilities. The benchmarks ran fine on both Macs, and the results are given in table 1.

As you might expect, the Portable easily outpaces the Mac SE, largely due to its higher processor clock rate. What you might not expect is that, under certain conditions, it's more than twice as fast as the Mac SE, as some of the memory tests (i.e., string and sort) and processing tests (i.e., Sieve and matrix) show. This is because the Portable, like the Mac SE/30, uses separate video RAM for the display's frame buffer. This eliminates the bus contention for memory between the processor and video circuits that occurs in the Mac Plus and Mac SE's design and so degrades their performance.

The Mac IIci is faster than the Mac IIcx. It's not an incremental step in performance, but a broad jump. As the tests on a stock Mac IIci (no cache board installed) show, the memory subsystem runs quite a bit faster: roughly 60 percent, the same as the increase in clock speed. We'll have to run application benchmarks to get the hard disk drive and heavy video usage into the act to see how well the Mac IIci performs overall, but the low-level results indicate that Apple's performance figures are probably accurate. The Mac IIci is a real processing powerhouse, and we haven't even considered the effects of the cache board.

Performance of the on-board video in 1-bit mode is very good: The Graphics Slow and Text DrawString tests ran at least twice as fast as on the IIcx. Even when the on-board video was set to the 8-bit mode, the times for the Slow test (21.9 seconds) and the QuickDraw test (0.23 seconds) were still better than those of a IIcx in 1-bit mode.

As we went to press, no firm prices had been set. However, you can expect the Macintosh Portable to cost in the range of $6500 to $7000—steep, but similar in price to 80386 portables such as the GRiDCase 1530, Toshiba T5100, and NEC PowerMate Portable SX, and only the GRiDCase 1530 uses a battery. If you're thinking about a Mac IIci, be prepared to pay a premium price: Estimates are $1500 to $2000 more than a similarly equipped Mac IIcx. Thus, a Mac IIci with 1 megabyte of RAM, a 40-megabyte hard disk drive, an Apple monochrome monitor, and a standard keyboard could cost about $7397. Mac IIcx owners will be able to upgrade to a Mac IIci with a logic board swap and a memory swap (remember that the IIci uses faster RAM). The prices and timetable for the upgrades had not been set.

Future Directions

The Mac Portable is an impressive first try by Apple to enter the portable computer market. Now working professionals don't have to give up the Mac's unique processing capabilities while on the road. The Portable won't make more problems than it solves because its battery life promises to be good and its LCD is as easy to read as a piece of paper. If the designers compromised on anything, it was size and weight. But considering what's crammed into the Portable's case and the quality of its display, we commend their judgment.

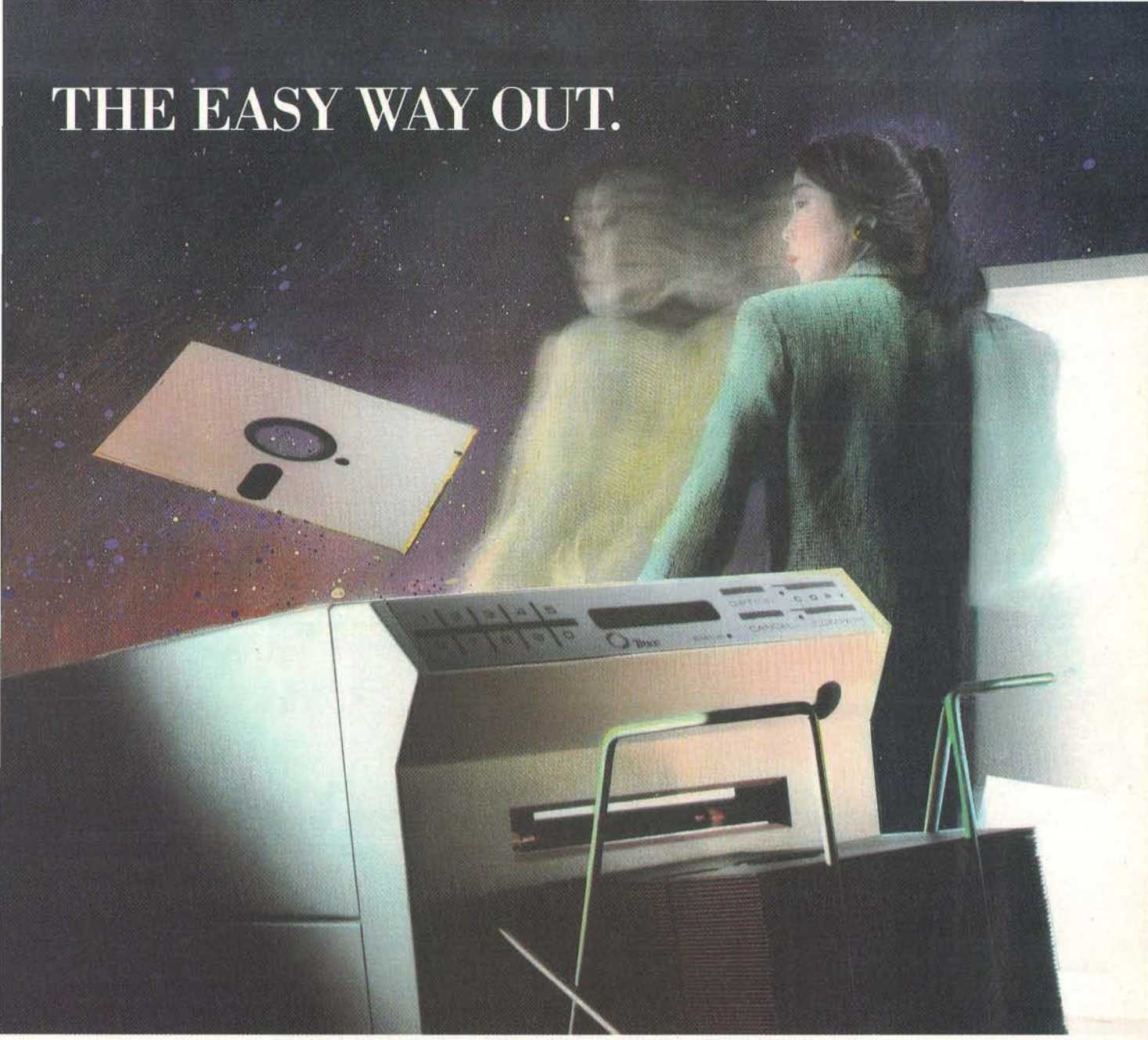
A few months ago, an official for a major laptop maker commented that his company would never design another model with a nonbacklit screen and neither would his competitors. "Even they aren't that stupid," he told a press conference. A few months ago, that sounded like a reasonable prediction. But Apple has done nothing less than change the rules of the game. Five years ago, the graphical user interface of the Macintosh screen was the face of the future. Today, the Macintosh Portable's active-matrix LCD is the face of the future all over again.

The Mac IIci represents the first major jump in performance for a Macintosh computer since the Mac II was introduced over two years ago. Its computing power, on-board video, and small desktop footprint make it equal or superior to a PS/2 Model 70 system. The Mac IIci is clearly ready to tackle the large computing jobs coming in the 1990s because, on top of its processing power, it is prepared to work in a 32-bit address space, all the way down to its firmware.

The Mac IIci's design also tells us much about Apple's future plans. The design optimizations indicate that the Motorola 68030 processor will be the heart of the Macintosh for some time to come. However, with the computer's I/O decoupled from the rest of the system, it's going to be easier than ever before to design Macs using faster 68030s. But what's really a welcome trend is that cache slot; it indicates that Apple is finally going to try to reduce the CPU's burden by off-loading certain functions onto dedicated hardware. We hope that they're considering DMA channels and a graphics coprocessor in future Macs. ■

Tom Thompson is a BYTE senior technical editor at large. He can be reached on BIX as "tom_thompson." Frank Hayes is a BYTE news editor based in San Francisco. He can be reached on BIX as "frankhayes."

THE EASY WAY OUT.



DISK TRACER AUTOMATES DISKETTE COPYING.

Put time-consuming formatting and copying tasks behind you with the new Disk Tracer. Now you can format and copy diskettes easily and automatically. Just as the paper copier eliminated messy carbon paper, now Disk Tracer eliminates the slow, tedious task of copying diskettes manually.

Simply place your original diskette and blank diskettes in the top tray, select the quantity desired, press COPY and walk away. Don't walk too far, Disk Tracer produces a perfect copy every 24 seconds... without your effort or attention! Disk Tracer does it all automatically, *fast*, freeing you and your computer. And by reducing your labor cost, it quickly pays for itself.

Disk Tracer is one of many state-of-the-art diskette copiers brought to you by Trace, with a product family that answers every need from high volume industrial diskette copying to our inexpensive desktop copiers. Trace is the number one choice of professionals worldwide. Call us today for more information or the name of a distributor near you.

Information Hotline: 1-800-366-5560

Trace

WORLD LEADER IN DISKETTE AND TAPE DUPLICATION SYSTEMS
TRACE PRODUCTS 2190 Bering Drive, San Jose, CA 95131

Circle 278 on Reader Service Card

Quit bitching about batch.

Now you can eliminate 90% of your batch file problems for $99.95.

The Builder™ is the first compiler that transforms sluggish batch files into blazingly fast .COM and .EXE files. Not only does it give you turbo language speed, it extends the DOS batch language with over 50 new commands and keywords.

For example, menu commands like *DropDown, PopUp,* and *LookAndFeel* are built into the language, so you can quickly produce an unlimited number of programs, and distribute as many copies as you wish.

The Builder also includes a powerful editor to provide an integrated development environment.

And it's the perfect tool for creating installation scripts. The Builder has DOS dexterity that BASIC and C can't match. And its small compiled code size won't hog memory or disk space.

What's more, by compiling a program with The Builder before you distribute it, you'll have bulletproof security.

Don't keep bitching about batch. Order The Builder today.

Call **1-800-873-9993** for complete details. Visa and Mastercard are welcome. Shipping and handling are free.

THE BUILDER

What batch files should have been in the first place.

hyperkinetix, inc. 666 Baker Street, Suite 405, Costa Mesa, California 92626 (800) 873-9993 (714) 668-9234 FAX: (714) 979-2813

Circle 123 on Reader Service Card (DEALERS: 124)

VROOMM Goes the Spreadsheet

Borland's VROOMM technology gives the new Quattro spreadsheet plenty of capabilities in a relatively small amount of memory

VROOMM, which stands for Virtual Real-Time Object-Oriented Memory Manager, is Borland's alternative to OS/2 and Extended DOS. The new memory-expanding technique is similar to the overlays used in many large programs, but it is much more flexible. With it, Borland has been able to endow the just-announced Quattro version 2 with a large grab bag of features, making it a very strong competitor for Lotus 1-2-3.

We were impressed with the way VROOMM allowed the new program to fit into tight memory spaces. We also liked a number of Quattro's new features. But on some low-end systems, the overhead processing that VROOMM memory management requires carries a price in general performance.

What VROOMM Does

The whole point of VROOMM is to avoid the "out of memory" error messages that are increasingly common in these days of large TSR programs and memory-gobbling network drivers.

VROOMM is a virtual memory system based on small, variable-size program segments. Borland calls these segments "objects" since, like the objects in object-oriented programming systems, they can call each other. However, the VROOMM objects are modules of binary code rather than source code and do not appear to share some of the benefits of traditional objects, such as accessibility by outside programmers and inheritance.

Whatever name they're called, the VROOMM objects have a fine granularity—most are only 2K bytes to 4K bytes in size. This lets the program load into memory only those parts of the program that will most likely be used. It also means that, unlike with traditional overlays, objects will load from disk quickly.

All this is fine for Borland's programmers, since it gives them a lot of room to work with. Other programmers may benefit as well, since the company has stated that it will someday make VROOMM technology available as a programming tool. But the question now is, what can the new Quattro do?

Linking with 3-D

Probably the hottest issue in spreadsheets this year has been three-dimensionality, and Quattro does not ignore this trend. While it does not have true 3-D capability, in the style of the new Lotus 1-2-3 release 3.0 or the older BoeingCalc, it does have enhanced linking capabilities that allow you to simulate 3-D spreadsheets. Both approaches allow you to break up large, complex worksheets into several small, interrelated ones.

In 1-2-3 release 3.0, each cell in a spreadsheet has three variables: column (A to IV), row (1 to 8192), and page (A to IV). Quattro takes a different approach, choosing instead to stay with the 2-D spreadsheet, but enhancing the ways these spreadsheets interact with each other. In Quattro, you can display four spreadsheets (e.g., DEPT-A, DEPT-B, DEPT-C, and DIV-1), consolidating the results from three departmental spreadsheets. The consolidation spreadsheet, DIV-1, can easily access data from any of the departmental spreadsheets. You can also perform summations over several similarly named spreadsheets. For example, the `@SUM([DEPT-*]C7)` formula uses the DOS filename wild card * and calculates the sum of the contents of the C7 cells in every spreadsheet file whose name fits the `DEPT-*` specification (i.e., DEPT-A, DEPT-B, and so on).

Quattro can also access information from non-Quattro spreadsheet files on a network, or from database files that are being updated by other network users.

Annotating Graphs

Unfortunately, Quattro does not yet support true 3-D graphics; however, the graphics capabilities it does offer are truly striking. The program includes the usual assortment of pie charts, bar graphs, line graphs, and so on, plus new text-only charts. These graphs are greatly enhanced by high-quality text fonts.

In addition to a set of fairly standard fonts (e.g., roman, sans serif, and Old English), Quattro includes a small set of Bitstream fonts. These fonts produce very high-quality text on a laser printer, as you might expect, but they can also do a surprisingly good job on a low-end dot-matrix printer.

Whenever Quattro needs a Bitstream font in a particular size or style (such as bold or italic), it generates the appropriate font file. This can happen whenever you view, annotate, or print a graph, or when you view or print a spreadsheet. Generating each file can take a lot of time, especially on slower machines, but once that particular font file is generated, you do not need to generate it again. You can save some time by generating most font files at once when you install the program. However, all these font files take up a lot of disk space and dominate your Quattro directory.

Another interesting part of Quattro is its annotation facility, which allows you to modify graphs in a WYSIWYG fashion. With this feature, it is easy to select text and move it around the screen, or to

continued

File Manager For C

C Programmers choose db_FILE because it's fast and flexible.

The combination of relational B-tree indexing and network model database technology delivers better performance than file managers using relational technology alone. Build simple B-tree/ISAM applications or complex database applications. You decide how to optimize runtime performance.

SQL Support included.

db_RETRIEVE – the SQL-based relational Query and Report Writer is now included in this special offer.

Applications completely portable.

Free lifetime phone support.

C source code is now included!

No royalties.

SPECIAL LIMITED OFFER
db_FILE, db_RETRIEVE and source code for each – at one low price!
Single-User Package $295.00
A $1780 value.
Multi-User Package $595.00
A $2890 value.

db_FILE™
File Manager 2.2
File Structure: Relational B-tree indexing and network database model. Use independently or in combination for real power.
Transaction processing supported
Not RAM resident
Operating Systems: MS-DOS, UNIX, XENIX
C Compilers: UNIX, XENIX, Microsoft, Lattice, TurboC
Major LANs Supported

For your nearest distributor call:
1-800-db_RAIMA (1-800-327-2462).

RAIMA™ CORPORATION BY109FM

*Raima reserves the right to discontinue this promotion at any time without notice, so please check pricing when you call.
Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA
(206)747-5570 Telex: 6503018237 MCI UW FAX: (206)747-1991
Texas: (214) 231-3131 International Distributors: U.K.: (0992) 500919
Germany: 07127/5244 Switzerland: (01)725 0410 France: (1)46092828
Benelux: 31(02159)46 814 Sweden: (013)124780 Italy: 045/584711
Norway: 47 244 88 55 Denmark: (2)887249 Singapore: 468 3888
Australia: (02) 959 5122 Japan: (03)473 7432 Taiwan: (02)511 3277
Mexico: (83) 57 35 94 Brazil: (0192) 52 9770 Colombia: 57 1 218 9245
Argentina: 54 1 313 5371 Chile: 56 2 696-4308 Uruguay: 92 19 37
Caribbean: (809) 834 4069 Central America: (506) 28 07 64
© Copyright Raima Corporation 1989

COMPANY INFORMATION

Borland International, Inc.
1800 Green Hills Rd.
P.O. Box 660001
Scotts Valley, CA 95066
(408) 438-5300
Inquiry 860.

add a small text box and an arrow pointing to a particular feature of a graph.

Quattro's graphics capabilities also include two other features not often found in spreadsheet programs: the ability to include graphs inside spreadsheets, and the ability to arrange graphs into a slide show–style presentation.

"Publishing" Spreadsheets

One of the strong points of the Windows- and Macintosh-oriented spreadsheets, such as Excel, is their ability to use multiple fonts, both on the screen and in printed documents. The problem with this approach is that drawing the various fonts on the screen can take a lot of time.

Borland has implemented a compromise approach for Quattro. You can have up to eight different fonts in the printed version of your spreadsheet, but, to save time, the on-screen version of your spreadsheet will show only one standard font. As you can imagine, it can get a little confusing trying to remember which cells in a spreadsheet are in which font. You can preview the spreadsheet to see what it will look like when printed, but this takes some time.

Quattro also includes other desktop publishing–like features, such as boxes, grids, and shading. And, unlike the case with the text fonts, Quattro does give you some indication on the screen as to what the lines will look like. Unfortunately, the lines on the screen take up a whole row or column, thus reducing the amount of the spreadsheet that you can display on your screen.

Recalculations Faster than 1-2-3

In tests of brute-strength recalculation, our early version of the program invariably beat out all the current versions of 1-2-3 (releases 2.01, 2.2, and 3.0). This speed advantage may be due in part to what Borland calls Intelligent Minimal Recalculation, where the program somehow decides whether it is faster to do a minimal recalculation or a full recalculation (when almost all the cells are involved, as in most benchmark tests). Quattro also features background recalculation, which can make the program seem even faster.

The early version of Quattro was also fast at scrolling and inserting rows. One area, however, where Quattro seems to be slower than 1-2-3 is with operations regarding disk access, such as loading the program or loading spreadsheets.

I should also add that benchmarking, while never easy, is particularly hard with Quattro. The problem has to do with VROOMM and the way Quattro—or the part of it that resides in memory—keeps changing from operation to operation. For example, we found that in some cases a recalculation got faster on successive iterations or slowed down, depending on which part of the spreadsheet was displayed.

Another weakness of VROOMM is apparent even to a casual user. Sometimes, every keystroke that you enter results in a disk swap. This is related to the small size of the VROOMM objects: Although they will load quickly, they must also be loaded more often. This is especially noticeable on low-end systems or when you are using very large spreadsheets. After loading a 335K-byte spreadsheet, the program told us we still had 40K bytes of memory left, but it became extremely slow. Whenever we hit a cursor key, a considerable amount of disk swapping took place. Borland claims, however, that this will be speeded up by the time the product ships.

A 1-2-3/Windows Hybrid

In general, the new Quattro, like the original version, is pretty much a cross between 1-2-3 and Excel. It provides both good 1-2-3 compatibility and superior printing and graph-making capabilities. And it provides a rash of other features, such as Undo, a transcript of user actions (useful for macros or returning a spreadsheet to a previous condition), the ability to edit menus, good mouse support, and the ability to read and write a large number of file formats without translation. The product's list price is $495, twice that of the previous version.

Our only serious complaint with Quattro is that there should be some way for users to signify different fonts on the screen. Also, VROOMM's object-swapping mechanism is a little slow, but that will probably be fixed by the time the product ships. Otherwise, Quattro looks like a very useful product, especially for users who want the advantages of Excel (and then some) but do not want to sacrifice compatibility with 1-2-3. ■

Rich Malloy is an associate managing editor for BYTE. He can be reached on BIX as "rmalloy."

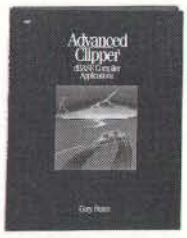
THE COMPUTER PROFESSIONALS' BOOK SOCIETY

The easy, reliable way to satisfy your professional book needs . . . .

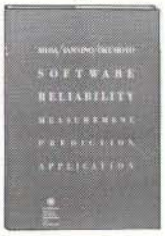
3 books for only $2.95 (Values to $145.80)

and get ***dBASE IV™ Essentials*** *FREE!*

3131 $24.95

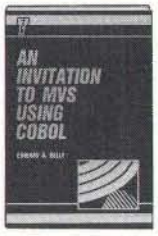


3007P $17.95

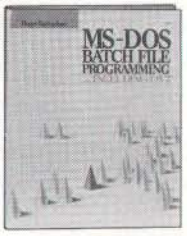


9824 $49.95

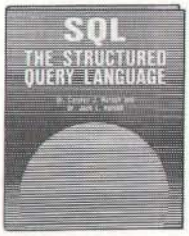
3030P $17.95



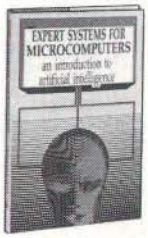
3221 $29.95



3028P $19.95

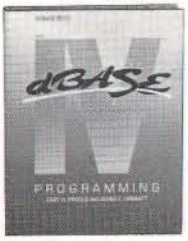


3016P $17.95

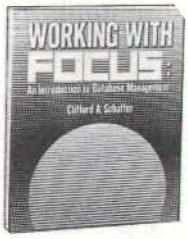


2838 $19.95

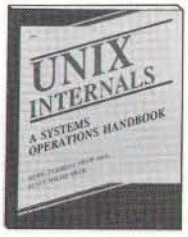
2956 $32.95
Counts as 2



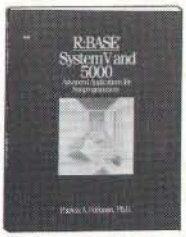
3066P $26.95



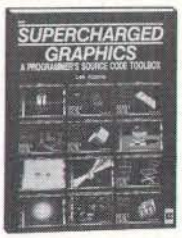
2810P $22.95



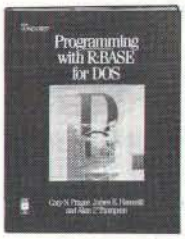
2951P $18.95



2978P $17.95

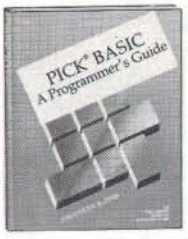


2959P $19.95



3196P $24.95

2897 $28.95

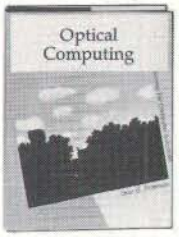


2845 $34.95
Counts as 2

9810P $24.95

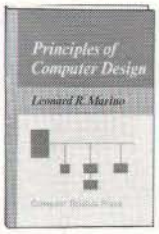
9764P $19.95

9832 $36.95



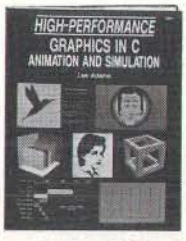
9152 $39.95
Counts as 2

9786 $32.95

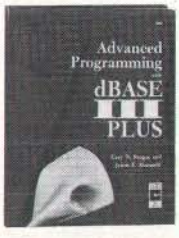


9813 $39.95

2916P $19.95

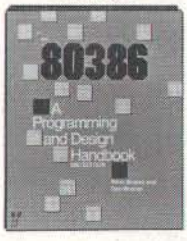


3049 $36.95
Counts as 2

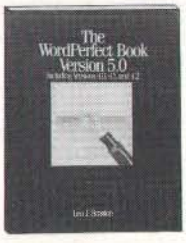


2876P $19.95

9808 $34.95



3237P $24.95



3127P $16.95

2888 $32.95

All books are hardcover unless numbers are followed by a "P" for paperback.

©1989 Computer Professionals' Book Society, Blue Ridge Summit, PA 17294-0870

FREE when you join the

CPBS Computer Professionals' Book Society

dBASE IV™ Essentials

A unique and timely discussion of all the new programming features offered by dBASE IV™ —including both SQL and QBE.

How the Club Works

YOUR BENEFITS: You get 3 books for $2.95 plus shipping and handling when you join. You keep on saving with discounts up to 50% off as a member.

YOUR PROFESSIONAL BOOKSTORE BY MAIL: Every 3-4 weeks, you will receive the Computer Professionals' Book Society News describing the Main Selection and Alternates, as well as bonus offers and special sales, with scores of titles to choose from.

AUTOMATIC ORDER: If you want the Main Selection, do nothing and it will be sent to you automatically. If you prefer another selection, or no selection at all, simply indicate your choice on the reply form provided. As a member, you agree to purchase at least 3 books within the next 2 years and may resign at any time thereafter.

BONUS BOOKS: Starting immediately, you will be eligible for our *Bonus Book Plan*, with savings of up to 80% off publishers' prices.

IRONCLAD NO-RISK GUARANTEE: If not satisfied with your books, return them within 10 days without obligation!

EXCEPTIONAL QUALITY: All books are quality publishers' editions especially selected by our Editorial Board.

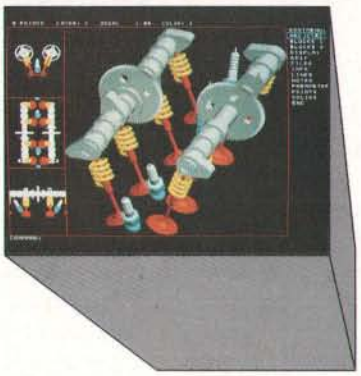
BYP1089

Circle 268 on Reader Service Card

Aw . . . What the Heck!

EXTREMELY POWERFUL

DesignCAD 3-D version 2.0 is as powerful as most CAD systems costing $5000 - $10,000! Features like: Complex Extrusions-linear, scaler, and circular, Blending of Surfaces, Shading, Cross Sectioning, Complex Sweeps and Translations, and Boolean operations make DesignCAD 3-D one of the most powerful 3-D CAD systems available . . . at any price! Engineers, Architects and Consultants constantly tell us that they use CAD systems costing thousands of dollars which are not as powerful as DesignCAD 3-D.



VERY EASY TO USE

Just because DesignCAD 3-D is powerful doesn't mean it is difficult to use. Single keystroke commands and side-bar menus which give short directions on how to proceed make DesignCAD 3-D a snap to use! While not required, DesignCAD 3-D supports all popular digitizers and mice.

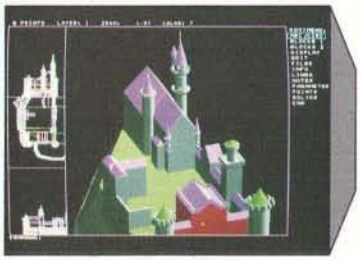
Many of the older, more cumbersome CAD systems require weeks of training before a user can be productive. DesignCAD 3-D users find they can be producing useful drawings in a matter of minutes! In a recent CAD contest only one contestant was able to match our drawing time. The package sold for $3000.00. The other CAD packages took up to twice as long to perform the same drawing and cost up to $5000.00!

Still don't believe us? The goblet pictured below required only 16 keystrokes and 3 commands to create! The top, front, side, and isometric views were created simultaneously . . . in less than one minute!

VERY LOW PRICED

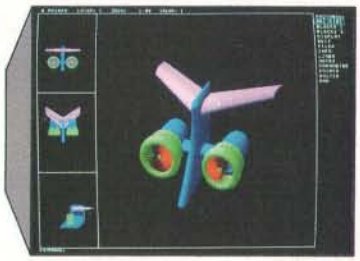
The first question asked by many people is, "Why is DesignCAD 3-D priced so low?" The answer? After developing DesignCAD 3-D version 2.0, we were unable to decide how the product should be priced. We consulted experts. We used the finest spreadsheets on the market. We took employee polls. Finally, in the great American Tradition, we said, *"Aw . . . What the Heck! Let's see the other guys beat this price!"* DesignCAD 3-D version 2.0 sells for $399.

DesignCAD 3-D only $399!



WHY BUY THIS ONE?

There is a very important reason to buy DesignCAD 3-D. PERFORMANCE. No other CAD system can match our price/performance ratio. Many people make the serious mistake of thinking that it is necessary to spend thousands of dollars to obtain "a good 3-D CAD system." This is not true! We talk to people everyday that are sadly disappointed with their "expensive" CAD systems. Don't be one of them! Call us and we will send you a complete set of literature and a free slide show demo disk. Once you compare DesignCAD 3-D version 2.0 with other CAD systems we know you will choose DesignCAD 3-D.



DON'T TAKE OUR WORD FOR IT

Here is what other people have to say about DesignCAD 3-D:

"After you've worked with DesignCAD, the single keystroke commands are simple to remember and it becomes easy to "flick one key" to execute a command. An extremely ergonomically designed program."

HENRY LEVET, Levet & Daigle Architects - New Orleans, LA
Designed a 65,000 sq. ft. nursing home using DesignCAD

"Recently I worked with a firm that builds decks. They purchased your product on my recommendation. I sat down with them and in two hours they were very proficient in DesignCAD. Now they are more effective; and we can communicate . . . it's wonderful to be able to do a block repeat 42 times and there are 42 2x4's to make the deck!"

J. TURNER, Architect, TAO Ltd. - The Woodlands, Texas

"Allows scientists and engineers to expend minimum time learning and using CAD software so that their time can be expended on the project at hand. It also allows scientists and engineers to quickly present to management all views of a subject. (3-D)."

DR. STEVENS, NASA Space Scientist/Engineer

HOW DO I GET ONE?

DesignCAD 3-D version 2.0 is available from most retail computer stores, or you may order directly from us. DesignCAD 3-D is available in a number of foreign languages from distributors throughout the world. All you need to run DesignCAD 3-D is an IBM PC Compatible and 640K RAM. DesignCAD 3-D supports most graphics cards, printers, plotters and digitizers. Free information and a demo diskette are available by contacting us at:

American
Small Business Computers, Inc.
327 South Mill Street
Pryor, OK 74361
918/825-4844
FAX: 01-918-825-6359
TELEX: 9102400302

Circle 23 on Reader Service Card

DISASTERS AND DIVERSIONS

The agony of a drenched disk and the thrill of new CD-ROMs

I have just spent half an hour using Krazy Glue and epoxy to mend an Austrian ceramic *ButterKasse* we bought during our trip to Graz three years ago; it arrived broken in shipment. Given just how far behind I am—*Wrath of God* is going to be good, but writing it has been blooming slow work—you'd think something that has waited three years for repairs might be allowed to wait a little longer, but read on. A story goes with it.

It all started when I got an Amiga game called Populous, written by Bullfrog Games and published by Electronic Arts (EA). Populous is one of a recent flock of new programs for the Amiga. Most are games, but I'm told by people I trust that there's a flood of new general-purpose and business products for the Amiga just around the corner. By contrast, Atari seems to have fallen into the doldrums and is pinning its hopes on becoming another PClone maker.

I've always had a soft spot for Commodore, a company that's trying to do new and innovative things rather than follow the crowd, and the Amiga remains one of the most interesting machines around.

Anyway, shortly after I got to looking at the box blurbs for Populous, it became clear that this is no ordinary game: it appears to be an electronic implementation of the Manichaean heresy. The blurbs include: "Cruel ice, lush grassland, parched desert. With 500 worlds, a deity's work is never done" and "The all-powerful can perform miracles in their sleep. But omnipotence isn't what it used to be. These days, it takes an awesome natural disaster to dominate a world." This is clearly not your run-of-the-mill computer game.

However, it takes determination to play this game if you have an Amiga 2500. My first attempt was a failure. That is: I treated the thing much as I would a game for the Macintosh. I booted up the system, inserted the Populous disk, clicked on its icon to open it, clicked on the Populous icon—and found myself stuck in the demonstration mode. It wouldn't actually play the game.

This is because EA has an arcane copy-protection scheme. It requires you to boot up your machine, catch it before it loads the rest of the operating system, and insert the EA game disk. AmigaDOS comes in two parts: the DOS itself, and a disk of programs called the Workbench that you must have to do anything other than play games.

Many EA games require you to substitute the game for the Workbench, which is easy enough if you boot up with floppy disks but requires tricky timing if you have a hard disk. Doing it the EA way deprives you of the Amiga's main advantage, true multitasking; the Workbench runs at least as well as Macintosh's MultiFinder.

Booting up with the Populous disk already inserted in the floppy disk drive didn't work either. It got me to the introductory part of the game, including instructions and the tutorial, but when I attempted to actually play, the machine went galley-west. Now what?

A quick call for help on BIX got me the following advice: the Amiga 2500 has both 68000 and 68020 chips on-board. Left to itself, the machine uses the 68020, but if you hold down both mouse buttons when you power up, you're given a choice of booting with either chip (or with Unix, although that's not implemented yet). To play Populous, you must tell the machine to boot with the 68000. It seems there exist in the 68000 instruction set a couple of commands that have inconsistent undocumented features. When Motorola brought out the 68020, there were fixes. Alas, some Amiga programmers like the 68000's incompatible instructions.

Anyway, booting with the 68000 chip did the trick: Populous worked fine.

Fascinations

It turns out that the silly game is fascinating; at least it was for me. It's fairly easy to learn. It's strategy-oriented but works in real time. You can pause the game, but if you don't, you sure can't just sit there and watch, lest Satan kill off all your followers. Not every second counts, but certainly every minute does.

The graphics are neat. The user interface is odd but learnable. Despite appearances, this isn't a game review, so I won't go into details; suffice it to say that I started playing this strange game at midnight and found myself still sitting there at 7:00 a.m. listening to the birds. Worse: that happened *twice*. Which still doesn't explain why I was mending a ceramic *ButterKasse*, but read on.

Meanwhile, it's summer-vacation time here at Chaos Manor, and our youngest son, Richard, is taking the summer off from college. One way he's been amusing himself is with Accolade's Fast Break 3-on-3 basketball game on the Amiga. He plays in the mornings before I get up—on this particular morning, after I came to my senses and turned off the Amiga.

An hour ago I came upstairs to finish this column. I'd had it about half done before I started Populous last night—I'm not a *complete* idiot—so it looked to be a short job. First, though, a quick look at Populous, "to get a couple of details to write about," said I to myself. When I booted up, the Amiga pronounced my disk—the uncopyable, irreplaceable Populous disk—unreadable.

Close examination showed just why. While I was asleep, Richard had managed to upset a glass of orange soda on

continued

the Populous disk, and it was now all wet and sticky.

Futility

Years ago I read about a library whose 8-inch CP/M floppy disks were all soaked in dousing a fire. Since there was nothing else to try, the librarians dried out the disks—and lo, they worked. Maybe, thought I, the same could be done with the 3½-inch Populous disks. What the heck, it was worth a try.

There were four disks soaked in orange soda. I washed them all out and set them in front of a fan to dry. Then, being impatient, I experimented with one of them: wash it out, shake it to get as much water out as possible, and try to dry it with a hair dryer.

That didn't work.

Neither did letting the disks dry naturally at low temperature in front of a fan. I put one disk on top of the vent from the Zenith FTM monitor, where the temperature is about 109°F. That didn't work either.

In fact, nothing I tried worked. Unlike 8-inch and 5¼-inch floppy disks, if a 3½-inch disk gets wet, it's probably just plain dead.

Certainly my Populous disks were dead. Nothing for it but to get another set. To do that, I'd have to telephone the company.

No phone number on the Populous box. Maybe on the game manual? But my desk was all set up for doing the column, meaning that it was covered to a depth of 9 inches in paper and boxes and manuals, so it took 10 minutes of increasingly frustrating activity until I found the Populous manual. Of course, it had no phone number in it, and while I was looking for that manual, I managed to kick over the large glass of water Richard had left on the floor by the Amiga....

While I cleaned that up, Mrs. Pournelle got the phone number from Pacific Bell information. I called. Two rings, and it was answered by a computer that began an interminable spiel, offering me the opportunity to get various people I didn't want to talk to if only I'd punch in various numbers; eventually I punched "0" and got a human. By now I was speaking in a preternaturally calm voice: "Please let me speak to the product manager for the game called Populous."

There were several mysterious clicks and clanks and sounds from the telephone. Several rings. More clicks. Finally a recording told me that someone, I forget just who, wasn't available, and would I care to leave a message? Very slowly and calmly I hung up and dialed the number again. I got the machine, but punching "0" got a human—so far as I knew, the only human EA employed. "The product manager for Populous isn't answering," I said carefully. "May I have the director of public relations or press relations?"

This time I got a very pleasant young lady who much sympathized with my problem and promised to mail me a new disk. Now it's time to have a few words with my son. I figured that before I did that I really ought to calm myself: I should do something requiring a maximum of care and patience and a minimum of brain—and that, preferably, has nothing to do with either computers or people; at which point I spotted the broken *ButterKasse*....

I'm sure there's a moral to this story, but I'm not certain what it is.

First, who's the villain? The proximate cause is Richard for spilling the drink, but my leaving it on that table is at least contributory negligence. In any case, the incident wouldn't have been worth mentioning if it hadn't involved an irreplaceable disk.

Next, there's EA with their arcane copy-protection scheme, which not only makes the disk irreplaceable, but also makes the game frustratingly hard to boot up and play. Behind them are the petty thieves—they like to call themselves "pirates," but they don't deserve such a glamorous term—who copy and distribute copyrighted software and make EA believe that copy protection is necessary.

For reasons I have never quite understood, in the Amiga and Atari worlds it's very common for stolen copies of new games to be available on BBSes and at swap meets as soon as they appear on the market—indeed, sometimes before they're officially released.

The rest of the computer world is abandoning copy protection. In the IBM PC world, I think there are no copy-protected games at all; instead, the companies rely on "security checks," in which you're required to type in a word from the manual. This doesn't prevent illegal copying of the games—manuals can be photocopied—but it does slow things down, and it's pretty hard to distribute a printed manual on a BBS.

There's still some copy protection in the Mac world. Less every year, though, and what's left is the "key disk" variety that lets you play a game off a hard disk and checks only to see that you've got the original distribution floppy disk.

In the Amiga and Atari worlds, copy protection is the rule rather than the exception.

I don't know why this is. I do note that there are fewer Macs than PCs, and fewer Ataris and Amigas than Macs. The elaborate manuals customary for PC games may be too expensive an investment for the smaller markets. Finally, copy protection is much harder in the PC and Mac systems than in Atari and Amiga systems. Really wicked schemes like the unlamented ProLock are harder to implement. Besides, anyone can buy disk copying programs like Copy II PC and Copy II for the Macintosh if they get unhappy enough. If there's something similar available for the Amiga, I don't know about it.

Whatever the reason, I sure wish companies like EA would rethink their position. The house rule at Chaos Manor is that I won't review copy-protected business software. I will look at copy-protected games. That doesn't mean I like having to do it.

Words!

The latest item at Chaos Manor is the *Oxford English Dictionary* (*OED*) on CD-ROM. I've had it for about a week now, and it's just wonderful. Every word in the English language—well, every word used up to 1928, anyway—with every meaning, its history, who used it first in print, and who's typically been using it since. Just this year, they brought out a new and revised edition of the *OED* that brings it up to the 1980s.

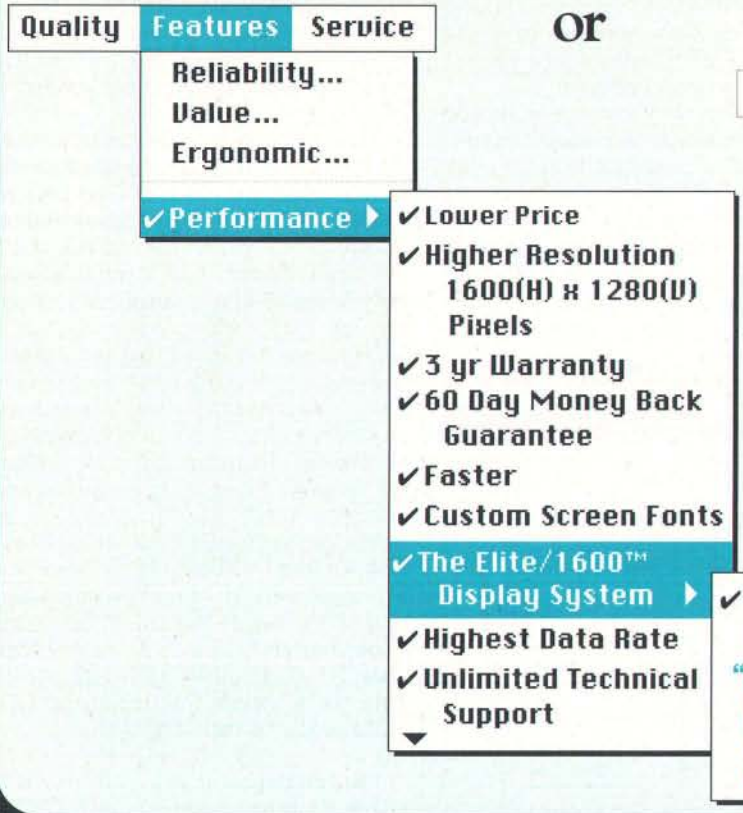
I first got the *OED* in the two-volume set (complete with magnifying glass in a small drawer of the slipcase) as a bonus for joining the Book of the Month Club. (Karen Anderson dubbed that the "transistorized version," which tells how long ago *that* was.) I use it at least weekly, although it isn't very convenient: the books are enormous and hard to set down, and the magnifying glass is a must. Thus, I was quite excited at the prospect of getting the *OED* on a CD-ROM.

The OED CD-ROM is the original edition—alas, without a four-volume *Supplement*. A new CD-ROM of the second edition is in preparation.

The manual states that "The *OED* on CD cannot be a substitute for the book itself, since reading its very long entries on screen (some are as long as 60,000 words) would be tiring and impractical...." I've got news for them: compared to reading those lengthy entries in the tiny print of the transistorized version I've got, reading them on the screen is flipping bliss.

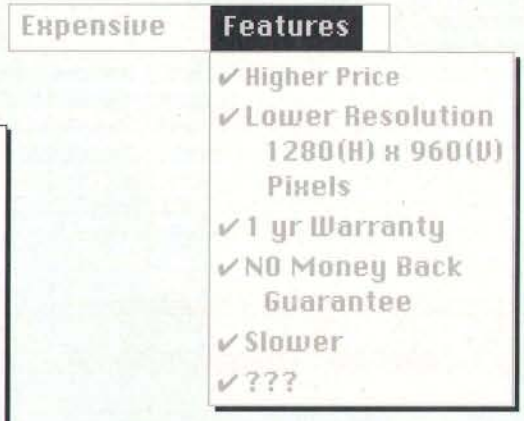
continued

OURS



or

THEIRS?



GET THE PICTURE?

Meet our new **Elite/1600™** a complete ultra high resolution 19-inch monochrome display system with a 1600 x 1280 pixel resolution. It offers the highest quality two-page display system available for the IBM PS/2 Series, and IBM PC and compatible.

It has the same resolution as the Sun-4 workstation monitor. The extraordinary display, combined with a clean, stable, flicker-free picture means your images are razor sharp, alignment perfect, drawings pin-point precise.

Each display system comes complete with a high resolution monitor, video interface card, and software drivers.

The **Elite/1600™** is part of our extensive family of display products for the IBM compatible and Macintosh computers.

We carry a complete line of high resolution color, monochrome and gray-scale display systems.

The monitor you've got in mind is probably in our warehouse right now!

Call our toll free number today, for our free information package.

1-800-343-5532

Discover for yourself how beautiful a big monitor can be.

Got the picture?

ELITE MICROSYSTEMS

4201 Remo Crescent, Bensalem, PA 19020 USA
Phone: (215) 639-1636 FAX: (215) 639-3420

Circle 94 on Reader Service Card

The OED CD-ROM is extremely well indexed and has good retrieval software. The user interface is really odd. To look up a word, you set a variable called "the lemma" to equal the word. Naturally, on learning that, the first thing I did was "set lemma=lemma." For my pains, I got four screens of definitions and origins. The first definition is the expected one from mathematics. The second definition is: "The argument or subject of a literary composition, prefixed as a heading or a title," which, when you think of it, sort of fits, since once you've set the lemma, the OED CD-ROM lets you look things up in a variety of ways.

You can see every instance of its use; you can see which writers used it in ways the *OED* editors thought worth recording. You can look up its etymology. Doing that with the word *lemma* took me to the word *dilemma*, which is a term originating in rhetoric and formal debate; also to *argument*, which originally didn't mean "dispute" but referred to the points you made in a debate; and so forth, for 10 minutes before I got back to work. The OED CD-ROM is a wonderful time trap.

Some of the other features aren't easily learned, either. I just looked up the word *phoenix* and was told it couldn't be found, but to try the spelling index. Eventually I figured that one out: tell it the lemma is ph*, and it wants at least three letters. Tell it it's pho*, and it finds nothing. Tell it phe*, and by gollies it finds *phenix*, which is listed as "obsolete spelling of ph<oe>nix," and finally *ph<oe>nix* itself. It won't search on ph<oe>*. This isn't an optimum way of handling diphthongs. I can live with it, but I sure wish they'd fix that in the next edition.

You can get the OED CD-ROM direct from Oxford University Press. Mine was arranged courtesy of the (private dealer despite the name) Bureau of Electronic Publishing (P.O. Box 779, Upper Montclair, NJ 07043, (201) 857-4300), which puts out a catalog of interesting CD-ROM products, including both disks and drives.

I had no trouble at all getting the OED CD-ROM to run inside its own DESQview window (but see last month's column; I run DESQview with an 80386 and QEMM-386 to get *big* windows). Alas, unlike Microsoft Bookshelf, the OED software isn't memory-resident; you can't run anything else like a word processor with it, and for that matter, it eats up so much memory that I wasn't even able to get SideKick up—I'd hoped to use SideKick to cut and paste. However, the DESQview Notebook utility does work properly, letting you cut stuff out of the OED CD-ROM screen and paste it into other windows.

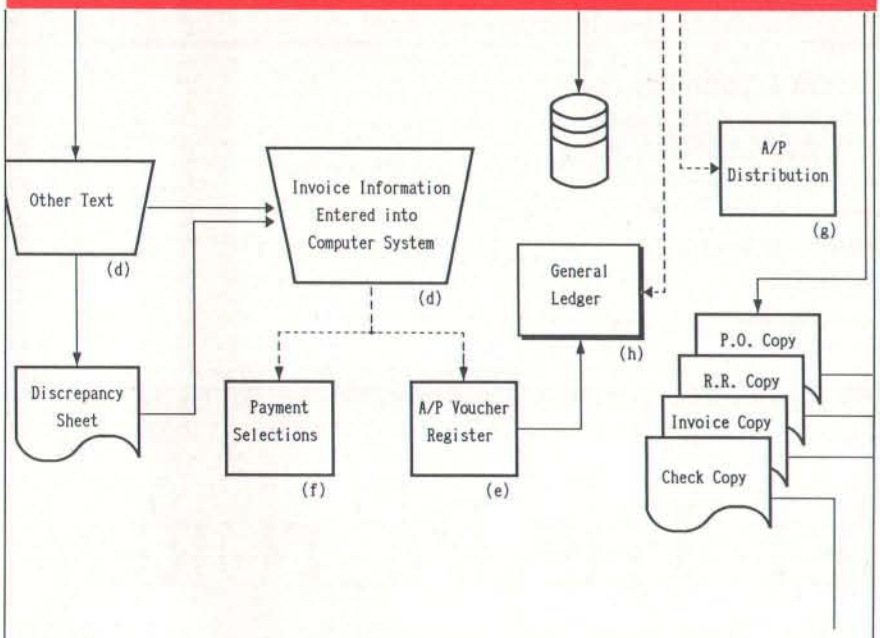
I can think of tons of improvements they could make to the user interface, but so what? What's here now is wonderful. I could rave on for the rest of the column. For anyone in love with words, the *OED* on CD-ROM isn't just recommended, it's a necessity, and more than enough reason to go buy a CD-ROM drive. (Indeed, enough CD-ROMs are out there now that I wish I could have several drives on-line at once: OED, Microsoft Bookshelf, World Factbook....)

Romanji

I was never any use at foreign languages. Somehow I got through high school Latin, which greatly improved my English. The University of Washington Ph.D. program required knowledge of

continued

ARE YOU STILL DRAWING FLOWCHARTS BY HAND?



FLOW CHARTING II+

Flow Charting II+ will *amaze* you with its speed, power and simplicity.

- Update and print charts as fast as the situation changes
- See your revisions right away—no long wait for charts to be hand drawn
- Select 26 standard shapes; 10 text fonts
- Tutorial manual makes learning easy
- Runs on IBM or compatibles
- Produces excellent organizational charts!
- Only $229!

PATTON & PATTON
Software Corporation
Excellence in charting the flow of ideas

For more information, see your local retailer or call
1-800-525-0082, ext. 47 (outside Calif.) 408-629-5376 (Calif./Int'l.)
81 Great Oaks Blvd., San Jose, CA 95119

Circle 204 on Reader Service Card

Our MAJOR ADVANTAGE-Supplying you with the Broadest Range of Software Ammunition.

ADVANTAGE SOFTWARE

APPLICATION SOFTWARE

	LIST	OURS
COMMUNICATIONS		
Carbon Copy plus	195	115
Close-Up		
Customer	195	135
Support	245	165
Co/Session	249	182
Crosstalk XVI	195	99
Mirror III	100	67
PC Anywhere III	145	79
Procomm Plus	75	49
DATABASE		
Clarion	695	409
Clipper	695	439
dBASE IV	795	489
dBXL	249	145
FoxBASE+	395	199
FoxBASE+/MAC	395	199
Paradox 3.0	725	479
PFS:Professional File	299	189
Q&A	349	229
R&R	149	109
R:Base for DOS	725	489
DESKTOP PUBLISHING		
Adobe Illustrator '88	695	409
Adobe Illustrator '88 (MAC)	495	300
Corel Draw!	495	299
Draw Applause	495	315
First Publisher	99	79
First Publisher Art Gallery	129	82
GEM Artline	495	285
GEM Desktop Publisher	299	183
PageMaker	795	489
PageMaker (MAC)	595	299
Ready, Set, Go (MAC)	495	320
Springboard Publisher	139	80
Ventura Publisher	895	539
GRAPHICS		
Chart-Master	375	239
Freelance Plus	495	CALL
GEM Graph Present. Team	495	305
Graph Plus	495	329
GraphWriter II	495	CALL
Graph-in-the-Box	140	75
Harvard Graphics	495	289
Micrografx Designer	695	459
Microsoft Chart	395	270
Perspective Junior	149	109
Pinstripe Presenter	200	CALL
PIXIE	295	177
Powerpoint (MAC)	395	265
Xerox Presents	495	319
INFORMATION ORGANIZERS		
Agenda	395	CALL
askSam	295	179
GOfer	80	45
GrandView	295	189
Memory Mate	70	43
SideKick Plus	200	135
Tornado	100	55
Who-What-When	190	119
ZyIndex Professional	295	159
PROJECT MANAGEMENT		
Harvard Project Manager	695	439
InstaPlan 2.0	99	95
Microsoft Project	495	329
SuperProject Plus	395	255
Time Line v. 3.0	595	359
Time Line Graphics	195	135
SPREADSHEETS		
Legend Twin Level III	249	195
Lotus 1-2-3	CALL	CALL
Lucid 3-D	149	CALL
Microsoft Excel	495	239
Microsoft Excel (MAC)	395	270
Microsoft Multiplan 4.0	195	125
Microsoft Multiplan (MAC)	195	125
PFS:Professional Plan	99	CALL
PlanPerfect	395	199
Quattro	248	165
SuperCalc5	495	319
Symphony	695	CALL
Wingz (MAC)	495	299

	LIST	OURS
SPREADSHEET UTILITIES		
3-D Graphics	145	129
4Views	150	119
4Word	100	61
@ BASE	195	119
@ Liberty	295	199
Allways	150	85
Baler	495	449
Graph-in-the-Box	140	75
Hal	150	CALL
Impress	140	CALL
Inword	100	59
Look & Link	100	60
Note-It Plus	80	55
Noteworthy	80	49
PanaView	145	129
See More	80	49
Sideways	70	43
SmartNotes	80	48
Spellin!	80	49
SQZ Plus	100	63
WORD PROCESSING		
Ami	199	129
DisplayWrite 4	495	342
Grammatik III	99	52
Manuscript	495	CALL
MaxThink 89	89	71
Microsoft Word	450	249
Microsoft Word (MAC)	395	249
MultiMate Advantage II	695	299
Office Writer 6.0	495	302
PFS:Professional Write	199	129
Q & A Write	199	135
RightWriter	95	52
Samna Word IV	595	316
Sprint	200	139
WordPerfect 5.0	495	239
WordPerfect (MAC)	395	231
WordPerfect Executive	249	129
WordPerfect Library	129	69
WordStar 2000+ Personal	495	302
WordStar Professional Rel 5	495	239
XyWrite III Plus	445	256

LANGUAGES

	LIST	OURS
Lahey F77L	595	535
Micro Focus COBOL	CALL	CALL
Microsoft C	450	299
MS FORTRAN	450	299
MS Macro Assembler	150	99
MS QuickPASCAL	99	69
Smalltalk/V 286	200	149
Turbo C 2.0	150	99
Turbo C 2.0 Professional	250	169
Turbo Pascal 5.0	150	99
Turbo Pascal 5.0 Professional	250	169

OPERATING SYSTEMS/ CONTROL PROGRAMS

	LIST	OURS
Concurrent DOS 386 2.0	395	235
DESQview 386 (w/QEMM)	190	115
Interactive 386/IX	1095	989
QEMM 386	60	39
MS Windows/386	195	125
PC-MOS 386 (single user)	195	179
PC-MOS 386 (five users)	595	539
SCO 386 UNIX Sys V (comp)	1495	1195
SCO UNIX Sys V (comp)	1295	999
VM/386	245	199
VM/386 Multi-User	895	759
VM/386 NetPak	150	129

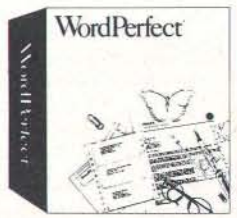
WordPerfect

WordPerfect 5.0 integrates text and graphics to let you create professional looking newsletters, reports, and documents–without neglecting the features that made it number one in the first place!

Graphic images can be placed anywhere on the page, scaled, moved, and can include a caption and border. 5.0 also has enhanced print capabilities, and a WYSIWYG preview mode. Master Document combines files to generate tables of contents, indexes, etc.

WordPerfect 5.0 succeeds 4.2 as the world's best word processor. Once you've tried it, you'll never go back!

List: $495 ***Ours: $249***



WordPerfect CORPORATION

UTILITIES

	LIST	OURS
Brooklyn Bridge	140	85
Copy II PC	40	25
Disk Technician Advanced	190	119
FASTBACK Plus	189	109
Laplink 3	140	85
MACE GOLD	150	88
Magellan	195	CALL
MKS Toolkit	199	155
Norton Commander	89	52
Norton Utilities	100	59
Norton Utilities Advanced	150	89
PC Tools Deluxe	129	80
Software Carousel	80	49
Spinrite	59	49
V feature Deluxe	120	95
XTree	70	39
XTreePro	129	70

SCIENCE/ENGINEERING

	LIST	OURS
CAD		
AutoCAD Release 10	3000	CALL
AutoShade	500	389
AutoSketch	150	95
DesignCAD	CALL	CALL
DesignCAD 3-D	399	209
Drafix CAD Ultra	395	259
Generic CADD Level 3	300	179
Generic 3-D Solids Modeling	349	195
PCB ARTWORK/SCHEMATICS		
HiWIRE Plus	895	805
Micro-CAP III	1495	1269
Schema II	495	450
smARTWORK	895	805
Tango-CAD Pack	995	949
Tango-PCB Series II	595	559
DATA ACQUISITION/ANALYSIS		
Asystant Plus	995	849
DADiSP	795	719
LABTECH Notebook	995	799
MATHEMATICAL TOOLBOXES		
Derive	200	166
Eureka: The Solver	167	115
Eureka: The Solver (MAC)	195	134
Gauss Math & Stat System	395	350
Mathematica 386	695	CALL
AT 386/7	995	CALL
Mathematica (MAC)	795	CALL
PC MathCAD 2.5	495	315
Appl. Packs (for MathCAD)	99	89
PC-Matlab	695	559
Control System Toolbox	495	399
System ID Box	495	399
TK! Solver Plus	395	319
PLOTTING AND GRAPHING		
Grapher	199	149
Grapher/Surfer Bundle	600	499
Surfer	499	379
TECH*GRAPH*PAD	395	319
Temple Graph	299	259
SCIENTIFIC TEXT PROCESSING		
ChiWriter	150	129
EXP	150	129
PC TEX	249	226
T³	595	479
STATISTICS		
CSS	495	469
Microstat II	395	336
NWA StatPak	495	366
P-Stat	695	639
SPSS/PC+	795	727
StatGraphics	895	599
StatPac Gold	595	549
Statview II (MAC)	495	345
SYSTAT	595	449
SYSTAT (MAC)	595	449
SYSTAT (w/ SYGRAPH)	795	595

Terms & Policies

All prices subject to change without notice. We accept Visa, MC, AMEX (2% surcharge on AMEX). Shipping $4 per item sent UPS Ground. Allow 14 days for personal/company check clearance. Returns subject to 15% restocking fee. RA # required. PO's welcome from Fortune 1000 and other qualified organizations.

ADVANTAGE SOFTWARE

A Division of Voyager Software Corp

In the U.S. call:

1-800-333-3141

International: **201-389-8950**

Fax: **201-389-9227**

1163 Shrewsbury Ave., Shrewsbury, NJ 07702

Circle 16 on Reader Service Card.

Circle 285 on Reader Service Card

386 Now Available

Experts Agree on WATCOM C:

"We searched the industry for the best 286 and 386 C-compiler technology to incorporate with our developer toolkits. Our choice was WATCOM."
Nancy Woodward, VP & GM Development Products
Novell, Inc.

"WATCOM's latest release of its rising star is a clear winner....It is a clearly superior value when compared to all compilers..."
Richard Relph
INFOWORLD, May 22, 1989

INFO WORLD BEST IN ITS CLASS

"WATCOM is definitely the leader in object-level optimizations...For flat-out executable speed, WATCOM's compiler was the clear winner."
Steve Apiki and Jon Udell
BYTE, February 1989

"WATCOM C broke with tradition to make a fast, efficient C programming environment that has other C compiler designers rethinking their strategy."
Bill Machrone
PC Magazine, January 17, 1989

PC MAGAZINE EDITORS' CHOICE September 13, 1988 Watcom C, Version 6.5

"Microsoft library- and source-compatibility makes WATCOM C7.0 /386 ideal for porting DOS applications to 32-bit native mode. This compiler enables full 386 performance without 640K limitations."
Richard M. Smith, President
Phar Lap Software, Inc.

WATCOM C7.0
100% ANSI C optimizing compiler and run-time library, graphics library, windowed source-level debugger, development tools, and Express C integrated environment for DOS and embedded systems. Price: $395.00

Now WATCOM C7.0 /386
100% ANSI C optimizing compiler and run-time library plus development tools supporting 386 32-bit protect mode for embedded systems and DOS extenders including 80386 software tools from Phar Lap Software and OS/386 from A. I. Architects. Price: $895.00

For specifications, licensing options and orders, contact:

WATCOM

1-800-265-4555

WATCOM
415 Phillip Street — Telephone: (519) 886-3700
Waterloo, Ontario — Telex: 06-955458
Canada N2L 3X2 — FAX: (519) 747-4971

WATCOM & Express C are trademarks of WATCOM Systems Inc.
© Copyright 1989 WATCOM Products Inc.

two foreign languages, but fortunately you could demonstrate competence by taking an examination. I've always been good at boning up for exams, and that plus psyching the test got me through.

One of my languages was Spanish, and between formal study and living in Southern California, I learned enough to get by in Cal-Mex (which we consider more elegant than Tex-Mex). On the whole, though, I am absolutely the wrong person to evaluate a computerized language instruction program. You've been warned.

Traveler's Guild: Japanese consists of a couple of thin manuals, two 3½-inch floppy disks, and a tape. The program starts you off with a map of Japan, goes through some generalities, and then gets down to drilling you on vocabulary through a phrase-book approach. Phrase categories are standard: greetings, personal condition, going places, weather/seasons, food/eating, and so on. Words and phrases are given on-screen, questions are asked, and you type in the answers. In addition, there's a booklet that accompanies the pronunciation tape.

It all seems to work as advertised; that is, the program works, and the tape gives you pronunciations. Whether or not it will teach you Japanese is something I'm not competent to say. It can't hurt.

One thing it won't teach you is to read Japanese.

There are four different types of characters in use in modern Japan. First, there's kanji, an ideographic system borrowed from Chinese, in which each character—some quite elaborate—stands for a different word. Second, there's hiragana, which looks a bit like ancient Mycenaean Greek: each character stands for a syllable (e.g., ma, pa, ta, and ga). Third is katakana, which is similar to hiragana but has more elaborate characters and is used for syllabic representation of words of foreign origin; and finally there's romanji, which is a roman alphabetic representation of katakana and hiragana characters.

Traveler's Guild: Japanese uses romanji characters because, according to its book, they are "easiest for English speakers to learn and remember," which is probably true. But it's also true that romanji is a lot easier to get onto your screen; anything else would have to be in graphics mode.

Since no program whatever is likely to teach *me* Japanese—I have enough trouble remembering the names of my favorite sushi items—all I can do is make you aware of this program. I surely can't evaluate it.

More Words

The gadget of the month is WordFinder WF-224 marketed by SelecTronics. This is a box about half again the size of a package of cigarettes. You could carry it in a pocket, but you probably wouldn't; for that you'd want the WF-225, which is smaller than a box of coffin nails. Both hinge open, with a small screen on one half and a QWERTY keyboard on the other. The WF-225's keyboard is harder to use, and the screen is smaller; but you *can* use it. Otherwise, the two units are identical.

The software and dictionary are the ones you find in the WordFinder thesaurus program: some 100,000 words, including major countries and cities, and some proper names, like Pournelle and Dvorak. There are also some 220,000 synonyms (which, unlike the primary dictionary words, don't have in-box definitions). You type in a word, spelled correctly or not; it attempts to correct the spelling if it's wrong. Once you have a valid word, you can get a definition (some of them are fairly complex) or a synonym.

So far it's an interesting gadget, but nothing I'd be likely to write about. Indeed, I'd probably have ignored the WF-224 if it hadn't come from Mike Wiener of Microlytics, the developer of the WordFinder software and the chap who saw to it that my personal electronic dictionary was incorporated into the original WordFinder thesaurus. When Mike sent the WF-224, he enclosed a note calling my attention to a unique feature: the Flashcard. When the WF-224 asks you for a word, enter the * (wild card) character and press the Def key; instantly there appears a random word. Mike's note said, "I bet you'll see a word you don't know within 10 tries."

Foo, thought I. I grant you a tiny box like that will have some words I don't know, but it's not going to have so many that it will find one in 10 tries. After all, I make my living with words. But what the heck, it's worth a try.

The fifth word up was *rollick*. OK, I thought I knew what it meant, but let's be honest: I wasn't sure. I pressed the Def key again. "To behave in a carefree, jovial way" came up on the WF-224 screen. Interesting. A quick trip to the OED—I have it ready in a DESQview window—told me *rollick* is also a noun meaning "exuberant gaiety," but the verb is "To frolic, sport, or romp in a joyous, careless fashion; to go off, move along, enter, etc., in this manner." Certainly the WF-224 was close enough.

continued

FINALLY. A debugging tool tough enough to handle the DOS Nasties.

New Version 2.0

Soft-ICE™

Nasty over-write? No sweat!

Soft-ICE memory range break points help you track down memory over-write problems whether you are doing the over-writing or another program is over-writing you.

Hung program? No problem!

When the system hangs, you now have hope. With Soft-ICE you can break out of hung programs no matter how bad the system has been trashed. And with Soft-ICE's back trace ranges you can re-play the instructions that led up to the crash.

Program too large? Not with Soft-ICE!

Soft-ICE runs entirely in extended memory. This means you can debug even the largest DOS programs. And since your program runs at the same address whether Soft-ICE is loaded or not you can find those subtle bugs that change when the starting address of your code changes.

System debugging? Soft-ICE is a natural!

Soft-ICE is ideal for full source level debugging of TSRs, interrupt service routines, self booting programs, DOS loadable device drivers, real-time kernels, non-DOS O/Ss and ROMs. Soft-ICE can even debug within DOS & BIOS.

How Soft-ICE Works

Soft-ICE uses the power of the 80386 to surround your program in a virtual machine. This gives you complete control of the DOS environment, while Soft-ICE runs safely in protected mode. Soft-ICE uses the 80386 to provide real-time break points on memory locations, memory ranges, execution, I/O ports, hardware & software interrupts. With Soft-ICE you get all the speed and power of a hardware-assisted debugger at a software price.

Don't want to switch debuggers? You don't have to!

Soft-ICE can run stand-alone or it can add its powerful break points to the debugger you already use. Use your favorite debugger until you require Soft-ICE. Simply pop up the Soft-ICE window to set powerful real-time break points. When a break point is reached, your debugger will be activated automatically.

MagicCV with Soft-ICE

Using Soft-ICE with CodeView gives you the features necessary for professional level systems debugging. MagicCV and Soft-ICE can work in concert with CodeView to provide the most powerful debugging platform you will find anywhere.

"These may be the only two products I've seen in the last two or three years that exceeded my wildest expectations for power, compatibility and ease-of-use."

—Paul Mace
Paul Mace Software

Soft-ICE	$386
MagicCV	$199
MagicCV for Windows	$199
Buy Soft-ICE & MagicCV(W)	—Save $86.
Buy MagicCV and MagicCVW	—Save $100.
Buy All 3	—Save $186.

30 day money-back guarantee
Visa, MasterCard and AmEx accepted

1988 BYTE Award of Distinction

New Soft-ICE 2.0 features

- Back Trace Ranges
- Symbolic & Source level debugging
- EMS 4.0 support with special EMS debugging commands
- Windowed user interface

™ Nu-Mega TECHNOLOGIES

CALL TODAY (603) 888-2386
or FAX (603) 888-2465

RUN CODEVIEW IN 8K MagicCV™

CodeView is a great integrated debugger, but it uses over 200K of conventional memory. MagicCV uses advanced features of the 80386 to load CodeView and symbols in extended memory. This allows MagicCV to run CodeView in less than 8K of conventional memory on your 80386 PC.

NEW—Version 2.0 includes EMS 4.0 driver.
Attention Windows Developers!
Version available for CVW.

P.O. BOX 7607 ■ NASHUA, NH ■ 03060-7607

Circle 195 on Reader Service Card

ITEMS DISCUSSED

Amí $199
Samna Corp.
5600 Glenridge Dr.
Atlanta, GA 30342
(404) 851-0007
Inquiry 987.

Expert 87 ..... $495
Magic 7 Software
101 First St., Suite 237
Los Altos, CA 94022
(415) 941-2616
Inquiry 988.

Fast Break 3-on-3
IBM PC $39.95
Mac $44.95
Accolade, Inc.
550 South Winchester Blvd.,
Suite 200
San Jose, CA 95128
(800) 245-7744
Inquiry 989.

Grolier's Academic American Encyclopedia on CD-ROM $395
Grolier Electronic Publishing
Sherman Tpk.
Danbury, CT 06816
(800) 356-5590
Inquiry 990.

Logitech Mouse $139
Logitech, Inc.
6505 Kaiser Dr.
Fremont, CA 94555
(415) 795-8500
Inquiry 991.

Mrs. Pournelle's Reading Program $100
Roberta J. Pournelle
3960 Laurel Canyon Blvd., Suite 372
North Hollywood, CA 91604
Inquiry 992.

Oxford English Dictionary CD-ROM $950
Oxford University Press, Inc.
200 Madison Ave.
New York, NY 10016
(212) 679-7300
Inquiry 993.

Populous $49.95
Electronic Arts
1820 Gateway Dr.
San Mateo, CA 94404
(415) 571-7171
Inquiry 994.

ProBas ToolKit $99
Hammerly Computer Services, Inc.
9309 Jasmine Court
Laurel, MD 20707
(800) 343-7484
Inquiry 995.

ProIcon $175
The ProIcon Group
P.O. Box 1123
Salida, CO 81201
(719) 539-3884
Inquiry 996.

QuickPak Professional $149
Crescent Software
11 Grandview Ave.
Stamford, CT 06905
(203) 846-2500
Inquiry 997.

The MicroHelp Toolbox $79
MicroHelp, Inc.
4636 Huntridge Dr.
Roswell, GA 30075
(404) 552-0565
Inquiry 998.

Traveler's Guild: Japanese $139
Traveler's Guild
315 West Washington
Marquette, MI 49855
(906) 228-5030
Inquiry 999.

WordFinder WF-224 ..... $99.95
SelecTronics
701 Decatur Ave. N, Building 204
Minneapolis, MN 55427
(612) 545-6823
Inquiry 1000.

WordStar 5.5 ..... $495
WordStar International, Inc.
33 San Pablo Ave.
San Rafael, CA 94903
(415) 499-1200
Inquiry 1001.

Incidentally, I used the DESQview mark-and-transfer routine to move the definitions from the OED window to this one. Works like a charm.

Try the WF-224 again. The sixth word this time was *abscission*. Well, all right, I know what that means, but I can't say I was *sure*. Try again. It took 18 tries to come up with *perfecto*, which turns out to be a thick tapered cigar, and no, I didn't know that. I thought they'd included a word of foreign origin.

The WF-224 also checks spelling. If you punch in *Pournelle*, it says that's spelled right. But if you give it *Pournell*, it corrects it to *perennial*; however, if you hit the right-arrow button, it finds something else and will keep trying until, by gollies, it gets *Pournelle* on about the fourth try! It accepts *perenial* and gives the right answer, but if you give it *mispeled*, it finds *misapplied* as the first choice; keep hitting the right arrow, though, and it gets it right.

It's a fun gadget. I'll lend it to one of my college sons and see what happens.

Of Mice and Bugs

Logitech has new mouse software. They no longer bundle the Point editor with their mice, although I gather you can get it if you buy their desktop publishing package. Now they include a thing called Pop-Up DOS, which is a DOS shell. Pop-Up DOS enthusiasts swear it's easier to use and just plain better than Norton Commander. Maybe. I'm quite certain that had I learned Pop-Up DOS before I learned the Commander, I'd never have been tempted to switch; now the burden's the other way, and so far I'm still using the Commander, but we'll see as time goes on. One thing: Pop-Up DOS comes with a good tutorial and reference book, although I do wish the index and table of contents were a little more thorough.

Obviously, Pop-Up DOS works well with a Logitech mouse. You get the help file by pressing the center mouse button, for example. They've kept the pattern from Niklaus Wirth's Lilith operating system, in which the center button produces a menu, the left button executes commands, and the right button makes the menu go away and generally acts as the Escape key; but since that can drop you right out of the program, Pop-Up DOS requires that you double-click on the right button or physically press the Escape key.

Pop-Up DOS does a number of things similar to the Norton Commander. It shows a full tree of your hard disk directory structure. There's a neat little card

continued

When we started selling MKS products in 1986, the Tax Collectors were among the first to notice. They assessed our promise to bring the power and flexibility of a UNIX environment to the DOS desktop.

And then they came to call.

We're happy to report that the Tax People* quickly decided that MKS products were the perfect way to train users on UNIX operating systems using the PCs everyone was already familiar with. And the perfect way to speed development of new programs and procedures.

Get the new - but don't give up the old

The MKS Programming Platform gives programmers the best of both worlds - virtually unrestricted access to the power and flexibility of UNIX operating systems, and full DOS or OS/2 capabilities. With MKS your PC becomes a powerful and productive UNIX workstation, whenever you need it.

The Platform includes four proven members of the MKS family of software: *MKS Toolkit, LEX & YACC, RCS,* and *Make.*

The heart of the Platform is the *MKS Toolkit.* It provides a complete set of utility programs and over 150 commands compatible with UNIX System V.3. It also includes the MKS Korn Shell, a command interpretor, MKS Vi editor, and the MKS AWK programming language.

Next is *MKS LEX & YACC,* which work together as a highly efficient program generator, simplifing the creation of languages and compilers for DOS and OS/2. The set is completed with *MKS RCS* (Revision Control System), which gives total control of text file revisions, and *MKS Make,* which provides an efficient way to automate the production and maintenance of any size project.

All together they are the most efficient, most productive, and friendliest way to cross the bridge between DOS or OS/2, and UNIX.

Beyond multiple platform support

The Programming Platform performs on standard PC networks like Novell NetWare and PC NFS with the illusion of a complete UNIX timesharing system. This means you can hook your PC to PC NFS, allowing it to be used as a UNIX workstation.

MKS is an active participant on the POSIX standards committee, and we track the shell and utilities standard to the fullest extent. We take care to build the underlying POSIX kernel functionality on DOS and OS/2 into MKS software before moving utilities. That's why the Platform gives you 100% UNIX and POSIX compatibility, with no surprises.

Ideal training tools

Fast, painless training is another benefit of the Programming Platform. Developers can use their familiar PC keyboards while moving effortlessly to UNIX on the desktop, and exposure to new commands and functionality becomes part of the novice's working day.

The Taxman adds it up

When you stack up all the advantages of the Programming Platform - access to powerful development tools, time-saving management functions, full portability, easy training, and our unswerving dedication to the POSIX standard - it's no wonder that the people with the toughest jobs to do, like the Taxman, turn to MKS.

To learn more about The Programming Platform and other MKS productivity and development tools, call us today. Maybe we can make your job a little less taxing.

After Long Investigation, The Taxman Came To Talk To Us

30 day money-back guarantee
MKS Programming Platform prices are:

DOS	$665
OS/2	$1225

In Continental USA call: 1-800-265-2797
Outside Continental USA call: 1-519-884-2251
Fax: 1-519-884-8861

Authorized MKS Dealers:

Belgium	2-736-6064
England	364-53499 or 1-833-1022 or 0763-73455
Netherlands	20-14-24-63
West Germany	551-792488 or 061-214908 or 721-886-664

Head Office:
35 King Street North
Waterloo, Ontario
Canada, N2J 2W9

MKS
More Power to You

*We're not allowed to use their official name. But you know who we mean.
MKS is a trademark of Mortice Kern Systems Inc. Other trademarks have been cited and MKS acknowledges them.

Circle 185 on Reader Service Card

file built in; alas, there's no provision for sorting those silly cards. I'm seriously thinking of writing a small Turbo Pascal program that will do it. You can launch programs from within Pop-Up DOS, but in addition you can link programs. You can define all .GV files as GrandView applications, so if you double-click on a .GV file, it launches GrandView with that file in it.

Other Pop-Up DOS features include a calendar, a hexadecimal/decimal calculator, and a small editor that is more than good enough to edit stuff like AUTOEXEC.BAT, CONFIG.SYS, and generally whatever else you want. Unlike the SideKick editor, it doesn't do word wrap. On the other hand, it works nicely with mice (as you'd expect). On the gripping hand, Pop-Up DOS has no view or examine function that lets you read files; to get the equivalent of the DOS TYPE command, you have to either exit Pop-Up DOS or click on the file bringing it into the Pop-Up DOS editor—either of which is inconvenient compared to Norton Commander's F3-view command.

In other words, Pop-Up DOS is a reasonable competitor to Norton Commander and other DOS shells, and since you get it free with the Logitech Mouse, it's certainly worth trying, especially if you haven't got used to something else.

That's the one hand. On the other hand, the new Logitech Mouse has an odd shape: instead of the modified wedge that Logitech has made famous, the new version looks like a slice of a cylinder. Some people like it. I don't; I have trouble distinguishing the buttons.

On the gripping hand, by the time you read this, Logitech will have brought out a new trackball. I've had almost no time to play with it, but from what little experience I've had, I think it may well replace the mouse as the proper pointing device. I know there have been trackballs before, but most have been clumsily designed. The Logitech trackball is small; it's set so that you manipulate the ball with your thumb, leaving the fingers to rest on the buttons in a natural manner. This is definitely the right way to go. More next month.

Finally, while I'm discussing Logitech, I want to again praise MultiScope, their new OS/2 Presentation Manager debugger. While MultiScope naturally works with Logitech Modula-OS/2, it's also the best debugger I know of for IBM C/2, Pascal Compiler/2, and Macro Assembler/2; and for Microsoft C, Pascal, and Macro Assembler. It works in both run-time and postmortem modes and with both OS/2 Text and PM.

If you're programming for OS/2 in *any* language, you need MultiScope. Highly recommended.

Failure

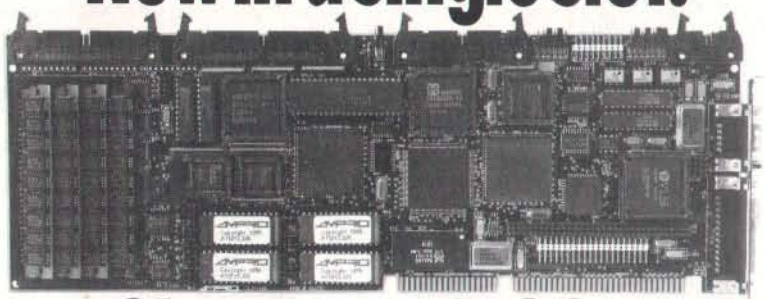
I keep hearing wonders about Windows, and Windows/386 in particular. More, I have Ami, a Windows text editor and desktop composition program that looks awfully good in demonstrations. This looked like a good program to try on the new Northgate 386 with the Video Seven VGA card and Princeton monitor.

There's only one problem. It takes 40 minutes to install Windows/386. When I finished this tedious process, the program reported that everything was all right, and I only needed to reboot and type WIN386. I did that, the screen flickered, and I was back at DOS again. No error message. Nothing. Just click, clack, and no effect.

Clearly, there are some odd bugs in

continued

All the advantages of Ampro's Little Board/286. Now in a single slot.



Slot Board/286.

One philosophy. Two systems. Ampro's *new* Slot Board/286, like the Little Board/286, is a complete AT-compatible single board system. Each is equivalent to an AT motherboard and four expansion cards. Now, you can choose between stackable systems with the Little Board/286 or passive backplane systems with the Slot Board/286.

PC/AT Software compatible. Supports all standard PC/AT operating systems. DR-DOS is included with each board.

Everything you need. StackPlane™ or backplane. 512K to 4 MB on-board DRAM. Bootable Solid State Disk. Disk controllers. Display controllers. A selection of I/O ports. Card cages and passive backplanes for easier system implementation.

Better answers for embedded systems. Bolt-in or plug-in. Little Board/PC and Little Board/286 with their compact, easy to build-in StackPlane architecture. Slot Board/286 with its passive backplane for I/O and peripheral intensive applications.

Available worldwide. Call Ampro or any of the distributors listed below for complete details on Ampro Little Boards or Slot Board/286.

Slot Board/286 Features

- IBM PC/AT compatible
- 12 or 16 MHz 80C286 CMOS CPU
- Up to 4MB DRAM
- On-board Bootable Solid State Disk
- 2 serial ports (RS232C/RS422/RS485)
- Parallel printer port
- AT Bus hard disk interface
- Floppy disk controller
- SCSI controller
- Enhanced Award ROM BIOS
- Math co-processor support
- Real time clock
- Low power (approx. 8 Watts)
- Wide operating temp. range: 0 to 60° C
- Low parts count. High reliability
- Optional Mini Modules: Video controllers LCD Display Driver Serial/Parallel expansion Modem ... and more

All trademarks are the property of their respective owners

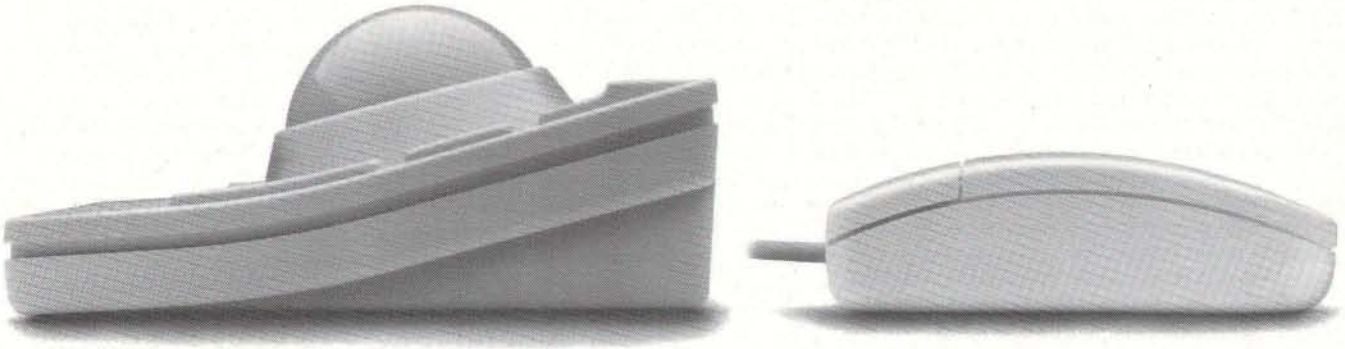
(408) 734-2800

AMPRO
SINGLE BOARD SYSTEMS

Ampro Computers, Inc., 1130 Mountain View/Alviso Road, Sunnyvale, CA 94089. Telex: 4940302 FAX: (408) 734-2939

Reps: USA – contact AMPRO for the name of your nearest rep. **Australia** – 61 3 720-3298; **Austria** – 43-1/45 4510-0; **Canada** – (604) 438-0028; **Denmark** – 45 3 66 20 30; **Finland** – 358 0 585-322; **France** – 331 4502-1800; **Germany, West** – 49 89 611-6151; **Hong Kong/PRC** – 5 8613118; **Israel** – 972 3 49-16-95; **Italy** – 39 6 811-9406; **Japan** – 81 3 257-2630; **Netherlands** – 31-10-411 8521; **Sweden** – 46 8 55-00-65; **Switzerland** – 41 1 740-41-05; **United Kingdom** – 0296-435511

How an upside down idea made the mouse obsolete.



Frankly, we thought any input device that operated by dragging it across an already cluttered desk was great technology misapplied. We took a different approach.

Now RollerMouse makes the conventional mouse obsolete.

Control Without Bending Your Elbow

All the pointing accuracy and speed you only hoped for from your old mouse is right at your fingertips. Moving from point to point with our oversized trackball is fluid, effortless and fast at 200 CPI resolution.

Using our exclusive four-button control, you have maximum click and click lock versatility. With programmable pop-up menus, RollerMouse works with software written with or without a mouse in mind. And RollerMouse technology means you never need to disassemble it for cleaning.

More Application Productivity

If you work with the latest graphics-based applications, such as desktop publishing, CAD/CAM/CAE or any object-oriented PS/2, PC or Mac operating system, don't be held back by old mouse technology.

RollerMouse™

The other kind of mouse.

Buy from the leader in precision pointing devices. CH Products perfected computer control technology more than 25 years ago. And the latest technology is at a dealer near you.

For more information, call:
(619) 744-8546
8:00 a.m. – 4:30 p.m. PST
For credit card orders, call:
USA (800) 624-5804
CA (800) 262-2004
8:00 a.m. – 4:30 p.m. PST

CH products™

A Division of Joystick Technologies, Inc.
1225 Stone Drive, San Marcos, CA 92069

All product names are registered trademarks of their respective owners. All rights reserved.

Circle 50 on Reader Service Card
(DEALERS: 51)

Windows/386; perhaps I'll learn, but for the moment I think I'll stick to DOS and DESQview. It's sure less frustrating. I have installed Windows/286, but just now I'm sufficiently disgusted with Windows that it wouldn't be fair to Amí to try it. I'll report on it another time. Meanwhile, I sure wish Microsoft would get its installation act together. It could at least give an error message.

Grolier

I keep my radio on the local university's good music station, and tonight they're doing a docudrama about the French Revolution, with Captain James Tiberius Kirk (aka William Shatner) as Robespierre yet. One event portrayed was the assassination of Marat by Charlotte Corday. I got to wondering what happened to her after she stabbed Marat (who certainly had it coming).

I've got plenty of books, including Carlyle's *The French Revolution*, and Corday's story is in one of them, but this seemed like a good opportunity to try the new version of Grolier's Academic American Encyclopedia on CD-ROM. You may recall that this was just about the first CD-ROM of any size to be published, and Gary Kildall's Knowledge Corp. developed the early indexing and data-retrieval software. The user interface was, to be kind, not optimum. Since then, there have been several revisions.

Installation of the new version 2 is straightforward: the program comes with a floppy disk as well as the CD-ROM. Put the floppy disk in drive A, log on, and type Install. It takes care of the situation from there.

I'm pleased to say that the new Grolier software is considerably improved over the first version. It's now quite intuitive. There are also multiple (up to 10) windows and hypertext links from one article to another, which is neat.

Looking up Corday yielded six references in four articles. The primary one told me that she'd been guillotined, which I suppose is no surprise, since almost everyone you ever heard of who lived in France around 1789 seems to have been shortened. I then got myself trapped playing around with linkages and ended up reading a lot more about European history than I'd intended; the hypertext-link feature really does work, making it simple to trace down ideas.

Grolier's Academic American Encyclopedia isn't the world's best encyclopedia, but it's certainly not the worst. It does get rather cursory in places, and details of history aren't its strongest point; but then encyclopedias are supposed to be a starting point for learning, not the entire accumulated knowledge of the human race. You can learn a lot browsing through it with hypertext links.

I do wish they'd use the new Grolier retrieval software on an even more complete encyclopedia, but until they do I'm glad to have this one. Recommended.

Languages Yet Again

I've been considering just what you can do with Turbo Pascal. Modern programmers would have you believe that Pascal and Modula-2 are dead, and that C is the only viable language. For my money, that just isn't so.

Indeed, I'd go the other way: every time I hear of a big software project in trouble, I find it was written in C. More to the point, it was written by one programmer but needs to be maintained by another. Under those circumstances, C becomes something close to a write-only language, particularly if combined with Unix. The code is perfectly comprehensible to the person who wrote it—provided said person is a full-time programmer—but it becomes unfathomable for someone coming in from outside.

Pascal, on the other hand, and in particular Turbo Pascal, may not completely live up to Niklaus Wirth's goal of a self-documenting language, but it's sure closer than C. True, Pascal doesn't always produce code that's as compact as C code; but it's generally good enough, and me, I'd rather have fat, understandable code than a program that's compact, efficient, and incomprehensible.

For that matter, BASIC most certainly isn't dead. If you take Microsoft QuickBASIC and add toolkits like those published by Crescent Software, Hammerly Computer Services, and MicroHelp, you can do anything you like, including TSR programs. True, compiled BASIC makes for fat code, but most of the tools I mentioned are in assembly language and will thus be smaller and run faster than the same stuff in C. If you make a program that's largely links between assembly language routines, the result can be quite impressive—and still be readable. I'm in the process of going through Mrs. Pournelle's Reading Program and replacing my own code with routines from these toolkits, and the result is gratifying.

I've been saying this for years, and I still believe it: the real computer revolution comes about when people stop having to worry about *how* to make the computer do something and concentrate on *what* they want it to do. Moves—such as Windows and OS/2—that take us toward the use of C and other arcane languages are steps in the wrong direction.

OS/2 got more accessible when Logitech put out Modula-OS/2; it will get even more so when we have QuickBASIC and Turbo Pascal for OS/2.

Winding Down

There's still an enormous pile on my desk. There's Expert 87 from Magic 7 Software, which looks fair to be the PC-DOS "expert system generator" for the rest of us. I liked the original version, and it has been revised to be even better. A bit complex, but that kind of program always is. Recommended.

There's WordStar 5.5, which is so much improved I may change over; if they'd had this four years ago, WordStar International would own the world.

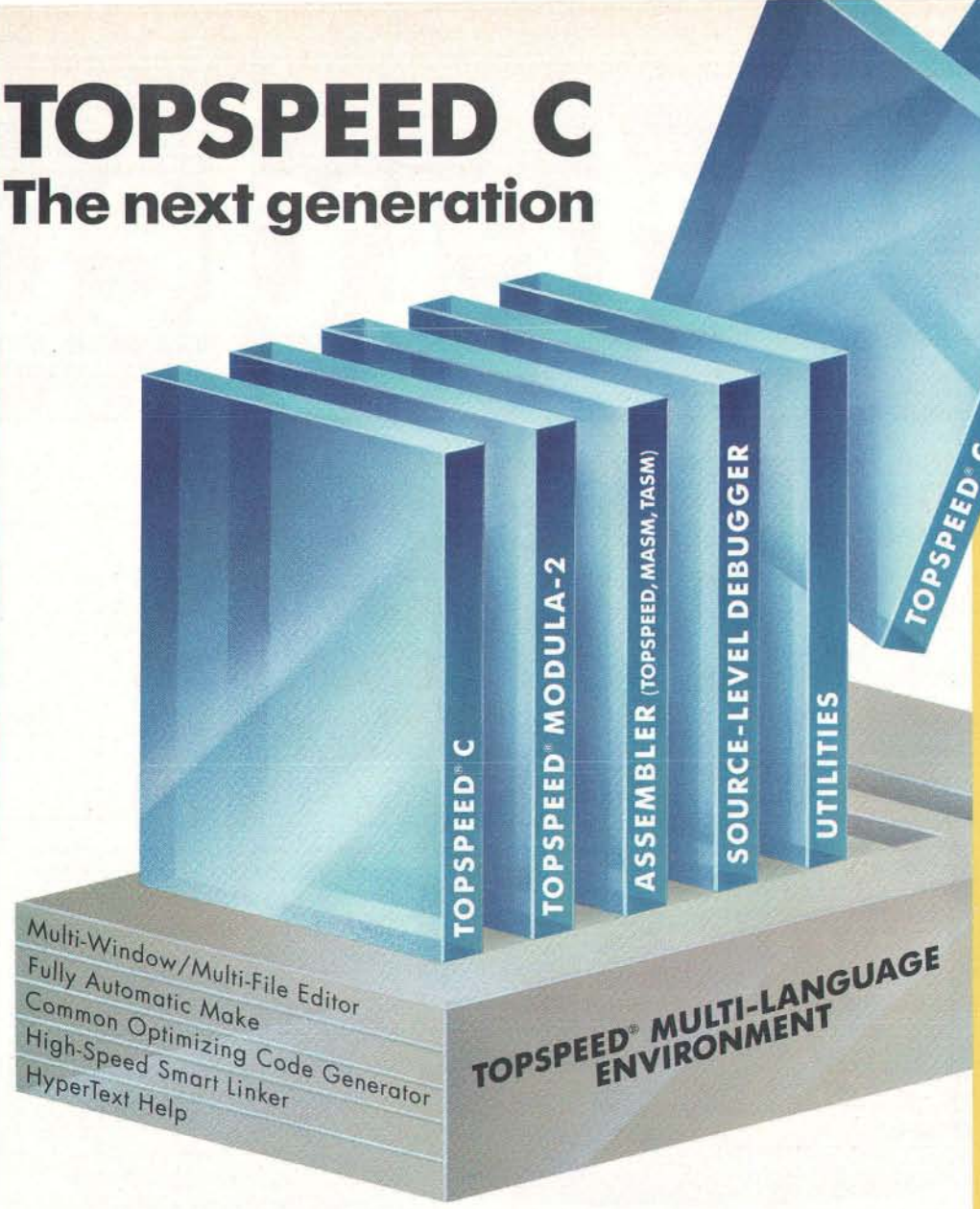
Finally, there's ProIcon, a Mac implementation of the Icon programming language (the book *The Icon Programming Language* by Ralph and Madge Griswold is available from Prentice-Hall). This is a high-level, SNOBOL-like, string and list processing language (see "SNOBOL and Icon" by Ezra Shapiro in the July 1985 BYTE) available on Unix systems, including the VAX, the Amiga, and the Atari ST. Programs in Icon look a bit like a cross between Pascal and C. It is not as strongly typed as Pascal, but more so than C. More another time.

The pseudobook of the month is *The Man-Kzin Wars II* series created by Larry Niven; the story of interest is "The Children's Hour," a novella by Pournelle and S. M. Stirling (Baen Books, 1989). The real book of the month is *The Bloody Crossroads: Where Literature and Politics Meet* by Norman Podhoretz (Simon and Schuster, 1986, $16.95). I particularly liked his essays on George Orwell and Albert Camus.

The game of the month is Accolade's Fast Break 3-on-3. Richard says it's very hard to learn, but once you've got the hang of it, it's both fun and instructive. It must be fascinating; he's still coming up here to play it on the Amiga. We're both a lot more careful about orange soda. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

TOPSPEED C
The next generation



TopSpeed C. Compiler and library conform 100% with proposed ANSI standard. Source compatible with MS C and Turbo C (where ANSI compatible). Library is a superset of both MS and Turbo C's libraries. Extensions include: Time-sliced scheduler for concurrent functions. Powerful text window management. Borland text windows supported. MS's graphics, plus: Bar chart & polygon plotting, standard formatted text IO to graphics windows. Interface to Borland's Graphics Interface (BGI). Mouse support. All BIOS and DOS calls supported. Common UNIX calls. 6 memory models plus user-definable memory models. Smart linker includes only functions and data used in the final program. Optional run-time checks include overflow, stack, array bounds, and pointer checks. Run-time and compilation errors automatically pinpointed in source code.

Common optimizing code generator. All compilers produce highly optimized code using the same code generator. 8086/286/386 specific code. Automatic optimal register allocation. Common Sub-expression Elimination. Expand any function as inline code. Pass parameters in registers (optional). Inline 80x87 code or emulation.

Automatic make. Fully automatic make with version control recompiles and rebuilds EXE, LIB and DLL files as necessary without the need of a make script. Make dependencies are described by project files, which simply list the objects to be included, as well as the names of other dependent projects. One single make can result in multiple compilations using different compilers and/or assemblers, linking and building of libraries, DLLs and an EXE file.

Seamlessly integrated environment. Up to 10 active editor windows, each with a capacity of 1/2 MB source code. Compiler errors and warnings pinpointed in source code; automatic file-switch when stepping between errors or warnings. All menus and hot-keys redefinable. By default, editor commands compatible with Turbo and SideKick. Keyboard macros a la SuperKey. Cut and paste between editors, help system, and directly from screen memory. Multi-file search commands, programmer's calculator, built-in ASCII, key scancode, and color tables. HyperText help system with library reference.

DOS and OS/2 Professional Editions. Professional Editions include: Support for Microsoft Windows. DOS Dynamic Link Libraries. Full source code to libraries. Start-up assembler code. High-speed Assembler is fully integrated in the environment. Disassembler. Program execution profiler. Code locator for embedded systems programming. Watch utility for viewing any selection of DOS calls as they are executed. Programmer's interface to debugger. Post Mortem Debugger. And more. OS/2 Professional Edition has full support for Presentation Manager.

TopSpeed and TechKit are trademarks of Jensen & Partners International. Other brand and product names are trademarks or registered trademarks of their respective holders.

TOPSPEED C:

Standard Edition $199
(DOS Compiler & VID)

DOS Prof Edition $395

OS/2 Prof Edition $495

Call on TopSpeed Modula-2 (with objects) compiler & toolkit prices.

TO ORDER:

In the U.S., call:
1-800-543-5202
In Canada, call:
1-800-543-8452

Call on shipping & handling charges & volume discounts. VISA/MC accepted.

30-day unconditional money-back guarantee.

Jensen & Partners International

1101 San Antonio Road, Suite 301
Mountain View, CA 94043
Phone: (415)967-3200
FAX: (415)967-3288

In England & Europe contact:
Jensen & Partners UK Ltd., 63 Clerkenwell Road, London EC1M 5NP. Phone: (01)253-4333. FAX: (01)251-1442. C Standard Edition £149; C DOS Prof Edition £295; C OS/2 Prof Edition £370. Call on handling & VAT charges, and TopSpeed Modula-2 product prices.

Quarterdec

DESQview 2.2 and DESQview 386. The multitasking, windowing environments that work with your favorite software.

DESQview™ is the operating environment that brings OS/2™ power to DOS. And it lets you, with your trusty 8088, 8086, 80286, or 80386 PC, leap into the next generation in PC productivity. For not much money. And without throwing away your favorite software.

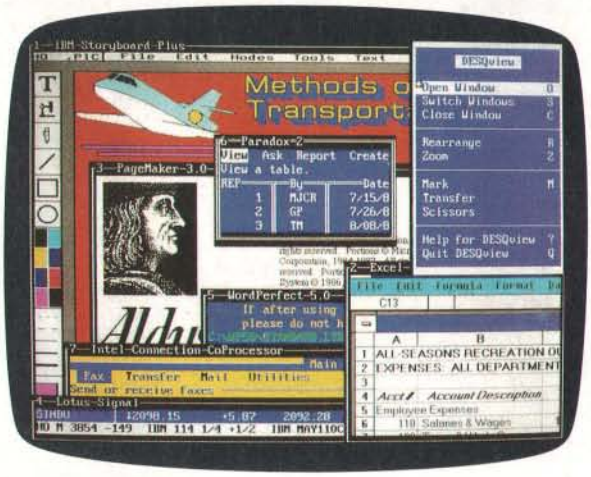
Introducing DESQview 2.2

And now, DESQview 2.2 adds capabilities, performance, and compatibility enhancements you've been asking for:

Like being able to fine tune DESQview performance "on the fly." Run Lotus Express and Metro. And the Intel Connection Co Processor. Even use the DOS 4.0 shell with DESQview. Have DESQview automatically install Quattro, Sprint, Aldus PageMaker, Microsoft Excel, Word Perfect, Dataease and as many as 80 other programs. And using the DESQview API, be able to dynamically link them.

More bang; less bytes

While other programs get bigger, we've worked to make DESQview smaller. And we've succeeded in a big way on PCs and PS/2™s with extended, EMS 3.2 (AboveBoard), EEMS and EMS 4.0 memory—as well as on 386 PCs and PS/2s. For example, DESQview overhead on EMS 4.0 and 386 PCs can be as low as 10K on EGA/VGA PCs. And DESQview actually *increases* memory 30K on CGA PCs; 20K on monochrome and Hercules PCs. That's good news for users of big desktop publishing, CAD and database programs.



DESQview lets you run your favorite programs in windows side-by-side.

Introducing DESQview 386

For users of 80386 PCs and PS/2s (or PCs with 80386 add-in boards, such as the Intel Inboard 386), there's DESQview 386 (a combination of DESQview 2.2 and the new QEMM-386 Quarterdeck Expanded Memory Manager, version 4.2).

DESQview 386 gives you extraordinary power. Run text, CGA, EGA, VGA, and Hercules programs in windows and in the background. Run 32-bit 386 programs, like Paradox 386, and IBM Interleaf simultaneously with your favorite DOS programs. All with the speed and performance you expect out of your 386. And with protection against 'misbehaved' programs.

Promise and performance

And, of course, both DESQviews have all the features that made prior versions the popular choice in operating environments. The ability to multitask in 640K and beyond. View programs in windows or full screen. Transfer data. Access DOS via menus. Dial your phone. And create keystroke macros within and between programs.

Our story gets better and better

If there's any doubt about our commitment to your PC and PS/2 productivity, just look at our accomplishments over the years. We think you will understand why GE, Ford, Aetna, Monsanto, and so many other major corporations use DESQview.

And why PC Magazine twice gave DESQview its Editor's Choice Award for "The Best Alternative to OS/2," why readers of InfoWorld voted DESQview "Product of the Year" three times. Why, by popular vote at Comdex Fall for two years in a row, DESQview was chosen "Best PC Environment" in PC Tech Journal's Systems Builder Contest, and just won their "Professional Solutions" Award.

DESQview lets you have it all now.

INFO WORLD 1986 PRODUCT OF THE YEAR 87 88

PC MAGAZINE 87 88 EDITOR'S CHOICE

TECH Professional Solutions Award 1989 Best Operating Environment

PC WORLD BEST BUY

1988 BYTE AWARD OF DISTINCTION

k Delivers.

QEMM. Break the 640K barrier for $59.95

Your 80386 PC, IBM Personal System/2 Model 80, PC or AT with 80386 add-in board, as well as your IBM Personal System/2 Models 50 or 60 can all break through the DOS 640K barrier. Now you can have maximum use of your memory—whether you have one megabyte or 32—with the Quarterdeck Expanded Memory Manager. All without having to purchase special expanded memory boards.

QEMM uses hidden features within your existing memory to make it compatible with the Lotus-Intel-Microsoft Expanded Memory Specification (EMS) version 4.0.

Now you can run colossal spreadsheets, databases, and CAD models designed for expanded memory, using Lotus 1-2-3, Symphony, Framework, Paradox, AutoCAD, Excel and more.

And if you'd like to use these programs all together —multitasking beyond 640K— QEMM works with our popular DESQview multitasking environment.

If you are one of the 12 million or so 8088, 8086 or 80286 PC users who feel left out, don't despair. We have options that let you keep your computer and favorite programs and give you today what the newest PCs and operating systems are promising for the future.

Visit your dealer for more information on barrier-breaking Quarterdeck products.

DESQview API Toolkit. New C and Pascal Libraries, Debugger. Panel Designer. And more.

API Reference Manual

The key to the power of the DESQview API, our Reference Manual contains all you need to know to write Assembly Language programs that take full advantage of DESQview's capabilities. And there's an 'include' file with symbols and macros to aid you in development.

API C Library

Here are C language interfaces for the entire set of API functions. It supports the Lattice™ C, Metaware™ C, Microsoft® C, and Turbo C compilers for all memory models. Included with the C Library package is the API Reference Manual and source code for the library.

API Pascal Library

NEW!

The Pascal library provides interfaces for the entire set of API functions. It supports Turbo Pascal V4.0 and V5.0 compilers. Included are the API Reference Manual, source code for the library, and example programs.

API Debugger

The DESQview API Debugger is an interactive tool enabling the API programmer to trace and single step through API calls from several concurrently running DESQview-specific programs. Trace information is reported symbolically along with the program counter, registers, and stack at the time of the call. Trace conditions can be specified so that only calls of interest are reported.

API Panel Designer

This interactive tool helps you design windows, menus, help screens, error messages, and forms. It includes an editor that lets you construct an image of your panel using simple commands to enter, edit, copy, and move text, as well as draw lines and boxes. You can then define the characteristics of the window that will contain the panel, such as its position, size, and title. Finally, you can specify the locations and types of fields in the panel.

The Panel Designer automatically generates all the DESQview API data streams necessary to display and take input from your panel. These data streams may be grouped into panel libraries and stored on disk or as part of your program.

More Tools are Coming

Quarterdeck is committed to adding tools as needed by our users. To that end we have been working with Ashton Tate and Buzzwords International on dBASE III and dBASEIV translators. And in the works, we have BASIC and DOS Extender libraries.

Quarterdeck

Quarterdeck Office Systems, 150 Pico Blvd., Santa Monica, CA 90405 (213) 392-9851
FAX: (213) 399-3802

For additional information, please use the following Reader Service numbers: DESQview: #230 QEMM: #231 API Tools: #232 API Conference: #233

MONTGOMERY GRANT

BYTE
10 89

OUTSIDE USA .....CALL
(718)692-0790
For Customer Service
Call Mon-Fri: 9:30am-4:30pm
(718) 692-1148

Retail Outlet: Penn Station, Main Concourse
(Beneath Madison Square Garden) New York City, NY, 10001
Store Hours: Mon-Thurs. 8:30am-8pm/ Fri,8:30am-4:30pm/ Sat,-Closed /Sun,9:30am-7pm
FOR ORDERS & INFORMATION CALL TOLL FREE
1-800-759-6565

OR WRITE TO:
Montgomery-Grant Mail Order
Department, P.O. Box 58,
Brooklyn, N.Y., 11230
FAX NO. 7186923372
TELEX 422-132 MGRANT

ORDER HOURS: Mon-Thur 9am-7pm/Fri 9am-5:00pm/Saturday CLOSED/ Sunday, 9:30am-6:00pm
NO SURCHARGE FOR CREDIT CARD ORDERS / WE INVITE CORPORATE AND EDUCATIONAL CUSTOMERS
CORPORATE LEASING & PERSONAL FINANCING AVAILABLE /DISCOUNTS FOR QUANTITY ORDERS/TOLL FREE TECHNICAL SUPPORT

EPSON EQUITY 1+
IBM XT COMPATIBLE
• 640K RAM w/Clock Calendar • 4.77 - 10 MHz. • 360K Drive • Serial & Parallel Ports • MS DOS 3.3 • GW Basic **$669**

SAME w/SEAGATE 20MB HARD DRIVE.....$919
SAME w/SEAGATE 30MB HARD DRIVE.....$949
SAME w/SEAGATE 40MB HARD DRIVE.....$1019
SAME w/TWO 360K FLOPPIES.....$719
EPSON EQUITY 1e.....$729

EPSON EQUITY II+
IBM AT COMPATIBLE
• 640K RAM • 80286 Microprocessor • 1.2MB Floppy Drive • Serial & Parallel Ports • MS DOS 3.3 • GW Basic **$1059**

SAME w/SEAGATE 20MB HARD DRIVE.....$1299
SAME w/SEAGATE 30MB HARD DRIVE.....$1339
SAME w/SEAGATE 40MB HARD DRIVE.....$1399

EPSON EQUITY 386/20
• 80386 Microprocessor • 20MHz • 1MB RAM Expandable to16MB • 1.2MB Floppy Drive • MS DOS 3.3 • GW Basic **$2599**

WE CAN RECONFIGURE ANY OF OUR COMPUTER PACKAGES TO FIT YOUR SPECIFICATIONS. CALL FOR INFORMATION. ALL COMPUTER SYSTEMS SUPPORT MDA, CGA, EGA, VGA, & MULTISCAN. WE CARRY MODEMS, DRIVES, CARDS, MONITORS, MEMORY UPGRADES & ALL OTHER ACCESSORIES FOR YOUR COMPUTER.

LEADING EDGE MODEL D
IBM XT COMPATIBLE PKG.
•512K RAM Expandable to 768MB • 8088-2 Microprocessor • 360K Floppy Drive • 4.77-7.16 MHz. • MS DOS 3.3 & GW Basic • 12" Monitor **$599**

SAME w/SEAGATE 20MB HARD DRIVE.....$829
SAME w/SEAGATE 30MB HARD DRIVE.....$869
SAME w/SEAGATE 40MB HARD DRIVE.....$929
LEADING EDGE MODEL D2+ w/30MB.....$1599

AST 286 *IBM AT COMPATIBLE* $799
• 80286 Processor • 512K Expandable to 4MB • 1.2MB Floppy Drive • Serial & Parallel Ports • Video Card

SAME w/SEAGATE 20MB HARD DRIVE.....$1049
SAME w/SEAGATE 30MB HARD DRIVE.....$1079
SAME w/SEAGATE 40MB HARD DRIVE.....$1149
AST PREMIUM 386/16 MHz.....$2199
AST 386/25 MHz.....$3475
AST 386/33 MHz.....$4199

LAPTOP COMPUTERS

AMSTRAD PPC-512 512K, 1 FLOPPY	$499	NEC ULTRALITE 2MB	2399
AMSTRAD PPC-640,640K 2 DRIVES, MODEM	$699	NEC MULTISPEED HD	$1949
TOSHIBA 1000	$639	NEC PROSPEED 286 w/20MB	$3099
TOSHIBA 1600	$3179	NEC PROSPEED 386 w/40MB	$4499
TOSHIBA 3100e	$2699	ZENITH 184 w/2 FLOPPIES	$1469
TOSHIBA 1200H	$1849	ZENITH 184-2 w/20MB	$2199
TOSHIBA 1200HB	$1999	ZENITH 286 w/20MB	$2999
TOSHIBA 3200	$3399	SPARK EL	$899
TOSHIBA 5100	$4199	COMPAQ SLT 286-20	$3799
TOSHIBA 5100 w/100MB	$4799	COMPAQ SLT 286-40	$4199
TOSHIBA 5200	$4999		
TOSHIBA 5200 w/100MB	$5299		

MODEMS, EXTERNAL DRIVES, & ACCESSORIES AVAILABLE FOR ALL LAPTOPS.

AMIGA 500 • 2000 • 2500 • COMPUTERS

Amiga 500 w/Built-in 5.25" Drive **$549**
Amiga 500 w/1084 Monitor **$819**
Amiga 2000 H.D. **$1999**
Amiga 2000 w/ Built-in 3.5" Drive **$1449**
Amiga 2500 **$3269**
Amiga 1084 RGB Monitor **$289**
Amiga 1010 Disk Drive **$179**

PRINTERS

STAR
NX-1000.....$164.95
NX-1000 RAINBOW.....$214.95
NX-2400.....$284.95

CITIZEN
180 D.....$149.95

DICONIX
150+.....$329.95

OKIDATA
OKIMATE 20.....$139.95
OKIDATA 180+.....$219.95
OKIDATA 183.....$249.95
OKIDATA 320.....$329.95
OKIDATA 321.....$459.95
OKIDATA 390.....$454.95
OKIDATA 391.....$629.95

EPSON
FX-1050.....$429.95
FX-850.....$334.95
LQ-510.....$329.95
LQ-850.....$519.95
LQ-950.....$569.95
LQ-1050.....$719.95
LQ-2550.....$899.95
LX-810.....$179.95

NEC
P-2200.....$319.95
P-5200.....$489.95
P-5300.....$649.95

PANASONIC
KXP-1092i.....$289.95
KXP-1524.....$519.95
KXP-1595.....$409.95
KXP-1124.....$309.95
KXP-1180.....$177.95
KXP-1191.....$229.95
KXP-3131.....$294.95

TOSHIBA
301.....$329.95
311.....$369.95

SANYO PR-3000A
DAISY WHEEL.....$59.95
HP DESKJET.....$599
HP DESKJET PLUS.....$689
HP PAINTJET.....$1029

LASER PRINTERS
HP LASERJET SERIES II
hp $1629

1MB EXPANDER.....$299
2MB EXPANDER FOR LASERJET II.....$499
HP LASERJET IID.....$2799
PANASONIC KXP-4450.....$1349
BROTHER HL-8E.....$1859

MONITORS
MAGNAVOX EGA.....$319
w/EGA Card.....$449
MAGNAVOX VGA.....$349
w/VGA Card.....$539
ZENITH 1490.....$629
NEC MULTISYNC IIA.....$509
NEC MULTISYNC IIID.....$619
PARADISE VIDEO CARDS.....IN STOCK!

NEC POWERMATE 1
IBM AT COMPATIBLE
• 80286 Microprocessor • 10 Mhz. • 640K RAM Expandable to 10.6MB • 1.2MB Floppy Drive • Serial & Parallel Ports • MS DOS 3.3 & GW Basic **$999**

SAME w/SEAGATE 20MB HARD DRIVE.....$1249
SAME w/SEAGATE 30MB HARD DRIVE.....$1279
SAME w/SEAGATE 40MB HARD DRIVE.....$1349

NEC POWERMATE 1+
IBM AT COMPATIBLE
• 640K RAM Expandable to 16MB • Zero Wait State • 8-12 MHz. • 1.2MB Floppy Drive • Serial & Parallel Ports • MS DOS 3.3 GW Basic • 80286 Processor **$1149**

SAME w/SEAGATE 20MB HARD DRIVE.....$1399
SAME w/SEAGATE 30MB HARD DRIVE.....$1439
SAME w/SEAGATE 40MB HARD DRIVE.....$1499

NEC POWERMATE 386 SX
• 80386 SX Microprocessor • 2MB RAM • 16 MHz. • 1.2MB Floppy Drive • Windows 386 • Serial & Parallel Ports • MS DOS 3.3 **$1769**

NEC POWERMATE 386SX w/NEC 42MB.....$2299
NEC POWERMATE 386/20 w/42 MB.....$3599

VENDEX HEADSTART III
• 8-12 MHz. • 1MB RAM • 5.25" 1.2MB Floppy Drive • 3.5" 1.44MB Floppy • 30MB Hard Drive • VGA/EGA/CGA/MDA Included • Serial & Parallel Ports • Mouse • MS DOS 3.3 **$2299**
$1000 SOFTWARE INCLUDED

IBM XT
• 256K RAM Expandable to 640K • 360K Disk Drive **$699**

IBM XT w/TWO FLOPPIES.....$799
IBM XT w/1 FLOPPY & SEAGATE 20MB H.D.....$949

IBM PERSONAL SYSTEM 2
ALL MODELS IN STOCK.....CALL
5.25" 360K EXTERNAL DRIVE for IBM PS/II-30.....$129
PACIFIC RIM 5.25" 1.2MB EXTERNAL DRIVE for IBM PS/II 50/60/70/80.....$259

HYUNDAI MODEL 286E
•640K RAM Expandable to 1MB • 80286 Microprocessor • 12 MHz. • 1.2MB Floppy Drive • Serial & Parallel Ports • MS DOS 3.3 • GW Basic **$899**

SAME w/SEAGATE 20MB HARD DRIVE.....$1149
SAME w/SEAGATE 30MB HARD DRIVE.....$1179
SAME w/SEAGATE 40MB HARD DRIVE.....$1249

EVEREX STEP 386 IS $1799
•386 SX Microprocessor • 16MHz. •1MB RAM • 1.2MB Floppy Drive

EVEREX 386/20 MHz w/1MB.....$2999
EVEREX 386/20MHz. w/4MB.....$3899
EVEREX 386/25 MHz.....$3499

apple IIGS COMPUTER PKG.
•Apple IIGS Computer • 512K Upgrade •RGB Color Monitor • 3.5" Disk Drive **$1299**

IMAGEWRITER II PRINTER.....$439
ALL OTHER APPLE MODELS.....CALL

COMPAQ DESKPRO 286
•640K Expandable to 2.1MB • 8-12MHz. •80286 Microprocessor • 1.2MB Floppy Drive • Serial/Parallel Ports **$1629**

SAME PKG. w/SEAGATE 20MB.....$1879
SAME PKG. w/SEAGATE 30MB.....$1919
SAME PKG. w/SEAGATE 40MB.....$1979

COMPAQ 286e $1849

DESKPRO 386S
•80386 SX Microprocessor • 1MB RAM Expandable to 13MB • Serial/Parallel Ports •16 MHz. • 1.2 MB Floppy Drive **$2399**

COMPAQ 386/33 W/84MB $7499

DESKPRO 386-20e
•80386 SX Microprocessor • 1MB RAM Expandable to 16MB • Serial/Parallel Ports • 20 MHz. • 1.2 MB Floppy Drive **$3699**

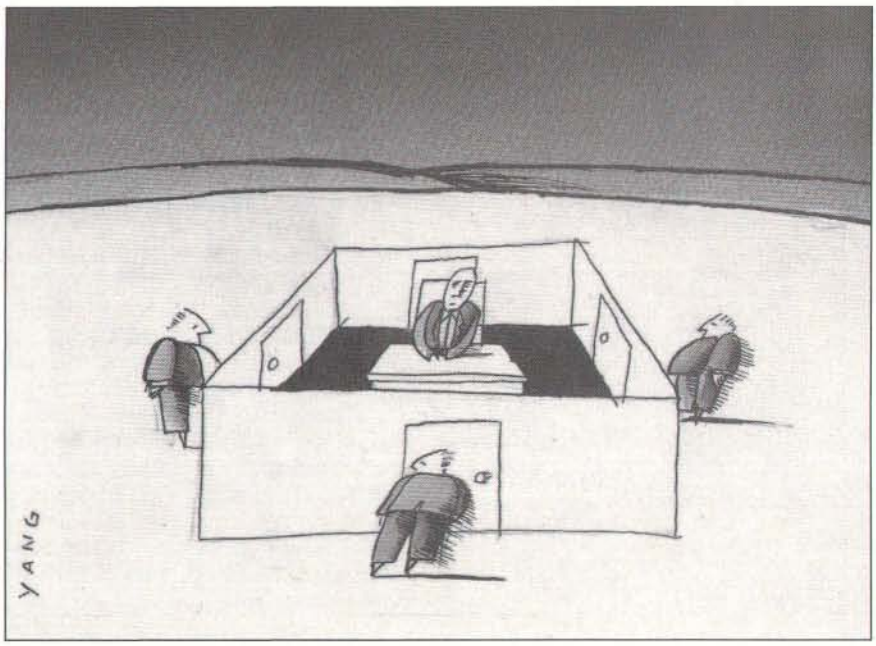
CUSTOM CONFIGURATIONS AVAILABLE FOR ALL COMPUTERS

RUSH SERVICE AVAILABLE. CALL FOR DETAILS.

Certified Check,Bank Check, Money Orders, Approved P.O.s, Visa , Mastercard, Am-Ex, Diner's Club, Carte Blanche, & C.O.D.s accepted. Please call before submitting P.Os. No additional surcharge for Credit Card orders. Non-certified checks must wait 4-6 weeks for clearance. N.Y. residents add applicable sales tax. Prices and availability subject to change without notice. Not responsible for typographical errors. Return of defective merchandise must have prior return authorization number or returns will not be accepted. IBM XT AT are registered trademarks of International Business Machines Corp. Please add 5% shipping & handling. Volume orders over $2000 are discounted to 3% shipping and handling. APO FPO orders please add 10% shipping and handling. All APO FPO orders are shipped first class priority air. All orders can be shipped Air Express. Call for details. DCA #800233

THE ROOT TO HAPPINESS

Having installed Unix, you can assign privileges and get down to working with the printer



In the last issue, I discussed some of the pros and cons of running Unix on a personal computer. I also outlined a brief scenario of installing Unix co-resident with DOS, using SCO Xenix as a practical example. In this and the next few columns, I'll go over some specific commands and procedures that you might find useful when setting up your system. Since I assume you have access to Unix manuals, I won't go into specific details of all standard Unix commands.

Getting Started

Once you have installed the Unix or Xenix system, you will find that you are running your system as the system administrator, with full *superuser* (also known as *root*) privileges. At this level, you can do essentially anything you want on the system, from running backups to reading other people's mail.

The system administrator has great power. As with any power, a certain amount of responsibility is needed, if for no other reason than because careless use of root privileges can wipe out an entire system in seconds. So you should get into the habit of logging in as root only when necessary to perform superuser functions, and then logging off. (Most of the procedures in these early columns will require you to use root privileges.)

Needless to say, you should carefully protect the root password, because anybody who discovers it can have free access to your system. But you should not protect it so well that you yourself forget it. Write it down in a safe place.

Much of the worry about needing root privileges can be negated by using one of the system-administration utility packages provided on many systems. On SCO Xenix, for instance, there is a good package called `sysadmsh`, which is a full-screen menu-based utility. (The `sysadm` log-in uses this shell exclusively.) In the long run, it pays to learn the details of the administration commands without the menu. Such knowledge allows you not only to get the most out of your system, but also to be able to use it on other versions of Unix, should you need to. While most versions of Unix are administered in the same general way, the menu systems are guaranteed to be entirely different. The selections in administration menus on different systems may have very different results than those you expect.

Adding Users

If the entire system is used only by you, there's no law that says you can't log in as root all the time, since that's essentially what you're always doing on a single-user system like DOS or the Mac. This method does make administration easier. Otherwise, the first thing you will probably want to do is give yourself log-in permission. But adding new users is a superuser function; you must be root.

The process of manually adding a user to the system is not really hard, but even experienced Unix system administrators prefer to use an automated process since there are many options and, therefore, many things to forget. Done by hand, you would have to add an entry to the `/etc/passwd` file containing the new user's log-in name, user ID number, group ID number, home directory, and log-in shell. If the user ID or log-in name matches anyone else's on the system, there will be problems, so these must be checked. The `/etc/group` file should be updated with the new user's real name. An initial password must be selected, and a home

continued

ILLUSTRATION: JAMES YANG © 1989

Circle 30 on Reader Service Card

TPU for UNIX and DOS.

Introducing nu/TPU from a/Soft.

nu/TPU gives you one hundred powerful TPU subroutines for faster and easier UNIX and DOS applications development. EVE, EDT, and VI interfaces are all included plus multiple windows, its own programming language, and unlimited extensions. You can import your customized VAX TPU programs to your UNIX or DOS system without change. nu/TPU comes with one year of free hotline support, 30 day money-back guarantee, free TPU library exchange, our technical bulletin board for news, interface code samples, and our TPU open forum. Call us for more technical details.

(508) 683-4369

a/Soft

a/Soft Development, Inc.
1353 Salem Street
North Andover, MA 01845

nu/TPU is a trademark of a/Soft Development. VAX is a trademark of Digital Equipment Corporation. UNIX is a trademark of AT&T. MS-DOS is a trademark of Microsoft.

directory and mail file created and set to appropriate access permissions. Finally, a copy of your system's standard user `.profile` or `.cshrc` file should be placed in the new user's home directory and suitably modified, if necessary, for that user's terminal type. It's better to use the program to be sure all this is done. Many systems have a program called `mkuser`, `newuser`, or `adduser`, or a selection in the administration menu for this task.

The Joys of Printing

A Unix system with a dedicated printer is a joy to work with. You simply plug in the cable and copy a file to `/dev/lp`, and you're on your way. (On some systems the printer port may be called `/dev/lp0`, on others, `/dev/lp1`.) Want to do background printing? Just make your copy in background with a command like this:

```
cp filename /dev/lp &
```

(The & specifies that this is a background task.) Nothing could be easier. And although Unix has a wonderful line-printer spooling system, it can be annoying to set up and run, so I recommend that you leave well enough alone for starters (on small, single-user systems, at least). Once you start adding other users and processes that have to access your single printer, you can learn to run the spooler. Meanwhile, at least you'll have hard-copy output. Systems like SCO Xenix, with its `mkdev lp` script, greatly simplify spooler setup.

Serial printers are trickier, since the serial ports on a Unix system are usually set up for terminal log-ins, not printers. The trick here is knowing the default baud rate of a serial line, which in many cases is 9600 bps. Therefore, the first steps to take are: Set the printer to 9600 bps and disable the log-in on its port.

With SCO Xenix, to disable the log-in, you can simply type `disable tty2a`. Regular Unix is a bit more complicated; you have to edit the `/etc/inittab` file. A typical entry might contain the line

```
2a:2:respawn:/etc/getty
   tty2a 9600
```

and you want to change the word `respawn` (which means that a log-in process will be continally generated for that line) to `off`. The final step is to run the command `init q`, which forces the `inittab` to be reread, activating your new entry (and deactivating the port for log-ins).

Try directing a copy of a text file to the serial port (using `cat /etc/passwd > /dev/tty2a`), and see what happens. A printout of the password file means you got it on the first try. Garbled nonsense output, even a single character, is a good sign because it means that some data is getting to the printer but the baud rate on the printer doesn't match the port.

No output could mean that you are addressing the wrong port or that the transmit and receive pins (pins 2 and 3 on a regular 25-pin RS-232C connector) are switched. The best method of diagnosing this is with a through connector with LEDs that show data flow. If your computer is an AT compatible, you might try the port under DOS to make sure that the hardware, at least, is physically working.

A Unix system with a dedicated printer is a joy to work with.

Baud Rate Blues

If your printer won't work when set to 9600 bps, you may have to force the printer port to 9600 bps or whatever your printer will accept. You have to create a small shell driver program that accepts a filename or standard input. While the program is active, it changes the port's baud setting; that is just what you want:

```
stty 4800 ixon -ixany ixoff  \
  -parity -echo clocal  \
  opost -tabs </dev/tty2a  \
  2>/dev/null
cat -
```

Everything after the baud rate is part of the set of options to the `stty` command. The three `ix` options ensure that the standard XON/XOFF protocol will be followed (your printer should be set up to match), `-parity` turns off parity encoding, and the other options tend to work well on printers. You must redirect the `stty` command *from* the device; this forces the settings to be in effect for that device, rather than for your current terminal port. Use this driver program by piping standard input to it, and then redirecting the output to your printer port:

```
cat /etc/group | drive_prog > \
   /dev/tty2a
```

Creeping Featurism

You can make the whole thing a bit neater by wrapping all this in a one-line shell program. If your printer is an Epson, call the program epson:

```
cat $* | drive_prog > /dev/tty2a
```

Now simply typing `epson filename` will print that file on your Epson printer. You can make things fancier by adding the `pr` command to the `epson` program to format the output into pages, create another command with the `pr` command built in, or use `getopt` to add capabilities to `epson`. This is how you begin customizing your system. (It's also the beginning of creeping featurism.)

Final Note

For regular users—not just root—to execute the programs `drive_prog` and `epson`, both must be marked as readable and executable, and placed in the default search path of the standard shell. As a regular user, if you type the one-line command `echo $PATH`, you will see a list of directories that the shell searches for executable files (minimally, the list generally contains `/bin` and `/usr/bin`). If you find the programs useful, type the following lines as superuser and then log out and back in as yourself to make them part of your system's repertoire:

```
chmod u=rwx,g=rx,o=rx  \
 drive_prog epson
cp drive_prog epson /usr/bin
```

The first line lets regular users use (but not modify) the two files. The `chmod` command must operate on three sets of permission bits, so its syntax can get complex. You could also write the same command as chmod 755 filenames; this does the same thing but operates directly in octal notation. The second line simply copies your programs to the system `/usr/bin` directory. To be safe, do an `ls /usr/bin` before typing the `cp` command, to make sure there are no programs of the same name already there.

In the next issue, I'll discuss modifying the search path so it will be in effect automatically for all system users. ■

David Fiedler is editor and publisher of the Unix newsletters Unique *and* Root *and coauthor of the book* Unix System Administration. *He can be reached on BIX as "fiedler."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Circle 138 on Reader Service Card (DEALERS: 139)

DISC DRIVE REPAIR SPECIAL

Formatted Cap.	Flat Rate	SPECIAL
10-19 mb	$99	89.10
20-29 mb	$125	112.50
30-39 mb	$150	135.00
40-49 mb	$175	157.50
50-85 mb	$210	189.00
86-120 mb	$275	247.50
121-150 mb	$325	292.50
151-275 mb	$425	382.50
276-380 mb	$495	445.50

TEST & EVALUATION $25

SHIPPING YOUR DRIVE FOR REPAIR
Pack your drive carefully and fully protected in a sturdy shipping box. Include your name, address and daytime telephone number. Allow $9 for shipping per drive.
WE DO DATA RECOVERY
CALL FOR QUOTE
FLOPPY 5 1/4" REPAIR $45
VALID THROUGH 11/30/89

DISC DRIVES LIQUIDATION

XT/AT FLOPPY DRIVES

3 1/2"	720k	NEW	$105
3 1/2"	1.44mb	NEW	115
5 1/4"	360k	REF.	49
5 1/4"	720k	REF.	59
5 1/4"	1.2mb	REF.	89

KITS FOR IBM AT & COMPATIBLES

84 MB	ST506	$695
147 MB	ESDI	1395
230 MB	ESDI	1695
320 MB	ESDI	1995

XT/AT HARD DRIVES

5 MB	REF.	$75
10 MB	UNU.	105
20 MB	REF.	159
30 MB	REF.	239
42 MB	UNU.	295
72 MB	REF.	595
120 MB	NEW	1295

SCSI HARD DRIVES

20 MB	$225	85 MB	$995
42 MB	295	147 MB	1495

THOUSANDS OF DISC DRIVES IN STOCK
We Feature Technical Support for Everything We Sell
We Specialize in Disc Drives — Ask for Our Brochure

jb TECHNOLOGIES, INC.
21011 Itasca St., #F Chatsworth, CA 91311
TEL 818 • 709 • 6400
FAX 818 • 314 • 2935
TELEX 678953

UTAH COBOL™

VERSION 5.0

$69.95

Plus $4.00 Shipping

Best Buy OF THE YEAR

For IBM® PC's, XT's, AT's and other DOS machines. Needs only 1 disk drive and 128K memory. This is the one you've heard so much about - with fast compile times, small object code modules, not copy protected, no royalties, and clear error messages. Version 5.0 is based upon ANSI-74 standards with new dynamite features including:

- Nested IF's and nested conditions.
- Indexed files (ISAM) with up to 24 keys (includes START verb). This advanced feature requires the software package Btrieve® which is optionally available.
- ACCEPT (line, column) numerics with decimal point alignment, numeric checking, AUTO-SKIP, SECURITY, LENGTH-CHECK, EMPTY-CHECK, ATTRIBUTE (color), FROM ESCAPE KEY, DAY, DATE, TIME, DAY-OF-WEEK.
- Fast memory mapped DISPLAY's (line, column) ERASE, BEEP, ATTRIBUTE (color). Can display entire screen with one DISPLAY statement.
- Windowing, pop-ups, color and overlays. This advanced feature requires the software package Saywhat?!™ which is optionally available.
- An easy to use, COBOL source code EDITOR with auto line numbering, A-margin, B-margin tabing with full screen cursor control.

Also available: Utah **SuperSort®**, a fast sort program callable from Utah COBOL; Utah **FORTRAN**; Utah **BASIC**; Utah **PASCAL**; Utah **PILOT**. Used by 50,000 professionals, students and teachers in 40 countries. 30-day money back guarantee. Discover the ease and simplicity of COBOL, today!

Phone order rushed by UPS 2nd Day Air:
(702) 827-3030

MasterCard VISA

Since 1977
Ellis Computing, Inc.
5655 Riggins Court, Suite 10
Reno, Nevada 89502

IBM is a registered trademark of International Business Machines, Inc. Btrieve is a registered trademark of Novell, Inc. Saywhat?! is a trademark of The Research Group. SuperSort is a registered trademark of Micropro International Corporation. Utah COBOL is a trademark of Ellis Computing, Inc. © 1987 Ellis Computing, Inc.

Circle 95 on Reader Service Card

You could buy a new

DELL SYSTEM 210 with

512K of RAM

20 Mbyte Hard Drive

12.5 MHz Processor Speed

$1699.00

OR Northgate's™ New 212

Microstation™ with...

1 Full Megabyte RAM
100% GREATER!

32 Mbyte Hard Drive
50% LARGER!

12 MHz Processor Speed

$1699.00

How can Northgate afford to offer a 286/12 with 32MB hard drive and one full megabyte of RAM when Dell's newest Series 210 system, for the same money doesn't match up?

Maybe it's the high cost of color advertising. We use two colors and pass the savings on to our customers. Would you rather get more computer for the money...or be entertained with color pictures?

Here's a fresh idea... Make Northgate and Dell's money-back guarantee program meaningful: Order from both companies.

30 days later send back the loser.
Or keep life simple and place your order with Northgate. Odds are it's the one you'll keep anyway.

NORTHGATE COMPUTER SYSTEMS

"We hear you!"

Northgate Computer Systems, Inc.
13705 First Avenue North
Plymouth, Minnesota 55441

Phone Northgate for full details and pricing

800-548-1993

Canada Toll Free Order Hotline: 800-338-8383

VISA MasterCard TeleCheck

FINANCING: Use the Northgate "Big N" revolving credit card instead of tying up Visa or MC credit. Millions in financing available, easy to qualify. OR...Lease Northgate with up to five-year terms. Ideal when cash flow is important. Phone for details.

BUYER'S SCORE SHEET.
Read the Specs. Check the Leader.
Total the winning checks and make your decision.

Standard Features	DELL	✓	NORTHGATE	✓
Processor	12.5 MHz 80286		12 MHz 80286	
Memory	512K		One Megabyte	
Video Interface	16 Bit Built-In (Factory Fixable) Only		16 Bit Add-on (On-Site Fixable)	
Display	12" VGA Mono .31 DP		12" VGA Mono .31 DP	
Floppy Drive	One - 1.2 or 1.44		None - 1.2 or 1.44	
Std. Hard Drive Capacity	20 Mbyte		32 Mbyte RLL	
Hard Drive Type	IDE Built-In		Can use - RLL, MFM, IDE, ESDI	
I/O Capabilities	2 Ser., 1 PP		2 Ser., 1 PP	
Keyboard	"Mushy Touch" 101		Famous OmniKey/102	
Software	Diagnostic		On-Line Help, MS-DOS	
Space Saver Case	15"W, 15"L, 4"H		14.5"W, 16.5"L, 5.5"H	
Moneyback Period	30 Days		30 Days	
Warranty	1 Yr. Parts & Labor		1 Yr. Parts & Labor	
Phone Tech Support	Unlimited, Toll Free		Unlimited, Toll Free	
Hours Open - Sales	Standard Daytime, Eve		24 Hrs. All Day Every Day - Effective 9/1/89	
Hours Open - Tech	Standard Daytime, Eve		24 Hrs. All Day Every Day - Effective 9/1/89	
Total	**$1,699**		**$1,699**	
SCORE	**DELL**		**NORTHGATE**	

And the winner is...

Call NOW!

Northgate, 212 Microstation, and OMNIKEY/102 are registered trademarks of Northgate Computer Systems, Inc. ©1989.

©1989. Northgate, OMNIKEY/102, OmniKey PLUS, and the Northgate 'N' logo are trademarks of Northgate Computer Systems, Inc. All other product and brand names are trademarks and registered trademarks of their respective companies.

Prices and specifications are subject to change without notice. Northgate reserves the right to substitute components of equal or greater quality or performance. All items subject to availability.

Northgate offers flexible purchase plans including a lease program to fit your individual financing needs.

P.S. Ask about OmniKey PLUS, the new Northgate Keyboard designed the way you want!

Hot 386/20 MHz System

Scorching 386/20 MHz Price

$2599.00

COMPLETE SYSTEM: 20MHz Processor; 65MB Hard Drive; 800,000 KBS Data Transfer; 1MB RAM (Expandable to 16MB); 1.2 and 1.44 high density floppy drives; 14" Monitor; Herc. Compat. Card; MS-DOS 4.01; Full Size Desktop Case with 5 drive bays; OmniKey Keyboard; 1-Year parts/labor warranty; Replacement parts express overnight at our expense or At-Your-Office next day onsite service, one year at no extra cost. THE BEST PHONE TECH SUPPORT IN THE COMPUTER BUSINESS. Toll free, unlimited.

NOTE: Pipeline Page Mode system architecture is preferred in many applications to cache design. It is faster than all but the largest cache systems in certain applications requiring substantial memory calls.

***Buyers Beware!* Northgate charges credit card sales only when system is in the shipping process. Others use your money by charging cards at time of sale. We recommend you be aware of this when considering your vendor.

When you want to know all about a computer system ... Ask Dr. Jerry Pournelle.*

Put a machine in Pournelle's workshop. He'll soon tell you everything you want to know about it with no punches pulled.

Recently, Dr. Pournelle looked at Northgate's 80386 Pipeline Page Mode system and reported in BYTE July, 1989 (excerpted):

*Jerry Pournelle holds a doctorate in psychology and is a writer who also earns a comfortable living writing about computers present and future.

"... the case is sturdy, and the motherboard construction is clean and neat. The boards are thick; I've seen some clones with boards so thin they wave in the breeze."

"... I like this machine a lot."

"... The workmanship is superior."

"... there sure wasn't any installation required for this system. I just turned it on, and it came up in MS-DOS 4.01."

[a software program] ... "which is all graphics is almost twice as fast on the Northgate 80386 as on my other machines. So is Windows ..."

"... I rate the Northgate 80386 as better than good enough on CPU and disk speed and wow! on video speed."

"... I have reports from other people who have Northgate computers, and they're happy."

"... All in all, the Northgate 80386 looks like one of the best deals in town."

Sudden Service: We Ship All Orders for 386/20 Systems within 4 days!**

"We hear you!"

800-548-1993

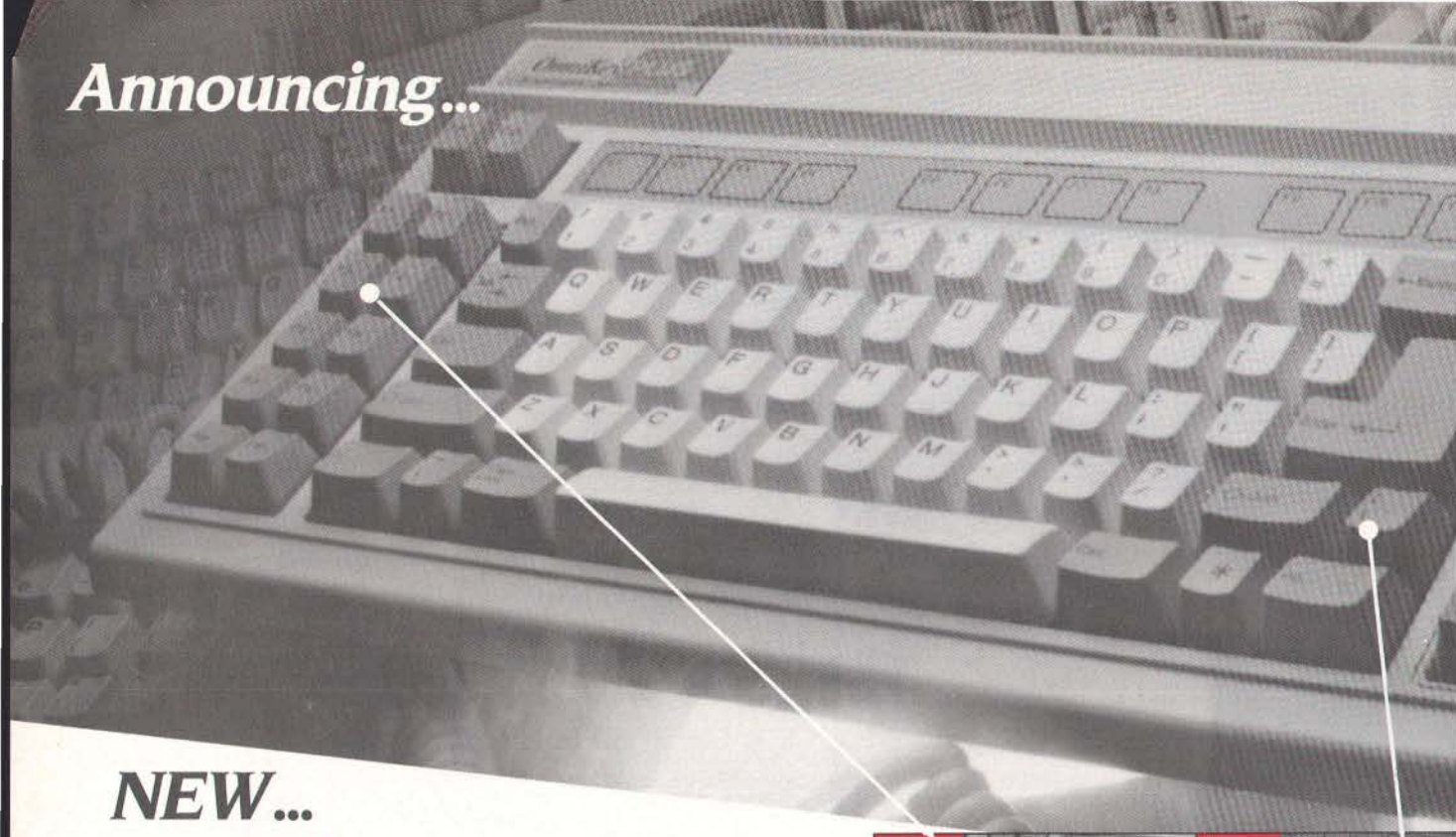
NORTHGATE COMPUTER SYSTEMS, INC.
13705 First Avenue North, Plymouth, Minnesota 55441

Canada Toll Free Order Hotline: 800-338-8383

HOURS: Monday - Friday 7 a.m. - 8 p.m. Central
NEW EXTENDED SAT. HOURS: 8 a.m. - 4 p.m. Central

FINANCING: Use the Northgate "Big N" revolving credit card instead of tying up Visa or MC credit. Millions in financing available, easy to qualify. OR...Lease Northgate with up to five-year terms. Ideal when cash flow is important. Phone for details.

©1989. Northgate, OMNIKEY/102, OmniKey PLUS, and the Northgate 'N' logo are trademarks of Northgate Computer Systems, Inc. All other product and brand names are trademarks and registered trademarks of their respective companies.



Announcing...

NEW...

Northgate OmniKey/PLUS™

The keyboard you asked us to design!

Thousands of you asked us to make a keyboard designed the way you want, not what IBM and all their keyboard clones force on you.

Now . . . discover OmniKey/PLUS!

As are all our keyboards, Northgate's engineers designed this gem from the ground up. It's not a PacRim economy job anyone can buy. IT'S EXCLUSIVELY NORTHGATE.

One look, one touch tells you this is the best in keyboard design, in quality, in all its many features so you can type faster, confident all the keys are where you want them.

Now! Two separate keypads. Cursor arrows in logical, comfortable array—*gone is the ill-conceived "inverted T."* And the backslash key is placed "just right." See detail panels.

Will you prefer OmniKey/PLUS enough to discard your current keyboard? Take ten days to make up your mind. If not, return for full product cost refund.

Quantities may be limited so call or send your order today.

F KEYS ON THE LEFT...
12 easy to reach, programmable F Keys where they belong and where your fingers expect to find them instinctively.

CONVENIENCE CLUSTER ...
Large Backspace Key, hard to miss; L shaped Enter Key; Ba slash next to Shift; Unshifted Asterisk Key—a wonderful ad

LOOK! Just a few ne

- Alps Click/Tactile Key Switches
- Dip Switch compatible with nearly any IBM PC type system—PS/2, Zenith, Compaq, Dell, Tandy, AT&T
- OmniKey/PLUS weighs 5.5 lbs., made to stay put on your desk
- Cable plugs into back of keyboard
- Low Profile Elegant Styling!

Introductory Limited Time Price

$119.00

PATENTS PENDING

For Dealer and Distributor Program Pricing, Phone Keyboard Dept. at 612-553-0734.

- Compatible with virtually every IBM type computer in the world!
- Ten-day trial return for unquestioned full refund
- Three-year unconditional warranty, any cause, we will repair or replace.

RSOR/SCREEN KEYPAD ...
th arrows in familiar diamond
tern. No need to hit Num
ck or hold down Shift Key.
d we "nuked" the inverted T.

NUMERIC KEYPAD ...
With all the math operands in place around the numbers. Large INS, DEL and ENTER Keys. Has lighted indicators above pad.

eatures of OmniKey/PLUS.

New OmniKey/102 Model Also Available . . . $99.00

For those who prefer Northgate's OmniKey/102, an up-dated version now joins our line. Same trial offer, same 3-year warranty.

Phone Toll Free

800-526-2446

HOURS: Mon.-Fri 7am-8pm, Sat. 8am-4pm Central

Canada Toll Free Order Hotline: 800-338-8383

NORTHGATE COMPUTER SYSTEMS

"We hear you!"

Northgate Computer Systems, Inc.
13705 First Avenue North
Plymouth, Minnesota 55441

©1989. Northgate, OMNIKEY/102, OmniKey PLUS, and the Northgate 'N' logo are trademarks of Northgate Computer Systems, Inc. All other product and brand names are trademarks and registered trademarks of their respective companies.

Yes. Ship my OmniKey order(s). I understand I may use it for 10 days and if I wish, may return it for full product cost refund. I agree to pay for freight both ways.

Northgate will accept COD and purchase orders from credit-worthy buyers for quantities totalling $500.00 or greater. Dealer and distributors: for quantity prices phone our corporate headquarters 612-553-0734.

FAX orders to 612-553-1695.

SHIPPING: Allow 5 days for order processing before shipment. Thereafter, shipments can be:

- UPS Ground add $7.00 ea.; allow 2-3 weeks for delivery.
- Overnight Air add $25.00 ea.
- Second Day Air add $12.00 ea.

Northgate Computer Systems, Inc.
13705 First Avenue North, Plymouth, Minnesota 55441

Name _____

Company _____

Ship to (address) _____

City _____ State _____ Zip _____

Phone _____

Computer Brand & Type _____

Qty.	Item		Shipping	Total
	OmniKey/PLUS*	$119.00		
	OmniKey 102	$ 99.00		
	C/T 101	$ 99.00		
	TOTAL OR ORDER*	$		

*You must specify which cable you require—for additional cables add $25.00 ea.

Compatibility Notes: Please read before placing your order.

OmniKey/PLUS is made compatible through a combination of dip switch settings and the proper connecting cable. We must know the computer make and model you will be using with OmniKey/PLUS. Otherwise we cannot guarantee compatibility.

_____ Brand _____ Model (AT/XT)

Prepaid amount enclosed $ _____

Please charge to my: ☐ Visa ☐ MasterCard

Card No. _____ Expires _____

Signature of Cardholder _____

(My signature authorizes a charge to my account for the above merchandise prior to shipping to initiate processing of my order.)

Here's How Buyers Who Demand the World's Highest Performance and Quality... Order from Northgate™...

DIAL 800-548-1993

Canada 800-338-8383

You'll be connected to a Northgate Account Manager. In an instant, you'll know you're dealing with a professional. A highly trained individual who understands computers and more importantly, understands people like you.

You'll immediately feel confident. Your questions will receive intelligent, careful consideration. And you'll get the truth, not the baloney.

If you're strictly shopping for the lowest price without considering quality and performance, don't call. But if you want the most computer for your investment...a system that runs rings around the others...with the most meaningful warranty in the computer industry...*

CALL NORTHGATE TODAY!

Join the ranks of Fortune 500 corporations... colleges and universities... individuals...government agencies around the world.

HOURS: Monday through Friday 7 a.m. - 8 p.m. Central
NEW EXTENDED SATURDAY HOURS: 8 a.m. - 4 p.m. Central

NORTHGATE™ COMPUTER SYSTEMS

NORTHGATE COMPUTER SYSTEMS, INC.
13705 First Avenue North, Plymouth, Minnesota 55441

"We hear you!"

* If anything in your Northgate system goes down and disables your computer, Northgate guarantees to ship the proper replacement part OVERNIGHT AT OUR FREIGHT EXPENSE. You get a brand new part—be it the largest and most expensive hard drive to the smallest part—and it's shipped to you BEFORE YOU RETURN THE OFFENDING PART. Check our competition. In most cases, they must get the part back before you get a replacement. Often that's weeks. And you sit there, out of business until they get the old part repaired or replaced.

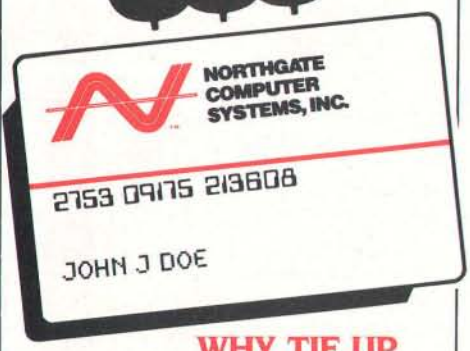
Northgate's phone tech crew is here to back you up. Unlimited phone help is available for as long as you own your Northgate. And for one year, you're protected with Northgate's Overnight Parts Replacement Warranty. If a system needs to come back for service, all parts and labor are FREE unless damage is caused by the end user.

Call Northgate™ Today!

Now Northgate Gives You Credit and No Payments Until 1990*

(Payments begin 90 days from the date your Northgate Computer System is delivered to you.)

Payments as low as $40/month**



WHY TIE UP YOUR OTHER CREDIT CARDS?

Use the Northgate, "Big N" credit card, and avoid the "payment crunch."

Simply fill out the "Big N" application, and send it in. Prompt approval assured!

Once you're approved, simply call our TOLL FREE number and one of our expert system consultants can help you design the Northgate System which will best suit your needs, and it will be shipped to you right away.

Best of all, there will be no payments due on your Northgate System for a full 90 days starting from the day you take delivery!

Northgate also offers flexible long term leasing plans too. You can choose the plan that will best fit your needs, with terms up to 5 years.

Phone Northgate Now!...

800-548-1993

HOURS: Monday - Friday 7 a.m. - 8 p.m. Central
NEW EXTENDED SAT. HOURS: 8 a.m. - 4 p.m. Central
Canada Toll Free Order Hotline: 800-338-8383

BIG 'N' REQUEST FOR CREDIT

NOTICE TO WISCONSIN APPLICANTS
You must disclose your marital status:
☐ married
☐ unmarried
☐ legally separated

A married person may apply for individual credit. I am applying for (please check appropriate box):
☐ **JOINT CREDIT** with another person. Complete entire application.
☐ **INDIVIDUAL CREDIT** but rely on income or assets of another person as a basis for repaying the credit requested. Complete entire application.
☐ **INDIVIDUAL CREDIT.** Complete sections "a" and "b" only.

Please complete all appropriate sections, providing at least two year's residence and employment history. This will enable your application to be processed as quickly as possible. If you are self-employed, please be sure to complete section "D" on back.

Applicants must be 18 years of age or older.

a. Your Personal Information

Requested Line of Credit $_____

Your Name: First Initial Last **Date of Birth:** Mo. Day Yr. **Social Security Number:**

Present Address Street Apt. # City State Zip **Home Phone** ( ) –

Date of Residence: Month Year **Monthly Payment: $** Buy ☐ Rent ☐ Other ☐

Previous Address: **Dates of Residence:** From To

Your Employer: (If self-employed, see rear panel.) **Date of Employment:** Mo. Yr. **Position:** **Monthly Income:** Gross $ Net $

Employer's Address: Street City State **Business Phone:** ( ) –

Previous Employer: **Address:** **Dates of Employment:** From To

Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation.

Other Income:

I have received since: (Date) Monthly Income: Gross $ Net $

Name and Address of Nearest Relative Not Living With You: Relationship

b. Credit Information

Include joint applicant's information, if joint account requested.

	Bank Name / Address		
Bank Account:		☐ Checking ☐ Savings	
Bank Account:		☐ Checking ☐ Savings	
		Payment	Balance
Bank Loan Reference:			
Bank Card Reference:	☐ VISA ☐ Mastercard		
Other Credit Card Reference			
Other Credit References:	Account No.: Expires:		
Driver's License No.	State: Expires:		

c. Joint Applicant's Personal Information

*If you are a married Wisconsin applicant, you must provide your spouse's information below, even though your spouse may not be signing this contract.

Joint Applicant's Name: First Initial Last **Date of Birth:** Mo. Day Yr. **Social Security Number:**

Address Street Apt. # City State Zip **Date of Residence:** Mo. Yr. **Home Phone** ( ) –

Employer: **Date of Employment:** Mo. Yr. **Position:** **Monthly Income:** Gross $ Net $

Employer's Address: Street City State **Business Phone:** ( ) –

d. Self-Employed Information

Complete this section only if you are self employed.

Business Name: ☐ Proprietorship ☐ Corporation ☐ Partnership

Business Address: Business Telephone: ( ) –

Description of Business: Your Position: In Business Since:

Your annual income from business: Business' annual income: (gross) (net)

You must provide at least one of the following:

1. Business Bank: Name Telephone: ( ) – Personal Banker's Name:
2. Accountant's Name: Telephone: ( ) –
3. **Financial statement on business attached.**

BY1089

Complete this application and mail to Northgate today!

*Interest will accrue during deferred period. 1.5% per month, 18% APR.

**Based on purchase price of $1,299.00 on the "Big N" revolving charge. Proces subject to change without notice. Offer not valid for APO or FPO customers.

©1989, Northgate. OMNIKEY/102, OmniKey PLUS, and the Northgate 'N' logo are trademarks of Northgate Computer Systems, Inc. All other product and brand names are trademarks and registered trademarks of their respective companies.

NORTHGATE COMPUTER SYSTEMS, INC.
13705 First Avenue North, Plymouth, Minnesota 55441

Compuclassics

IF YOU DON'T SEE YOUR PRODUCT LISTED PLEASE CALL US!

ABOVE SOFTWARE
Above Disk 52.00
ACCOLADE
Test Drive II 26.00
ADOBE
Illustrator/Windows 409.00
ALDUS
Pagemaker 479.00
ALPHA
Alpha/Four 319.00
AMERICAN SMALL BUSINESS
Design Cad 159.00
Design Cad 3D 209.00
APPLAUSE
Perfect Addition 39.00
APPLICATION TECHNIQUES
Pizazz Plus 69.00
ASHTON-TATE
DBase IV 485.00
Framework III 455.00
DBase III Plus 455.00
DBase IV LAN 649.00
Multimate Advantage II 295.00
ASK SAM
Ask Sam 4.2 179.00
AUTODESK
Autosketch 2.0 95.00
BANNER BLUE
Org Plus 52.00
BITSTREAM
Bitstream Fonts Call
BLOC PUBLISHING
FormFiller 2.0 85.00
BLAISE
Turbo C Tools 92.00
Turbo Power Tools Plus 92.00
BORLAND
Turbo C 99.00
Turbo Pascal 99.00
Turbo C Pro 169.00
Turbo Pascal Pro 169.00
Quattro 165.00
Sidekick Plus 135.00
Sprint 135.00
Paradox 479.00
BOURBAKI
1 Dir Plus 49.00
BRIDGEWAY
Fast Trax 35.00
BRIGHTBILL-ROBERTS
Hyperpad 65.00
BRODERBUND
Print Shop 39.00
Memory Mate 45.00
BUMBLEBEE
DB Fast/DOS Plus 145.00
BUTTONWARE
PC File DB 69.00
CALIFORNIA SCIENTIFIC
Brainmaker 79.00
CENTRAL POINT
PC Tools Deluxe 79.00
Copy II PC 24.00
CHRONOS
Who-What-When 115.00
CLARION
Professional Developer 409.00
COREL SYSTEMS
Corel Draw 1.1 345.00
COMPUTER ASSOCIATES
Supercalc V 305.00
Superproject Expert 449.00
CONCENTRIC DATA
R & R Report Writer 109.00
CORE
Corefast 69.00
CROSSTALK
Crosstalk Mark 4 145.00
Remote 2 115.00
DAC
Lucid 3D 60.00
DAC Easy Bonus Pack 115.00
DAC Easy Accounting 59.00
DATAEASE
Dataease 4.0 499.00
DATASTORM
Procomm Plus 55.00
DELRINA
Perform 172.00
DELTA TECHNOLOGY
Direct Access 55.00
DIGITAL RESEARCH
Gem Artline 285.00
Gem Presentation Team 285.00
DIGITALK
Smalltalk V286 139.00
DYNAMIC MICROPROCESSOR
PC Anywhere III 72.00
ELECTRONIC ARTS
Backup Pro 62.00
Twist and Shout 65.00
FIFTH GENERATION
Fastback Plus 109.00
FORMWORX
Formworx w/Fill & File 89.00
FOX
Foxbase Plus/LAN 295.00
FUNK
Sideways 42.00
Allways (1-2-3 or symphony) 85.00
GAZELLE
QDOS II 39.00
GENERIC
Generic CADD Level 3 169.00
GIBSON
Spinrite 49.00
GOLDEN BOW
V Cache 45.00
HAVENTREE
Interactive Easy Flow 109.00
HELIX
Headroom 79.00
IBM
DOS 4.01 125.00
Displaywrite IV 289.00
INDIVIDUAL
101 Macros For WordPerfect 45.00
INSET
Inset Plus 125.00
INSIGHT DEVELOPMENT
Laser Control 85.00
Print-A-Plot 105.00
INTUIT
Quicken 40.00
LASERGO
Go Script 139.00
Go Script Plus 269.00
LEARNING COMPANY
Reader Rabbit 25.00
LOTUS
Agenda 275.00
1-2-3 v 3.0 CALL
MATHSOFT
Mathcad 305.00
MECA
Managing Your Money 119.00
MERIDIAN
Carbon Copy Plus 109.00
MICROGRAFX
Windows Graph Plus 329.00
Designer 449.00
MICROLOGIC
Tornado 52.00
MICROLYTICS
Gofer 45.00
MICROPROSE
F19 Stealth Fighter 45.00
MICRORIM
RBase For DOS 489.00
MINDSCAPE
Balance of Power 1990 29.00
MULTISOFT
PC Kwik power pack 72.00
Super PC Kwik 49.00
MICROSOFT
Quickbasic 67.00
Quick C 67.00
Windows 286 67.00
Windows 386 135.00
Quickpascal 57.00
Macro Assembler 99.00
C Compiler 299.00
Word 209.00
Flight Simulator 35.00
MICROTEK
Spectrum 49.00
NANTUCKET
Clipper 439.00
NEW ENGLAND
Graph-In-The-Box 75.00
NOLO
Willmaker 35.00
NORTH EDGE
Timeslips III 169.00
NOVELL
Advanced Net 2.15 1850.00
ELS 4- user 419.00
OWL
Guide 169.00
PAPERBACK
VP Planner Plus 129.00
PATTON & PATTON
Flowcharting II Plus 139.00
PAUL MACE
Mace Utilities Gold 85.00
PEACHTREE
Cmplte Acctng W/Data Query 235.00
PERSOFT
Ize 259.00
Smarterm 240 205.00
PERSONICS
Ultravision 79.00
See More 1-2-3 49.00
PETER NORTON
Norton Utilities 59.00
Norton Commander 52.00
Norton Utilities Advanced 85.00
POLARIS
Packrat 259.00
PRECISION SOFTWARE
Superbase 4 409.00
PRIME SOLUTIONS
Disk Technician Advanced 115.00
PRIMETIME
Primetime 65.00
PROXIMITY TECHNOLOGY
Choice Words 59.00
PUBTECH
File Organizer 145.00
QUAID
Copywrite 59.00
QUALITAS
386 To The Max 55.00
386 To The Max Pro 95.00
QUARTERDECK
Desqview 79.00
QEMM 386 37.00
REFERENCE
Grammatik III 52.00
RIGHTSOFT
Rightwriter 52.00
RIX
Colorix VGA Paint 105.00
ROYKORE
Opus One 265.00
SAMNA
AMI Professional 319.00
SANTA CRUZ OPERATIONS
SCO Operating System 386 469.00
SCITOR
Project Scheduler 4 429.00
SIERRA ON-LINE
Leisure Suit Larry #2 32.00
Kings Quest IV 32.00
Space Quest III 39.00
SIMON & SCHUSTER
Typing Tutor IV 29.00
Webster Prof Thesaurus 75.00
SOFTKLONE
Mirror III 55.00
SOFTLOGIC
Disk Optimizer 45.00
SOFTWARE DIRECTIONS
Print Q 85.00
SOFTWARE MASTERS
Flash 49.00
SOFTWARE PUBLISHING
Harvard Graphics 279.00
PFS 1st Publisher 79.00
PFS 1st Choice 99.00
PFS 1st Graphics 89.00
Professional Write 139.00
SOLUTION SYSTEMS
Brief 165.00
SPECTRUM HOLOBYTE
Tetris 24.00
Falcon-AT 32.00
STSC
Statgraphics 569.00
STORAGE DIMENSIONS
Speedstor 35.00
SUBLOGIC
Jet 32.00
Scenery Disks CALL
SYMANTEC
Q & A 219.00
Timeline 369.00
Grandview 189.00
SYMSOFT
Hotshot Graphics 149.00
SYSTEMS COMPATIBILITY
Perfect Exchange 50.00
Software Bridge 85.00
THREE D GRAPHICS
Perspective Jr. 99.00
TIMEWORKS
Publish It! 115.00
TRAVELING SOFTWARE
Laplink III 85.00
Viewlink 85.00
TURBO POWER
Turbo BTree Filer 79.00
Turbo Professional 79.00
UNISON WORLD
Printmaster Plus 35.00
VERSASOFT
DB Man V 219.00
WHITE CRANE
Brooklyn Bridge 75.00
WOLFRAM RESEARCH
Mathematica 386 599.00
WORDPERFECT
Word Perfect 239.00
Word Perfect Library 65.00
Word Perfect Network 349.00
WORDSTAR
Wordstar Professional 5.5 239.00
WORDTECH
Quicksilver Diamond 349.00
DBXL Diamond 1.3 145.00
XEROX
Xerox Formbase 319.00
Ventura Publisher 499.00
Xerox Presents 309.00
XTREE
Xtree Pro 75.00
XOR
NFL Challenge 59.00
ZSOFT
Publishers Paintbrush 159.00
PC Paintbrush IV 59.00

HARDWARE

AST RESEARCH
5251/11 Enhanced Plus 599.00
Six Pack Plus 64k 129.00
ATI
VGA Wonder 256 335.00
BELKIN/DATASPEC
Cables/Switchboxes CALL
CENTRAL POINT
Copy II Option Deluxe 119.00
CURTIS
Ruby Plus 65.00
EVEREX
Internal 2400 Modem 149.00
Computers CALL
FIFTH GENERATION
Logical Connection 512k 579.00
HAYES
Smartmodem 2400 449.00
HEWLETT PACKARD
Font Cartridges/Soft Fonts CALL
INTEL
Above Board Plus 512k 449.00
Coprocessors CALL
KENSINGTON
Masterpiece Plus 109.00
LOGITECH
Scanman PC 199.00
New Logimouse89.00
MICROSOFT
Bus or Serial mouse w/paint 109.00
MICROSPEED
Fast Trap Serial 95.00
MOUSE SYSTEMS
Bus or Serial mouse II 89.00
NEC HOME
Multisync 3D 699.00
ORCHID
Pro Designer VGA Plus 409.00
PANASONIC
KXP 1124 Printer 365.00
PARADISE
VGA Plus 265.00
POLAROID
EGA Palette 2399.00
PLUS
Handcard 40 699.00
PRACTICAL PERIPHERALS
2400 External Modem 179.00
SEAGATE
Hard Disks CALL
SUMMAGRAPHICS
Summasketch Plus 12 x 12 399.00
SYSGEN
Bridge File w/adaptor 289.00
TOUCHBASE
Worldport 2400 Modem 255.00
Worldport 2496 Fax Modem 499.00
VIDEO 7
Vram VGA 256k 459.00

INTERNATIONAL ORDERS 818 • 347 • 2444

FAX YOUR ORDER! (818)347-9977

We ship to APO & FPO PO Boxes

WE WELCOME CORPORATE ACCOUNTS AND INTERNATIONAL ORDERS

➤ IMMEDIATE SHIPMENT ON PURCHASE ORDERS FROM GOVERNMENT AND STATE AGENCIES, CITIES, COUNTIES, SCHOOL AND UNIVERSITIES. ➤ Prices subject to change without notice and while stocks last. ➤ We Ship the latest versions. ➤ We accept Visa, Master card, American Express. ➤ 2% Surcharge on American Express. ➤ Please call (818) 347-9400 for an Authorization # for defective goods or your return will not be accepted. ➤ Due to copyright laws we cannot take back any software where the seal has been broken. ➤ $5 minimum shipping per item, less on bulk orders. ➤ $9 Blue Label shipping, $3.50 C.O.D charge. ➤ Heavier items are charged accordingly. ➤ We do not guarantee compatibility. ➤ Call for prices for any software item not included in this ad. ➤ Order desk open 7 a.m. to 5 p.m. (PST), Saturday 10 a.m. - 2 p.m. (PST). ➤ P.O. Box 10598,Canoga Park, CA 91309. Showroom: 7959 Deering Ave., Canoga Park, CA 91304 ➤ Customer Service 818 347 9400, General Office 347 7500

ORDERS CALL 800 733 3888

Circle 56 on Reader Service Card

A COMPENDIUM OF OS/2 APPLICATIONS

A new OS/2 application guide lists hundreds of programs

This month, I come to you from Milan, Italy. I'm here to teach a seminar on OS/2. I don't speak Italian, however, so the whole class is wired up like at the United Nations. After I speak, the participants dial a language to listen to, whether Italian or French or whatever. I've thought of taking my shoe off and banging it on the table to make a point, but I'm not sure the joke would be in good taste.

Last month, I talked to OS/2 applications developers. But where are the OS/2 applications? They are finally starting to appear. I recently received my copy of IBM and Microsoft's new edition of the *OS/2 Application Guide*. (You can get a free copy by calling (800) 426-2468, ext. 120.) The guide shows about 800 applications, roughly half of which are currently (as of June) shipping.

What does this tell us about OS/2 applications? Well, they're out there—and in places that you wouldn't expect. They include many industry-specific applications (more of those, in fact, than anything else), one being a $14,000 program that assists in designing microwave antennas. But OS/2 applications don't have to be expensive—one is under $18.

What Do They Do?

OS/2 applications are a pretty diverse lot.

There's a bunch of accounting programs—general ledger, accounts payable and receivable, inventory, payroll, order entry, and job costing. Accounting packages are not inexpensive—from $600 for the cheapest I could find (that's about 800,000 lira here in Milan) ranging up to a $2500 package that helps you track bad checks.

The business category yielded a few surprises. Recently, a researcher in Great Britain wrote to me looking for a large mass-storage device that works under OS/2. I'm an Iomega Bernoulli Box fan from way back, but unfortunately Iomega hasn't released the OS/2 drivers for the Bernoulli Box yet. (The company actually has the drivers finished; I understand there are some legal niceties to get out of the way before the drivers see the light of day.) So I had to tell the researcher to wait a little longer.

Advanced Graphic Applications has a better solution: Discus, a WORM (write once, read many times) controller board and drivers for OS/2. It's not cheap at $3600—and you have to add the WORM drive itself to the package—but the nearly limitless storage it provides could make it worthwhile for someone with truly large mass-storage needs.

Everyone knows about the weakness of the OS/2 print spooler, but I had no idea that someone had done something about the problem. Software Directions offers a "mainframe-style disk-based print spooler" (does that mean it requires lots of memory, needs a professional staff to maintain it, and you have to wait overnight for it to do anything?). It's called PrintQ and costs $199. It supports serial printers, too.

Asynchronous Renaissance

Asynchronous communications was once an important branch of PC software, and discussions of whether to go with PC-Talk, Crosstalk, or Smartcom were common at users group meetings. The market has pretty much settled down, with several packages each holding onto its share. But OS/2 was really made for communications. One of the best parts of using OS/2 is downloading BIX traffic in the background with Logicomm while working in the foreground on BRIEF. of these that I have mentioned Logicomm before, although it's not in IBM's guide.

continued

ILLUSTRATION: STEPHEN TURK © 1989

ITEMS DISCUSSED

BBS $80
MichTron, Inc.
576 South Telegraph Rd.
Pontiac, MI 48053
(313) 334-5700
Inquiry 981.

Discus $3600
Advanced Graphic Applications, Inc.
90 Fifth Ave., Sixth Floor
New York, NY 10011
(212) 337-4200
Inquiry 982.

HyperAccess/5 ..... $199
Hilgraeve, Inc.
Genesis Center, Suite A
111 Conant Ave.
Monroe, MI 48161
(313) 243-0576
Inquiry 983.

MsgVu $35
Dave Briccetti and Associates
P.O. Box 1713
Lafayette, CA 94549
(415) 945-7565
Inquiry 984.

PrintQ $199
Software Directions, Inc.
1572 Sussex Tpk.
Randolph, NJ 07869
(201) 584-8466
Inquiry 985.

Prolog $650
Arity Corp.
29 Domino Dr.
Concord, MA 01742
(508) 371-1234
Inquiry 986.

There is a new group of asynchronous programs, as the old masters haven't made an appearance yet.

For simple terminal emulation, file transfer, and general-purpose communications, there are ChipChat ($300), Hilgraeve's HyperAccess/5 ($199), and Professional YAM ($139). The only one of these that I have had a chance to try is HyperAccess. Matt Gray, president of Hilgraeve, is very convincing when he pitches the product. "We've been using OS/2 ideas like threads for years. We've implemented multitasking in our DOS version of HyperAccess, so porting to OS/2 was quite easy."

Gray says that in communications you spend a lot of time waiting. The Hilgraeve people implemented a block-oriented file transfer protocol that employs that waiting time to compress and decompress files on the fly. And it's pretty impressive. I consistently got 4000-bps throughput when using 2400-bps modems, even with the DOS version. As is the case with many companies, Hilgraeve ships both the DOS and OS/2 versions in a single package. This is a good idea in my opinion, at least for the time

continued

Simulators for Motorola Micros

The 2500 A.D. Software Simulators enable programs to be tested on the development system in a controlled environment. We offer simulators for the 6800, 6801, 6805, 6809 and 68c11, as well as for the Hitachi 6301 and Rockwell 6502. All simulators support the following features:

- Full screen symbolic debugging
- Break on address with pass count
- Full single stepping control
- Instruction undo capability
- File, printer and serial port output
- Expression evaluation capability
- Ram, Rom and Stack limit checking
- Break on register or memory value
- Subroutine step or execute control
- Interrupt simulation capability
- File and keyboard input
- Disassembly to screen or file

The Simulators are priced at $150.00 for MSDOS and Xenix, $500.00 for Ultrix. Also available are Macro Assemblers for the above parts, and C Compilers for the 6801, 6301, 6809 and 68c11.

To order call Toll Free:

1 800 843-8144

In Colorado: 1 719 395-8683
Fax: 1 719 395-8206
Telex: 752659/AD

2500ADSOFTWARE INC
109 Brookdale Avenue
P.O. Box 480
Buena Vista, CO 81211

Circle 10 on Reader Service Card

COMPUTER DISCOUNT WAREHOUSE™

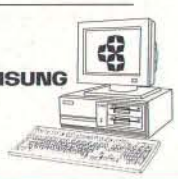
#1 CDW Sales · CDW Services/Support · CDW Product Knowledge · CDW On Time Delivery · CDW Frequent Buyers Program

S-330, 4.77/10 MHz, 640K, 6 Slots, Built-In CGA, DOS 3.3, Enhanced Keyboard
S-330, 1 Floppy $745.50
S-330, 20 Meg/40 Meg 994.95/1019.52

S-550 AT Compatible, 8/12 MHz, 8 Slots, 2S/P/C, Built-In EGA, DOS 3.3, S-550, 1.2M Floppy $1056.45
S-550, 20 Meg/40 Meg 1425.80/1499.45

S-800, 386 20 MHz, 8 Slots, 1 Mge, 1.2 & 720K Floppies $2093.69
S-800, 40 Meg/80 Meg 2498.01/2760.00

SAMSUNG



WHY PAY RETAIL?

CDW™ Sells For Less

AND **SERVICES** YOU BETTER

Emerson™

CDW™ LETS YOU BRING THE FAMOUS EMERSON EC800 BUSINESS MACHINE HOME

Comes Ready to Use with a 30 Meg Hard Drive Loaded with the Following Software: Menu Magic, Home Accountant, Sidekick/Turbo Basic, Window Word, Silk, EuroGroup Pub, Arrays, Borland Int'l. and Fontex

CDW™ price **$849.53**
Your Choice of Color or Mono Monitor.
ADD:$199.00 for Color, $84.10 for Mono

NOVELL

Entry-Level 286 Starter Kit, 4 Users ..$429.90
Entry-Level 286 Starter Kit, 8 Users ..899.89
NOVELL 286 Software, V. 2.15 ..... 1839.65
NOVELL SFT Netware V. 2.15 ..... 2986.60
NOVELL NETPRO 1120.50

NetWare®

HARDWARE, SOFTWARE & PERIPHERALS AT DISCOUNT PRICES

COMPUTERS

AST SPECIALS

MDL 80 ..... CALL CDW™ — MDL 390C ..... IN STOCK
MDL 140 ..... FOR ALL — MDL 3150C ... & READY
MDL 300C ..... AST — MDL 386/25 ..... TO SHIP
MDL 340C ..... PRICING — MDL 386/33 ..... CALL

WORKSTATIONS

AST 105X ..... ALL AST
AST 386SX Model 5 / Model 45 ..... WORKSTSTIONS
AST Bravo ..... IN STOCK
SAMSUNG PC TERMINAL/286 ..... $1054.60
EARTHSTATION V40 or 286, Arcnet or Ethernet ... CALL

PACKARD BELL

PB1000, 12 MHz ... $1219.70 — PB900, 12 MHz ... $1198.86
PB1000, 40 Meg ... $1614.61 — PB900, 16 MHz ... $1368.70

IBM PS/2

MDL 30, 20 Meg $1655.17 — MDL 55SX, 30 Meg $2899.59
MDL 60, 40 Meg ... 3340.15 — MDL 55SX, 60 Meg 3178.39
MDL 60, 70 Meg ... 3644.52 — MDL 70, 60 Meg ... 3747.20
MDL 30286, 1 Dr. 1412.10 — MDL 70, 121 Meg ... 5259.84
MDL 30286, 20 M 1929.50 — MDL 80, 40 Meg ... 4374.40
MDL 50Z, 30 Meg 2876.75 — MDL 80, 70 Meg ... 5069.37

COMPAQ

286, MDL 1 ... $1549.95 — 386, 25MHz, Mdl300 ... $3895.99
286E, MDL 1 ... 1899.50 — 386-20E, 40 Meg ... 4565.12
286E, MDL 20 ... 2172.45 — 386-20E, 100 Meg 5564.22
386E, MDL 40 ... 2453.41 — PORT. II, MDL 2 ... 1858.10
386, 20 MHz, 130 5718.33 — PORT. II, MDL 4 ... 2697.42
386, 25 MHz 60 ... 5683.90 — PORT. III, MDL 20 ... 3495.85
386S, MDL 1 ... 2324.49 — PORT. III, MDL 40 ... 3999.35
386S, MDL 20 ... 2783.12 — PORT. 386, MDL 40 .5426.24
386S, MDL 40 ... 3092.84 — PORT. 386 MDL 100 6689.74

TOSHIBA

T-1000 ..... $657.95 — T1600 ..... $3237.60
T1200, 2 Drive ... 1455.74 — T5100 ..... 4238.78
T1200, 20 Meg ... 1959.60 — T5200, 40 Meg ... 4943.82
T3100e ..... 2688.76 — T5200, 100 Meg ... 5375.50
T3200 ..... 3393.25 — CALL FOR ACCESSORIES

WYSE

MDL 2108 ..... $895.50 — MDL 2214 ..... $1921.30
MDL 2112 ..... 1271.20 — MDL 3216 ..... 2060.37

Zenith | data systems

Minisport ..... NEW!
Supersport 88, 2 Dr/20 Meg ..... CALL CDW™
Supersport 286, 20/40 Meg ..... FOR LOWEST
Turbosport 386, 40 Meg / ..... ZENITH
Turbosport 386, 40 Meg / w/modem ..... PRICING

DRIVES, TAPES & CARDS

FLOPPIES, DRIVES & TAPES

CONNER 40 Meg / 110 Meg ..... $445.29 / 995.80
GENOA 60 Meg Int. Tape / Ext. Tape ... 689.60 / 819.10
GENOA 150 Meg Int. Tape 1078.85
IOMEGA 20+20 External 8" 1658.92
IOMEGA B1441 ..... 998.65
IOMEGA B144X 1299.10
IOMEGA B244X 1990.25
IOMEGA B120X 992.80
IOMEGA B220X, External 5.25" 1619.40
IRWIN 20 M / 40 M Internal Tape ..... 399.10 / 539.20
MOUNTAIN 4440 Int. / Ext. ..... 385.80 / 557.75
MOUNTAIN 150M Filesafe 1398.39
PLUS Passport 20 / 40 ..... 479.10 / 579.88
PLUS 20 & 40 System Kit 489.75
PLUS PS/2 MC System Kit 585.58
PRIAM 40 Meg / 60 Meg ..... 669.55 / 749.95
SYSGEN 5.25" Ext. Floppy 225.25
WELTEC 5.25 External Floppy 207.77

MiniScribe

MIN-8425 ..... $239.40 — MIN-3085 ..... $729.40
MIN-8438 ..... 299.85 — MIN-6085 ..... 599.52
MIN-3053 ..... 599.95

Seagate

SEAGATE 20 Meg $265.58 — SEAGATE ST-251-0 $299.56
SEAGATE 30 Meg ... 279.32 — SEAGATE ST-251-1 ... 325.23
SEAGATE 4096 80 ... 559.95

STORAGE DIMENSION

150 Meg ..... $1899.80 — 320 Meg Internal ..$2317.88
320 Meg Subsystem 2995.72 — 520 Meg Internal 5852.97

HARD DRIVE CARDS

PLUS DEVELOPMENT 20 Meg $527.44
PLUS DEVELOPMENT 40 Meg 677.80
WESTERN DIGITAL 30 Meg 399.37

PRINTERS

EPSON

LX810 ..... CALL — LQ510 ..... ALL EPSON
LQ850 ..... CDW™ — LQ950 ..... MODELS
FX850 ..... FOR BEST — LQ1050 ..... READY
FX1050 ..... PRICE EVER — LQ2550 ..... TO SHIP
CDW™ stocks all cut sheet feeders and ribbons.

NEC

P2200 ..... $344.65 — P5300 ..... $685.63
P5200 ..... 509.12 — P960XL 1039.24

DICONIX by KODAK

150P /300 ..... $309.17 / 475.17

TOSHIBA

321SL ..... $468.95 — Expresswriter 311 ... $377.16
341SL ..... 592.84 — Expresswriter 301 ... 328.84
351SX ..... 949.95 — CALL FOR ACCESSORIES

brother

M-1724L ..... $579.64 — M-1709 ..... $384.47
HR20 ..... 340.60 — HR40 ..... 629.12

OKIDATA

ML 182 Turbo ..... $234.48 — ML 321 ..... $479.28
ML 172 ..... 199.95 — ML 390 ..... 475.96
ML 380 ..... NEW — ML 391 ..... 639.48
LASERLINE 6 ..... 1292.69 — ML 393 ..... 995.90
ML320 ..... 329.68 — ML 393 Color 1067.60

Panasonic

1124 ..... $339.18 — 1592 ..... $142.44
1595 ..... 453.45 — 3131 ..... 318.30
1180 ..... 193.95 — 1524 ..... 562.10
1191 ..... 232.12 — CALL FOR ACCESSORIES

LASER PRINTERS

BROTHER HL-8e $1799.90
H-P LaserJet Model 2 / IID ..... 1699.95 / 2744.95
H-P Deskjet 599.00
NEC LC890 ..... 3095.60
PACIFIC DATA 25 in 1 Cartridge 283.86
TOSHIBA Page Laser 12 ..... 2479.58

INTEL BOARDS & COPROCESSORS

INTEL Above Board Plus $410.68
INTEL Inboard 386/PC $569.53
INTEL Visual Edge 448.39
INTEL Connect Co-processor 712.43

MATH COPROCESSORS

INTEL 8087-2 ..... $149.90 — INTEL8087-3 ..... $112.20
INTEL 80287-6 ..... 137.30 — INTEL 80287-8 ..... 208.55
INTEL 80287-10 ..... 223.55 — INTEL 80387-16 ..... 389.60
INTEL 80387-20 ..... 390.65 — INTEL 80386-25 ..... 541.92
INTEL 80387-SX ..... 362.82 — INTEL 80387-33 ..... 575.20
INTEL 80C86-A 395.50

TERMINALS

WYSE 50/60 Amber or Green ..... $373.40 / $300.16
WYSE 85 / 30 Amber ..... 375.90 / 294.10
WYSE 99GT 394.82

PLOTTERS, DIGITIZERS & SCANNERS

CalComp

1023 ..... $3745.38 — 12 x 12 ..... $358.12
1043 ..... 6477.15 — 12 x 18 ..... 719.10
1044 ..... 9915.06 — 36 x 48 ..... 3236.15

HURTA

1212IS1 ..... $349.06 — 36 x 48 ..... $2891.53
12 x 17 ..... 499.35 — 4 Button Cursor 75.00

LOGITECH

Scanman PC ..... $168.89 — Scanman PS/2 ..... $225.50

Summagraphics

12 x 12 ..... $367.40 — 12 x 18 ..... $599.50

HEWLETT PACKARD

HP7440A $968.30
HP7475A 1389.89
HP7550 ..... 2926.56
HP7570 LOWEST PRICE
HP7576-EXL ..... CALL
HP SCANJET + ... 1049.66

HOUSTON INSTRUMENT

HI DMP-52 / DMP-52MP
HI DMP-56A
HI DMP-61
HI DMP-62
Image Maker

NOVELL NETWORKING

SOFTWARE STARTER KITS

Entry-Level 286 Starter Kit, 4 Users $429.90
Entry-Level 286 Starter Kit, 8 Users 899.89
NOVELL 286 Software V. 2.15 ..... 1839.65
NOVELL SFT Netware V. 2.15 ..... 2986.60
NOVELL NETPRO 1120.50

INTERFACE CARDS

3COM ETHERLINK $375.45
ARCNET PC110 LANboard PS/2 ..... 412.50
ARCNET PC130 LANboard 164.27
ARCNET PC130E LANboard 189.50
ARCNET SMC 16-Bit File Server Board 437.55
ARCNET SMC 16-Bit Workstation Board 359.25
ETHERNET Interface Connector (NE1000) 298.90
ETHERNET Plus Board (for 286) (NP600) 635.35
G-NET Interface Card w/Cable 298.52
NOVELL NE2000 ..... 394.15
THOMAS CONRAD 16 Port Hub 814.25
THOMAS CONRAD 8 Port Hub 378.65
Ethernet Terminators 39.50

Novell trained and authorized sales and support. See WORKSTATIONS under Computers.

MODEMS & COMMUNICATIONS

EVEREX 1200B / 2400B ..... $97.90 / 184.15
EVEREX 2400 Ext. / 2400 PS/2 ..... 199.80 / 205.45
INTEL 2400 Int. / 2400 Ext. ..... 149.75 / 176.94
PACKARD BELL 2400 Int. / 2400 Ext. ..... 169.95 / 199.22

HAYES

HAYES 1200 ..... $278.60 — 2400B $378.45
1200B ..... 269.20 — 2400PS2 ..... 387.15
2400 ..... 416.08 — Personal Modem 109.70

U.S.Robotics

Courier 1200 ..... $278.60 — 1200 External $129.10
Courier 2400 ..... 279.60 — 2400B 199.70
1200B ..... 108.45 — 9600 HST 645.20
Dual 9600 HST 978.65

MEGAHERTZ CORPORATION

2400 for ZENITH .. $167.10 — 1200 for COMPAQ SLT .. $259.80
2400 for NEC ..... 225.88 — 2400 for TOSHIBA ... 183.74

BATTERY BACKUP & SURGE

AMERICAN

AME-1200VX ..... $911.45 — AME-520ES $409.48
AME-330XT ..... 257.72 — AME-800RT 699.19
AME-450AT 395.82

DataShield

500 Watt ..... $555.05 — SS700+ $787.90
800 Watt ..... 628.56 — 1200 Watt 962.75
S100 ..... 59.55 — 6 Outlet Surge 27.85

Durant Technologies, Inc.

BPS-300 ..... $330.10 — BPS-550 ..... $499.85
BPS-500 ..... 465.11 — BPS-1200 ..... 710.65

tripp lite

BC-450 ..... $349.50 — 4 Outlet $44.25
BC-1200 ..... 649.55 — LC-1200 ..... 158.85
BC-2000 ..... 1179.80 — LC-1800 ..... 196.80

MISC. & ACCESSORIES

A-B Switching Box (Parallel or Serial) $39.95
BASF 5 Pack of 10 DS/DD w/Case 39.00
INTELLICOM Long Link 129.70
KENSINGTON Masterpiece 99.99
KENSINGTON Masterpiece Plus 123.40
KEYTRONICS 5151 IBM or AT&T 133.95
KEYTRONICS 101 ..... 94.95
5TH GEN Logical Connection 256K / 512K ... 447.72 / 514.36
Electronic 4-Way Switchbox 94.85
XT Power Supply 150 Watt 59.00

FAX MACHINES AND BOARDS

CompleteFax 9600 ... $399.50 — SHARP FO-220 ..... $854.48
Quadram JT-Fax 9600 ... 527.65 — SHARP FO-300 ..... 1199.10
Quadram JT-Fax Port ... 329.25 — SHARP FO-330 ..... 1085.7

SOFTWARE

WORDPERFECT 5.0 5.25" / 3.5" ..... $229.90 / 238.90
ASHTON TATE dBase III+ / dBase IV ..... 424.00 / 476.10
ASHTON TATE Multimate Advantage II 288.12
LOTUS 1-2-3 5/25" / 3.5" ..... 299.95 / 305.95
LOTUS 1-2-3 V.3 / LOTUS Networker ... 337.00 / 1592.20
BORLAND Paradox 3.0 ..... 439.17
BORLAND Quattro / Sidekick + ... 149.52 / 131.25
MICROSOFT Excel / Windows 386 ..... 252.50 / 129.05
MERIDIAN Carbon Copy 119.37
SYMANTEC Q&A 217.40
SOFTWARE PUB. Harvard Graphics 274.71
XEROX Ventura Software Version 2.0 ..... 479.00

MONO MONITORS & CARDS

CDW™ Color / Mono Cards w/P ..... $99.00 / 89.00
HERCULES™ Color / Mono Cards w/P .. 146.14 / 179.84
AT&T Monochrome Monitor 189.40
AMDEK 410A / 1280 ..... 149.99 / 679.78
COMPAQ Mono / VGA Mono ..... 177.00 / 209.95
IBM PS/2 8503 ..... 209.95
SAMSUNG Amber 84.10
NEC Monograph 1297.25
PGS MAX 12E / MAX 15 ..... 139.40 / 258.20
PACKARD BELL Green or Amber 89.95

COLOR GRAPHIC MONITORS

IBM PS/2 8512 ..... $449.40
IBM PS/2 8513 ..... 540.20
SAMSUNG RGB Color 199.00
MAGNAVOX 8762 ..... 259.05

VGA & EGA PRODUCTS

VGA & EGA MONITORS

COMPAQ VGA Monitor $548.68
MAGNAVOX 943EGA / 9CM062 ..... 365.40 / 372.52
MITSUBISHI 1409 / 1410 ..... 282.44 / 385.50
MITSUBISHI 1381 Diamond Scan 519.20
NEC Multisync II Plus 888.10
NEC Multisync XL 19-Inch 2080.40
NEC Multisync 2A / Multisync 3D ..... 499.85 / 695.85
PACKARD BELL 8541 VGA 319.20
PACKARD BELL 8524 Enhanced VGA 389.95
PACKARD BELL 8526 Multisync 477.40
PGS Ultrasync 12 ..... 493.33
PGS Ultrasync 14 / 16 ..... 519.66 / 887.77
SONY Multiscan 1302 / 1303 ..... 619.95 / 548.52
ZENITH Z-1490 ..... 620.80

VGA DISPLAY CARDS

ATI VGA Wonder 256 ..... $262.98
ATI VGA VIP 232.24
GENOA 5200 / 5300 ..... 305.55 / 273.20
RENAISSANCE RVGA II / RVGA I ..... 239.89 / 192.05
PARADISE VGA / VGA + 16 ..... 220.68 / 288.33
VIDEO 7 VGA 257.15
VIDEO 7 Fast Write / VRAM VGA ..... 312.15 / 434.25

EGA DISPLAY CARDS

GENOA Super EGA Hi-Res 800 x 600 ..... $243.40
NEC MVA 1024 ..... 950.50
PARADISE Auto Switch EGA 480 ..... 188.88
VIDEO 7 Vega Deluxe 219.74

CAD MONITORS & CARDS

MITSUBISHI 6905, 19-Inch $2320.90
MITSUBISHI 3905L80K 1835.62
MITSUBISHI 3905080K 1798.80
SIGMA Laserview 1687.18
VERMONT Cobra 2777.75
METHEUS 1104 ..... 1039.00

MICE

LOGITECH C9 Serial /PS/2 ..... $89.95
LOGITECH BUS 94.99
MICROSOFT Mouse (Bus Version) 109.34
MICROSOFT Mouse (Serial Version) 117.25
MICROSOFT Mouse w/Windows 138.37
MOUSE SYSTEMS (Serial Version) 99.55
MOUSE SYSTEMS (Bus Version) 108.77

MOST ORDERS RECEIVED BY 5:00 P.M. C.D.T. SHIP SAME DAY

HIGH VOLUME BIDS INVITED
2840 MARIA, NORTHBROOK, IL 60062 FAX (312) 291-1737

PC Magazine says..."You may find a better deal here than anywhere else."

WHY WAIT? CALL COMPUTER DISCOUNT WAREHOUSE™ NOW!

Open terms available to approved credit

CDW™ EXTENDED HOURS
Sales 7:30-7:30 CDT Mon-Fri.
9:00-3:30 CDT Sat.
Tech Support 9:00-5:00 CDT Mon-Fri.

(800) 233-4426

In Illinois (312) 498-1426 — FAX (312) 291-1737
NEW AREA CODE 708 — EFFECTIVE 1/1/90

Credit card charges are not submitted until time of shipment. Shipping and handling additional. On all hard drive orders under $200.00 please add $5.00 handling fee. Non-defective returns subject to restocking fee. All prices reflect 3% discount for cash. Allow 10 business days for shipping when paying by personal check. Software, chips and other electronic components are not refundable. All pricing subject to change. ™ - Registered trademarks of IBM and COMPAQ.

Credit card charges are not submitted until time of shipment.

MEMBER MMC MICROCOMPUTER MARKETING COUNCIL of the Direct Marketing Association, Inc.

PCWEEK CORPORATE SERVICE MODE MEMBER

VISA · DISCOVER · MasterCard · AMERICAN EXPRESS

BT89

Circle 61 on Reader Service Card

when the market is undergoing the transition to OS/2.

Another example of how multitasking and communications go hand in hand is with BBSes. For years, BBS operators have looked for ways to run their BBSes (which are usually not very memory-intensive operations) in the background while they're doing other things in the foreground. Just such a thing is possible with MichTron's BBS software. It, of course, supports multiple serial ports, as *any* OS/2 communications application would by definition. At $80, MichTron's product is already shipping and looks worth a try.

The final item in this category will appeal to members of electronic conferences, like BYTE's own BIX. When you start using BIX, you join a conference or conferences. For example, beekeepers might join the bee.keepers conference (I don't know if there is such a conference, but there could be—there are many conferences), or writers might join the writers conference. Some conferences are quiet, like ibm.at, which generates about 20 messages a month tops. Writers, on the other hand, can generate 20 messages an *hour*. Most of it is just chatter, but occasionally a nugget appears, like a useful phone number, book reference, or snippet of code.

When traffic is heavy, it would be nice to be able to save and categorize messages. Such a facility is offered by MsgVu. I tried an early version on BIX and truthfully didn't like it very much, but then I'm pretty crotchety about software. Once I find something I like, I tend to stay with it. Logicomm and Mirror serve me well in OS/2 and DOS, respectively. These programs *don't* keep track of messages, however—they just handle basic communications. MsgVu costs just $35, making it almost as inexpensive as Logicomm.

Accounting for the Databases

Databases weigh in at 82 products. *82 products?* Well, the number is a mite padded. Every accounting package on the market thinks it's a database. Even PrintQ, the OS/2 print spooler I mentioned earlier, groups itself here. Of course, all the big names are shipping already, except for Ashton-Tate.

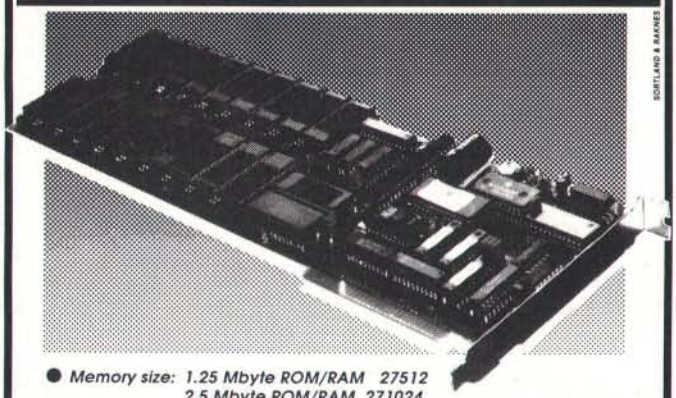
Although, strictly speaking, Prolog is not a database (I'll get letters on that one, but it's true), Arity's Prolog for OS/2 is good news. My DOS Prolog classes are often hampered by limited memory space, as Prolog does a lot of searching to get its work done and creates huge data structures—all of which live in RAM—in the process of that work. Arity's DOS-based compiler and interpreter are among the best, so the OS/2 product will no doubt be a useful tool for professional Prologers.

I see I've run out of space already. So many packages, so little time. I'm trying to get some specifics on the new High Performance File System (HPFS) that's going into OS/2 1.2. I hope to be able to tell you about it next month. See you then. ■

Mark J. Minasi is a managing partner at Moulton, Minasi & Company, a Columbia, Maryland, firm specializing in technical seminars. He can be reached on BIX as "mjminasi."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

5 Mbyte PROM/RAM CARD = IBM PC-compatible



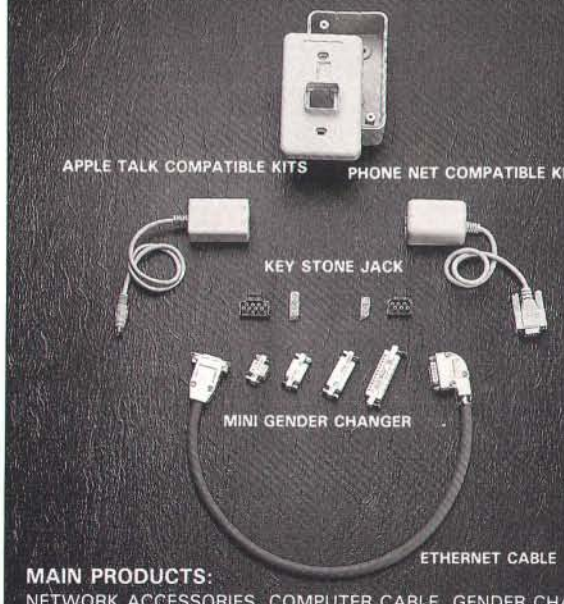
- Memory size: 1.25 Mbyte ROM/RAM 27512
  2.5 Mbyte ROM/RAM 271024
  5,0 Mbyte ROM/RAM 272048
- Additional 16K EEPROM
- On board PROM programmer for ordinary file handling
- Real time AT clock
- Timers for cyclic interrupting
- On board BIOS extension
- Battery backup for RAM and clock

STEINCO has developed a unique memory card which outranges all mechanical storage devices in hostile environment. On the board we have also utilized several other functions for use in data processing. With MS-DOS installed , the card will boot from PROM, and data transfer between the card and the computer take place with standard MS-DOS function calls. It is also possible to edit and save files on the card. This can be done because the card holds a unique PROM programmer on board.

STEINCO A/S STEINCO
P.O.Box 113, N-5427 Urangsvåg, NORWAY.
Phone +4754-20888 Telefax +4754-21248 Telex 42255 stein n.

YOUR LAN CONNECTION ACCESSORIES LET "GOOD WAY" TO RESPOND

FACE PLATE & SURFACE MOUNT BOX FOR IBM TYPE 1 & 2



MAIN PRODUCTS:
NETWORK ACCESSORIES. COMPUTER CABLE. GENDER CHANGER. DATA SWITCH. ARCNET PASSIVE HUB

GOOD WAY INDUSTRIAL CO., LTD.
P.O. Box 91–202, Taipei, Taiwan, R.O.C. Factory: No. 14-1, Dah Her Lane 2, Taichung, Taiwan, R.O.C.
Office 3F, 309, Fu Hsing N. Rd., TAipei, Taiwan, R.O.C. Fax: 886-4-2542648.
Tel: (02)717-7689 (Rep.) Fax: 886-2-7169807.
Telex: 12445 SUWORS.

Circle 260 on Reader Service Card
Circle 112 on Reader Service Card

BITWISE COMPUTERS -MORE THAN JUST A PRETTY FACE

Model	Model 212M	Model 212	Model 325	Model 333	Portable III-212	Portable III-325
CPU	12 Mhz 80286	12 Mhz 80286	25 Mhz 80386	33 Mhz 80386	12 Mhz 80286	25 Mhz 80386
RAM	512K 0 Wait	1 Meg 0 Wait	4 Megs Interleaved	4 Megs Cache	1 Meg 0 Wait	4 Megs Interleaved
DISPLAY	Monochrome	VGA color	VGA color	VGA color	Plasma CGA	Plasma CGA
PRICE	**$1,395**	**$1,895**	**$3,195**	**$4,895**	**$2,195**	**$3,495**

Prices are for complete systems, including Comptuer, Monitor, Keyboard, Hard Disk, DOS, Documentation, and 1 Year Warranty

All Desktop Systems Include:

- Compact Case 17''w x 7.25''h x 14''d
- 8 Expansion Slots, 5 Full Length Free
- 5 Drive Slots, 3 free
- Teac 1.2 or 1.4 Meg Floppy (add $95 for both)
- Trident VGA Card, 100% register compatible, up to 1024x768
- Keytronics 101 Key US Made Keyboard
- 2 Serial Ports, 1 Parallel Port, 1 Game Port
- Seagate 40 Meg 28 ms MFM (ST-251-1) Hard Disk
- MS-DOS 3.3 or 4.01 with Manuals

Monitor Upgrades

Model	Monitor	Resolution	Dot Pitch	Price
VGA-41	Packard Bell	640x480	.41	Standard
VGA-31	CTX	640x480	.31	Add $30
VGA-IIA	Nec-IIA	800x600	.28	Add $290
VGA-3D	Nec-3D	1024x768	.24	Add $425
Mono	Packard Bell	720x348	.29	Subtract $450

All Portable Systems Include:

- Portable Case 15''w x 9''h x 8''d (20 lbs empty)
- High Contrast Plasma Screen (call for LCD prices)
- 5 Expansion Slots, 3 Full Length. 2 slots free in 2 drive system
- 3 Drive Slots, Teac 1.2 or 1.4 Meg Floppy (add $95 for both)
- 40 Meg ST-251-1 Self Parking 28 ms hard disk standard
- ALL Hard Disk Upgrades available (see table)
- Simultaneous Display on screen and external monitor
- MS-DOS 3.3 or 4.01 with Manuals

Plasma Display Upgrades

Model	Screen	Resolution	Gray Scales	Price
CGA	640x400	640x200	4	Standard
EGA	640x400	640x350	4	Add $290
VGA	640x480	640x480	16	Add $540

Hard Disk Upgrades

Model	Size	Access Time	Controller Type	Price
ST-125-1	20 MB	28 ms	MFM 1:1	Subtract $85
ST-251-1	42 MB	28 ms	MFM 1:1	Standard
ST-277N-1	66 MB	28 ms	SCSI 1:1	Add $60
ST-277R-1	66 MB	28 ms	RLL 1:1	Add $95
ST-296N-1	85 MB	28 ms	SCSI 1:1	Add $245
Microscience	121 MB	28 ms	ESDI 1:1	Add $700

Bitwise — Building and servicing PCs since 1985. Questions? Call Us! we understand what we sell! Shipping — You pay UPS Shipping Charges only, F.O.B. Troy, NY, no surcharges. Full 1 Year Parts & Labor Warranty, 30-day money back guarantee. These are cash or check in advance prices. VISA, MC, DISCOVER, welcomed (2% surcharge). COD, add 1.5%. Personal Financing and Corporate Leasing Available.

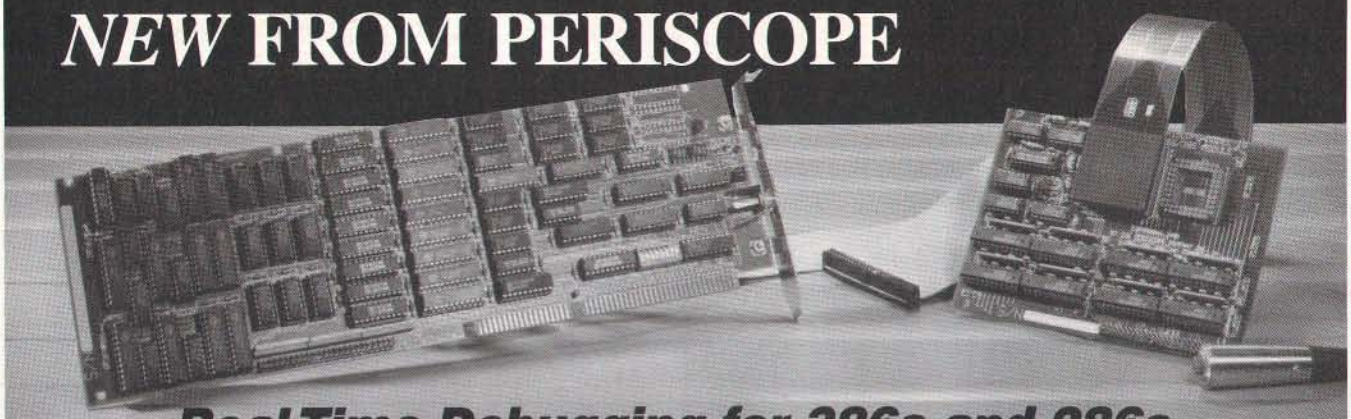
1-800-367-5906
518-274-0755
Fax 518-274-0764

Bitwise Designs Inc.
701 River St.
Troy, NY 12180-1233

BITWISE
DESIGNS, INC.

Circle 38 on Reader Service Card (DEALERS: 39)

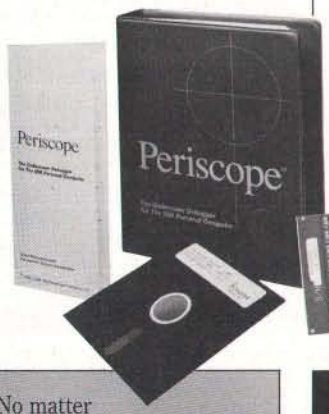
NEW FROM PERISCOPE



Real-Time Debugging for 386s and 286s

User Jeff Garbers, Crosstalk Communications' Director of Software Development, has been debugging with Periscope® Model IV and says, "The hardware really makes Periscope shine, especially when you've got timing-related problems. I can now track down changing pointers and altered buffers on my 386. I've been using it to debug Crosstalk® Mk. 4 and there's just no better way to do it."

Periscope IV gives you the ability to debug time-sensitive programs, hardware-interrupt routines, and programs with intermittent errors. You can run your program at full speed while tracking down unwanted memory overwrites. You can use the information captured in Periscope IV's real-time trace buffer to see EXACTLY what the system is doing, and to improve its performance.



Periscope manual, disk, quick-reference card, and 512K Plus board that provides write-protected RAM for Periscope Models I, III, and IV.

A New Generation of Hardware-Assisted Debugging

Compatible with virtually any 286 or 386 with an AT-style bus, Periscope IV works on machines running up to 25MHz with any number of wait states. Because it gets information directly from the CPU, instead of from the system bus, Model IV is not sensitive to bus compatibility issues.

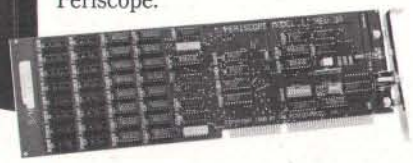
Periscope IV collects CPU information in its hardware trace buffer while the CPU runs at full speed. Whether you tell Periscope IV to capture just selected information or to capture everything, you can use its powerful trace buffer commands to search for and display the execution history the way you need to see it. And you can use the CPU cycle count information to get the last bit of performance out of your code.

With Periscope IV you can set hardware breakpoints on memory accesses (within the first 16MB), I/O ports, and data. You can also set breakpoints on the occurrence of specific sequences of events, such as "watch for the routine FOO to begin executing, then while it is, watch for the variable BAR to be written." This capability, called sequential triggering, enables you to define complex conditions, then stop your program and examine what has happened when these conditions occur.

If you're developing a large application that needs all of the lower 640K, you can use the optional Plus board to keep Periscope totally out of normal DOS memory. The Plus board requires the use of a second slot.

The Periscope IV software is an extension of the software that comes with all models of Periscope. So, along with Periscope IV's powerful hardware, you get a full-function software debugger with source and symbol support for most popular PC compilers and linkers, Microsoft® Windows support, PLINK overlay support, dual monitor support, support for debugging device drivers and TSRs as well as regular programs, DOS independence, crash recovery, ease-of-use, and much more.

Prices on Periscope range from $145 for software-only Model II-X to $2,995 for a 25MHz 386 hardware-assisted Model IV. Call 800/722-7006 for pricing details, free information, to talk about your debugging needs, or to order your Periscope.



Order Your Periscope, Toll-Free, Today! 800-722-7006

MAJOR CREDIT CARDS AND QUALIFIED COMPANY PURCHASE ORDERS ACCEPTED

PC MAGAZINE The BEST of 1988

"No matter what your debugging needs, a single call to the Periscope Company has always sufficed..."

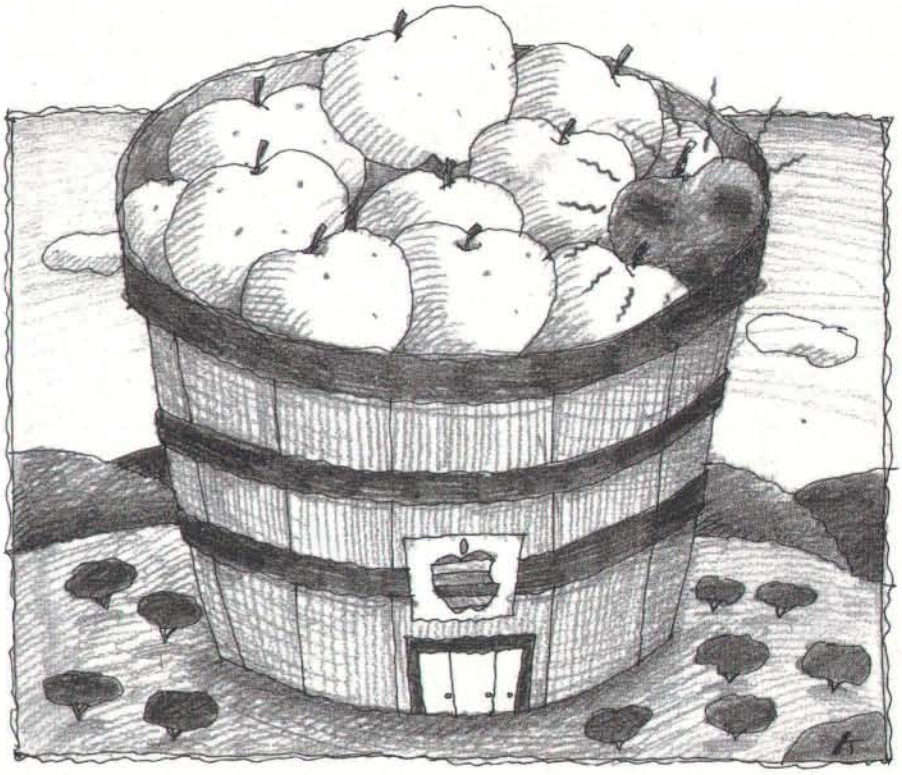
Ross Creenberg
"Best of 1988" (Development Tools)
PC Magazine, January 17, 1989

The Periscope Company, Inc.

1197 PEACHTREE ST.
PLAZA LEVEL
ATLANTA, GA 30361
404/875-8080
FAX 404/872-1973

Circle 205 on Reader Service Card (DEALERS: 206)

CRIMES OF THE HEART?



Views on yesterday's follies and hopes for tomorrow's machines

I am writing this column not long after someone stole and disseminated the source code to some of Apple's Macintosh ROM. As bad as this crime is (and let's make no mistake about it, this is a *crime*), the real tragedy is what it does to the people who work at Apple. People, many of whom are my friends and who have been loyal Apple employees for years, have come under suspicion. Apple has always been a tough place to work: too much hurry up and wait; too many changes in product direction, development, and marketing; and too many reorganizations. This latest incident just makes life tougher for Apple employees.

I'm appalled at the idiots who stole and disseminated this code and then had the gall to link themselves with some greater good. A criminal act is just that, no matter what the intentions might have been. Cloaking themselves in the banner of "open software" and spouting off about "freedom from the tyranny of proprietary operating systems" is a load of rubbish, nothing more.

These criminals have represented themselves as members of the nuPrometheus League. My hope is that when they are caught (and they will be, after many innocent Apple employees are harassed in the process), their punishment fits the crime. Recall that the Greek god Prometheus was chained to a rock for eternity by Zeus, while a vulture picked over his liver. I hope the nuPrometheus League meets a similar fate.

Don's Wish-List Macs

By all signs, Apple expects to make a big marketing push during the first quarter of its 1990 fiscal year, which will be starting about the time that you read this column. Rather than talk about the products that Apple expects to announce for 1990 availability, I want to push the discussion even further. It's time for me to unveil my Mac wish list. What do I want to see in new Mac products for 1990 and beyond?

The first Mac on my wish list is a natural: a new low-end computer designed to replace both the Plus and the SE. I've called this machine the Mac Classic before, and that's a name that befits its position in the product line.

The Mac Classic would have a modular design, based on the design-for-manufacturing (DFM) methods used in the IIcx. In order to make it easily transportable, it would consist of two units, one each for the CPU and the monitor, plus the keyboard. This could all be fastened together for carrying.

The CPU unit would contain a 16-MHz 68020 processor and single-in-line-memory-module (SIMM) slots for up to 8 megabytes of RAM. This unit would be the size of the current 80-megabyte external Apple SCSI hard disk drive, but it would weigh less. Its basic configuration would have 2 megabytes of RAM, so that System 7.0 would run (albeit without virtual memory). It would also have an FDHD floppy disk drive and a 20-megabyte small-format hard disk drive. Two Apple Desktop Bus (ADB) ports, two serial ports, a floppy disk drive port, a SCSI port, and a sound port complete the unit.

Oh, yes, there would also be a processor expansion port. Not an internal expansion slot. Forget that nonsense. The Mac Classic would be an information appliance, just like the original 128K-byte Mac. When you want to slice tomatoes with your food processor, you don't have to open the case and install a new motor (possibly damaging the components inside). You simply install a new blade.

continued

ILLUSTRATION: G. BRIAN KARAS © 1989

Likewise, you shouldn't have to open up your Mac Classic to install some new gizmo, like a floating-point chip.

This processor expansion port allows expansion doodads to be attached as easily as hooking up a second floppy disk drive or an external hard disk drive. Apple should sell an externally powered expansion chassis to hold multiple expansion boards, and it should encourage third-party vendors to create stand-alone accessories that would connect to the expansion port.

The monitor unit would contain the monitor's analog driver board and a 9-inch monochrome monitor. You would attach the monitor to the CPU box through some sort of sliding/docking catch that would incorporate the power and data connections (although separate ports would be available if you wanted to separate the CPU from the monitor with a cable). The mouse and keyboard would be one of the standard ADB keyboards that Apple now provides.

The Mac Classic would not have color or gray-scale capabilities built in (though they could be easily added), nor would it have many configurations, keeping in mind its price tag and its intended audience. The street price for the Mac Classic should be around $900, with pricing for students falling around $700.

This machine would replace the current Mac Plus and perhaps the SE, and it would likely sound the death knell for the Apple II line. Of course, these are all marketing reasons why Apple might not produce a Mac Classic or might delay its availability. Given IBM's premature dropping of its own AT system, Apple is likely to give market concerns more than mere lip service before unveiling any machine as tempting as my Mac Classic.

The Hyper Mac

OK, I admit it. I'm getting sick of Apple being handed its technological lunch by workstation vendors like NeXT and Sun. Don't get me wrong, I like the NeXT cube and the technology that it represents. And I wouldn't be able to get through a day without Midas, my trusty Sun-3/50NFS workstation. Then there are the new SPARCstations. These are impressive machines at impressively low prices. But they're still not Macs. The NeXT cube and the Suns won't run my huge library of Mac software. And their interfaces, while sporting many new and clever features, aren't as battle-tested and easy to use as the Mac's.

It's time to unleash a Hyper Mac! This would be a single-user machine running the Mac OS. Apple doesn't need to get involved in fighting Sun on Sun's terms. Sun has the Unix expertise and experience to win that battle, as the current nonsales of A/UX sadly point out.

The Hyper Mac would be a high-end machine capable of running existing 32-bit clean Mac software. It would be a six-slot machine, based on a new DFM design center that would clean up the existing Mac II family chassis and motherboard designs. As many components as possible would be surface-mounted to the motherboard, including the CPU. The chassis would also incorporate a beefed-up power supply, providing enough juice to power six NuBus cards without even flinching.

Now to the Hyper Mac's guts. Naturally, this baby will need a new ROM. Apple might as well make it a full megabyte, even if its software aces don't need all that space for now. The Hyper Mac's heart will be a very fast CPU, one that can compete with the likes of Sun's SPARC chip. Better make it a 68040 running at 40 MHz. Apple will want to toss in some kind of static RAM cache to optimize the performance of this fast processor.

There's no point in having this kind of raw computing horsepower tied to a 10-MHz NuBus. So the Hyper Mac will have a NeXT-class NuBus, running at least at 25 MHz, faster if the hardware gurus can pull it off. And direct memory access. Lots of it.

DMA is sorely missing on existing Macs and is one reason that real-time computing applications aren't being written for the Mac. The Hyper Mac's DMA channels will fix that.

How about RAM? Lots of it, virtual memory notwithstanding. We're talking minimum disk paging here. Thus, the Hyper Mac will have 16 SIMM sockets, for 16 megabytes of RAM when using 1-megabit-density SIMMs. Using 4-megabit-density SIMMs, the Hyper Mac could pack in 64 megabytes of RAM, enough for serious computing, even real-time stuff like shaded color animations that pump out 75,000 polygon transformations per second. Apple shouldn't sell the Hyper Mac with anything less than 8 megabytes of RAM.

How about an optical disk drive? Not yet. Apple should let NeXT and Canon

continued

People are talking about us.

"Lahey F77L is definitely for the programmer's market, with features for the casual and professional user...*EDITOR'S CHOICE" PC Magazine*

"It is a fantastic product." *PC Australia*

"This is a very good implementation of FORTRAN, better than the one I use on my minicomputer system." *IEEE Software*

"It should be the last FORTRAN compiler you will need to buy..." *Your Computer*

"Lahey F77L was by far the easiest compiler to use..." *Programmer's Journal*

"Compilation speed is Lahey FORTRAN's most remarkable feature; it is unbelievably fast...Realistically, Lahey FORTRAN is the most efficient and productive FORTRAN development tool for the DOS environment..." *BYTE, Nov. '87, p.187—David W. Burleigh*

F77L 4.0 EDITOR, LINKER, PROFILER GRAPHICS MAKE, WEITEK

When people talk about FORTRAN the name mentioned most often is

Lahey Computer Systems Inc.

Contact us to discuss our products and your needs. (800) 548-4778
Lahey Computer Systems, Inc. P.O. Box 6091, Incline Village, NV 89450
Tel: (702) 831-2500 FAX: (702) 831-8123 Tlx: 9102401256

Circle 151 on Reader Service Card

You know exactly what your company wants in a color printer.

Circle 117 on Reader Service Card

get those systems up to snuff in terms of speed and maybe include them in Hyper Mac II. For now, Apple should stick with small-format hard disk drives. The base configuration would come with one 160-megabyte unit, although the chassis could hold four, plus two FDHD floppy disk drives for quick backups and reading in data and software.

Anything else? The usual SCSI, serial, sound, and ADB ports. The SCSI port should have a faster transfer rate. Oh, and Apple should also throw in a better sound chip than its current Mac II sound chip, maybe a digital signal processor chip. In fact, I vote for a DSP chip.

And Ethernet. Not a NuBus slot-wasting Ethernet card, but built-in Ethernet on the motherboard. Make it thin and *thick* Ethernet, please (don't make NeXT's mistake on that one).

Is that it? Not quite. I'd also want built-in video. No more of this extra video-card expense. Apple should have built-in video with the same 8-bit high-resolution colors found on the SPARCstations. The built-in video should be capable of driving monochrome and RGB monitors, including full-page and two-page units. If you want 16- or 24-bit color, you could add a NuBus card loaded with video RAM.

Quite a machine, eh? Wait until you hear the price Apple should sell it for. Under $10,000 for a base configuration (19-inch monochrome monitor, extended keyboard, mouse, 8 megabytes of RAM, and a 160-megabyte hard disk drive). I can hear the screaming in Cupertino now. But consider the competition: The NeXT cube sells at Businessland for under $10,000, and SPARCstations can also be had in many versions for under $10,000. Those are the real price points the Hyper Mac must attack.

OK, Apple. There you have it. Two new machines on my Mac wish list. Building either one would reassert your technological prowess in the marketplace and capture sales now going to your competitors. Building both of them might just put some of your competitors back where they started: as niche vendors. ■

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

LightSpeed 9624E 9600 baud modem

shipping $7.00 **$799.00**

True 9600 bps modem, V.32, full duplex.
9600/4800/2400/1200/300 bps
MNP Class 5 error correction & data compression for data flow up to 19.2 Kbps
Fully CCITT V.32/V.22bis/V.22, Bell 212A/103J compliant.
Auto speed detection
Extended AT command set
Non volatile memory storage
Cable and software included (specify PC or MAC)
Synchronous and asynchronous modes

LightFax 9624 superior fax/modem

shipping $7.00 **$499.00**

- 9600 baud fax compatible with all Group 3 fax machines
2400 baud modem 100% Hayes™ compatible. Switch from fax to modem with one command
Excellent picture quality, superior to standard fax
Fax directly from application or from flexible text/graphics editor
Full status lights in fax or modem mode
Compatible with all PCs and MACs
Powerful software for scheduled sending, broadcasting, file queuing etc.
Complete with fax and modem software and cable (specify PC or MAC)

Never buy another ribbon! with MacInker™

over 100,000 sold

Re-ink ANY fabric ribbon

- Universal Cartridge MacInker re-inks most cartridges with appropriate adapter. Universal Spool MacInker re-inks all spools

Operation is very simple and automatic

Extra dark, lubricated ink yields better than new print quality

Ink's cooling and lubricating effect extends printhead life

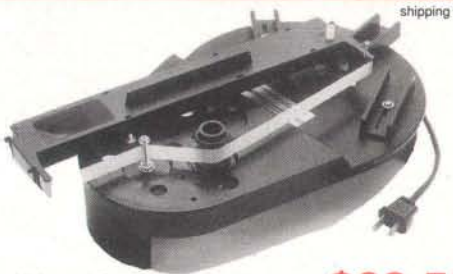
Average cartridge can be re-inked 60-100 times at 5 cents/re-inking

Multicolor Adapters for multiband cartridges (Rainbow, Imagewriter, Epson, NECs, Okidata etc.)

Dedicated MacInkers available for special cartridges and Band Printers

Customers vary from individuals to Fortune 500 Corporations, reporting documented savings of $30,000/year with MacInker

shipping $4.50



Universal Cartridge MacInker shown with Epson cartridge **$68.50**

Universal Cartridge MacInker 68.50
Multicolor Adapter (specify printer) 40.00
Epson only **MacInker** mod. 271EP 42.00
Imagewr. only **MacInker** mod. 234 IM..42.00
Universal Spool MacInker 68.50
Heat Transfer Adapter 25.00
Extra Ink bottle, black ....3.00 **pint**.....18.50
Colored ink bottle .....4.00 **ex. reservoir.** 5.00
All MacInkers delivered complete with bottle of ink, ink meter, reservoir, reservoir cover.
Go color !! Single & multicolor, standard and heat transfer cartridges available: red, green, blue, brown, purple, yellow, orange, white, silver and gold. Indelible and OCR ink cartridges available.

Call for free catalog

Satisfaction or 30 day refund - Immediate shipment - Major credit cards - POs from national accounts

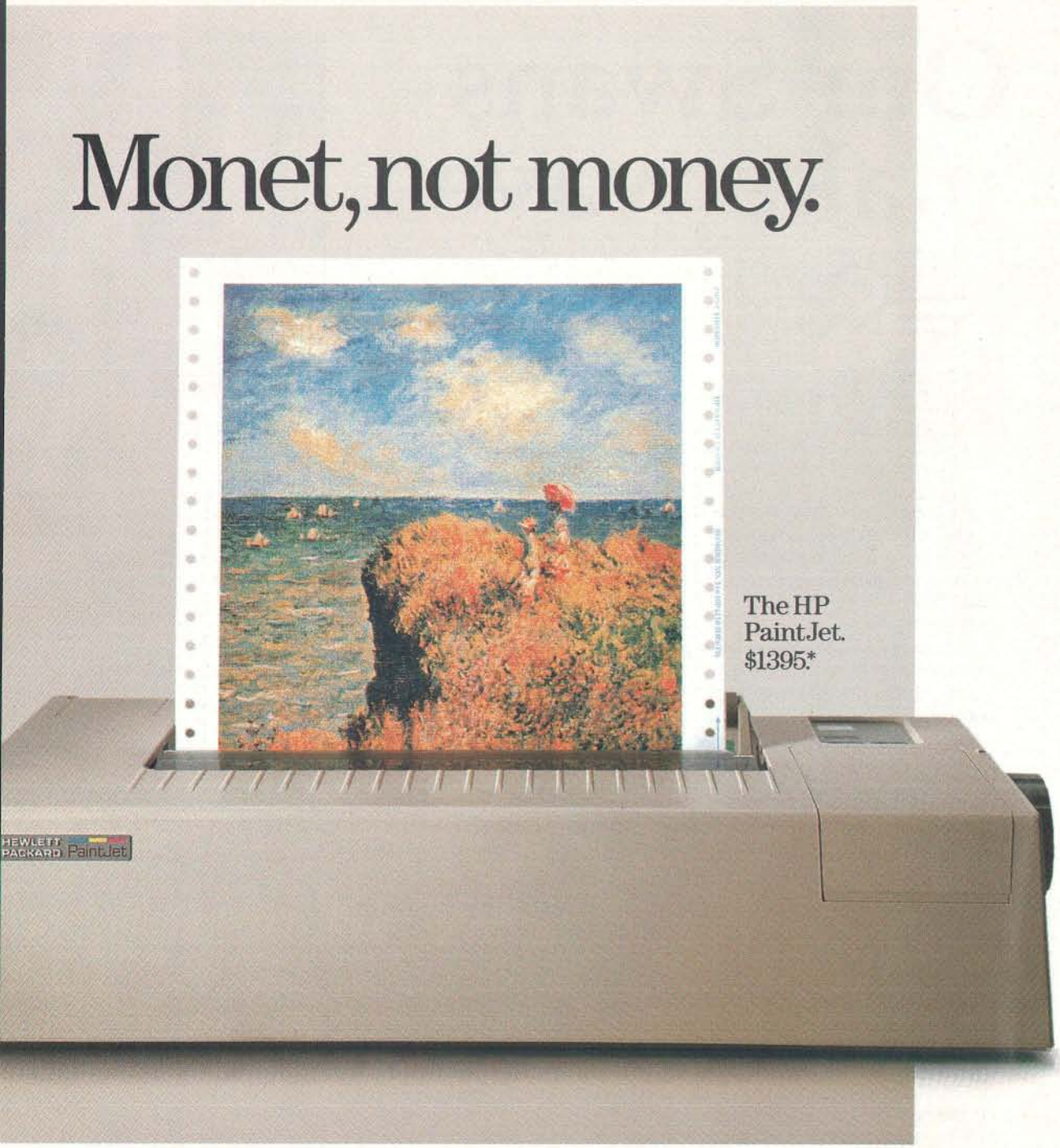
Computer Friends, Inc. **Order Toll Free 1-800-547-3303**

14250 NW Science Park Dr.
Portland OR 97229

in Oregon (503)626-2291
fax (503)643-5379 **telex 4949559 CF**

Circle 62 on Reader Service Card

Monet, not money.



The HP PaintJet. $1395.*

Who says fine art is out of reach? The HP PaintJet color printer produces brilliant color for a price any business can afford.

So now there's no limit to what you can create

with your business communications. Surprise your audience with thousands of colors. Beamed up on an overhead. Or tucked neatly into a report. Persuading people up to 85% more effectively than black and white.

The PaintJet works with all your favorite graphics, presentation, spreadsheet and word processing software. Just hook it up to your IBM-compatible or Macintosh computer and start painting.

For only $1395 (add $125 for the Macintosh interface).

Call **1-800-752-0900 Ext. 711K** for your nearest authorized HP dealer and a free sample output. The HP PaintJet. It's what artists are starving for.

There is a better way.

HEWLETT PACKARD

Circle 118 on Reader Service Card

*Suggested U.S. list price. Business graphics created using Microsoft® Excel, which is a U.S. registered trademark of Microsoft Corp. ©1989 Hewlett-Packard Company PE12916

Our Swans make waves.

The Swan line of computers is creating waves of excitement among computer users. One reason is price. Swan computers are true bargains, offering you the most for your investment. But price doesn't tell the complete value story.

Swan computers are solid, reliable performers ... assembled by Tussey Computer Products, a solid, reliable company with a tradition of unsurpassed customer satisfaction.

Swan computers are highly compatible. In fact, all Swan computers feature the top-rated Phoenix ROM BIOS to assure 100% PC compatibility.

And the benefits keep coming, wave after wave . . .

30-Day Satisfaction Guarantee

If you're dissatisfied with any Swan brand name product, you can return it within 30 days from the date of shipment and get your money back. No questions asked.*

Toll-free Technical Support

When you own a Swan, you can call our toll-free number and be in touch with our expert technical and service staff. They'll answer your questions and help you take fullest advantage of your system's capabilities.

Full 1-Year Warranty

Every Swan brand name product is backed by a full 1-year warranty on parts and labor. A second year of coverage is available through the Swan Extended Warranty (SEW). Ask for details when you order your Swan.

Fast, Sure Delivery

You want your Swan up and running and doing its job for you. Fast. So any order we receive before 4 p.m. EST is shipped the same day. Even orders received after 4 p.m. are shipped within 24-hours.**

We also insure your order at no cost to you. And we don't charge your credit card until your order is actually shipped.

Convenient On-Site Service

Swan offers you the valuable option of on-site service from Sorbus®, a Bell Atlantic™ Company. When your computer needs serviced, an experienced technician will be dispatched to your site quickly, minimizing downtime, maximizing convenience and value.

Swans make waves in business and education.

Swan offers a full line of services tailored to the needs of educational and corporate computer users. Call our Educational & Corporate Sales Department toll-free at 1-800-468-9044. Learn how a Swan can be a business animal ... or a teacher's pet.

Swans make waves in the computer industry.

With their compatibility, reliability and performance, Swans add up to value for their owners. So it's no surprise that Swans are making waves in the computer industry. Waves that may make some competitors run for safer ground.

Read what computer journals are saying ...

" ... If you enjoy getting the most performance for your dollar, the Swan ... is a good alternative" to showy, more expensive brand names.

— Computer Shopper, April 1989

"The excellent manual and 30-day money-back guarantee both indicate that Tussey Computer Products values customer service." *— PC Resource*

Swan 386/20D

"Tussey's Swan 386/20 flies."
— Computer Shopper, April 1989

Gracefully combining power and performance, this Swan has soared to the upper limits of today's technology.

- *80386-20 20/8 MHz Norton SI 22.0*
- *MS-DOS*, OS/2* & UNIX* Compatible*
- *Phoenix BIOS*
- *1MB of 32-Bit RAM Expandable to 16MB of 32-Bit RAM*
- *Shadow RAM for Video & BIOS*
- *Memory Interleave for near 0 Wait State*
- *80287 & 80387 Co-processor Socket*
- *200W Power Supply*
- *5 Device Bays: 3 Exposed, 2 Internal*
- *1.2MB 5.25" or 1.44MB 3.5" Floppy Drive*
- *Dual Floppy/Dual H.D. Controller w/1:1 Interleave*
- *Ports: 2 Serial, 1 Parallel*
- *8 Expansion Slots: 1) 32-bit, 4) 16-bit, 3) 8-bit*
- *Enhanced 101 Key Keyboard*
- *Clock Calendar w/Battery Backup*
- *Swan Setup & Utilities Diskette*

Options:

- *80287 or 80387 Co-processor*
- *Upgrades: 2, 4, 8, 10 or 16MB*
- *GW BASIC/MS-DOS add $89*

$1899

Base System with Single Floppy, No Video

386/20D	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono	14" Flat Mono	VGA Mono	VGA Color
w/48MB (28ms) & 1:1 Interleave	$2399	$2448	$2598	$2898
w/80MB (28ms) & 1:1 Interleave	$2749	$2798	$2948	$3248
w/150MB (18ms) ESDI w/1:1 Interleave	$3394	$3443	$3593	$3893

Tower Case Option for 386/20 w/230W power supply add $300

* Items returned must be as-new, without modification or damage. All warranty cards, manuals and packaging must be included. Return shipping must be be prepaid and insured, bearing a RA (Return Authorization) on the shipping label. Sorry ... shipping charges and upgrade fees are not refundable.

** Custom configured systems may take longer.

S=BTJ1

Swan 386SX

This system gives you 386 compatibility, power and performance ... at a 286 price.

- *80386SX 16/8 MHz Norton SI 17.6*
- *MS-DOS®, OS/2® & UNIX® Compatible*
- *Phoenix BIOS*
- *1MB RAM Expands to 8MB on Systemboard*
- *Shadow BIOS*
- *Memory Interleave for near 0 Wait State*
- *80387SX Co-processor Socket*
- *200W Power Supply*
- *4 Device Bays: 3 Exposed, 1 Internal*
- *1.2MB 5.25" or 1.44MB 3.5" Floppy Drive*
- *Dual Floppy/Dual H.D. Controller w/1:1 Interleave*
- *Ports: 1 Serial, 1 Parallel*
- *8 Expansion Slots: 6) 16-bit, 2) 8-bit*
- *Enhanced 101 Key Keyboard*
- *Clock Calendar w/Battery Backup*
- *Swan Setup & Utilities Diskette*

Options:

- *80387SX Co-processor*
- *Upgrades: 1.5, 2, 3, 4, 5, 6 or 8MB*
- *GW BASIC/MS-DOS add $89*

Swan 286/12

You probably never thought you could get into a reliable business system this inexpensively. But with the 286/12, you can. Now.

- *80286 12.5/6.25 MHz Norton SI 12.3*
- *MS-DOS® & OS/2® Compatible*
- *Phoenix BIOS*
- *512K of RAM Expandable to 5MB*
- *Shadow BIOS*
- *0 Wait State*
- *80287 Co-Processor Socket*
- *200W Power Supply*
- *5 Device Bays: 3 Exposed, 2 Internal*
- *1.2MB 5.25" or 1.44MB 3.5" Floppy Drive*
- *Dual Floppy/Dual H.D. Controller*
- *Ports: 1 Serial, 1 Parallel*
- *8 Expansion Slots: 6) 16-bit, 2) 8-bit*
- *Enhanced 101 Key Keyboard*
- *Clock Calendar w/Battery Backup*
- *Swan Setup & Utilities Diskette*

Options:

- *80287 Co-processor*
- *Upgrade to 640K, 1, 2, 3 or 5MB*
- *GW BASIC/MS-DOS add $89*

Swan XT10

The perfect budget-priced home computer. A solid, reliable, compatible performer.

- *10/4.77 MHz 8088-1*
- *Phoenix BIOS*
- *640K of RAM*
- *0 Wait State*
- *8087 Co-Processor Socket*
- *150W Power Supply*
- *4 Device Bays: 2 Exposed, 2 Internal*
- *Single 360K Floppy Drive*
- *Ports: 1 Serial, 1 Parallel, 1 Game*
- *8 Expansion Slots*
- *Enhanced 101 Key Keyboard*
- *Clock Calendar w/Battery Backup*
- *Swan Setup & Utilities Diskette*

Options:

- *8087 Co-processor*
- *3.5" Floppy Drive*
- *GW BASIC/MS-DOS add $89*

$1399

Base System with Single Floppy, No Video

386SX	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono	14" Flat Mono	VGA Mono	VGA Color
w/32MB (40ms) & 1:1 Interleave	$1799	$1848	$1998	$2298
w/48MB (28ms) & 1:1 Interleave	$1899	$2048	$2198	$2498
w/80MB (28ms) & 1:1 Interleave	$2249	$2298	$2448	$2748
w/187MB (18ms) ESDI w/1:1 Interleave	$2894	$2943	$3093	$3393

$899

Base System with Single Floppy, No Video

286/12	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono	14" Flat Mono	EGA	VGA
w/32MB (40ms) & 1:1 Interleave	$1299	$1348	$1698	$1798
w/48MB (28ms) & 1:1 Interleave	$1399	$1448	$1798	$1898
w/80MB (28ms) & 1:1 Interleave	$1749	$1798	$2148	$2248

$549

Base System with Single Floppy, No Video

XT10	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono'	CGA	EGA	VGA
Single Floppy	$699	$869	$1098	$1198
Dual Floppies	$779	$949	$1178	$1278
*w/32MB (40ms) Hard Drive	$979	$1149	$1378	$1478

* Includes Single 360K Floppy Drive

' Upgrade from 12" to 14" Flat Screen, add $49

To order: No surcharge on Discover, Visa, MasterCard or AMEX. • Your credit card is not charged until your order is shipped. **Shipping:** 3% or $5 minimum for UPS Ground. Call for shipping charges on Express Air, APO, FPO, AK, HI and all foreign orders. • If part of your order is backordered, the remainder will be shipped UPS Ground. • Allow 2 weeks for personal and company checks to clear. • Defective items replaced or repaired at our discretion. • PA deliveries add 6% sales tax. • Prices and terms subject to change without notice.

Open: 8a.m.-11p.m. M-F, 10a.m.-8p.m. Sat, 12p.m.-8p.m. Sun

Swan TECHNOLOGIES a division of tcp

TUSSEY COMPUTER PRODUCTS

3075 RESEARCH DRIVE • STATE COLLEGE, PA • 16801

Order Now Toll-Free

1-800-468-9044

FAX: 814-237-4450 • International: 814-234-2236

Circle 307 on Reader Service Card

Make a mating

Get real compatibility. Call our toll-free number and our expert staff will mate you with hardware, software, or peripherals to fit your unique needs. And at a price you'll love.

And when you shop Swan, you'll get the benefits of a strong, supportive relationship:

- We won't charge your credit card until your order is shipped.
- Orders received before 4 PM EST will be shipped same day ... and each order is insured at no cost to you.
- You'll deal with a financially sound, respected company.
- We'll be here after the sale to help you.
- Software orders over $100 and accessories under 6 pounds will be shipped Federal Express.

FEDERAL EXPRESS

PRINTERS

Panasonic

1180 (192 cps, 80 col, 9-pin) $179

1191 (240cps, 80 col, 9-pin) ..... $Call
1124 (192cps, 80 col, 24-pin) $329
1595 (240cps, 132 col, 9-pin) $449
1524 (240cps, 132 col, 24-pin) $569
1624 (192cps, 132 col, 24-pin) ..... $Call
4450 (11ppm laser printer) $1375

EPSON

LX-810 (180 cps, 80 col, 9-pin) $189

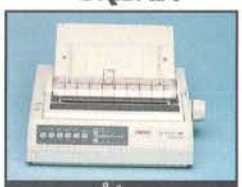
FX-850 (264cps, 80 col, 9-pin) ..... $Call
FX-1050 (264cps, 132 col, 9-pin) ..... for
LQ-510 (180cps, 80 col, 24-pin) ..... Best
LQ-850 (264cps, 80 col, 24-pin) ..... Price
LQ-1050 (264cps, 132 col, 24-pin) ..... on
LQ-2550 (400cps, 132 col, 24-pin) .. Epson

star

NX-1000 (144 cps, 9-pin) ... $Call

NX-1000 Rainbow
(144cps, 80 col, 9-pin) $229
NX-15 (120cps, 132 col, 9-pin) $349
NX-2400 (170cps, 80 col, 24-pin) ..... $Call

OKIDATA



320 (300 cps, 80 col , 9-pin) $339

172 (180 cps, 80 col, 9-pin) ..... $Call
182 Turbo (220 cps, 80 col, 9-pin) .... $Call
321 (300cps, 132 col, 9-pin) $469
390 (270cps, 80 col, 24-pin) $469
391 (270cps, 132 col, 24-pin) $659
393 (450cps, 132 col, 24-pin) ..... $Call

Citizen

120D (120 cps/9-pin) $159
180D (180cps, 80 col, 9-pin) $179

Diconix

150+ (180cps, 80 col) $345
300 (300cps, 80 col) $399

Hewlett-Packard

Deskjet (240cps, 80 col) $599
Deskjet Plus (240cps, 80 col) .... $Call
Paintjet (167cps, 80 col) $1049

NEC

P2200 (170cps, 80 col, 24-pin) $359
P5200 (265cps, 80 col, 24-pin) $529
P5300 (265cps, 132 col, 24-pin) ... $689

LASER PRINTERS

Panasonic

KX-P4450 ..... $1375

Hewlett-Packard

LaserJet Series II
• 8 ppm/512K $1749
LaserJet Series IID ..... $Call

MONITORS

TTL Monochrome

Magnavox 7623 Amber $99
Packard Bell with tilt/swivel Amber or Green $89
Samsung 14" Mono Flat $139
Swan Monochrome SW525 ..... $89

RGB/CGA

Magnavox 8762 ..... $249
Magnavox 8515 ..... $289
Samsung SC452C $219
Swan RGB $219

EGA

Imtec 1453 ..... $349
Magnavox 9053 ..... $359
Packard Bell 1431 ..... $349

Multisync

Imtec 1455N Multi $419
Mitsubishi Diamond Scan $499
NEC Multisync 3-D ..... $Call
NEC Multisync Plus ..... $Call
Sony 1304 ..... $699

VGA

Amdek 732 ..... $429
Imtec 1453 Q $349
Magnavox 7749 (Grey Scale) $129
Magnavox 9082 ..... $429
NEC Multisync 2a ..... $Call

PC ADD ON BOARDS

Boca

RAM Card XT or AT ..... $Call
I/O card XT or AT $79

Micron

RAM Card (MB-28-DH) populated w/2MB RAM $699

TOPS

TOPS/DOS 2.1 ..... $119
Flashcard $169
Net Print $119
Teleconnector $39

intel

8087 ..... $84
8087-1 ..... $159
8087-2 ..... $119
80287 ..... $129
80287-8 ..... $189
80287-10 ..... $214
80387SX $297
80387-16 ..... $339
80387-20 ..... $379
80387-25 ..... $479
80387-33 ..... $Call

BOARDS

AboveBoard Plus $399
AboveBoard Plus I/O $449
Connection Co-processor .... $Call
InBoard 386/PC $589
Call for Daughterboard Pricing

VIDEO CARDS

EGA

ATI
EGA Wonder 800 ..... $239

Paradise
Autoswitch 480 ..... $179

Swan
EGA $169

VGA

ATI
VGA Wonder ..... $Call

Orchid
Pro Designer VGA $319
Pro Designer VGA + ... $Call

Paradise
Paradise VGA + ... $249
VGA Professional ..... $Call
VGA + 16 ..... $299

Swan
VGA $199

Video 7
VEGA VGA $279
Fast Write VGA $369
VRAM VGA $499

MISC.

Swan
Switchable (Mono/CGA) $69

TOSHIBA

LAPTOPS

T1200 (10MHz) $1379
T1600 (12MHz/20MB) $3259
T3100e (12MHz/20MB) $2749
Call for other Toshiba models

DISKS

		3.5"	5.25"
BONUS	DS/DD	—	$6.95
MAXELL	DS/DD	$19.95	$9.95
VERBATIM	DS/DD	$19.95	$9.95
SONY	DS/DD	$19.95	$10.95

FLOPPY DRIVES

Mitsubishi

3.5" (720K) $89
3.5" (1.44MB) $109

Sony

3.5" (720K) $79
3.5" (1.44MB) $99

Roctec 5.25"

QTY	360K	1.2MB
1-3	$74	$89
4-9	$62	$73
10+	- Call for Quote -	

PC HARD DRIVES

KALOK

KL320 20MB (40 ms) ..... $219/$259*
KL330 32MB (40 ms) ..... $249/$299*

MiniScribe

8438 30MB (68 ms) $249
3650 40MB (61 ms) $299
3053 40MB (25 ms) $449

Seagate

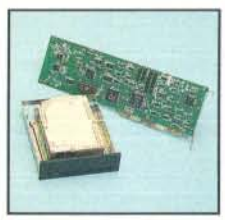
ST-225 20MB (65 ms) ..... $219/$259*
ST-238 30MB (65 ms) ..... $249/$299*
ST-125 20MB (40 ms) ..... $249/$299*
ST-151 40MB (24 ms) $439
ST-157R 48MB (28 ms) $349
ST-251-1 40MB (28 ms) $439
ST-4096 80MB (28 ms) $599

IMPRIMIS

CONTROL DATA

80MB (28 ms) $629
150MB ESDI (16.5 ms) .. $1299/$1495*

**Kit Price - includes cables, controller and mounting screws.*



Seagate
ST 157R Hard Drive
• 48 MB formatted
• 3.5" Technology
with Adaptec RLL Controller
• 1:1 Interleave
• Supports 2 Hard Drives & 2 Floppy Drives
$489

Call Today & Ask For Our Free Catalog

Swan TECHNOLOGIES a division of tcp

TUSSEY COMPUTER PRODUCTS
3075 RESEARCH DRIVE • STATE COLLEGE, PA • 16801

Open: 8a.m.-11p.m. M-F, 10a.m.-8p.m. Sat, 12p.m.-8p.m. Sun

Order Now Toll-Free
1-800-468-9044 S=BTJ
FAX: 814-237-4450 • International: 814-234-2236

call. 1-800-468-9044

SOFTWARE

AMERICAN
Design CAD 3.0 ..... $155
Design CAD 3-D $209

ASHTON-TATE
dBase III+/IV ..... $Call/$459

BEDFORD
Integrated Accounting $139
Toolbox ..... $Call

BLOC PUBLISHING
Personal Lawyer $39
Popdrop $34
Formfiller $89
Formtool $55

BORLAND
Paradox 3.0 ..... $449
Quattro $169
Turbo C 2.0 ..... $107
Turbo C Professional $159
Turbo Lightning $69
Turbo Pascal 5.5 ..... $99
Turbo Pascal Professional $169

BRODERBUND
Print Shop $34
Print Shop Companion $37

CENTRAL POINT
Copy II PC $27
Deluxe Option Board $109
PC Tools Deluxe 5.1 ..... $49

COMPUTER ASSOCIATES
Supercalc5 ..... $Call

COREL
Corel Draw $289

DAC SOFTWARE
Dac Bonus Pack $119
Dac Easy Accounting $59
Dac Easy Light $45
Dac Easy Payroll $59
Lucid 3-D $69
Call for Pricing on Tutors

FIFTH GENERATION
Fastback Plus $104

FOX
Foxbase+/386 ..... $199/$299

FUNK
Allways for 123/Symphony ..$89/$89
Sideways $42

GENERIC SOFTWARE
Generic CADD Level 3 ..... $169

INTUIT
Quicken 3.0 ..... $44

LOGITECH
Finesse $89

LOTUS
Agenda $269
123 v 2.01/3.0 ..... $299/$Call
Freelance Plus $339
Magellan ..... $Call
Symphony $439

MERIDIAN
Carbon Copy Plus $112

MICROSOFT
Excel ..... $Call
Flight Simulator 3.0 ..... $35
MS-DOS & GW BASIC ..... $Call
Quick BASIC $67
Quick C $67
Quick Pascal ..... $Call
Windows 286/386 ..... $64/$129
Word 5.0 ..... $Call
Works $99

PETER NORTON
Norton Commander $54
Norton Utilities $55
Norton Advanced Utilities $79

QUARTERDECK
DESQView/DESQView 386 $79/$119
QEMM $39

REFERENCE SOFTWARE
Grammatik III $54

SAMNA
Ami/Ami Pro ..... $99/$Call

SOFTWARE PUBLISHING
First Publisher $79
Harvard Graphics ..... $Call
PFS First Choice 3.0 ..... $89

SYMANTEC
Grandview $195
Q & A $209
Q & A Write $129
Timeline 3.0 ..... $359

THREE D GRAPHICS
Perspective Junior $99

WORD PERFECT
Library $69
Word Perfect 5.0 ..... $219

WORDSTAR
Wordstar Professional v 5.5 ..... $199
Wordstar v 5.5 Upgrade ..... $Call

XEROX
Ventura Publisher 2.0 ..... $Call

MODEMS

ATI
2400 etc Internal $159

Hayes Smart Modem
1200 bd Internal/External ..$259/$289
2400 bd Internal/External ..... $Call

Practical Peripherals
2400 bd Internal/External ..$149/$199

Swan Technologies
1200 bd Internal $69
1200 bd External $89
2400 bd Internal $99
2400 bd External $149

MICE

IMSI
Optical Mouse
w/Dr. Halo III $72

Microsoft
Mouse $109
Mouse with Windows $139

Logitech
NEW Bus Mouse (320 dpi) $75
NEW Serial Mouse (320 dpi) $79
with Paint add $10
ScanMan $199

Swan Peripherals ... Feather your nest for less.

Top-quality Swan peripherals can make your PC an even better place to work and play ... and at prices that won't crack your nest egg.

Every Swan brand name product comes with a 30-day, money-back trial guarantee. And every Swan product is backed by a full one-year warranty on parts and labor. You also get toll-free technical support and customer service.

You'll be tickled when you discover what a reliable Swan add-on can do for your home or office PC system.

Swan Modems

Make the world your partner. With the Swan Modem, you'll be able to communicate with other PCs and information services around the world through your pulse or touch tone phone. You'll tap into a world of data and broaden your horizons. Every Swan Modem comes complete with communication software and full documentation.

- Hayes® compatible • Auto answer/dial
- Include PC Talk III software

2400 bd internal* $99
1200 bd internal $69
2400 bd external $149
1200 bd external $89
** includes Bit Com v 3.5 software*

Swan Video Cards

Different people have different uses for their PC's ... from everyday uses like word processing and spreadsheets to today's more demanding applications, such as desktop publishing and presentation graphics. A Swan video card can help you better meet your needs today ... or help you ride the wave of technology into tomorrow.

Switchable Card •Hercules® to CGA
• Parallel Port $69

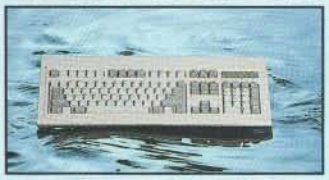
EGA Card • EGA/CGA/TTL
• 640 x 480 Resolution $169

VGA Card • Register-level compatible
• 256K RAM • 17 VGA Modes $199

Swan Tape Backups

Protect that nest of important data stored on your hard drive. Swan Tape Backups store 40MB on a single tape cartridge ... reliably, conveniently and economically. A Swan tape drive can be installed on any Swan computer and most XT- or AT-compatibles.

40MB XT or AT Internal $299
40MB XT or AT External $399



Swan Keyboards

It's important to have choices. So Swan gives them to you. You can depend on the Swan family of tactile keyboards for reliable typing with either the reassuring audible feedback of the "touch and click" or the quiet response of the "silent" keyboard.

101 Key Touch & Click or Silent . $79
84 Key Touch & Click $69

To order: No surcharge on Discover, Visa, MasterCard or AMEX. • Your credit card is not charged until your order is shipped. **Shipping:** 3% or $5 minimum for UPS Ground. Call for shipping charges on Express Air, APO, FPO, AK, HI and all foreign orders. • If part of your order is backordered, the remainder will be shipped UPS Ground. • Allow 2 weeks for personal and company checks to clear. • ALL SALES (except Swan products) ARE FINAL. • Defective items replaced or repaired at our discretion. • PA deliveries add 6% sales tax. • Prices and terms subject to change without notice.

VISA MasterCard DISCOVER American Express Card

MMG MICROCOMPUTER MARKETING COUNCIL

S=BTJ2

a division of tcp

TUSSEY COMPUTER PRODUCTS

Circle 308 on Reader Service Card

The #1 Distributors In Europe & The Rim Now Sell The #1 Software Protection In The World.

Software developers creating the latest applications for IBM PC/XT/ATs or compatibles can now turn to local distributors for the *first-class* in *world-class* software protection.

Rainbow Technologies' Software Sentinel™ family of hardware keys is protecting over $1 *billion* in personal computer software. Right now. Worldwide. With virtually unbreakable security.

The hardware key concept is simple and effective. Developers incorporate unique codes in their software program which interact with the Sentinel key. The key is shipped with the program and must be connected to the PC in order for the software to run. It's that easy.

Choose Rainbow's SentinelPro™ for most applications or the Sentinel-C for custom configurations. Each model assures the developer that only *holders of the key* can run the software. Without adversely affecting the operation of protected or unprotected programs.

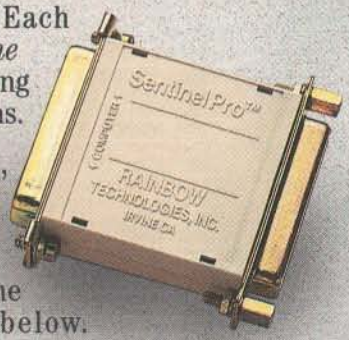
No matter where you sell your software worldwide, stay in control of your distribution and revenue by choosing the internationally accepted standard in protection. For additional information, contact Rainbow Technologies Ltd. in the U.K. or one of the European or Pacific Rim distributors listed below.

SentinelPro™

- Runs under DOS, OS/2 and Xenix, on IBM PC/XT, AT, PS/2 and compatibles, and Atari ST
- Algorithm technique (Never a fixed response)
- Parallel port version
- Minimal implementation effort
- Higher level language interfaces included
- 100 times faster than fixed-response devices (1 ms)
- ASIC design for reliability
- Evaluation kits are available

Sentinel-C

- Protects multiple packages with one device
- 126 bytes of non-volatile memory programmed before shipment of the software
- Rainbow supplies the developer a unique adapter for programming the unit
- Higher level language interfaces included
- Runs under DOS, OS/2 and Xenix, on IBM PC/XT/AT, PS/2 and compatibles
- Parallel port version
- Evaluation kits are available



EUROPE

- **FRANCE**
  Kontron Electronique
  Vélizy Villacoublay (Paris)
  tel: (33) 1 3946 9722
  fax: (33) 1 3946 0240
- **ITALY**
  BFI IBEXSA SPA
  Milan
  tel: (39) 2 331 00535
  fax: (39) 2 349 2344
- **BENELUX**
  IntroCom Electronica
  Hengelo, The Netherlands
  tel: (31) 74 430 105
  fax: (31) 74 429 895
- **SPAIN**
  MECCO
  Barcelona
  tel: (34) 3 422 7700
  fax: (34) 3 432 2847
- **WEST GERMANY**
  Kontron Datasystems GmbH
  Eching (Munich)
  tel: (49) 81 65 707-0
  fax: (49) 81 65 707 113
- **SWITZERLAND**
  IBV AG
  Birmensdorf (Zurich)
  tel: (41) 1 737 0176
  fax: (41) 1 737 1832
- **SCANDINAVIA**
  PERICO A/S
  Oslo, Norway
  tel: (47) 2 491500
  fax: (47) 2 397064

PACIFIC RIM

- **AUSTRALIA AND NEW ZEALAND**
  FMS Pty. Ltd.
  Melbourne
  tel: (61) 3 699 9899
  fax: (61) 3 699 7501
- **CHINA**
  Beta Trading
  Hong Kong
  tel: (85) 2 5 448963
  fax: (85) 2 5 459173
- **JAPAN**
  Giken Shoji Co., Ltd.
  Nagoya
  tel: (81) 52 251 4721
  fax: (81) 52 251 0229

Call Today For More Information.
DISTRIBUTOR INQUIRIES WELCOME.

Circle 235 on Reader Service Card
(DEALERS: 236)

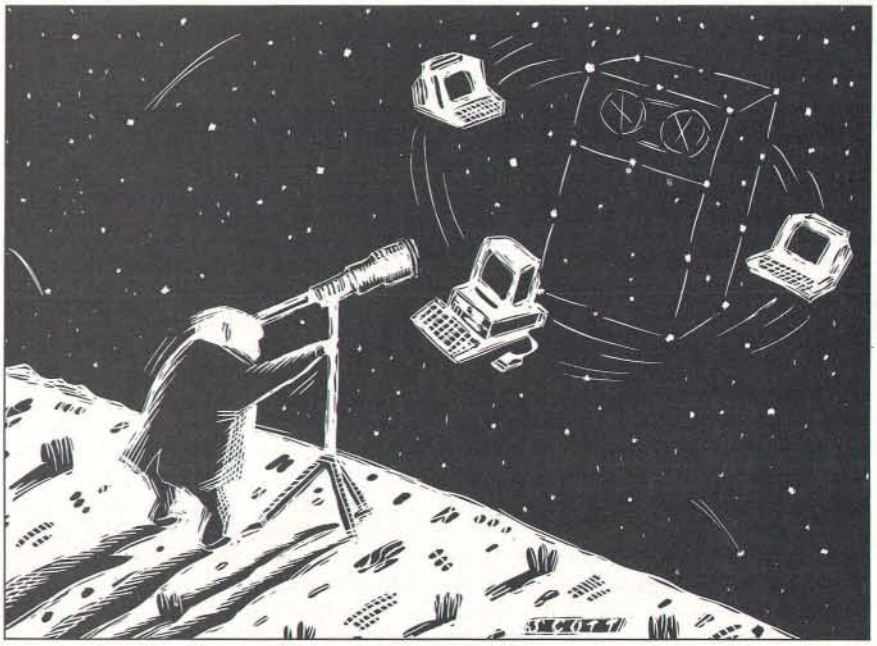
RAINBOW TECHNOLOGIES, LTD.

Shirley Lodge, 470 London Rd., Slough, Berkshire, SL3 8QY U.K. Tel: 0753-41512 Fax: 0753-43610
USA: Rainbow Technologies, Inc., 18011-A Mitchell South, Irvine, CA 92714 • (714) 261-0228 • TELEX: 386078 • FAX: (714) 261-0260

©Copyright 1989 Rainbow Technologies, Inc. All product names are trademarks of their respective manufacturers.

IBM'S VISION FOR YOUR OFFICE

Is OfficeVision a glimpse of the future, or a blast from the past?



When IBM announced its Systems Application Architecture last year, it was clear that the company had some sort of grand plan, but it wasn't clear what the plan was. With the announcement of OfficeVision, the first collection of software for SAA, the plan's outlines have begun to appear.

OfficeVision is a collection of programs that support common requirements, much like those supported by Borland's SideKick. Unlike SideKick, however, OfficeVision also supports E-mail through a LAN or a mainframe, and it has a programming interface that allows other vendors to integrate their software into OfficeVision. It also has an address book, a basic word processor, a phone dialer, and a filer.

Next year's version will add more features, including the ability to support outside software. OfficeVision will have the same graphical user interface as Presentation Manager (PM). Eventually, the product will be available on every computer that IBM sells.

So what does this tell us about IBM's plans for the future?

First, IBM is committed to the infusion of personal computers throughout its corporate base. Personal computers (IBM would prefer you to use PS/2s) are an integral part of OfficeVision. The indication is that future applications will require personal computers to reduce the load on the mainframe processor.

Second, IBM believes that the LAN is here to stay. LANs provide the bulk of the communications required by SAA, and the first version of OfficeVision will be a LAN product. In the future, LANs will be even more necessary to SAA than they are now.

Finally, IBM still has its eye on the continuation of the mainframe as the backbone of corporate computing. Ultimately, SAA depends on data residing on a mainframe. This means that IBM plans to have data managed centrally by a data-processing department.

Personal Processing

Even though there will eventually be versions of OfficeVision for IBM's minicomputer and mainframe lines, IBM introduced it first in the personal computer marketplace, partly because of OS/2, which was intended for this purpose. It's also because OfficeVision requires some hefty computing resources that are more readily available on personal computers.

The first versions of OfficeVision will look familiar to current users of PM or Windows. The graphical interface will be the same, and it will be controlled by a mouse in the same manner. These processes are heavy users of the CPU, however, so it will take some time for IBM to tune them for use by terminals on their mainframes.

The first version of OfficeVision to be introduced will be called OfficeVision/2 LAN. The introduction for this version, scheduled for last month, should have taken place by the time you read this. This version is designed for machines using OS/2, and it will communicate with others using a Token Ring LAN. Later, there will be support for Ethernet when OS/2 Extended Edition 1.2 is shipped in January 1990.

LAN Connection

OfficeVision is designed to work with a LAN. The E-mail capability in the initial version depends on it, and future releases will depend on it more. As SAA and OfficeVision software progress through their development, they will depend on

continued

ILLUSTRATION: JULIE SCOTT © 1989

data stored on mainframes and minicomputers.

Currently, OfficeVision will support only IBM's Token Ring network. It's a safe bet that other companies, including 3Com and Novell, will find a way to support OfficeVision, too. In the meantime, OfficeVision/2 LAN will also quietly support DOS machines. IBM has worked with Consumers Software of Vancouver to develop MS-DOS workstation support for OfficeVision.

LAN usage becomes more critical with software such as Executive Decision/VM. This package is designed to run on both a mainframe running in a virtual machine environment and a personal computer running OS/2. Executive Decision is a true SAA application. It runs on the personal computer, but it uses a LAN to reach a mainframe where the data is actually stored. As a result, the personal computer never really has the data available internally. Instead, it extracts what it needs from the corporate database on the mainframe.

Central Storage

Eventually, this centralized storage is what IBM intends for the majority of the computing environment. There are some sound marketing and business reasons for this. Simply put, IBM's plan puts the corporate data-processing department in charge of the data again.

The concept is simply this: The personal computer would become an "intelligent workstation." Processing would be shared between the workstation and the central computer. While there may be some local data storage, most data would reside on the central mainframe. The SAA software on the workstation would find the data it needed, wherever it was. The user would never know where the data was kept or how it was found.

Let's say, for example, that you were working with employee records to determine pay raises for the next year. The information might come from personnel data on an AS/400, financial data from the corporation's 3090, and employee performance data from a database server on the LAN. The application would send out Structured Query Language (SQL) queries to each of the three databases.

When the response comes back, the software on the workstation will present it in a single picture. You would have no way to know that three computers were queried. In fact, you'd probably have no way to query those computers directly.

The data used for the queries would remain in its respective databases. It would not be transferred to the personal computer, and the databases could not be manipulated unless that capability was given to a specific user.

ITEMS DISCUSSED

Executive Decision/VM ..... $7500 to $45,000

OfficeVision/2 LAN
- OS/2 ..... $750
- DOS $210

OS/2 1.2
- Standard Edition $340
- Extended Edition $830

IBM Corp.
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900
Inquiry 1101.

Corporate Safety

From the viewpoint of the corporation's management, this change is a distinct improvement over today's situation, where the corporate data is spread among literally thousands of personal computers. There, the corporation has no way of ensuring that important data is safe and properly backed up. In addition, it has no assurance that the data is up-to-date or correct. Management decisions are being made with data that may be corrupted or outdated, and data vital to the operation of the corporation may be lost through something as minor as the failure of a $200 hard disk drive.

Clearly, corporate management prefers greater control over the company's information than is frequently the case now. Unfortunately, until very recently, there has been no way to provide this. There simply weren't any good ways to consolidate the corporation's data so that it would be secure yet still available to personal computer users when needed.

Now that LANs and SQL have been teamed, that bottleneck is no longer a problem. Users can access a mainframe database almost as easily as they can access data on their personal computers. The only problem is that frequently the methods for doing so are proprietary.

The proprietary nature of these databases is, of course, part of IBM's plan. The idea is that you would have to buy an IBM brand of central computer along with your IBM PS/2. They would be linked by an IBM Token Ring LAN.

This process would continue as development of SAA continues. More and more applications would use central databases for all their data. This would include programs that today use mostly local storage, such as spreadsheets and word processors. You would have the ability to draw from vast corporate resources, but you would be controlled by a central data-processing department.

From IBM's point of view, this is ideal. Companies would come to depend more and more on central mainframes, while at the same time buying more and more personal computers. Everybody benefits, except perhaps the user who may need something that IBM isn't selling. Particularly frustrated by this situation will be small businesses that don't have the resources to buy an IBM mainframe. Those users will simply be left out in the cold by IBM's solution.

Third Parties

Fortunately, there is a SQL world outside of IBM. SQL servers are available from Oracle, Ashton-Tate, Gupta Technologies, and WordTech. SQL databases are available for minicomputers and mainframes from a variety of sources besides IBM. In short, as the benefits of SAA become clear, there will be a way to achieve them outside of IBM.

In fact, most of the benefits of SAA can be achieved without using a central mainframe at all. LAN-based database servers will handle virtually all the same operations as a mainframe DBMS and will permit control of the database to remain with the individual department. New advances in data archiving will let these servers be protected and backed up in much the same way as a mainframe but without requiring a mainframe's staff.

Clearly, SAA has much to offer corporate users. Most important, it offers security of data. After all, the data does belong to the corporation, and it is in the corporation's interests to protect it. That this can be done without moving to IBM as a sole supplier probably ensures that it will happen all the faster. What is missing is a middle ground. Not everyone and not every company needs or can support a minicomputer or a mainframe. At this point, IBM's solution will freeze them out of SAA. ■

Wayne Rash Jr. is a contributing editor for BYTE and a member of the professional staff of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as "waynerash," or in the to.wayne conference.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

POWER HUNGRY!

Introducing CompuStar II. It's one hungry machine! Feed it the toughest applications you can dish out and it's ready in seconds before all of the others get started.

IT FEEDS ON THE COMPETITION.

CompuStar II's enormous appetite for devouring your toughest challenge (and the competition) comes from its unique, modular design, interchangeable, plug-in CPU modules are available in 80286, 80386SX and 80386 configurations. The modules are remarkably inexpensive — around £500 for a '286 module, and incredibly powerful.* The 33MHz '386 module achieves a stunning MIPS rating! Best of all, for up to one full year after purchase, you can trade in the module you originally select toward the purchase of any of the other more powerful modules.

IT DEVOURS OTHER COMPACTS.

Unlike other small footprint micros, CompuStar II won't put your computer expansion needs on a diet. Each system features an amazing six bus slots — four of them available in a fully configured VGA system. That's 25% more than IBM gives you. Better yet, you can have up to 11 slots with CompuStar II's exclusive bus expansion chassis. No other compact system available offers this much room for growth. And no other comparably sized system can accommodate that growth better than CompuStar II. It's whopping 200 watt power supply gives you more than twice as much reserve power as IBM and others.

And CompuStar II has more room for disk/tape drives — four compartments in all; three accessible from the front panel. IBM and others give you just three compartments and only two are accessible from the front. CompuStar II also accommodates 5.25" and 3.50" disk drives. Others restrict you to 3.50" only.

IT'S ALSO WELL MANNERED.

Worried about quality and reliability? Don't! Wells American has been making PCs longer than IBM, Compaq, Dell, Apple and a host of others. In fact, with over 16 years experience, nobody has been manufacturing micros longer than Wells American. Each CompuStar II is money-back guaranteed for 31-days and warranted for one year with an exclusive on-site service agreement — all inclusive in the price of the machine. When you think about it, buying an IBM or other system instead of our new CompuStar II is sort of like eating hamburger when you could have had steak — and paid less for it. CompuStar II. . .from Wells American. It makes "mincemeat" of everything else.

To receive a free CompuStar II product information kit, call our exclusive UK/FRG distributors listed below

Wells American

EXCLUSIVE UK DISTRIBUTOR:
Trafalgar Supplies Ltd.
Victoria House • Desborough Street • High Wycombe • Bucks. • HP11 2NF
Tel. (0494) 448874 • FAX (0494) 449483 • Freeephone 0800 585386

EXCLUSIVE FRG DISTRIBUTOR:
WMI Computer Service
Badenerstraße 1 D-7890 Waldshut - Tiengen 1
Tel: 07751/2088 • FAX: 07751/7749

IBM is a trademark of International Business Machines Corporation. Dell refers to Dell Computer Corporation.
*CompuStar II's CPU performance is so incredible you won't believe it! Call or write for complete benchmark information.

© Wells American Corporation 1989

BYTE Subscriber Services Available

Your BYTE subscription brings you a complete diet of the latest in microcomputer technology every 30 days. The kind of broad-based objective coverage you've read in this issue. To ensure that you receive the best possible service during the term of your subscription, we have listed below a wealth of services, available to you as a BYTE subscriber.

BONUSES

- ☑ ***Annual Separate Issues:*** In addition to BYTE's 12 monthly issues, subscribers also receive our annual IBM PC issue free of charge, as well as any other annual issues BYTE may produce.
- ☑ ***Reader Service:*** For information on products advertised in BYTE, circle the numbers on the Reader Service Card enclosed in each issue that correspond to the numbers for the advertisers you select. Drop in the mail and we'll get your inquiries to the advertisers.
- ☑ ***Subscription Service:*** If you have a problem with, or a question about your subscription, you may contact us at the following addresses.

Europe:
BYTE Subscriptions
McGraw-Hill House
Maidenhead, Berkshire
England SL6 2QL

Outside Europe:
BYTE Customer Service
Department
Box 6821
Hancock, NH 03449 U.S.A.

Mail us the details along with the name, address and postal codes of the subscription. If the problem involves a payment, please include a copy of the credit card statement or front and back of your cancelled check. For information regarding back issues and editorial indicies, write to the following address:

BYTE Customer Service
Department
Box 328
Hancock, NH 03449 U.S.A.

PAID SERVICES

- ☑ ***BIX:*** BYTE's Information Exchange puts you on-line 24 hours a day with your peers via computer conferencing and electronic mail. All you need is a microcomputer, a modem and a password. See the BIX ad (refer to Index for page) in this issue of BYTE for cost information on foreign registration and usage.
- ☑ ***Program Listings:*** Listings of programs that accompany BYTE articles are now available on BIX, on disks or in quarterly printed supplements (see reply cards in this issue for cost information).
- ☑ ***Microform:*** BYTE is available in microform from University Microfilm International in the U.S. and Europe. See Contents page for cost information.

DISCOUNTS

- ☑ Group discounts available for one-year subscriptions. For details write to the following address:

BYTE Group Subscriptions
P.O. Box 555
Hightstown, NJ 08520 U.S.A.

Be on the leading edge of micro technology. Subscribe to BYTE magazine and in addition benefit from all the aforementioned services. Complete and mail in a subscription card from the adjacent page.

BYTE McGraw-Hill

Order your BYTE subscription with one of the convenient order cards in this issue or through a McGraw-Hill representative or magazine agency listed below:

McGraw-Hill Representatives:

France:
McGraw-Hill
18 Rue Des Cordonniers
78600 Maisons Lafitte
1-39-62-57-79

Italy:
McGraw-Hill/Ceti
Lungo Po Antonelli 205
10153 Torino
11-8999023

Netherlands:
McGraw-Hill Benelux
Waaldijk 8
5327 AC Hurwenen
Netherlands
04182-1553

Scandinavia:
McGraw-Hill
Holm Marketing
Granstuevej 13
DK-2840 Holte
Denmark
2-422-806

Spain:
McGraw-Hill De Espana
Santa Beatriz 4
28038 Madrid
1-433-8777

Turkey:
McGraw-Hill
Halitaga Kad Eksioglu Ishani
Kad 4 No 101 Kadikoy
Istanbul
11-337-8145

United Kingdom:
Circulation Field Sales
McGraw-Hill
McGraw-Hill House
Maidenhead, Berkshire SL6 2QL
England
0628-23431

Austria/Switzerland/West Germany:
McGraw-Hill
Postfach 40 02 69
D-8000 Munchen 40
West Germany
89-525847

Agencies:

Austria:
Minerva
Postfach 367
A-1001 Vienna

Belgium:
Office International Periodiques
Avenue Louise 485
B-1050 Brussels

Denmark:
Harck & Gjellerup Booksellers
G.E.C. Gad Norreport
31-33 Fiolstraede
DK-1171 Copenhagen K

United Kingdom:
Blackwells Periodicals
PO Box 40
Hythe Bridge Street
Oxford OX1 2EU

Finland:
Akateeminen Kirjakauppa
PO Box 128
SF-00101 Helsinki 10

France:
Dawson France
Rue De La Prairie
91121 Palaiseau Cedex

Greece:
A. Atzemiam & Co
9 Amerikis Street
Athens 10672

Italy:
D.E.A.
28 Via Lima
00198 Rome

Netherlands:
Faxon Europe
2 Voorburgwal 60
Box 197
1012 SC Amsterdam

Norway:
Narvesen As Subscriptions
Boks 6125
Etterstad, Oslo 6

Portugal:
Fernando Machado & Co
15 Rua Das Carmelitas
4000 Porto

Spain:
Diaz De Santos Sa
Liberia Cientificio Tecnica
Calle De Lagasca 95/PO Box 6.050
Madrid 6

Sweden:
Esselte Tidskriftscentralen
PO Box 45150
5-10430 Stockholm

Switzerland:
Hans Huber
Langgasstrasse 76 & Marktgasse 9
3000 Bern 9

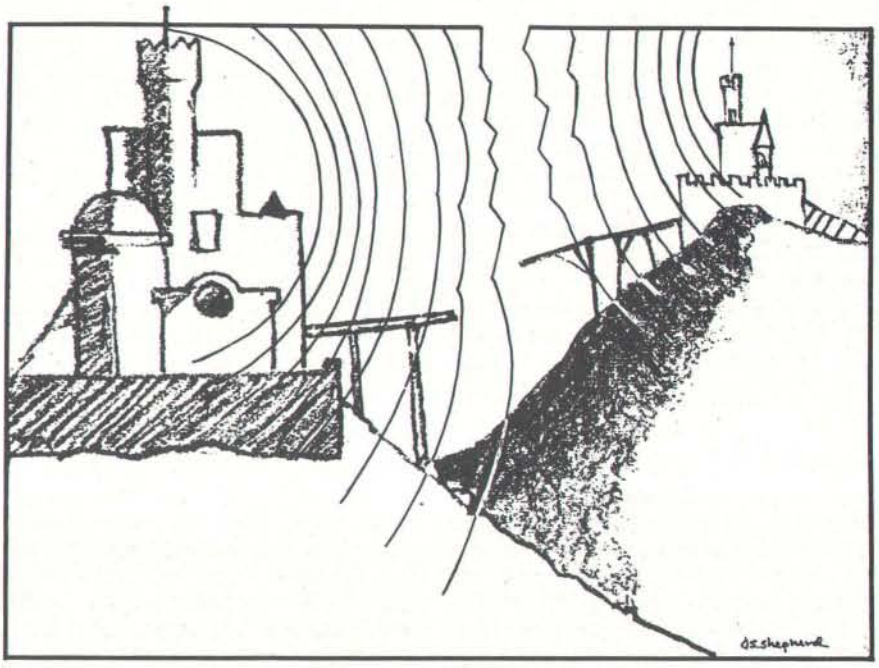
Turkey:
Caglayan Kitabevi
Beyoglu Takaoliyan Ust Pasaj
7-8-9-21 Istanbul

West Germany:
Kunst & Wissen
Willhelmstrasse 4
Postfach 46
D-7000 Stuttgart 1

Yugoslavia:
Cankarjeva Zalozba
Postni Predai 201
61001 Ljubljana

BREAKING DOWN THE BARRIERS

There are three approaches to linking PCs and Macs on a LAN—here's our favorite



There are many cultural barriers that make it difficult to integrate such diverse systems as Macintoshes, IBM PCs, Sun workstations, and DEC VAXes on a LAN. This month we look at a few of the issues you'll face and some products you might want to consider if you try to integrate the two most common types of microcomputers: PCs and Macs.

The first step toward PC-to-Mac communications is to connect the systems physically. You have two choices: You can use the Mac standard by buying LocalTalk boards for your PCs, or you can choose a common PC connection, Ethernet, and buy Ethernet adapters for your Macs.

Unfortunately, hooking up heterogeneous systems requires much more than just a physical connection. You've still got to make both systems speak the same language—which, in this case, is the same higher-level protocols. Those protocols are typically the ones that a LAN operating system provides.

Speaking the Lingo

A LAN operating system that integrates heterogeneous systems must follow one of three basic approaches.

In one method, the LAN can force one system to talk the lingua franca of the other. Apple's AppleShare PC follows this approach. You put a LocalTalk card in your PC and wire the PC to your Mac network, and then the PC can access files on the Mac AppleShare file server. The problem with this method is that one kind of system will need to abandon its native environment.

Another approach is to create a new LAN operating system, a sort of LAN Esperanto, and then implement that new system on both the Macs and the PCs. The TOPS LAN operating system, from Sun Microsystems, works this way. TOPS can run over either LocalTalk or Ethernet, and it doesn't require a dedicated server—both PCs and Macs can share files with the other systems on the LAN. The major drawback of this approach is that it typically doesn't use the native protocols of either system. TOPS, for example, doesn't presently support the AppleTalk Filing Protocol (AFP) on the Mac.

The third method is a compromise: Each system speaks its own "language," or native protocols, and a third party translates between those protocols. Novell's NetWare for Macintosh employs this technique. PCs use the NetWare LAN operating system, while Macs use their standard AFP services.

We believe that this approach, which essentially says, "Stick with what you know, and let a translator do the work," is the right one for most applications. Since Novell has the best implementation of this approach so far, we'll take a closer look at NetWare for Macintosh.

NetWare for Macintosh

NetWare for Macintosh is a translator, or gateway, that runs in a NetWare 2.15 server. Because NetWare uses Novell's proprietary NCP (NetWare Core Protocol) protocols internally, this gateway translates between NetWare's IPX (Internet Packet Exchange) and the AppleTalk protocols that the Macs require. It has five main components.

The LAN board and its driver implement the LocalTalk or EtherTalk protocols and the actual hardware interface. While you install either board with NetWare's standard NETGEN program,

continued

ILLUSTRATION: DEBORAH SHEPHERD © 1989

neither one actually uses a valid NetWare LAN driver. Instead, NetWare never really sees the board. A NetWare Value Added Process (VAP) works with the board; NETGEN creates a stub for the hooks to that VAP.

The next component provides three of Apple's protocols—the Datagram Delivery Protocol (DDP), the AppleTalk Transport Protocol (ATP), and the AppleTalk Session Protocol (ASP)—on the NetWare server. NetWare for Macintosh needs these protocols to match the standard AppleTalk protocol stack. (See the July NetWorks column for more information on these protocols.) Next up the protocol stack is NetWare for Macintosh's AFP VAP. It uses these lower-level protocols to act just like any other AFP server. Macs on the LAN can't distinguish this AFP VAP from any other AFP server.

The final piece of the puzzle is the Service Protocol Gateway (SPG), which translates between AFP requests from the AFP VAP and requests in the NCP format. Once the requests are in the NCP format, NetWare NCP can handle them just as it would handle NCP requests from a PC.

Tracing the Path

The easiest way to understand how all these pieces work together is to look at an example. Consider a file request from a Mac. First, the Mac user brings up the Chooser, selects the NetWare for Macintosh server, and logs onto it. The server's icon appears, and the user treats it like any other disk; to get a server file, the user double-clicks on that file.

The Mac AppleShare client software then goes to work. It requests the contents of the file using AFP. The AFP packet flows down through the usual ASP, ATP, and DDP layers and finally ends up on the LocalTalk wiring.

When the packet reaches the NetWare server's NL1000 LocalTalk board, the server takes over. It sends the packet up through the driver, DDP, ATP, and ASP layers to the AFP VAP. The AFP VAP hands the request to the SPG, which translates it into an NCP request. NCP gets the file and sends the data back through the reverse path.

Icons and Resources

The beauty of this technique is that the Mac never knows that the file isn't on an AppleShare server. NetWare for Macintosh uses the standard AppleShare client software on the Mac.

Presenting that illusion isn't easy. One big difficulty stems from the way Macs store files: A Mac file actually has two underlying files, a *data fork* and a *resource fork*. The data fork holds the file's data, while the resource fork contains such related items as icons and dialog boxes. Every Mac file must have these two components.

DOS files, of course, don't meet this requirement, and therein lies the problem. TOPS gets around this problem by using a Desktop file in every directory that contains the resource information for all the PC files in that directory. Similarly, NetWare for Macintosh uses a Desktop directory on the server to store the information for resource forks and icons for DOS files. Those files appear to the Mac user with a special DOS icon.

Print Services

AppleTalk also lets you share printers, so NetWare for Macintosh offers the same services. Instead of using an AFP VAP and SPG, however, it contains a corresponding AppleTalk Print Server (APS) VAP that lets a Mac user either queue print requests on the NetWare server or talk directly to the printer.

The APS VAP implements queuing by appearing to the Macs as a LaserWriter. When Printer Access Protocol packets from a Mac arrive at the server, they go up through the DDP and ATP layers to the APS VAP. The APS VAP then translates those requests into NetWare print queue requests. Then, when the NetWare print queue manager is ready to send a print request to the LaserWriter, it hands that request to the APS VAP. The APS VAP then acts like a Macintosh and sends the print job to the LaserWriter.

PCs can also use NetWare's standard printing facilities to queue up PostScript files for printing on the LaserWriter—so PCs and Macs can share a LaserWriter courtesy of NetWare's print queue.

Finally, Macs on the LAN can bypass the server and send print requests directly to the LaserWriter, although those requests will then not be in NetWare's print queue.

If a Mac user wants only the standard AppleShare client software features, then NetWare for Macintosh is happy to oblige. NetWare for Macintosh does, however, offer a few additional utilities for venturesome Mac users. The most interesting one is the Rights desk accessory, which lets Mac users manipulate NetWare's large set of file protections.

Almost There

With all these tools, you're almost done, but not quite. You still need applications that can either use files on both Macs and PCs or at least translate files between the two systems. Currently, only a few such applications exist, although more are appearing all the time.

One such application is Microsoft Word. We had some PC Word files on our 80386-based Samsung NetWare server. We decided to go for the gold and started Word on the Mac on one of those files. No problem; the Mac Word program recognized that the file was from a PC version of Word, translated the file automatically—without losing any formatting—and we were in business.

Unfortunately, if we had tried opening a WordStar file from MacWrite instead, we wouldn't have been as lucky. The greatest integrated LAN operating system in the world isn't much good if your applications can't take advantage of files from different machines.

A Look Ahead

NetWare for Macintosh is impressive, but it does have a few problems. There are, for example, several bugs in the print spooling code. Other problems have prompted Novell to suspend product shipments temporarily. (The product should be shipping again by the time you read this.)

More frustrating, however, is the product's immediate future. The design of Novell's new NetWare 386 version 3.0 supports a cleaner integration of products, such as NetWare for Macintosh, than does the design of NetWare 2.15. Sadly, the initial release of NetWare 386 doesn't support NetWare for Macintosh. If you want both the new features of NetWare 386 and the power of NetWare for Macintosh, you'll have to wait.

Still, the next year should be a good one for products that link heterogeneous systems. Token Ring Mac boards are becoming available. Competition in the LAN operating-system arena will heat up as TOPS and 3Com bring out strong new offerings with AFP support. Finally, more and more major applications now offer both Mac and PC versions, with some way to share files between those versions. The barriers, it seems, are slowly falling down. ■

Mark L. Van Name, a BYTE consulting editor, and Bill Catchings are independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Our Printer Sharing Unit Does Networking!

An Integrated Solution

Take our **Master Switch**™, a sophisticated sharing device, combine it with **MasterNet**™ networking software for PCs, and you've got an integrated solution for printer and plotter sharing, file transfer, electronic mail, and a lot more. Of course you can also share modems, minis, and mainframes or access the network remotely. Installation and operation is very simple.

Versatile

Or you can use the Master Switch to link any computer or peripheral with a serial or parallel interface. The switch accepts over 20 commands for controlling the flow of data. It may be operated automatically, by command, or with interactive menus. Its buffer is expandable to one megabyte and holds up to 64 simultaneous jobs. The **MasterLink**™ utility diskette for PCs comes with every unit and unleashes the power of the switch with its memory-resident access to the commands and menus.

Other Products

We have a full line of connectivity solutions. If you just want printer sharing, we've got it. We also have automatic switches, code-activated switches, buffers, converters, cables, protocol converters, multiplexers, line drivers, and other products.

Commitment to Excellence

At Rose Electronics, we're not satisfied until you're satisfied. That's why we have thousands of customers around the world including large, medium, and small businesses, factories, stores, educational institutions, and Federal, state, and local governments. We back our products with full technical support, a one-year warranty, and a thirty-day money-back guarantee.

ROSE ELECTRONICS

Call now for literature or more information.
(800) 333-9343

Give a Rose to your computer

P.O. Box 742571 • Houston, Texas 77274 • **Tel** (713) 933-7673 • **FAX** (713) 933-0044 • **Telex** 4948886

Circle 238 on Reader Service Card (DEALERS: 239)

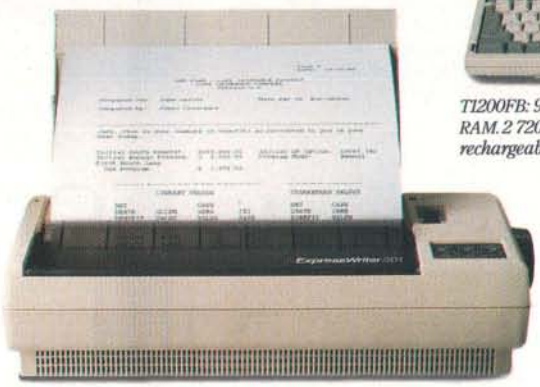
We develop products on the premise that

Page Laser12: 12 ppm, up to 3 paper bins, 750 sheet capability, Toshiba/Qume, Diablo, IBM & HP emulations.

T1000: 6.4 lbs, 4.77MHz 80C88, 512KB RAM expandable to 1.2MB. MS-DOS in ROM, 720KB 3½" diskette drive. Built-in RGB, parallel, serial and external drive ports.

P341SL: Wide carriage (up to 270CPL), 216/72 cps, advanced paper handling, 4 part forms.

T1200FB: 9.8 pounds, 9.54MHz 80C86, 1MB RAM. 2 720KB 3½" floppy drives, removable/ rechargeable battery pack.



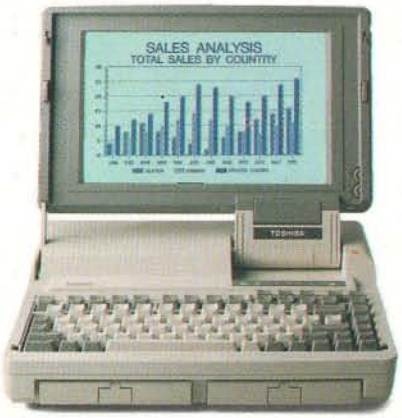
ExpressWriter 301: 4 lbs, letter-quality 24-dot print head, 60 cps, Toshiba/Qume and Epson LQ emulations, 5 resident fonts.

T3100e: 12MHz 80286, internal IBM slot, 20MB hard disk, gas plasma display, 1MB RAM expands to 5MB, 1.44MB 3½" diskette drive.

T5100: 16MHz 80386 microprocessor, 40 or 100MB hard disk, 2MB RAM expandable to 4MB. 14.6 lbs. Built-in EGA display with high resolution gas plasma screen.

P351SX: 360/120 cps, 24-pin letter quality, color option, Toshiba/Qume and IBM emulations standard, Epson & Diablo emulations optional.

great minds don't think alike.



T1600: 11.6 lbs, Battery-powered 12MHz 286, 20MB hard disk, 1.44MB floppy. 1MB RAM expands to 5MB, backlit EGA LCD, removable/rechargeable battery packs.

T5200: 20MHz 80386 processor, 2 internal IBM compatible expansion slots, 40 or 100MB hard disk, VGA display with external VGA monitor port, 2MB RAM expandable to 8MB.

© 1989 Toshiba America Computer Systems Division

T3200: 12MHz 286, 2 IBM compatible slots. 40MB hard disk, 1.44MB floppy, 1MB RAM expands to 4MB, EGA screen.

Carrying cases: available in leather or fabric, make our portable PCs even more portable.

ExpressWriter 311: 24-pin dot matrix, 180 cps draft/60 cps letter quality, 3 resident emulations (Toshiba/Qume, Epson LQ, IBM Proprinter), 16K buffer, 5 resident fonts plus card slots, 11 lbs.

Numeric Keypad: full function, 15 or 17 keys, for many of our portable PCs.

T1200HB: 10.8 lbs, 9.54MHz 80C86, 20MB hard disk, 1MB RAM, includes 384KB LIM-EMS. Removable/rechargeable battery pack.

P321SL/SLC (color): 216/72 cps, 24-pin letter quality, up to 360x360 DPI graphics, Toshiba/Qume and IBM emulations standard, Epson and Diablo emulations optional, 32KB print buffer, front panel controls, advanced paper handling.

People have their own quirky ways of doing things. Some think fast. Some slow. Some are deliberate. Some intuitive. Some work from 9 to 5. Others never stop.

That's precisely why we offer so many different products.

Including the widest range of truly portable PCs anywhere.

And a line of printers that includes everything from a high volume laser to a four-pound, letter-quality, battery-operated portable.

All of which can be easily networked. But all of which are designed to meet the specific needs of each of our individual users.

Because the fact is, at Toshiba, we have an incredibly diverse and sophisticated customer base.

And from what we've been able to determine they have only one thing in common.

They're all different.

In Touch with Tomorrow

TOSHIBA

Toshiba America Information Systems, Inc., Computer Systems Division

Circle 273 on Reader Service Card (DEALERS: 274)

The Optical Option

WORM and erasable optical drives offer practical solutions to large-scale storage requirements

Steve Apiki
and Howard Eglowstein

Optical storage technology sounds like science fiction, but using a laser beam to put hundreds of megabytes of data on a disk cartridge that fits into your hand has become a fact. Beyond the technology's Buck Rogers appeal lie practical, real-world devices that answer today's mass-storage requirements.

Optical drives—WORM (write once, read many times) and rewritable systems—are the most appealing, most elegant method yet devised for storing vast amounts of data. But these cutting-edge products have their limitations. Access times, while steadily improving, remain well behind those of magnetic drives. And the relatively high cost of optical drives has made them unacceptable for everyday use.

However, the current trend toward monstrous operating systems, shared databases, and more realistic visual images on disk may shift the economic balance in favor of optical storage. As files get ever larger, optical storage gets more and more appealing—no technology can compete with optical disks when you're measuring backup or even day-to-day requirements in gigabytes.

This month we focus on nine WORM and four rewritable optical disk drive systems available for both Macintosh and IBM PC-compatible computers (see table 1). All are full-height units that use 5¼-inch removable media cartridges with capacities of from 600 megabytes to more than 1 gigabyte. Many of the packages are resold versions of the same drive or controller bundled with different driver software. To make the most meaningful comparisons, we evaluated each product as a complete system.

WORMs vs. Erasables

WORMs and erasable optical drives both use lasers to pack information densely on a removable disk. But beyond that, they have little in common. The two technologies use different media, incorporate different recording and reading schemes, and have different uses (see the text box "Optical Technologies" on page 168).

WORM drives were the first type of writable optical storage device to become widely available; 5¼-inch drives were available as early as 1985. As the name implies, you can write to each disk only once, and you can't erase data stored on a WORM. This natural data permanence makes WORMs ideal devices for archival backups. They're well suited to situations in which permanent records are required by law; for example, an insurance company might use a WORM to save scanned reports. Another application might be at an engineering design firm that requires a permanent record of all design revisions.

Because of their huge capacity and relatively fast random-access retrieval capability, WORMs are also useful for general archival storage. While WORMs are, by nature, sequential write devices, vendors have gone to great lengths to make them emulate random-access write devices. As such, they're useful for incremental backups or for storing databases that must be regularly updated.

Erasable optical drives are a more recent development, and few are available. Erasable units are ideal for backups. Since you can remove and reuse them, they provide virtually limitless storage capability. Although too slow to be direct replacements for magnetic disks, erasable optical drives are functionally equivalent, and you can use them with almost any applications software.

Unlike WORMs, where competing formats make data interchange a remote possibility, the prospects for a standard for rewritable optical disk technology look good. The International Standards Organization (ISO) is in the final stages of issuing a formal standard, and manufacturers are working toward conformance. ANSI has an identical standard on the table. Although standards will allow data interchange between different manufacturers' products, data interchange is all but impossible between currently available units.

The Speed of Light

We tested the WORM and rewritable drives on two platforms: a 20-MHz Compaq Deskpro 386 and an Apple Macintosh IIcx. We installed each drive according to the manufacturer's instructions. Some PC software provided for either a RAM or magnetic disk cache. Where possible, we accepted the manufacturer's default values for cache size.

Our tests examine optical drive performance in three areas: as a backup device, as a large general-purpose disk, and as a medium for document storage and retrieval. The raw results for each test are shown in table 2. Graphs of these results appear in the figure. The bars in each graph are normalized against magnetic drives running on the appropriate machine; on the DOS side, we used Compaq's 120-megabyte ESDI hard disk drive, and on the Mac we used the Mac IIcx's 80-megabyte internal hard drive.

For the backup test, we copied a large directory structure from the system's primary magnetic drive to the optical drive. The test data was a 25-megabyte

continued

A collection of WORM drives

Left side: ISi 525GB, LaserDrive 810-111

Center, top to bottom: Maximum Storage APX-4200, Pioneer DD-S5001, SDI LaserStor 800, SDI LaserStor for Macintosh, Corel 800

Right side: Corel 940, LaserDrive 820-011

PHOTOGRAPHY: PAUL AVIS © 1989

Table 1: *Both WORM (write once, read many times) drives and rewritable drives are available in a range of capacities and prices. Unless otherwise noted, prices do not include media. Note that average access times provided by vendors didn't always correlate with our benchmark results in table 2.*

	Operating platforms	PC subsystem price	Macintosh subsystem price	Cartridge price (double-sided)	Formatted capacity per side (megabytes)	Format method	Average access time (milliseconds)	PC utility software[1]
WORM devices								
Corel 800	PC, PS/2, Macintosh	$3645[2]	$3645[2]	$145	400	CLV	168	Retrieval and backup
Corel 940	PC, PS/2, Macintosh	$3695	$3695	$160	470	Modified CAV	90	Retrieval and backup
ISi 525GB	AT	$6288	N/A	$350	640	CAD	110	Retrieval and backup
LaserDrive 810-111	PC, PS/2	$5495	N/A	$200	405	CLV	175	None
LaserDrive 820-011	Macintosh	N/A	$5995	$200	405	CLV	175	N/A
Maximum Storage APX-4200	PC	$4450	N/A	$195	380	CAV	28	Version retrieval
Pioneer DD-S5001	PC, Macintosh	$3895	$3695	$145	327	CAV	77	Retrieval and backup
SDI LaserStor for Macintosh	Macintosh	N/A	$4999	$150	366	CLV	168	N/A
SDI LaserStor 800	PC, PS/2	$4495	N/A	$150	393	CLV	168	Version retrieval, cache utilities
Rewritable devices								
AGA Discus Rewritable DR650	AT, PS/2, Macintosh	$6495	$6495	$250	325	CAV	61	None
RACET Cosmos 600	AT, Macintosh	$5645	$5590	$298	297	CAV	67	Security utilities
Sumo Systems RSSM600-B	PC, Macintosh, Sun, DEC VAX	$4700	$4500	$260	297	CAV	50	N/A
Summus LightDisk-650	AT, Macintosh, Sun, DEC LSI, VAX, MicroVAX	$6495[2]	$5495[2]	$250	297	CAV	132	None

CAD=Constant area density.
CAV=Constant angular velocity.
CLV=Constant linear velocity.
N/A=Not applicable.
[1] Utility programs in addition to drivers, format utilities, diagnostics, and other required software.
[2] Price includes media cartridge.

directory with many levels of subdirectories or folders and files of varying length scattered throughout. The PC tests used XCOPY to transfer the entire structure from the magnetic drive (see the backup write times in table 2).

Because WORMs can't erase data, they must use linked lists or similar schemes to point to file updates. This often results in longer read times for successive versions of a file. Incremental backups, a typical use for WORMs, force this condition.

The backup read test incorporates incremental backups. It does a total of five XCOPYs from the optical drive to the magnetic drive, with a partial backup after each. The partial backup uses XCOPY/M to update the disk with 5 megabytes of unchanged files. We timed each XCOPY of the full directory from the optical drive to the magnetic disk and averaged the results.

As a check on the efficiency of directories, we timed searches through the data structure for a nonexistent file, using the Whereis utility from Apple's Macintosh Programmer's Workshop (MPW) 3.0 on the Macintosh and a BYTE Lab utility on the PC.

Macintosh utility software[1]	Operating-system compatibility
Version retrieval	MS-DOS 3.0+, Mac OS
Version retrieval	MS-DOS 3.0+, Mac OS
N/A	MS-DOS
N/A	MS-DOS 3.0 - 3.3
None	Mac OS
N/A	MS-DOS 3.0+
Version retrieval	MS-DOS 3.0+, Mac OS, Novell
Version retrieval	Mac OS
N/A	MS-DOS 3.0-3.3, Compaq DOS 3.31
N/A	MS-DOS 3.0+, Mac OS, OS/2
Security utilities	MS-DOS 2.0+, Mac OS, TOPS, AppleShare, Novell Advanced NetWare/286 2.15
None	MS-DOS 2.0+, Mac OS, BSD Unix 4.0, VMS
None	VMS, VAXELN, Ultrix BSD UNIX 4.3, RT-11, RSX-11, RSTS/E MUMPS, Mac OS 4.2+, System V, MS-DOS 3.0+, Sun OS 3.5+

The Macintosh provided us with a particularly interesting challenge: The operating system has no equivalent to XCOPY. The Macintosh Finder has no provision for incremental copies. Simply clicking on the structure and dragging it from one disk to another will do the initial copy, but that's all.

The Finder still retains a few bugs that have been hanging around for some time. Trying to click and drag on our 25-megabyte structure resulted in repeatable Finder errors; the Mac kept complaining that some files were unreadable. Checking back, we found that a Mac SE with System 4.1/Finder 5.5 produced the same results as our Mac IIcx's copy of System 6.0.3/Finder 6.1. We completed the backup tests with the Backup facility in MPW.

If you were to open a large database file on a magnetic disk and make updates to it, the modified file would take up the same amount of space as the original. WORMs, on the other hand, must allocate new storage sectors to replace the old. Despite the wasted sectors, judicious updates on a large file can still be a legitimate use for a WORM drive. We tested the random-access capability of both WORMs and magneto-optical drives with a 20-megabyte database and a test program written in dBASE III Plus 1.1.

For each of five iterations, we made simple modifications to every one-hundredth record and then performed a nonindexed search. After indexing the data, we performed the same search in indexed mode. Table 2 shows the times for the sequential search and the index; the indexed search is not shown because it took too little time to yield meaningful results. FoxBASE+/Mac 1.0 took the same script that we used on the PC and executed it flawlessly on the Macintosh.

Our third test simulates drive use in a storage/archival application. An example would be the archiving of digitized claim forms in an insurance company. We digitized a full page of graphics at 300 dots per inch and stored it on the drive as a TIFF file. Using the image editors that come with Hewlett-Packard's Scanning Gallery (for the PC) and the Apple Scanner (for the Mac), we made four simple modifications to the image, saving it under the same filename between each modification. We noted the times for each read and subsequent file write.

This test allowed us to try out another exciting feature of WORM technology: the ability to retrieve old versions of previously deleted or updated files. Those drives equipped with version-retrieval software made it possible to retrieve the original file as well as the intermediate modifications. Generally, getting these older versions back involved running a special utility to return the directory system on the drive to the state that it was in immediately after the desired version was written. Rewritable drives lack the capability to retrieve previous versions.

Our last test was a qualitative evaluation of MS-DOS compatibility. The test program simply sequenced through a series of calls, trying each of the MS-DOS INT 21H disk functions. We'll discuss exceptions to the generally high degree of compatibility in the product overviews that follow.

The WORMs

In evaluating optical drives, capacity and speed are key considerations; but price, software capability, and efficient use of media often play important roles as well.

Your anticipated storage requirements are important; if you have a good idea of how much space you'll need, you'll be able to make an accurate price comparison based on cost per megabyte. If you plan to use an optical device for other than archival storage, consider whether you will need to back up the optical disk itself. Finally, if you need an optical device to back up your Macintosh, make sure that the backup software you select has the capabilities that you need.

Corel 800

Corel Systems is primarily a software company, but it bundles a variety of manufacturers' drives with its software and third-party interface cards to form complete drive subsystems. The Corel 800 subsystem uses the 800-megabyte Ricoh WORM drive and is available for both DOS and Macintosh environments; both versions cost $3645.

On the PC, the system includes a Future Domain SCSI card and cable. Setup and installation are straightforward: Corel provides both a comprehensive, but generic, software and installation manual and a slim installation guide with Ricoh-specific details. The software manual also includes an in-depth programming section.

The Corel drive was the slowest WORM we tested on both the PC and the Macintosh, but it responded properly to all the DOS 3.3 disk calls we tried.

Corel's DOS driver maintains a small disk cache in system memory. We tested with the default cache size (four sectors), but the size is user-selectable. The driver takes care of the physical-to-logical-sector mapping required to make the optical drive look like a random-access write device. When DOS requests a sector write, the driver maps that sector to a physical sector and updates the translation tables. The translation tables make it possible to rewrite logical sectors even though you can't modify physical sectors. The software writes the translation tables to disk every so often as part of its *history*

continued

Table 2: *Benchmark times (in minutes:seconds) for WORM (write once, read many times) drives and rewritable drives. We've included benchmarks for the Compaq Deskpro and Mac IIcx magnetic drives for comparison. Optical drives, on average, took about twice as long as magnetic drives to complete the same task. (See the figure for corresponding graphs.)*

PC tests	25-Mb backup write	25-Mb backup read	Directory search	50,000-record database search	50,000-record database index	1-Mb image write	1-Mb image read
WORM devices							
Compaq 120-megabyte ESDI disk drive	10:43	7:22	0:11	2:01	9:00	0:11	0:12
Corel 800	35:21	20:57	0:23	16:48	37:46	1:16	1:39
Corel 940	14:12	11:13	0:09	6:10	13:28	0:16	0:14
ISi 525GB	50:40	12:35	0:13	4:11	10:51	0:25	0:11
LaserDrive 810-111	21:16	17:37	0:19	16:23	24:49	0:23	0:22
Maximum Storage APX-4200	17:04	13:40	1:18	N/A	N/A	0:19	0:11
Pioneer DD-S5001	15:03	12:33	0:13	7:36	14:25	0:18	0:15
SDI LaserStor 800	46:02	33:51	0:14	18:17	29:34	1:37	0:20
Rewritable devices							
AGA Discus Rewritable DR650	26:29	8:22	0:05	3:35	8:39	0:15	0:11
RACET Cosmos 600	39:54	12:51	0:12	6:42	15:04	0:29	0:14
Summus LightDisk-650	34:55	14:26	1:00	17:24	45:04	0:16	0:10
Mac tests							
WORM devices							
Macintosh IIcx 80-megabyte hard disk drive	12:26	3:56	0:09	1:26	2:52	0:11	0:01
Corel 800	30:07	7:50	3:36	13:03	15:05	1:44	1:37
Corel 940	12:39	4:48	1:02	5:18	6:10	0:21	0:18
LaserDrive 820-011	29:57	4:06	0:26	8:34	8:21	3:44	0:17
Pioneer DD-S5001	13:01	4:31	1:49	5:57	6:38	0:19	0:19
SDI LaserStor for Macintosh	29:54	7:36	2:28	12:56	14:07	1:47	1:31
Rewritable devices							
RACET Cosmos 600	25:29	5:50	1:46	3:51	4:48	2:52	0:13
Sumo Systems RSSM600-B	25:44	5:45	1:44	3:50	4:39	2:48	0:13
Summus LightDisk-650	19:02	4:06	0:25	3:39	4:31	1:01	0:13

N/A = Not applicable.

markers. It updates these markers after a given time interval or after a number of write requests have transpired.

History markers make it possible to recover older versions of updated files. Corel's History utility lets you return to old versions either by specifying filenames or by locating any previous history markers. While this allows you to read old versions, you can't write to the cartridge in that state. If you need write access to an old file, you must make the old history marker current; this returns all files on the disk to the state they were in when that history marker was written. Except for Maximum Storage's APX-4200, all WORM version utilities work in a similar fashion.

Corel also provides diagnostic, format, and miscellaneous drive utilities. DOS patch software lets you use large partitions with larger sectors. Particularly useful is a set of programs that let you back up, restore, and verify directories. Corel saves all backups to single files on the optical drive. This is more efficient than using a series of small files, given the large cluster size.

The Corel 800 installs easily on the Macintosh as well. As with most Macintosh peripherals, you connect it to the Mac with a standard 25-pin-to-50-pin SCSI adapter. The required SCSI terminators are built into the drive itself, and the SCSI bus design lets you connect up to six external devices to the Mac's connector, as long as the devices have the two connectors required for daisy chaining peripherals. The Corel 800 has only one connector. If you plan to use the Corel drive in conjunction with other SCSI devices, plan on placing the Corel at the very end of the daisy chain.

On the Macintosh, the WORM Tools utility provides the commands you need to reactivate the history markers. It gives you a list of all the markers by date, but it lacks the convenient list-by-file functions of the PC software.

Using the standard Mac interface, you simply select a point in time, and the software restores the disk to its earlier status. Your drive will reappear on the Mac Desktop in a write-protected state. You then copy the files you need back onto your hard disk and deactivate the history marker. Tools also gives you functions to set various operating parameters in the device driver.

Other software provided with the Corel Mac package includes WORM Format, the formatter and partition program;

continued

We Just Added Two New Dimensions To Erasable Optical.

Speed And Capacity.

Its speed is Winchester class. Its capacity breaks the gigabyte barrier. It's the new LaserStor™ Erasable Optical. And its time is now.

No other erasable optical subsystem can touch these specs. 35 ms average seek time. 10 Mbits/sec average transfer rate. One gigabyte removable cartridge capacity.

The reason? We've built LaserStor around Maxtor's revolutionary Tahiti™ I magneto-optical technology.

We've also built LaserStor to work across the board. In PC/MS-DOS, Macintosh® and Novell® environments. In single- and dual-drive configurations. Completely documented and supported, plug-and-play, right out of the carton.

Get the added value you've been expecting from erasable optical. With the added dimensions only Storage Dimensions can deliver.

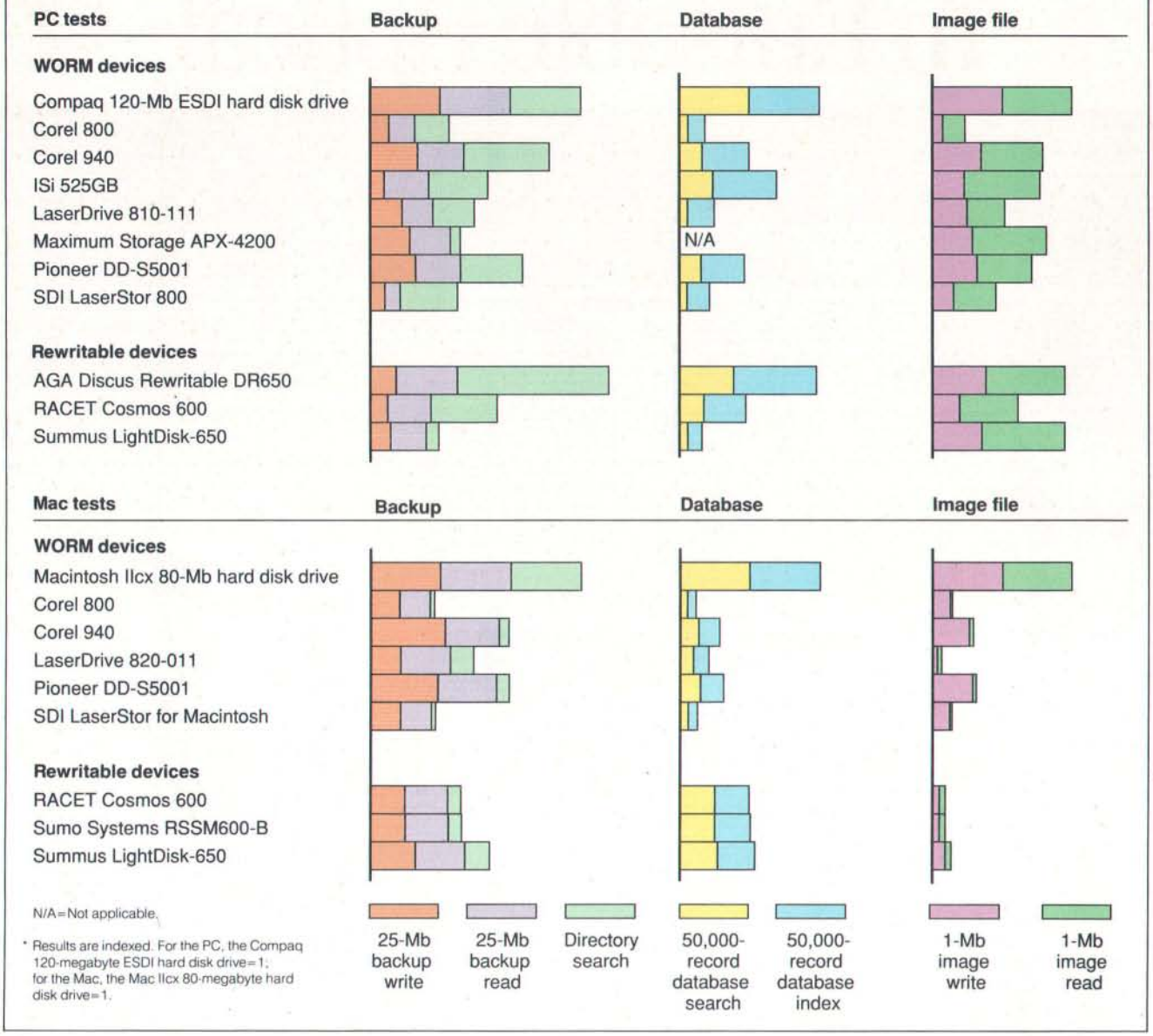
STORAGE DIMENSIONS
A MAXTOR COMPANY

United Kingdom 44 4862 29814 West Germany 49 8990 37 0222 France 33 1 46 86 20 98

LaserStor is a trademark of Storage Dimensions. Tahiti is a trademark of Maxtor Corporation. ©1989 Storage Dimensions

Circle 316 on Reader Service Card (DEALERS: 317)

OPTICAL DISK DRIVE BENCHMARK TESTS*



Graphs show each drive's relative performance in a suite of typical optical disk applications. We ran all tests on a Compaq Deskpro 386 and a Macintosh IIcx. For ease of comparison, we indexed our PC platform results to the Compaq's 120-megabyte ESDI hard disk drive, and the Macintosh platform results to the Mac IIcx's 80-megabyte internal hard disk drive. We stacked the results to conserve space; they do not represent a meaningful cumulative result. Shorter segments show better performance. The Corel 940 and the Pioneer WORM drives were consistently fast, while, among erasable drives, those from AGA and Summus split the PC and Macintosh environments.

WORM Diagnostics, for checking the operation of the WORM drive; and an INIT for the Mac's System Folder.

Corel 940

The Corel 940 is a 940-megabyte Panasonic WORM bundled with a Corel interface kit. Both the PC and Macintosh subsystems sell for $3695. The Corel 940's modified CAV format allows the drive to pack data at a high density without sacrificing speed. (For an explanation of CAV, CAD, and CLV formats, see the text box "Optical Technologies.")

While the software description for the Corel 800 is entirely applicable to the Corel 940, the hardware makes for a sharp contrast in performance. The Corel 940, with far better seek-time ratings, easily outperformed the Corel 800. On the PC, in fact, the Corel 940 was often the fastest drive we tested.

This drive is also one of the fastest WORMs on the Macintosh. We liked the external SCSI selection switch on the back panel and the daisy-chainable dual

continued

Everything OS/2 can do for you...

OS/2™ includes a built-in graphical interface so it's easy to use.

OS/2 provides an optional Communications Manager which allows easy networking.

OS/2 lets you run your DOS programs plus hundreds of programs DOS can't.

OS/2 lets you keep two or more programs running at the same time, so you can do more.

OS/2 lets you take advantage of 386™ power.

OS/2 lets you run programs larger than 640K, so you can use more powerful applications.

OS/2 lets you take full advantage of Micro Channel.™

OS/2 provides an optional Database Manager to make managing information easy.

This offer lets you do for less.

Right now, when you choose OS/2, you can get from $100 to $1,600 back on the kind of heavy duty memory that only OS/2 can handle. With this offer, the more memory you buy (up to 8Mb), the bigger your rebate.

Plus you can get thousands of dollars in rebates on over 100 different OS/2 programs. You can also get hundreds of dollars back on modems, accessory cards and hardware—all the things that help you do more work in less time with OS/2.

So if you're ready to move up to all the real advantages of OS/2, ask your IBM Authorized Dealer about these rebates today. To find the dealer nearest you call 1 800 IBM-2468, ext 128.

IBM®

OS/2, Operating System/2 and Micro Channel are trademarks, and IBM is a registered trademark of International Business Machines Corporation. 386 is a trademark of Intel. © IBM Corp. 1989.

Optical Technologies

Ask several vendors how optical disk technology works, and you're likely to get several different answers. In addition to variations in disk format, vendors use a variety of media types, recording techniques, and rotation schemes, each of which has its own unique advantages and disadvantages. Here, in a nutshell, are the basic technologies used in WORM (write once, read many times) drives and rewritable optical disk systems.

WORM drives are made up of a layer of recording material sandwiched between two plastic plates. The double-sided disk requires two recording layers. WORMs in this review use one of two recording materials: tellurium alloy or dye-polymer. These have excellent life expectancies of from 10 to 15 years, but WORM media technology is too new to have proven its durability in real-world use. Tellurium alloy is by far the most common recording material; six of the nine WORM drives we tested use it. Dye-polymer, used in the units from Pioneer and Storage Dimensions, Inc. (SDI), is cheaper to manufacture than tellurium-based products, and projected lifetimes are slightly better.

All the WORMs we tested except the Corel 940 use a recording technology known as *ablative pit*. They record by focusing a high-powered laser through the plastic layer to burn a hole in the recording material. The presence or absence of these burned pits represents data bits. To read back the data, the same laser shines a low-power beam on the media, and a photosensor detects reflectivity changes between the pits and the untouched surface. This rather complex process requires an expensive and heavy head assembly, and these drives provide only one head each; to access different sides of the disk, you must remove the cartridge, flip it over, and reinsert it.

The Corel 940 WORM uses a similar technique, but instead of burning a hole, the drive laser modifies the structure of the recording medium so that it changes the phase of reflected light. The drive detects phase changes in light from the read laser reflected off the disk surface.

While several companies are exploring different erasable optical technologies, magneto-optical is the only one currently refined enough for use in commercial products. Like WORM disks, magneto-optical disks consist of a layer of recording material sandwiched between two plastic disks. The magnetic recording material of an unused disk has a uniform magnetic orientation. At room temperature, the material is insensitive to normal magnetic fields, but at high temperatures (past its "Curie point") you can alter it magnetically.

To write on this material, the drive head heats the target area with a laser and applies a magnetic field to reverse the orientation of the target area. Once the material cools, it retains the reversed magnetic orientation; thus, the drives can represent data bits by varying magnetic orientations within the disk.

Erasing and rewriting data requires two passes. On the first pass, the head simply heats the target area and applies a uniform magnetic field to return the target area to its original orientation. The second pass writes the new data. The drive reads data by focusing a laser beam at the recording layer. The polarity of the reflected light changes according to the magnetic orientation of the disk (this is known as the *Kerr effect*). The drive detects reflected polarity and uses it to distinguish spaces from marks. Like WORM drives, magneto-optical drives can access only one disk side at a time.

Capacity vs. Speed

Optical drives use different rotation schemes and track organization to optimize access time or disk capacity. The two most common are constant angular velocity (CAV) and constant linear velocity (CLV). Like magnetic drives, CAV devices maintain a constant rotational speed. Since the data rate at the head is always constant, all tracks must contain the same amount of information. Although the outer tracks are longer, they can contain only as much data as the shortest (innermost) track. As a result, CAV disks waste potential disk capacity.

CLV drives maximize capacity, but they're more complex and generally slower than those using CAV. They vary the rotational speed of the disk to maintain constant velocity of the head over the disk, whether on an inner or an outer track. CLV drives, therefore, can pack the entire drive at the highest data density that the disk can support.

Corel's 940 and Information Storage, Inc.'s (ISi) WORM drives use two other methods, modified CAV and constant area density (CAD), respectively. Modified CAV, a CLV-CAV hybrid, involves splitting the disks into several concentric regions. Within each region, the disk spins at a constant rate; the rate increases for regions located nearer the outside of the disk. This method achieves high data density, and control is not as complex as when using CLV.

ISi's CAD drive is essentially CAV, but it puts an interesting spin on the technique by interleaving data tracks. The result is a honeycomb pattern of data bits with nearly the same data density on outer and inner tracks. For the user, this means very high capacity combined with good performance.

In addition to different rotation methods, optical drives use different methods for organizing tracks. Only ISi, Maximum Storage, and the Corel 940 use the concentric tracks familiar to magnetic disk users. This scheme results in relatively short seek times but suffers when the drive must transfer large amounts of information (i.e., when there are multiple tracks). The rest of the manufacturers chose a spiral track organization, where all data is arranged in a long continuous groove, as on a phonograph record. While this method is more efficient for sustained transfer, it's also slower at finding a randomly selected sector.

SCSI connectors. Most of the WORM drives that we tested automatically ejected the cartridge when we dragged the drive's icon into the trash. The Corel 940 has a manual cartridge eject.

The Macintosh software is standard Corel fare—formatting, diagnostics, and version-retrieval functions, as with the Corel 800. It's an excellent choice, especially if you want more storage.

ISi 525GB

At 640 megabytes per side, Information Storage, Inc.'s (ISi) 525GB was the largest-capacity drive for the PC that we tested. For $6288, the system includes a drive, a Western Digital SCSI controller card, and software. The unit also includes dual SCSI connectors for daisy chaining.

continued

Breakthrough $899 Offer—Now You Can *Drive* CD-ROM

For a limited time Compact Disk Products (CDP) is packaging the state-of-the-art NEC CD-ROM drive with Microsoft's most popular CD-ROM software:

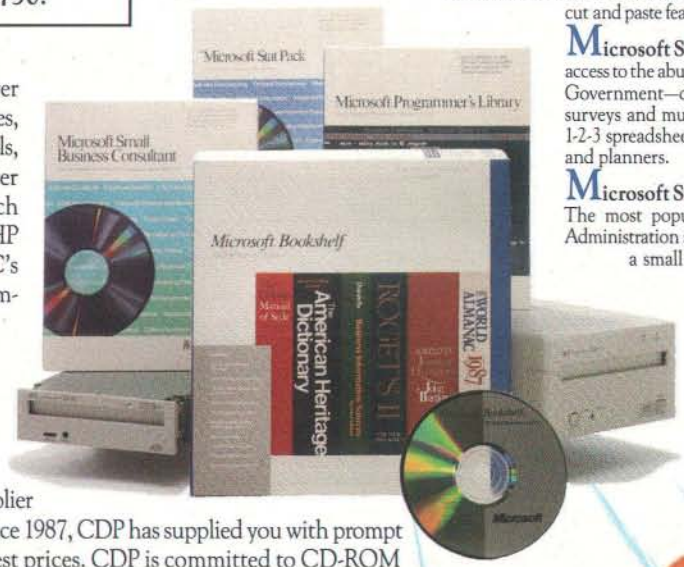
Package A—For $899, includes **Microsoft Bookshelf,** a coupon to purchase both **Microsoft Stat Pack** and **Microsoft Small Business Consultant** for only $50 each, a FREE copy of **CD-Play Demo** and FREE Federal Express delivery.*

Package B—For $1189 also includes **Microsoft Programmer's Library**

YOU SAVE OVER $750!

Buy CD-ROM now! CDP sells over 200 quality CD-ROM titles for libraries, schools, legal and medical professionals, programmers, and many others. Over 25 new titles are being published each month. With IBM, NEC, and HP announcing new CD-ROM based PC's or Mini's, a CD-ROM drive is becoming as necessary as a floppy drive.

"I believe more than ever that CD-ROM products will be a major force in the expansion of the information industry." **Bill Gates.**



CDP is the largest specialized supplier of CD-ROM products in the U.S. Since 1987, CDP has supplied you with prompt service and expert advice…at the best prices. CDP is committed to CD-ROM and it shows. Our Unconditional Guarantee is unmatched. Our free Federal Express delivery is an industry first. Call now and tomorrow you will be driving these power CD-ROM products.

Circle 55 on Reader Service Card

UNCONDITIONAL GUARANTEE

1) If FOR ANY REASON you are unhappy with your purchase you may return it within 30 days for a FULL REFUND.

2) During the 90-day NEC warranty period CDP will ship replacement drives overnight.

ORDER NOW! 800-MEGABYTe (634-2298)
(Order line open M-S, 9AM-9PM EST)

Fax Orders 212-737-8289 • Inquiries/Free tech. Support 212-737-8400

DEALER INQUIRIES WELCOME

FREE CD-ROM: Mail in your order coupon and receive the CD-ROM Source Disk FREE. Includes demos of many popular CD-ROM products and retails for $89.

*Federal Express delivery free for phone/fax orders within continental U.S. only.

Please send the package I've checked below.

☐ **Package "A"**—Complete NEC CD-ROM drive kit (internal or stand-alone) plus *Bookshelf* **and** *CD-Play Demo* (includes a coupon to purchase both *Stat Pack/Small Business Consultant* for $50 each) *for only $899!*

☐ **Package "B"**—Complete NEC CD-ROM drive kit (internal or stand-alone) plus *Bookshelf, CD-Play Demo* **and** *Programmer's Library* (includes a coupon to purchase both *Stat Pack/Small Business Consultant* for $50 each) *for only $1199!*

Please send the following drive configuration with my order:

☐ Stand-alone NEC CDR-77; Select ☐ PC/XT/AT/386 or ☐ Microchannel

☐ Internal NEC CDR-80(PC/XT/AT/386 Only)

NEC CD-ROM drives (retail $1198): Once again NEC has established an industry standard. Using 64K buffers (older drives use 8K) NEC delivers the speed users demand. Each drive includes full audio CD hardware (accessible with CD-Play Demo). The CDR-77 stand-alone drive also operates with Macintosh computers ($99 interface kit required).

Now! Get CD-Play Demo FREE Use Your CD-ROM Drive as an Audio CD Player!

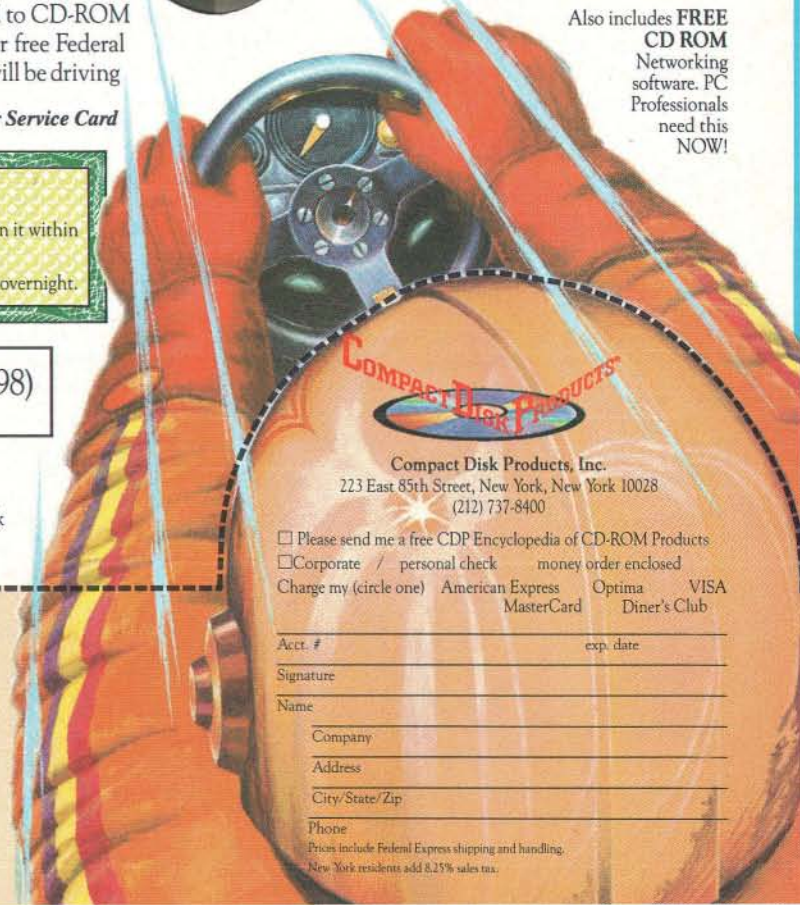
Microsoft Bookshelf (retail $295): An indispensable collection of writers' references for word processor users. This is the most popular CD-ROM title published. You get instant access to: **The World Almanac, Chicago Manual of Style, Bartlett's Familiar Quotations, Roget's II: Electronic Thesaurus, American Heritage Dictionary, Business Information Sources, The U.S. Zip Code Directory, Houghton Mifflin Spell Checker and Usage Alert** and more! All Microsoft CD-ROM's are RAM resident and include powerful cut and paste features for popular word processing packages.

Microsoft Stat Pack (retail $125): Now you have easy access to the abundance of statistics published by the Federal Government—census data, business statistics, agricultural surveys and much more, plus Microsoft Excel and Lotus 1-2-3 spreadsheet files for all tables. A must for marketers and planners.

Microsoft Small Business Consultant (retail $149): The most popular publications of the Small Business Administration and Deloitte, Haskins and Sells on running a small business. Answer tax, accounting, legal, personal, and financing questions in an instant. A gold mine for businessmen, accountants, and consultants.

Microsoft Programmers Library (retail $395): All the critics are raving *"…a masterpiece of simplicity and function."* **PC World,** May '89. A complete library (over 20,000 pages) of the latest releases of Microsoft's Technical Reference Manuals covering OS/2, Windows MS-DOS, C, MASM, etc. with 8 megabytes of source code.

Also includes **FREE CD ROM** Networking software. PC Professionals need this NOW!



Compact Disk Products, Inc.
223 East 85th Street, New York, New York 10028
(212) 737-8400

☐ Please send me a free CDP Encyclopedia of CD-ROM Products

☐Corporate / personal check money order enclosed

Charge my (circle one) American Express Optima VISA MasterCard Diner's Club

Acct. # exp. date

Signature

Name

Company

Address

City/State/Zip

Phone

Prices include Federal Express shipping and handling.
New York residents add 8.25% sales tax.

ISi's unique CAD format gives the unit a good access-time rating and respectable performance, especially considering its high capacity. The drive performed well on our benchmarks, often finishing at or near the top of the list.

The drive uses the DOS file system and simply looks like a logical block device to DOS. It maintains block-update information on disk, so you won't lose any data in a sudden blackout. All DOS disk-function calls worked smoothly.

ISi's WORM-TOS PLUS software includes a DOS patch (for larger sectors and partitions), a partition editor, and Back Track version utilities. The driver and patching software allow for up to 640-megabyte partitions. The Back Track utility suffers from a clumsy user interface but was able to recover older file versions without problems.

Overall, the 525GB is an excellent drive. It's fast and fully DOS-compatible, and it has outstanding capacity. Unfortunately, both the drive and media are relatively expensive.

LaserDrive 810-111

LaserDrive sells two nearly identical WORM drives, the 810-111 for DOS machines ($5495) and the 820-011 for the Macintosh (see below). The LaserDrive 810-111 media offers 405 megabytes per side, with interface cards available for both PC and Micro Channel machines. A second SCSI connector and external-device-select thumbwheel allow you to daisy chain other SCSI devices off the LaserDrive.

The LaserDrive was the largest drive we tested. It stands about 15 inches tall. While most of the test units were designed for desktop use, the LaserDrive can stand comfortably on the floor, freeing up valuable desk space.

The 810-111 had the worst access-time specification of the units we tested. But the system as a whole outperformed several drives with better ratings, turning in a moderate performance overall.

The drive uses the DOS file system and acts like a standard device driver disk. It emulates random-access writes by keeping logical address markers with each sector on the disk. The drive keeps a logical history in a reserved area on disk to keep track of current versions. It executed all the DOS test functions perfectly.

Installing both the hardware and software components was simple, and we had no trouble operating the drive. The driver makes it possible to have disk partitions as large as one disk side. Other software for the LaserDrive 810-111 is quite sparse; there are diagnostic and format utilities, but there is no provision for retrieving outdated versions.

LaserDrive 820-011

The $5995 LaserDrive 820-011 for the Mac includes driver/utility software and a cable, and it uses the same cartridges and drive as the LaserDrive 810-111.

In our benchmark tests, the Laserdrive 820-011 did well on the backup read test, behind the Corel 940, the Pioneer DD-S5001, and the rewritable Sumus LightDisk. But the LaserDrive's poor performance on the 1-megabyte image retrieval tests suggests that it's best used for backups or for storing large files.

ISi's unique CAD format gives the unit a good access-time rating.

The Mac OS has some difficulty calculating the actual amount of remaining space because of rewritten sectors. The utility software provided with the drive includes a desk accessory that displays the amount of rewritable space remaining on the drive. Formatting cartridges is simple: You just click on INITIALIZE in response to the standard Macintosh "This disk is unreadable" alert box.

Maximum Storage APX-4200

The Maximum Storage drive for the PC ($4450) is unique for two reasons. First, it uses an ESDI host adapter, so daisy chaining drives is out of the question. Second, and more important, its software approaches DOS compatibility from a radically different angle.

Unlike most other programs, which use the DOS file system, the APX-4200's MAXSYS software creates its own file system that's more appropriate for the drive's write-once capabilities. It traps all INT 21H calls, filters out those intended for the optical drive, and passes the remaining commands through to the standard INT 21H handler.

This high-level DOS interface makes for the slickest version-retrieval software of any of the WORMs that we tested. MAXSYS extends the standard MS-DOS naming convention from FILENAME.EXT to FILENAME.EXT#VN, where VN is the version number. By default, MAXSYS assumes the latest version, but you can specify any earlier one by simply putting the number at the end. This means that for functions that use ASCIIZ strings, you can explicitly specify the version number when you're calling the function. This won't work with DOS's COPY command, however, so Maximum Storage provides a COPY replacement. Other version utilities include LNK, which can effectively retrieve an old version of a file by linking it with a new directory entry, and XDIR, an expanded replacement for DIR that can handle version information.

Unfortunately, this software scheme also results in relatively poor DOS compatibility. The file system doesn't support hidden, system, or archive attributes, and our attempts to open a file by using a file control block failed. The APX-4200 was also unable to run our large database tests; Maximum Storage representatives confirmed the problem and are working on a solution.

The drive turned in excellent times on most of our other benchmarks, but it was slow on directory searches.

Pioneer DD-S5001

Pioneer Communications' DD-S5001 system includes a Pioneer WORM drive and a Corel interface kit for either PC compatibles ($3895) or Macintosh ($3695) computers. If you're working with DEC, Sun, or other machines or operating systems, contact Pioneer; several interfaces are available from third parties.

At 327 megabytes per side, the Pioneer drive has the lowest capacity of the WORMs we reviewed. But it's also the least expensive, and its media cost per megabyte is quite low.

The DD-S5001 performed exceptionally well in our benchmark tests. On the PC side, it earned the top composite score on the backup test, and it was near the top on both the database and image suites. It was fully DOS-compatible.

Difficult access to the SCSI switches inside the unit made installing the DD-S5001 on the Macintosh a cumbersome process. Fortunately, most people will need to set these switches only once. The cable attaches to standard SCSI connectors, and the unit includes two connectors for daisy chaining or connecting an external terminator.

Capacity and installation are only part of the story. The DD-S5001 is a fast WORM drive, and it consistently kept

continued

PC MAGAZINE
EDITORS' CHOICE
July 1989
VGAWONDER

PC WORLD
BEST BUY

VGAWONDER

Fabulous Offer

VGA*WONDER* Bundle Includes HARVARD Graphics

for an additional
$150.00*
While quantities last.
*M.S.L. $495.00

FASTER THAN THE AVERAGE BEAR

Are you asking yourself what a bear has to do with super speed, remarkable resolution and fabulous colors? We did, too. How can anyone bear to work with less than incredible speed, we asked ourselves. How can anyone bear to work without extraordinary resolution? Bear to work with less than 256 spectacular colors? We got so beared out, we decided to share one with you. Along with the bear facts about ATI's award-winning board.

Such as:

- high resolution 800×600 and 1024×768 graphics
- fast 16-bit bus support
- 100% register-level compatible in VGA®, EGA®, CGA®, MDA®, and Hercules® modes
- analog and digital monitor support
- easy, switchless installation
- high resolution and 132 column drivers
- Microsoft® compatible bus mouse and mouse port included
- available in 256K and 512K versions

Oh, and bear this in mind – when it comes to VGA*WONDER*®, you'll be getting a honey of a price!

For more information, contact your supplier or

ATI Technologies Inc.
3761 Victoria Park Avenue
Scarborough, Ontario
Canada M1W 3S2
Tel: (416) 756-0718
Fax: (416) 756-0720

ATI®
TECHNOLOGIES INC.
Technology you can Trust.

Registered trademarks are as follows: ATI, VGA*WONDER* – ATI Technologies Inc.; Microsoft – Microsoft Corp.; Hercules – Hercules Computer Technologies Inc.; VGA, EGA, CGA, MDA – International Business Machines Corp.

COMPANY INFORMATION

Advanced Graphic Applications, Inc.
(AGA Discus Rewritable DR650)
90 Fifth Ave.
New York, NY 10011
(212) 337-4200
Inquiry 1071.

Corel Systems Corp.
(Corel 800, Corel 940)
1600 Carling Ave., Suite 190
Ottawa, Ontario, Canada K1Z714
(613) 728-8200
Inquiry 1072.

Information Storage, Inc.
(ISi 525GB)
2768 Janitell Rd.
Colorado Springs, CO 80906
(719) 579-0460
Inquiry 1073.

LaserDrive Ltd.
(LaserDrive 810-111,
LaserDrive 820-011)
1101 Space Park Dr.
Santa Clara, CA 95054
(408) 970-3600
Inquiry 1074.

Maximum Storage, Inc.
(Maximum Storage APX-4200)
5025 Centennial Blvd.
Colorado Springs, CO 80919
(719) 531-6888
Inquiry 1075.

Pioneer Communications of America, Inc.
(Pioneer DD-S5001)
Optical Memory Products Division
Sherbrooke Plaza
600 East Crescent Ave.
Upper Saddle River, NJ 07458
(201) 327-6400
Inquiry 1076.

RACET Computers Ltd.
(RACET Cosmos 600)
3150 East Birch St.
Brea, CA 92621
(714) 579-1725
Inquiry 1077.

Storage Dimensions, Inc.
(SDI LaserStor for Macintosh,
SDI LaserStor 800)
2145 Hamilton Ave.
San Jose, CA 95125
(408) 879-0300
Inquiry 1078.

Sumo Systems
(Sumo Systems RSSM600-B)
1580 Old Oakland Rd.,
Suite C103
San Jose, CA 95131
(408) 453-5744
Inquiry 1079.

Summus Computer Systems
(Summus LightDisk-650)
17171 Park Row, Suite 300
Houston, TX 77084
(713) 492-6611
Inquiry 1080.

pace with the speedy Corel 940. The Corel software package provided with the drive handled the utility and driver functions.

Along with Corel's 940, this drive clearly proves that expensive is not always better.

SDI LaserStor for Macintosh

LaserStor for Macintosh, from Storage Dimensions, Inc. (SDI), sports dual SCSI connectors and internal SCSI address selection switches. For $4999, you get the drive system, cabling, and driver/utility software.

It's no coincidence that the LaserStor and the Corel 800 displayed almost identical performance—both use Ricoh disk subsystems and Corel software. The vertically mounted LaserStor takes up less desk space than many other drives. It installed easily and worked without any surprises.

SDI LaserStor 800

The LaserStor 800 PC-based WORM takes an unusual approach to solving the problems of slow access times and inefficient disk use: It caches both data and directories on the system's hard disk drive. The optical drive itself is the same unit that SDI's Macintosh WORM uses; the company plans to port the caching scheme to the Macintosh disk drive, but the software is currently available for the DOS environment only. As with the Pioneer drive, other operating-system support is available from third parties. For $4495, the PC system gives you the drive, cable, interface card, software, and a comprehensive combination user's and programmer's guide.

SDI's LaserCache software maintains logical-to-physical-sector translation tables and communicates with DOS at the device driver level, as do most other WORMs. Our tests showed it to be completely DOS-compatible. LaserCache, however, keeps translation tables and data in a reserved caching area on the magnetic disk. It reads the translation tables from the WORM only once, when the cartridge is mounted; from that point, it makes all updates to the cache. The unit also caches both data reads and writes and flushes the cache only as it approaches capacity. Before removing a cartridge, the user must flush both data and index information from the cache.

In addition to the advantage of greater speed, the cache also uses the WORM more efficiently than does a direct-write scheme. Rewritten translation tables and user data often waste a great deal of space on a WORM, where any written data consumes space. With LaserCache, rewritten information replaces old information in the magnetic cache, and permanent writes happen only when the cache is flushed.

We tested the unit with an 11-megabyte hard disk cache. The system has no defaults, but you must set aside at least 1 megabyte for caching space. Overall performance was disappointing, especially when you consider the several minutes it took to flush the cache after we finished the tests.

The caching software also makes it more difficult to retrieve older file versions. If you need to save a file and guarantee its recoverability, you must flush the cache after you save the file. If you're running a scanning or CAD application, for example, this means you must save the file, exit the application, run the cache flush utility, and reenter the application. Once you've done that, you can recall the file using LaserCache utilities.

The Rewritables

Rewritable optical drives are very new. Only two vendors, Sony and Ricoh, manufacture the drive mechanisms used in the systems we reviewed. But don't let the underlying similarities fool you. Software and interface components can make for significant differences.

AGA Discus Rewritable DR650

Among the erasable optical units we reviewed, the champion is AGA's DR650. Its high capacity, trouble-free operation, and blinding speed make it ideal for AT or PS/2 users with large storage requirements. The system runs on a standard

continued

MicroWay Means Numerics!

MicroWay is your best source for the software and hardware you need to get true 32 bit performance from your 386. These include 32-bit tools, such as NDP Fortran, C, and Pascal, and the 32-bit applications that were developed with them (see last paragraph). These products run in protected mode under Unix, Xenix, or Phar Lap extended MS-DOS.

Starting with release 1.4VM, NDP Fortran, C and Pascal not only access 4 gigabytes of memory, but run with Phar Lap's new VMM extension which provides 386 protected mode virtual memory. Now you can run a program with a 30 MB array on a 2 MB system simply by having 30 MB of space on your hard disk.

MicroWay also offers transputer based parallel processing boards and languages that run in an XT, AT, or 386. Each of the T800 RISC processors on these boards packs the power of a 20 MHz 386/1167. Our best selling board, the Quadputer2™, has four T800s and boasts 40 MIPS/6 megaflops of processor throughput.

Dr. Robert Atwell, leading defense scientist, calculates that NDP Fortran-386 is saving him $12,000 per month in rentals of VAX hardware and software while doubling his productivity!

Fred Ziegler of AspenTech in Cambridge, Mass. reports, "I ported 900,000 lines of Fortran source in two weeks without a single problem!" AspenTech's Chemical Modeling System is in use on mainframes worldwide and is probably the largest application to ever run on an Intel processor.

Dr. Jerry Ginsberg of Georgia Tech reports, "My problems run a factor of six faster using NDP Fortran-386 on an mW1167 equipped 386/20 than they do on my MicroVAX II."

MicroWay manufactures Weitek 1167 and 3167 coprocessor cards that run with the 80386. Both cards include an 80387 socket. The 1167 is 2 to 4 times faster than the 80387. The 3167 runs 30% faster than the 1167 in double precision. The key to achieving this speed increase is our NDP Fortran or C and the new 32-bit applications that offer Weitek support. Either processor provides a dramatic increase in throughput for graphics intensive applications. These include VersaCad and Hoops 3D graphics, ANVIL 5000 CAD/CAM, SRAC and Swanson Analysis finite element packages, Mathematica and a host of other packages that were recently ported to the 386 using our NDP Fortran and NDP C. **Please call (508) 746-7341 for more information.**

32-Bit Compilers and Tools

NDP Fortran-386™, NDP C-386™, and **NDP Pascal-386™** compilers generate globally optimized, mainframe quality code. Each runs in 386 protected mode under Unix, Xenix or Phar Lap extended MS-DOS. The memory model employed uses 2 segments, each of which can be up to 4 gigabytes. They generate code for the 80287, 80387, mW3167 or mW1167 and include high speed EGA graphics extensions written in C that perform BASIC-like screen operations. **NDP Fortran-386™** is a full implementation of FORTRAN-77 with Berkeley 4.2 and Fortran-66 extensions. **NDP C-386™** is a full implementation of AT&T's PCC with MS and ANSI extensions. **NDP Pascal-386™** is a full implementation of ANSI/IEEE Pascal, with extensions from C and Berkeley 4.2 Pascal.

NDP Fortran/C/Pascal-386/DOS each $595
NDP Fortran/C/Pascal-386/VM. $695
NDP Fortran/C/Pascal-386/UNIX. $795
NDP C++ $495

Phar Lap 386/VMM extensions are supported by the VM releases of NDP Fortran, C, and Pascal, making it possible to compile and run programs as large as the free space on your hard disk.

Phar Lap Virtual Memory Manager . . $295
Phar Lap Development Tools $495

NDP Windows™ — NDP Windows includes 80 functions that let you create, store, and recall menus and windows. It works with NDP C-386 and drives all the popular graphics adapters . . . . . Library: $125, C Source: $250

NDP Plot™ — Calcomp compatible plot package that is callable from NDP Fortran. It includes drivers for popular plotters and printers. Works with CGA, MDA, EGA and VGA . . . $325

NDP/FFT™ — Includes 40 fast running, hand coded algorithms for single and double dimensioned FFTs which take advantage of the 32-bit addressing of the 386 or your hard disk. Callable from NDP Fortran with mW1167 and 80387 support $250
387FFT for 16-bit compilers $250

NDP to HALO '88 Graphics Interface — Enables you to call graphics routines in HALO '88 from NDP Fortran, C or Pascal. $100

Parallel Processing

Videoputer™ — The highest performance graphics card on the market. Uses a T800 and TI 34010 in conjunction with a 130 MHz Brook-Tree DAC. Includes one MB of system RAM, one meg of video RAM and a library of graphics primitives. Runs standalone or in conjunction with a transputer network and drives 32 and 64 KHz analog monitors $4995

Monoputer™— The world's most popular PC transputer development product now extends the memory available for developing transputer applications from 2 to 16 MB. The board features a DMA bus interface for fast I/O.
Monoputer with T414 (0 MB) $995
Monoputer with T800 (0 MB) $1495

Quadputer™— This board for the AT or 386 can be purchased with 2, 3 or 4 transputers and 1 or 4 MB of memory per transputer. Two or more Quadputers can be linked together to build networks of up to 100 or more transputers providing mainframe power . . . . . from $3495

Linkputer™ — Uses four Inmos C004 programmable cross bar switches. It allows the user to dynamically change the topology of the processors in a network. Using this board, it is possible to get 100% linkage among eight Quadputers and design larger, custom topologies. . . . . CALL

Transputer Compilers and Applications
These Parallel languages are designed for use with Monoputer2 and Quadputer2.
Logical Systems Parallel C $595
3L Parallel C or **3L Parallel Fortran** . . $895
COSMOS/M - Finite element analysis .CALL
ParaSoft: Parallel Environment $500
Performance Monitor . . . $500
C Source Level Debugger $500
T800/NAG™ (See NDP/NAG) $2750

387BASIC™ — Our 16-bit MS compatible compiler introduces numeric register variables to produce the fastest running 80x87 code on the market. $249

NUMERICS HOTLINE
(508) 746-7341

386 Your AT

386/387 Turbo™AT — This board plugs into your 80286 socket, allowing your IBM AT to run 32-bit protected-mode code written for the 80386. Includes an 80387 socket. The most cost-effective AT upgrade!
386/387 Turbo AT/16MHz $495
386/387 Turbo AT/25 MHz $695

Weitek-Based Coprocessor Boards

mW1167™ and **mW3167™** coprocessor boards are built at MicroWay using Weitek components. Each includes an 80387 socket.
mW1167-16 . . . . . $895
mW1167-20 . . . . . $1095
mW1167 Microchannel-16/20 . . . . . CALL
3167-20 . . . . . $995
3167-25 . . . . . $1295
3167-33 . . . . . $1695
mW3167/80387 Board $150

Intel Coprocessors

8087	$84	**8087-2**	$120
80287-8	$195	**80287-10**	$220
80387-16	$350	**80387-16SX**	$310
80387-20	$400	**80387-25**	$500

80C287A (CMOS) $280
287Turbo-12 (for AT compatibles) $350
RAMpak™ - one meg 32-bit memory module for Compaq 386 20/25 . . . . . $395
RAMpak™ - four meg $1495

Multi-User Accelerators

MicroWay's **AT8™** and **AT16™** intelligent serial controllers run 8 to 16 terminals under Unix or Xenix without bogging down your AT, 80386 or PS/2 PC. **AT8**: $895 **AT16**: $1295

12 MHz PC Accelerators

FastCACHE-286 12 MHz $299
SuperCACHE-286 12 MHz $399
FastCACHE-286 9 MHz $199

MicroWay

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, U.K., 01-541-5466
USA FAX 508-746-4678 Italy 02-74.90.749 Holland 40 836455 Germany 069-75-2023

SCSI bus, and you can chain any SCSI device off the drive. Unfortunately, a Mac version of this product wasn't released in time for this review.

At $6495, the DR650 isn't cheap, but it proved to be the best drive to use with DOS. It consistently turned in top performances, matched only by the Summus drive on the image tests. Although the device driver lets you configure a system RAM cache, we ran it in the default configuration without caching enabled. Adding the cache should further enhance performance.

The only difference in capacity between this drive and the other magneto-optical units is in the data cartridge. All four of the units we tested can use both 325-megabyte-per-side cartridges and the 297-megabyte-per-side variety. But while they can use the same physical media, proprietary formats mean you can't swap cartridges between different drives to share data.

The higher-capacity cartridge has 1024 bytes per sector and less overhead than the lower-capacity, 512-byte-per-sector disk. The current version of the ISO standard for magneto-optical media covers both 512- and 1024-byte sectors. AGA has chosen to sell and support 325-megabyte, 1024-byte-per-sector cartridges. Because the cluster size is so much larger, these cartridges will cost you more in data overhead if you store small files.

AGA's software includes the driver, format and partitioning utilities, and a DOS patch to enable large partitions. It ran all our tests and executed all DOS disk function calls without a hitch.

RACET Cosmos 600

RACET's Cosmos 600, based on Ricoh's 600-megabyte magneto-optical drive, is available for both PC and Macintosh platforms. It's the most network-oriented erasable unit we reviewed, with support for TOPS, AppleShare, and Novell's NetWare. The PC system sells for $5645; the Macintosh version costs $5590.

On our DOS test machine, the AGA unit consistently outperformed the RACET drive. But the Cosmos 600 was by no means slow; it bested the Summus system on two of the tests.

RACET's drive was completely compatible with DOS. The PCMS software that comes with the drive is adapted from programs shipped with RACET's tape drives. Utilities include formatting, partitioning, and diagnostic programs. PCMS also lets you assign passwords to partitions.

An external SCSI device-select switch made Mac installation easier. Dual SCSI connectors let you connect the external terminator or another daisy-chained peripheral. Performance was solid—better than the Mac's internal hard disk drive on both the FoxBASE and MPW tests.

RACET's PCMS utility software works reliably, but it can be dangerous: It almost wiped out our hard disk drive. Most of the utilities search through the SCSI bus and bring up a screen with a list of the devices it finds. During the last phase of testing, we inadvertently selected device 0 (the Mac's internal hard disk drive) instead of device 1 (the RACET drive). PCMS happily stomped the Macintosh driver on the hard disk and destroyed the partition table.

Among the erasable optical units, the champion is AGA's DR650.

Sumo Systems RSSM600-B

The Sumo RSSM600-B uses the same internal subsystem as the Cosmos 600 and performed almost identically on all the tests. We tested the unit on the Macintosh, but Sumo began shipping a PC version as we went to press. Two SCSI connectors and an external SCSI address switch grace the back panel. Physically, the Sumo drive is the largest of the rewritables. It's approximately square and sized to fit beautifully under a classic Mac SE or Plus footprint.

Perhaps the Sumo's best feature is its price: $4500 for the Mac drive ($4700 for the PC) and $260 per 600-megabyte (double-sided) cartridge makes it the cheapest of the rewritables.

Summus LightDisk-650

Like the AGA system, Summus's LightDisk-650 incorporates Sony's magneto-optical drive. Unfortunately, Summus's system can't touch the AGA when it comes to performance. What Summus has going for it is a standard SCSI connection and software that lets it fit comfortably with just about any system. The drive is available for an impressive line-up of machines and a host of operating systems (see table 1); PC kits sell for $6495, and Macintosh kits sell for $5495. Installing the drive may require opening the case to get to the internal SCSI address switches.

The Summus drive for the PC doesn't come with any utility software. In fact, it doesn't come with any software at all. The driver card has a BIOS extension ROM that lets it recognize the LightDisk at boot time. You use a utility provided in the ROM to do a low-level format, and standard DOS FDISK and FORMAT commands for formatting and partitioning. All the DOS drive functions we tried worked correctly.

Although the Macintosh rewritables were close in terms of performance, the LightDisk edged out its two Ricoh-based competitors, RACET and Sumo.

The Disk Director 3.0 software (provided with the Macintosh version) handles the low-level formatting and partitioning. The LightDisk is unique in that the partitioning lets you split up the 297 megabytes into several partitions and have them all come up as different logical disk drives.

Buy or Wait?

Optical storage is a young technology, and compatibilities and specifications change rapidly; if you have an application in mind, call the vendor. If you're looking to an erasable optical drive as a medium for data distribution, you may do well to hold off on any purchase until these drives conform to a standard.

On the IBM PC–compatible side, several drives stand out. The ISi 525GB is fast and has an enormous capacity, but it's also quite expensive. The Maximum Storage APX-4200 has the best version-control software and performs respectably, but it has problems simulating random-access writes.

Our favorite WORM drives in both the DOS and Macintosh environments are the Corel 940 and the Pioneer DD-S5001. Both drives are excellent performers in all applications, and both are outstanding values.

The AGA Discus Rewritable DR650 is the obvious choice if you need a rewritable drive for DOS, but all four magneto-optical drives have strong points: the RACET Cosmos 600 has strong networking support, the Sumo RSSM600-B is relatively inexpensive, and the Summus LightDisk-650 delivers the best performance on the Macintosh. ■

Steve Apiki and Howard Eglowstein are testing editors for the BYTE Lab. You can reach them on BIX as "apiki" and "heglowstein," respectively.

Introducing the everything-but-the-kitchen sync.

Presenting a multiscanning color monitor so advanced it's compatible with virtually all the video standards to date. And with video standards to come, like SuperVGA and IBM® 8514/A.

It's the C1391 PanaSync™ color monitor. And whether your office PCs are running Hercules™, CGA, EGA or VGA, this 14" Panasonic® monitor will display each to its best advantage.

Of course, the PanaSync monitor is comfortable in virtually any IBM or [with an optional cable] Apple Mac™ II environment. And we've given as much thought to your comfort, as well. With an ergonomic design. Featuring front-mounted controls. Tilt/swivel stand. And text color switching from green to amber to paper white in TTL modes. The affordable PanaSync C1391 monitor. The future on display.

For more information, or the name of your authorized dealer, call toll-free **1-800-742-8086.**

Peripherals, Computers, Printers, Copiers
Typewriters and Facsimiles

Panasonic
Office Automation OA

Circle 201 on Reader Service Card

PanaPro™ Monochrome Desktop Publishing Monitors

PanaSync™ Multiscanning Color Monitor

IBM is a registered trademark of International Business Machines Corporation. Mac II is a trademark of Apple Computer, Inc. Hercules is a trademark of Hercules Computer Technology.

ACCESS MICRO SYSTEMS... CUSTOM ASSEMBLED.

THE POWER.

ACCESS--proven, powerful systems, with thousands in use today. ***ACCESS*** is the centerpiece of your computer-office management system. ***ACCESS*** reduces your workload--increases productivity.

Call CMO about the ***ACCESS*** 386/20 Tower system, rated 32% faster than the Compaq 386/16.

800-233-8950

THE FLEXIBILITY.

Your ***ACCESS*** system is custom-configured to fit your needs, your work style, and your budget. Your hand-assembled system is put through an exhaustive technical checklist and bench-tested a grueling 48-hours to insure that your system will work the first time--every time. To order call today:

800-233-8950

ACCESS 286/12

- 16-bit 80286 Main System Board Processor.
- Dual 6/12 MHz switchable CPU speed.
- 512K RAM, expands to 4MB on motherboard.
- Eight slots: (6-16 bit, 2-8 bit).
- Supports 80287 Math Coprocessor.
- One parallel, serial and game port.
- 102-key "AT" style enhanced keyboard.
- 1.2MB Hi-density 5.25" floppy disk drive
- Five ½ height drive bays.
- Western Digital 2:1 interleave controller.
- 220 watt high capacity power supply.
- Desktop case with Turbo and Power LED Display, keyboard lock, hardware and Turbo switch.
- Norton SI Rating V4.0: 15.3.
- Industry standard Phoenix compatible BIOS.
- One and Zero Wait State operations.
- Clock/Calendar with Battery Back-up.
- Monitor not included in above price.

Also available in small footprint and Tower case.

See chart for Video and Hard Drive Options.

ACCESS 286/20

- 16-bit 80286 Main System Board.
- Dual 10/20 MHz switchable CPU speed.
- 1MB RAM, expands to 5MB on motherboard.
- Eight slots: (6-16 bit, 2-8 bit).
- Supports 80287 Math Coprocessor.
- One parallel, serial and game port.
- 102-key "AT" style enhanced keyboard.
- 1.2MB Hi-density 5.25" floppy disk drive.
- Five ½ height drive bays.
- Western Digital 2:1 interleave controller.
- 220 watt high capacity power supply.
- Desktop case with Turbo and Power LED Display, keyboard lock, hardware and Turbo switch.
- Norton SI Rating V4.0: 22.5.
- Industry standard Phoenix compatible BIOS.
- One and Zero Wait State operation.
- Clock/Calendar with Battery Back-up.
- Monitor not included in above price.

Also available in Tower case.

See chart for Video and Hard Drive Options.

CUSTOMIZE YOUR *ACCESS* 286.

Select any of the Video and Hard Drive options and allow us to CUSTOM CONFIGURE Your ***ACCESS*** 286 System.

(Add to the base price above)

	40MB-28ms	80MB-28ms	159MB-23ms
Mono	$599.00	$799.00	$1399.00
EGA	$899.00	$1099.00	$1699.00
VGA	$999.00	$1199.00	$1799.00

ASSEMBLED • TESTED • GUARANTEED

FREE ***ACCESS*** Software Utilities Provided.

ACCESS 286/25

- 16-bit 80286 Main System Board.
- Dual 10/25 MHz switchable CPU speed.
- 1MB RAM, expands to 5MB on motherboard.
- Eight slots:(6-16 bit, 2-8 bit).
- Supports 80287 Math Coprocessor.
- One parallel, serial and game port.
- 102-key "AT" style enhanced keyboard.
- 1.2MB Hi-density 5.25" floppy disk drive.
- Five ½ height drive bays.
- Western Digital 2:1 interleave controller.
- 220 watt high capacity power supply.
- Desktop case with Turbo and Power LED Display, keyboard lock, hardware and Turbo switch.
- Norton SI Rating V4.0: 31.6.
- Industry standard Phoenix compatible BIOS.
- One and Zero Wait State operations.
- Clock/Calendar with Battery Back-up.
- Monitor not included in above price.

Also available in Tower case.

See chart for Video and Hard Drive Options.

Computer Mail Order. Since 1981—Low Prices, Large Selection, Fast Service.

MONEY BACK GUARANTEE
3 YEAR WARRANTY.

THE CONFIDENCE.

We offer what the competition doesn't--a 3-year limited warranty on parts, free technical support and computer consultant toll-free "hotlines"--where you'll receive clear answers to any ***ACCESS*** questions. Go ahead, give us a try:

800-233-8950

THE PRICE.

Check our features. Check our competition. You'll receive not only the amazing price, but a full 30-day money-back guarantee-- no questions asked when you order an ***ACCESS*** Micro System. Call Today:

800-233-8950

ACCESS 386/16

- 32-bit 80386 Main System Board.
- Switchable 6/8/16 MHz CPU speed.
- 1MB RAM, expands to 10MB on motherboard.
- Eight slots: (1-32bit, 5-16 bit, 1-8 bit).
- Supports 80387 Math Coprocessor.
- One parallel port, serial and game port.
- 102-key "AT" style enhanced keyboard.
- 1.2MB Hi-density 5.25" floppy disk drive.
- Five ½ height drive bays.
- Western Digital 1:1 interleave controller.
- 220 watt high capacity power supply.
- Desktop case with Turbo and Power LED Display, keyboard lock, and hardware switch.
- Norton SI Rating V4.0: 18.7.
- Industry standard Phoenix compatible BIOS.
- Zero Wait State operation.
- Clock/Calendar with Battery Back-up.
- Monitor not included in above price.

Also available in Tower case.

See chart for Video and Hard Drive Options.

ACCESS 386/20

- 32-bit 80386 Main System Board.
- Switchable 6/8/20 MHz CPU speed.
- 1MB RAM, expands to 10MB on motherboard.
- Eight slots: (1-32 bit, 5-16 bit, 1-8 bit).
- Supports 80387 Math Coprocessor.
- One parallel, serial and game port.
- 102-key "AT" style enhanced keyboard.
- 1.2MB Hi-density 5.25" floppy disk drive.
- Five ½ height drive bays.
- Western Digital 1:1 interleave controller.
- 220 watt high capacity power supply.
- Desktop case with Turbo and Power LED Display, keyboard lock and hardware switch.
- Norton SI Rating V4.0: 24.0.
- Industry standard Phoenix compatible BIOS.
- Zero Wait State operation.
- Clock/Calendar with Battery Back-up.
- Monitor not included in above price.
- 32K Static Cache Memory (optional).

Also available in Tower case.

See chart for Video and Hard Drive Options.

CUSTOMIZE YOUR *ACCESS* 386.

Select any of the Video and Hard Drive options and allow us to CUSTOM CONFIGURE Your ***ACCESS*** 386 System.

(Add to the base price above)

	80MB-28ms	159MB-23ms	338MB-18ms
Mono	$799.00	$1399.00	$1899.00
EGA	$1099.00	$1699.00	$2199.00
VGA	$1199.00	$1799.00	$2299.00

ASSEMBLED • TESTED • GUARANTEED

Free ***ACCESS*** Software Utilities Provided.

ACCESS 386/33

- 32-bit 80386 Main System Board.
- Switchable 6/8/33 MHz CPU speed.
- 1MB RAM expands to 16MB on motherboard.
- Eight slots:(1-32 bit, 5-16 bit, 1-8 bit).
- Supports 80387 or Weitek Math Coprocessor.
- One parallel, serial and game port.
- 102-key "AT" style enhanced keyboard.
- 1.2MB Hi-density 5.25" floppy disk drive.
- Five ½ height drive bays.
- Western Digital 1:1 interleave controller.
- 220 watt high capacity power supply.
- Desktop case with Turbo and Power LED Display, keyboard/lock and hardware switch.
- Norton SI Rating V4.0: 40.1.
- Industry standard Phoenix compatible BIOS.
- Zero Wait State operation.
- Clock/Calendar with Battery Back-up.
- Monitor not included in above price.

Also available in Tower Case.

See chart for Video and Hard Drive Options.

CMO

Computer Mail Order. Since 1981—Low Prices, Large Selection, Fast Service.

Circle 63 on Reader Service Card

A110

CMO And Access Micro Systems

ACCESS TURBO XT/10

- 8-bit 8088 Main System Board.
- Dual 4.77/10 MHz switchable CPU speed.
- 512KB RAM, expands to 640KB on motherboard.
- Eight 8-bit slots.
- Supports 8087-10 Math Coprocessor.
- One parallel port, serial port and game port.
- 102-key "AT" style enhanced keyboard.
- 360KB 5.25" floppy disk drive.
- Four ½ height drive bays.
- Dual floppy controller, supports 720K format.
- 150 watt high capacity power supply.
- Desktop case with Turbo and Power LED Display, keyboard lock, hardware and Turbo switch.
- IBM XT compatible EROS BIOS.
- Clock/Calendar with Battery Back-up.
- Monitor not included.
  Low profile case available.

30 Day Money Back Guarantee
1 Year Limited Warranty.

$539

See chart below for Video and Hard Drive Options for *ACCESS* Turbo XT/10

	1 Floppy	20MB-65m	40MB-28ms
Mono	$139.00	$409.00	$589.00
CGA	$339.00	$599.00	$779.00
EGA	$499.00	$769.00	$959.00

The Workstation

In addition to operating as a stand alone computer system, the ***ACCESS*** Turbo XT/10 is an ideal solution for your multi-user applications. The ***ACCESS*** Turbo can be configured as a Workstation on the Novell, 3Com, Unix and Xenix environments. Call TOLL FREE **800-233-8950** and talk with our trained and authorized sales and support staff. Look at our Networking section for a sample of products offered in the Novell Networking Arena.

Power System Or File Server

ACCESS 386/20 TOWER

- 32-bit 80386 Main System Board.
- Dual 8/20 MHz switchable CPU speed.
- 1MB 32-bit DRAM subsystem.
- System memory expandable to 9MB.
- Eight slots: Two 32-Bit, Five 16-Bit, One 8-Bit.
- 8MHz bus clock, wait state selectable.
- Supports 80387 Math Coprocessor.
- One parallel port and two serial ports.
- 102-key "AT" style enhanced keyboard.
- 1.2MB Hi-density 5.25" floppy disk drive.
- Five ½ height drive bays.
- Western Digital 1:1 interleave controller.
- 200 watt high capacity power supply.
- Vertical Tower case with Turbo and Power LED Display, keyboard lock, hardware and Turbo switch.
- COMPAQ compatible, 32% faster than COMPAQ 386.
- Landmark V0.99: 26.5 - 27.3 MHz.
- Norton SI Rating V4.0: 22.5.
- 64K Bios, setup and diagnostic utility built-in.
- Zero Wait State Operation.
- Clock/Calendar with Battery Back-up.
- Monitor not included.

$2099

See chart for Video and Hard Drive Options For *ACCESS* 386/20 Tower

	40MB-28ms	159MB-23ms	338MB-18ms
Mono	$599.00	$1399.00	$1899.00
EGA	$899.00	$1699.00	$2199.00
VGA	$999.00	$1799.00	$2299.00

FREE ***ACCESS*** Software Utilities Provided.

NETWORKING

ACCESS 386/20 Tower File Server with 2MB, 10MHz, 512K Workstations, Monochrome Displays, Arcnet Interfaces, Loaded Novell Netware.

ASSEMBLED • TESTED • CERTIFIED

Ready to Turn ON!

4-User 40MB Server ELS I...$6,899.00

6-User 80MB Server ELS II...$9,699.00

8-User 159MB Server ELS II.$12,499.00

For larger systems call us. We can custom configure any size network.

Novell Software

ELS 4-User Level 1.....$499.00
ELS Level-II V2.15.....$1,099.00
Advanced NETWARE 286 V2.1...$1,995.00
SFT NETWARE 286 V2.15.....$3,095.00

Interface Cards

ARCNET (8-bit) PC/XT.....$129.00
ARCNET (16-bit) 286/386.....$299.00
ARCNET MCA PS/2.....$299.00
Active Hub.....$299.00
ETHERNET (8-bit) PC/XT.....$239.00
ETHERNET (16-bit) 286/386.....$289.00
ETHERNET MCA PS/2.....$359.00
Standard Micro Systems.....Call

Computer Mail Order. Since 1981—Low Prices, Large Selection, Fast Service.

..Price and Power!

Great Packages Ready To GO!

NO ONE HAS PROVIDED BETTER SERVICE TO MORE CUSTOMERS FOR AS LONG AS CMO.

8 YEARS
AND STILL GROWING

AT CMO, GOOD SERVICE AND LOW PRICE ARE A TRADITION.

THE COLLEGIAN

***ACCESS* Turbo XT/10 Computer.**
512K Ram installed on the Motherboard.
Dual 360K 5.25" floppy disk drive.
102-key "AT" style enhanced keyboard.
One parallel, serial, and game port.

Epson LX-810 Printer.
9-Pin, impact dot-matrix.

Collegian Monitor.
Monochrome TTl display and adapter.
12" diagonal screen display.

Collegian Software.
PFs: First Choice.

$979

THE ACCOUNTANT

***ACCESS* 286/12MHz Computer.**
512K RAM installed on the Motherboard.
40MB Hard Disk Drive w/controller.
1.2MB 5.25" floppy disk drive.
102-key "AT" style enhanced keyboard.

Espon FX-1050 Printer.
264cps 136 column dot matrix.

Accountant Monitor.
Monochrome TTL display and adapter.
12" diagonal screen display.

Accountant Software.
Lotus 1-2-3

$2199

THE SECRETARY

***ACCESS* Turbo XT/10 8088 Computer.**
512K RAM installed on the Motherboard.
20MB Hard Disk Drive w/controller.
360K 5.25" floppy disk drive.
102-key "AT" style enhanced keyboard.

Brother HR-20
Daisywheel 20cps print speed.

Secretary Monitor
Monochrome TTL display and adapter.
12" diagonal screen display.

Secretary Software.
PFS: Write

$1299

THE PUBLISHER

***ACCESS* 386/16MHz Computer.**
1MB RAM installed on the Motherboard.
40MB Hard Disk Drive w/controller.
1.2MB 5.25" floppy disk drive.
102-key "AT" style enhanced keyboard.

Hewlett-Packard LaserJet II
8 Page per minute.

Publisher Monitor.
Monochrome VGA FlatSquare Display.
14" diagonal screen display.

Publisher Software
PFS: First Publisher

$4199

THE COMPANY

CMO is proud to be one of the few companies approved to represent the ***ACCESS*** Micro System product line. Thousands of ***ACCESS*** Micro Systems have been sold and they have a proven record of performance in homes and offices just like yours.

Our ***ACCESS*** systems utilize state-of-the-art components and are custom-assembled to fit your needs, your workstyle, and your budget. Plus all 286's and 386's come with a 3 year limited warranty.

Each and every ***ACCESS*** system goes through an extensive quality control checklist and is burned-in a minimum of 48 hours, assuring you trouble free performance.

Whenever you have questions or need technical support, our toll free lines put you in touch with **CMO's** knowledgeable computer consultants.

Call CMO Today

800-233-8950

CMO

Computer Mail Order. Since 1981—Low Prices, Large Selection, Fast Service.

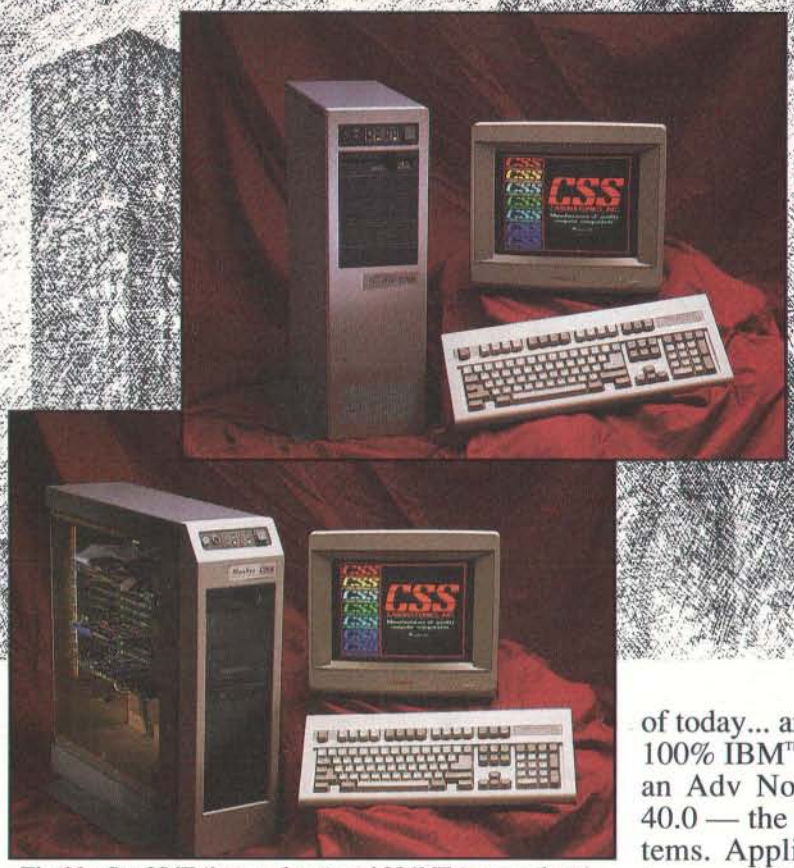
A110

Circle 64 on Reader Service Card

Reaching New Heights

The MaxSys 386T/33 and 386MT/33

- *12 slots*
- *10 half-height drives*
- *400 watt power supply!*



The MaxSys 386T (lower photo) and 386MT (upper photo) feature 12 slots to provide the systems with expandability.

At CSS, we've built a reputation for dependability, value, and performance. That's why we're pleased to unveil the latest addition to our line of computing solutions — The MaxSys 386T™ and 386MT™.

The architecture of the MaxSys 386T features 12 slots and a 400 watt power supply giving you mainframe capabilities at a fraction of the cost. The five full-height drive capacity allows you to configure up to three gigabytes (formatted) storage including erasable, optical, Winchester, and removable disk drives, as well as 8mm and 1/4" tape and floppies.

Our smaller version, the 386MT, features 12 slots, five half-height drives, and a 200 watt power supply. Both MaxSys systems allow you to upgrade your original hardware and software investments to meet the standards of today... and tomorrow. They're 100% IBM™ compatible and have an Adv Norton 4.0 SI rating of 40.0 — the highest for AT™ systems. Application options range from an ultra high-end personal computer to networked file/compute/print servers supporting diskless work-stations and ASCII terminals. Plus, the MaxSys systems run MS DOS™, Ethernet™, ARCnet™, Cheapernet, Helios™, Novell™, UNIX™/XENIX™, 3 Com™, Token Ring, OS/2™, or POSIX.

Both MaxSys systems are available in a variety of configurations and include full technical support, complete documentation, and a one year warranty.

Reach new heights — call us today.

	Norton 4.0 SI	Expansion Slots	Drive Capacity
CSS MaxSys	40.0	12	10 H/H
IBM Model 80	30.5	8	4 H/H
Compaq 386/25	30.5	8	4 H/H

Compared to IBM and Compaq the MaxSys 386T comes out on top.

A Solid Investment

CSS LABORATORIES, INC.

CSS Laboratories, Inc. and CSS logo registered and CSS MaxSys are trademarks of CSS Laboratories, Inc. Ethernet is a trademark of XEROX Corp. Novell is a trademark of Novell, Inc. MS DOS and XENIX are trademarks of Microsoft Corp. UNIX is a trademark of AT&T. Helios is a trademark of Perihilion. ARCnet is a trademark of Datapoint Corp. 3-Com is a trademark of 3-Com Corp.

1641 McGaw Ave., Irvine CA 92714
Tel: 714-852-8161 Fax: 714-852-9464

MCA Meets SX

New machines from IBM and American Mitac pair the 80386SX with IBM's Micro Channel architecture

Mark L. Van Name
and Bill Catchings

The IBM PS/2 Model 55 SX and the American Mitac MPS2386 differ in price, expandability, and compatibility.

The marketplace is still undecided about the 80386SX microprocessor and IBM's Micro Channel architecture (MCA), but that hasn't stopped two companies from introducing machines that incorporate both. The IBM PS/2 Model 55 SX and the American Mitac MPS2386 combine these two technologies in very different packages.

The mixture is in some ways an odd one. The 80386SX's main goal is to let you run 80386-specific software for little more than the cost of an 80286-based system. The MCA, on the other hand, boasts better performance, particularly for 32-bit peripherals, but at a higher cost.

The Model 55 SX base unit comes in two configurations: with a 30-megabyte hard disk drive ($3895), and with a 60-megabyte hard disk drive ($4295). The only standard software is the IBM Reference Diskette, which you use to tell the MCA bus about new peripherals. Our evaluation system had the 60-megabyte drive and came with an additional 2 megabytes of memory, an IBM 8513 VGA color monitor, and MS-DOS 3.3, for a total list price of $6560. (Although the machine didn't come with a math coprocessor, we added one before running the benchmarks.)

The standard American Mitac MPS2386 sells for $2695. It includes more standard software than the Model 55 SX: MS-DOS and GWBASIC 4.0, the Phoenix Reference Diskette for MCA configuration, and an expanded memory emulator. Two 3½-inch hard disk drives are optional for the MPS2386: a $650 40-megabyte drive and a $1500 100-megabyte drive.

Our 40-megabyte evaluation system included a Mitac VGA monitor (Tatung is the OEM), a 16-MHz 80387SX (which Mitac does not sell), a total of 4 megabytes of memory, and a 1.2-megabyte 5¼-inch floppy disk drive. We tested the machine running DOS 3.3; however, Mitac now offers only version 4.0.

With these extras (assuming $650 for the 80387SX), our evaluation unit would cost $5879. That puts it at almost $700 less than the IBM unit, without the 5¼-inch floppy disk drive and 80387SX included in the Mitac unit. Toss out those two items and the price is $5114, or over $1400 less than the Model 55 SX. Clearly, price is a major reason to consider the MPS2386.

Architecture

Because both these machines use the 80386SX rather than its speedier cousin, IBM and Mitac were able to skimp a bit on their memory architectures. In particular, neither system uses a cache. The MPS2386 relies instead on a combination of two-way interleaving and paging

continued

IBM PS/2 Model 55 SX

Company
IBM Corp.
1133 Westchester Ave.
White Plains, NY 10604
(800) 426-2468

Components
Processor: 16-MHz Intel 80386SX
Memory: 2 megabytes of 85-ns DRAM in a 2-megabyte SIMM, expandable to 4 megabytes on the motherboard; 128K bytes of BIOS ROM
Mass storage: 1.44-megabyte 3½-inch floppy disk drive; 30-megabyte hard disk drive (Model 8555-031) or 60-megabyte hard disk drive (Model 8555-061)
Display: IBM 8513 VGA monitor; VGA circuitry; 256K bytes of display memory; DB-15 monitor connector on the motherboard
Keyboard: 101-key IBM Enhanced
I/O interfaces: RS-232C serial port with DB-25 connector; DB-25 parallel port; PS/2-style keyboard connector and mouse connector; three 16-bit MCA slots, one with IBM video adapter extension

Size
16 × 4 × 15½ inches; 19 pounds

Price
Base system: $3895
System as reviewed: $6560

Inquiry 854.

American Mitac MPS2386

Company
American Mitac Corp.
410 East Plumeria Dr.
San Jose, CA 95134
(408) 432-1160

Components
Processor: 16-MHz Intel 80386SX
Memory: One megabyte of 100-ns DRAM in four 256K-byte SIPs, expandable to 8 megabytes on the motherboard; 128K bytes of BIOS ROM
Mass storage: 1.44-megabyte 3½-inch floppy disk drive; ST-506 hard disk drive controller card; 40-megabyte or 100-megabyte hard disk drive
Display: Mitac VGA monitor; VGA circuitry; 256K bytes of display memory; DB-15 monitor connector on the motherboard
Keyboard: Modified 101-key IBM Enhanced
I/O interfaces: RS-232C port with DB-25 connector; DB-25 parallel port; PS/2-style keyboard connector and mouse connector; six 16-bit MCA slots, one with IBM-compatible video adapter extension

Size
14½ × 6¼ × 16½ inches; 28 pounds

Price
Base system: $2695
System as reviewed: $5879

Inquiry 855.

(with 2K-byte pages) to let it run without wait states most of the time with its 100-nanosecond DRAM. The Model 55 SX also uses paging (with 2K-byte pages), but it lacks the MPS2386's interleaving. Not surprisingly, this architecture makes the IBM unit slower, even though it uses faster 85-ns DRAM.

The MPS2386's DRAM comes on either 256K-byte or 1-megabyte single in-line packages. You install these SIPs in matched sets of four into the eight SIP slots, so the unit's memory can total 1, 2, 4, 5, or 8 megabytes. The base system uses four 256K-byte SIPs to make 1 megabyte.

The Model 55 SX has far fewer memory options. Its two single in-line memory module slots can hold either 1- or 2-megabyte SIMMs. The base models include one 2-megabyte SIMM; you can have configurations with 2, 3, or 4 megabytes.

Performance

The MPS2386's better memory architecture makes it about 15 percent faster than the Model 55 SX on BYTE's CPU index and 10 percent faster on the FPU index. The Model 55 SX wins the video index handily, however. Its index of 2.42 bests the MPS2386's mark of 1.57.

The disk I/O performances of the two machines are nearly the same. Other drives, however, would probably yield far different results, since Mitac's 100-megabyte drive is faster than the 40-megabyte unit we tested. IBM, however, doesn't offer a larger drive for the Model 55 SX, and its 30-megabyte drive is even slower than the 60-megabyte system that we tested.

In the critical application index, the two machines were too close to call. Both lost by nearly a 20 percent margin to Compaq's AT-bus 80386SX machine. On the positive side, both the MPS2386 and the Model 55 SX are about 20 percent faster than IBM's 80286-based Model 50 Z.

Compatibility

As we expected, the Model 55 SX worked with all the MCA boards we tried, including Computer Peripherals' Hook-Up PS2400 internal modem, Gateway Communications' G/Ethernet adapter, and Pixelworks' Ultra Clipper UM1280 graphics card (an interesting test because the board acts as a bus master). The Model 55 SX also had no trouble with Microsoft's Serial Mouse with driver version 6.11, nor with Xircom's Pocket Ethernet Adapter.

The MPS2386 didn't fare quite so well. It successfully ran all but the Gateway G/Ethernet board. We were unable to use that board with NetWare or Gateway's test programs. Because the board worked in the Model 55 SX, and because the MPS2386 ran NetWare over the Xircom Pocket Ethernet Adapter, we concluded that the MPS2386 had a problem with its MCA bus. A Mitac spokesperson said that the firm would investigate the problem and fix it in later production runs.

We also had a minor problem with the MPS2386's Reference Diskette program. On the surface, the MPS2386 seems to use the same Phoenix Reference Diskette (PRD) program as most MCA clones (including those from Tandy and ALR). As with the Model 55 SX, when you install a new board in the system, the machine tells you to run PRD. PRD then tells you that it can't find the .ADF file for that card.

Every MCA board comes with a floppy disk that contains configuration information for that board in a file with a name like 77F4.ADF. (The number identifies the board, while .ADF is the standard extension.) Because IBM's MCA machines use 3½-inch drives, these floppy disks are always 3½-inch.

Unfortunately, the MPS2386's PRD program checks drive B for the floppy disk with the .ADF file—but our evaluation unit's drive B was a 5¼-inch drive. We knew to copy the proper .ADF file to the PRD disk, but if you didn't know much about the PRD, you would be in trouble.

The Phoenix PRD program is also more complicated than IBM's. IBM's sacrifices some flexibility for its simplicity, but it never makes you figure out what to do; it just tells you what to do and then works like a charm.

Neither system had any software problems. Both systems flawlessly ran a wide range of applications, including Borland's Quattro 1.0, Reflex 1.14, SideKick Plus 1.00A, SuperKey 1.16A, Turbo C 2.0, and Turbo Pascal 4.0; Digitalk's Smalltalk/V 1.2; Kermit 2.32/A; MicroPro's WordStar 3.3 and 4.0; Lotus's

continued

IBM PS/2 Model 55 SX, Mitac MPS2386

APPLICATION-LEVEL PERFORMANCE

IBM PS/2 Model 55 SX **9.5***

WORD PROCESSING	IBM	Mitac
XyWrite III+ 3.52	**Med./Large**	**Med./Large**
Load (large)	:14	:14
Word count	:04/:28	:04/:30
Search/replace	:07/:28	:07/:28
End of document	:02/:16	:02/:16
Block move	:11/:10	:11/:11
Spelling check	:11/1:25	:12/1:27
Microsoft Word 4.0		
Forward delete	:19	:19
Aldus PageMaker 1.0a		
Load document	:11	:12
Change/bold	:35	:36
Align right	:28	:27
Cut 10 pages	:23	:23
Place graphic	:06	:04
Print to file	2:30	2:27
Index:	**2.07**	**2.08**

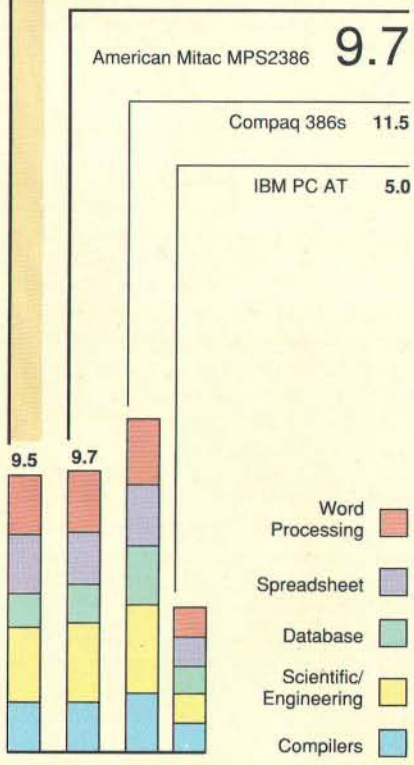
SPREADSHEET	IBM	Mitac
Lotus 1-2-3 2.01		
Block copy	:04	:05
Recalc	:02	:02
Load Monte Carlo	:29	:19
Recalc Monte Carlo	:07	:07
Load rlarge3	:07	:07
Recalc rlarge3	:01	:01
Recalc Goal-seek	:04	:05
Microsoft Excel 2.0		
Fill right	:07	:07
Undo fill	2:43	2:47
Recalc	:02	:03
Load rlarge3	:34	:32
Recalc rlarge3	:02	:02
Index:	**1.97**	**1.82**

DATABASE	IBM	Mitac
dBASE III+ 1.1		
Copy	1:07	1:01
Index	:20	:20
List	1:47	1:40
Append	2:28	2:07
Delete	:04	:03
Pack	2:06	1:35
Count	:17	:17
Sort	1:25	1:21
Index:	**1.21**	**1.36**

SCIENTIFIC/ENGINEERING	IBM	Mitac
AutoCAD 2.52		
Load SoftWest	1:05	1:03
Regen SoftWest	:49	:48
Load StPauls	:14	:13
Regen StPauls	:08	:08
Hide/redraw	16:40	16:53
STATA 1.5		
Graphics	:39	:28
ANOVA	:17	:16
MathCAD 2.0		
IFS 800 pts.	:21	:21
FFT/IFFT 1024 pts.	:22	:21
Index:	**2.61**	**2.76**

COMPILERS	IBM	Mitac
Microsoft C 5.0		
XLisp compile	5:21	5:28
Turbo Pascal 4.0		
Pascal S compile	:07	:07
Index:	**1.67**	**1.67**

All times are in minutes:seconds. Indexes show relative performance; for all indexes, an 8-MHz IBM PC AT=1.



*Cumulative application index. Graphs are based on indexes at left and show relative performance.

LOW-LEVEL PERFORMANCE[1]

IBM PS/2 Model 55 SX

CPU	IBM	Mitac
Matrix	7.08	7.36
String Move		
Byte-wide	52.93	38.46
Word-wide:		
Odd-bnd.	49.62	40.90
Even-bnd.	26.47	19.28
Doubleword-wide:		
Odd-bnd.	33.08	28.25
Even-bnd.	21.55	18.31
Sieve	37.42	34.98
Sort	31.99	33.85
Index:	**1.78**	**2.04**

FLOATING POINT	IBM	Mitac
Math	14.59	13.35
Error[2]		
Sine(*x*)	3.90	3.55
Error		
e^x	4.32	3.94
Error		
Index:	**4.02**	**4.41**

DISK I/O	IBM	Mitac
Hard Seek[3]		
Outer track	5.02	3.32
Inner track	4.96	3.33
Half platter	9.43	9.98
Full platter	10.00	13.31
Average	7.35	7.49
DOS Seek		
1-sector	14.91	17.51
32-sector	29.17	33.61
File I/O[4]		
Seek	0.23	0.16
Read	1.13	1.12
Write	1.13	1.00
1-megabyte		
Write	5.75	5.64
Read	5.10	5.49
Index:	**1.36**	**1.38**

VIDEO	IBM	Mitac
Text		
Mode 0	4.06	6.15
Mode 1	4.07	6.15
Mode 2	4.25	6.42
Mode 3	4.25	6.41
Mode 7	N/A	N/A
Graphics		
CGA:		
Mode 4	1.69	2.54
Mode 5	1.68	2.56
Mode 6	1.87	2.80
EGA:		
Mode 13	2.74	4.45
Mode 14	3.11	5.05
Mode 15	N/A	N/A
Mode 16	3.08	5.00
VGA:		
Mode 18	3.26	5.27
Mode 19	1.89	2.84
Hercules	N/A	3.81
Index:	**2.42**	**1.57**

N/A=Not applicable.

[1] All times are in seconds. Figures were generated using the 8088/8086 and 80386 versions (1.1) of Small-C.

[2] The errors for Floating Point indicate the difference between expected and actual values, correct to 10 digits or rounded to 2 digits.

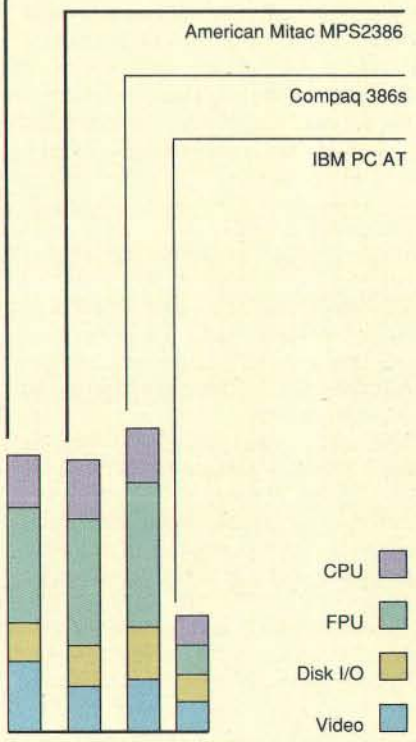
[3] Times reported by the Hard Seek and DOS Seek are for multiple seek operations (number of seeks performed currently set to 100).

[4] Read and write times for File I/O are in seconds per 64K bytes.

[5] For the Livermore Loops and Dhrystone tests only, higher numbers mean faster performance.

CONVENTIONAL BENCHMARKS

	IBM	Mitac
LINPACK	284.30	279.46
Livermore Loops[5] (MFLOPS)	0.09	0.10
Dhrystone (MS C 5.0) (Dhry./sec.)	3474	3612



For a full description of all the benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.

Symphony 2; Microsoft's PC Paintbrush 2.0, Windows/386 version 2.0, and Word 4.0; Norton Utilities 3.00; Novell's NetWare 2.15; and Symantec's Q&A 1.1.

Little Room to Grow

Neither of these systems gives you many mass storage options. The Model 55 SX offers only 30- and 60-megabyte hard disk drives and has only two drive bays. The drives are both anemic performers, with access times of 39 and 27 milliseconds, respectively. As for the two bays, one holds a Mitsubishi 1.44-megabyte 3½-inch floppy disk drive, and the other accommodates the hard disk drive. Even if there was more room for expansion, the skimpy 90-watt power supply probably wouldn't support another drive.

The MPS2386 gives you more initial capacity, with both 40- and 100-megabyte hard disk drive options. Those drives are also faster; a Mitac spokesperson said that future units will use NEC drives with access times of 28 and 19 ms, respectively. Our evaluation unit held a 40-megabyte Rodime drive with a 28-ms access time.

The MPS2386 also has more room to grow. You can buy an optional internal NEC 1.2-megabyte 5¼-inch floppy disk drive like the one in our evaluation unit. (The Model 55 SX has to use an external 5¼-inch drive.) Further, even with the 5¼-inch floppy disk drive installed, our system had one empty half-height 5¼-inch drive bay. Its 150-W power supply gives you enough power to support those additions.

The MPS2386 also offers six MCA expansion slots (one of which is occupied by the hard disk drive controller) to the Model 55 SX's three.

Cases and Innards

You get inside the MPS2386 as you would any AT clone: by undoing five screws on the rear of the case and sliding the cover forward. There's a lot of metal inside this unit, including a pair of support braces that run from the front to the back of the chassis.

The motherboard is 13½ inches square. Its many surface-mounted chips clash with the 19 wires and four resistors soldered on to fix late production problems (Mitac says the board will be cleaner in later production runs). Its 108 chips include the 80386SX-16, an 80387SX-16, and six Intel VLSI chips that perform most of the MCA functions. Removing the motherboard is slow but not difficult.

A Chips & Technologies VLSI chip provides VGA support. That chip uses eight 256K-byte DRAM VGA memory chips, and there are sockets for eight more. A new C&T chip that will support higher display resolutions will be able to use those extra sockets. The MPS2386's memory consists of 36 100-ns, 1-megabit DRAM chips on four 1-megabyte, parity-checked SIPs on the motherboard. Its keyboard controller and ROM BIOS (version 1.02.00) are by Phoenix Technologies.

The Model 55 SX opens easily, as you would expect from a PS/2: You just undo one screw on each side, and you're done.

The Model 55 SX is a solid, compact machine aimed at the entry-level user who wants an 80386.

The screws even remain attached to the case. Once the case is open, you see a little of the famed PS/2 engineering.

The speaker enclosure forms the front of the card cage and pops out easily. The MCA slots are on a daughterboard that's mounted perpendicular to the motherboard. It and its plastic support brace also come out easily. To take out the drives, you only have to remove their cables, take off the front bezels, and slide them out.

Even IBM, however, makes compromises. The on/off switch on the system's front actually moves a metal bar that extends to another on/off switch on the power supply. The motherboard also was no easier to remove than the MPS2386's; it's held in place by eight little blue screws that were difficult to replace.

The motherboard itself looks great at first: It's the size of a sheet of paper (8½ by 11 inches) and has only 67 chips, not counting memory. Among those chips are the 80386SX-16, a socket for an 80387SX-16, six large IBM VLSI support chips, and eight VGA 256K-byte DRAM chips. There were also 28 chips, including 16 85-ns, 1-megabit DRAM chips, on each of the evaluation unit's two 2-megabyte SIMMs. Surprisingly, the motherboard had 16 wire fixes—almost as many as the MPS2386.

Both systems have respectable keyboards. The Model 55 SX uses the familiar IBM Enhanced keyboard, whose main deficiency is the small size of its Return key. It has a good feel, with mechanical feedback that you can both feel and hear, but it's a little noisy.

The MPS2386 uses a Chicony Electronics keyboard with the common modified IBM Enhanced keyboard. The Enter key is larger than that on the IBM, while the backslash key is to the left of the Backspace key. This keyboard also has a nice mechanical sound and feel, and it's quieter than IBM's.

Both machines include a one-year carry-in parts-and-labor warranty, with extended warranty service and on-site service available. Who services the IBM unit depends on who sells it to you; you go to either your dealer or IBM. Similarly, you get service for the MPS2386 either from your Mitac dealer or from TRW's Customer Service Division, Mitac's service representative.

Mitac provides unlimited telephone support. When the support people called us back, they were helpful, although not well informed about the newly introduced MPS2386. Mitac's phone support is not toll-free, however.

A Question of Need

The Model 55 SX is a solid, compact machine aimed at the entry-level user who wants an 80386. You pay a high premium for the IBM logo: Choose the Model 55 SX over the MPS2386, and you pay over $1000 more and lose the ability to add more hard disk storage. If the IBM name is worth that much money to you, and if you're sure that you'll never need more disk storage, then the Model 55 SX might be the machine for you.

The big question is whether you need an 80386SX MCA machine at all (see "Battle of the Chips," March BYTE, for more on the 80386SX versus the 80286). Frankly, we don't recommend the combination unless you're wedded to MCA and you need to get into the 80386 world as cheaply as possible. If you just want an 80386SX, you'd be better off with an AT-bus Compaq or one of the less expensive compatibles. If, however, you've just got to have this odd combination of the 80386SX and the MCA, the Model 55 SX and the MPS2386 fill the bill. ■

Mark L. Van Name, a BYTE consulting editor, and Bill Catchings are independent computer consultants and freelance writers based in Raleigh, North Carolina. You can contact them on BIX as "mvanname" and "wbc3," respectively.

"Is there something we missed?"

Is there anything missing in the ACCEL-500 24-pin dot matrix printer?

Not performance. The ACCEL-500 can zoom through drafts at 480 cps. Print charts and graphs in dazzling color. And combine letter quality with high resolution color graphics.

Not versatility. The ACCEL-500 is compatible with most popular printers. So it's equally at home on Macintosh® and IBM®-compatible PCs. There's a paper-handling option for every office application, too.

Not convenience. The ACCEL-500's innovative Select-Dial™ makes paper handling a snap. And plug-in Intelli-Cards™ add fonts and printer emulations instantly.

Not reliability. The ACCEL-500 is a 'round-the-clock workhorse that takes even the most demanding workload in stride.

And certainly not value. The ACCEL-500 is priced below leading printer brands that offer far less capability.

In fact, it seems that the only thing missing from the ACCEL-500 is you.

ACCEL·500™

Advanced Matrix Technology
765 Flynn Road, Camarillo, CA 93010
(800) 992-2264 (805) 388-5799

ACCEL-500, Select-Dial and Intelli-Card are trademarks of Advanced Matrix Technology, Inc. Macintosh is a trademark of Apple Computer, Inc. IBM is a registered trademark of International Business Machines Corporation. Drawing courtesy of Wingz.

Circle 15 on Reader Service Card

The New 804 Series

AFFORDABLE CONNECTIVITY

A VERSATILE LAN-ALTERNATIVE FOR $395

THREE MODELS TO MEET YOUR APPLICATIONS

The Print Master® II 804 Series is BayTech's newest intelligent controller with four ports and a 256KB dynamically allocated buffer. Available in your choice of four serial ports (RS-232C or RS-422A), four parallel ports, or two serial and two parallel ports, the 804 Series offers affordable connectivity.

The 804 Series provides a cost-effective solution for users who want to maximize their resources. Each four port model allows you to connect any combination of computers, printers, and plotters for:

- **printer sharing**
- **plotter sharing**
- **buffering of data**
- **LAN printer expansion**

Models with serial ports allow you to also connect modems or any other RS-232C device for computer-to-computer communication and modem sharing.

The 804 Series allows simultaneous data input from computers, output of print data and full duplex communication between pairs of computers.

LAN APPLICATIONS

The 804 Series is ideally suited for expanding the printing capabilities of a LAN system. By acting as a printer server, it can off-load network traffic and provide port expansion and extra buffering.

BayTech products are covered by a one-year warranty and are supported toll-free by a team of application engineers.

Call us today to learn how the new Print Master® II 804 Series can become your connectivity solution.

BayTech

Bay Technical Associates, Inc.
Data Communications Products Division
200 N. Second Street, P.O. Box 387
Bay St. Louis, MS 39520 USA
FAX: 601-467-4551
Telex: 910-333-1618 BAYTECH
Phone: 601-467-8231 or toll-free

800-523-2702

Circle 33 on Reader Service Card (DEALERS: 34)

Color Printer Quells Price-Tag Blues

ColorQuick offers Mac users a slow but effective alternative to pricey thermal printers

Tom Thompson

Volumes extol the color-imaging capabilities of Macintosh computers, but a single word describes printing those images: expensive. But people who balk at paying $7000 to $15,000 for laser and thermal wax-transfer color printers now have a new alternative, Tektronix's $2495 ColorQuick ink-jet printer for the Mac II and Mac SE/30.

With a 216-dot-per-inch resolution, the ColorQuick doesn't rival high-end printers, but its output looks crisp and vibrant on coated paper. What's more, ink-jet prints are more durable than wax-transfer prints, so, for example, artists can fold proofs for mailing, and the ink won't flake or run if the paper accidentally gets soaked (as has happened to me).

The printer has some limitations, including sluggish text speed. But when you compare its price and operating costs to those of high-end printers, the ColorQuick can be a winner for some applications.

A Generous Host

Color printers are expensive because, in many instances, they come with their own microprocessor, RAM, and firmware to handle networking protocols and page-description-language commands. Rather than duplicating these components, ColorQuick opts to tap the host computer to build page images into memory and transfer color data through the Mac's SCSI port to the printer. (This is the same approach that Apple's black-and-white LaserWriter IISC SCSI printer uses.)

This design trades cost savings for computer downtime: ColorQuick ties up the host for the entire printing operation. This can be especially annoying if you are printing large images or lengthy documents.

Nuts and Bolts

ColorQuick's bidirectional print head builds page images one band at a time as four ink jets simultaneously spray dots of cyan, magenta, yellow, and black ink. A levered cover on the print head allows easy access to ink tanks and seals the tanks securely during printing. Lamps on the top of the front of the printer show ink levels. The tanks that store the liquid inks sit on the print head. Also on the print head is a cartridge containing an anticlogging fluid designed to keep the ink jets flowing smoothly. Easy-to-reach buttons let you select form- or line-fed paper, set the media type, and place the printer on-line.

The printer accepts plain paper, coated paper, and transparency film in cut-sheet, roll, or tractor-fed forms. Cut-sheet and roll feeders come standard; a tractor feeder is available as an option at a cost of $300. Both standard feeders handle up to B-size (tabloid) or A3-size media; you can also hand-feed 12- by 18-inch sheets.

Two 50-pin SCSI ports and a Centronics port let Macs and PCs share the printer. The manual explains how to connect a PC, but you must first determine if your PC applications have the appropriate drivers.

The manual is complete and well illustrated. It points out that the printer

continued

ColorQuick

Company
Tektronix, Inc.
Graphics Printing and Imaging Division
MS 63-447
P.O. Box 1000
Wilsonville, OR 97070
(800) 835-6100

Features
Four-color ink-jet printer prints 16.8 million colors; drivers selected using Macintosh Chooser; two 50-pin SCSI ports and one Centronics port; includes sheet and roll feeders; supports Apple's 32-Bit QuickDraw

Size
5⅓ × 15 × 26 inches (without feeders); 28½ pounds (without feeders)

Hardware Needed
Mac II, IIx, IIcx, or Mac SE/30 with at least 2 megabytes of RAM

Software Needed
System 6.0.3/Finder 6.1 or higher

Documentation
User manual

Price
$2495

Inquiry 851.

doesn't have an internal SCSI terminator. This is nice to know if you're cabling the printer to an external SCSI hard disk drive. Many disk drives have hard-to-remove internal terminators and therefore should be placed at the end of a chain of SCSI peripherals (so the order would be, for example, the Mac, a printer, a tape drive, and then the hard disk drive). You set the printer's SCSI ID by means of a small rotary switch. A self-test switch and configuration DIP switches for PCs sit under a hinged front cover that protects them while keeping them readily accessible.

Although the printer is rated at 216 dpi, the Mac software you use determines the actual resolution. For example, most bit-map-based applications, such as MacPaint or PixelPaint, operate on pixels and will print only at the Mac's 72-dpi screen resolution. Vector-based applications, on the other hand, treat graphics as objects and use Color QuickDraw's drawing primitives for additional resolution.

To achieve this extra resolution with text, you must use a font that's three times larger than the document's font. This is because Color QuickDraw uses these larger characters (say, 30-point Courier) to draw the text at 216 dpi; the text actually appears as 10-point Courier on the page. If the larger font is not installed, you can end up with poorly formed text.

Standard ColorQuick disks provide the large fonts in 11 typefaces: Courier, Times, Helvetica, Helvetica Narrow, Palatino, Symbol, ITC Avant Garde Gothic, ITC Bookman, ITC Zapf Chancery, ITC Zapf Dingbats, and New Century Schoolbook. Although these fonts match the PostScript fonts, remember that they are bit-mapped screen fonts, not PostScript fonts. Also, these additional fonts take up space on your hard disk—over 2 megabytes' worth.

Putting It to Work

My review unit arrived with sheet and roll feeders, spare ink cartridges, and a box of 3½-inch floppy disks. The disks held system software, ColorQuick's printer driver, and the larger fonts. Unfortunately, the printer doesn't ship with a SCSI cable or terminator.

I used ColorQuick with a Mac II running System 6.0.3 with 5 megabytes of RAM and a SuperMac Spectrum/8 video board with a 19-inch color monitor. Although the ColorQuick driver can operate with 2 megabytes of RAM, most color applications require well over 1 megabyte. You might consider upgrading your system RAM to 4 megabytes.

The printer comes filled with ink, so the messiest part of the setup is removing the seal on the print head's ink tanks. You'll probably get ink all over your hands no matter how carefully you do this. However, refilling the ink tanks is easy and clean. Sealed ink cartridges are keyed to prevent you from emptying the wrong color into the wrong tank. One end of the cartridge goes into the appropriate well, breaking one seal; you break a second seal on the cartridge top to let the ink flow into the tank.

ColorQuick sports one of the best printer drivers I've seen because it gives plain-English messages (e.g., "Printer out of paper" and "Put the printer online"). When a problem is flagged, you have the choice of either correcting it and resuming the printing operation, or clicking a cancel button to abort the job. A status window graphically shows how much of the page had been printed before the job halted. The window also indicates ink tank levels.

Smooth Color Blends

I printed images with PixelPaint 2.0, MacDraw 1.1, SuperPaint 2.0, and Cricket Graph 1.0. Line artwork, such as charts and graphs, reproduced best. Most PixelPaint artwork with color blends achieved similar quality. Colors blended in smooth gradations. Interestingly, ColorQuick handled some blends (red to yellow to green) better than others (purple to red), but this may be due to a combination of factors and not just the printer.

Although MacDraw 1.1, Cricket Graph 1.0, and SuperPaint 2.0 use the original eight QuickDraw colors, ColorQuick will accommodate those who still use these applications. The driver does require Color QuickDraw, however, so you can't coax colors out of, say, MacDraw 1.1 using a Mac SE or a Mac Plus.

PageMaker 3.0 documents, including the hairlines and colored text, printed fine. However, PageMaker and text-only documents printed slowly: It took nearly 2 minutes per page on low resolution (72 dpi) and over 3 minutes at high resolution (216 dpi). Speed is significant, since printing ties up your Mac. You can't even run the print job in the background under MultiFinder.

Scanned color images were hit-and-miss: Either the printed image looked good, or it didn't. I couldn't determine the cause of this inconsistent quality, especially when I printed two images with nearly the same set of colors, and one looked awful and the other looked sharp and colorful.

You should use coated paper for best results. Images printed on regular paper appeared muddy and flat. Tektronix estimates that coated paper costs 28 cents per sheet. You can expect to pay approximately 40 cents per sheet or more with thermal wax-transfer printers.

ColorQuick's sluggishness when printing text makes it a poor general-purpose printer. However, it shines with artwork, printing most of it at the rated 216-dpi resolution. The nearest price competitor, the $1395 Hewlett-Packard PaintJet, prints at only 180 dpi.

For the right color-printing applications, such as artist's proofs or color transparencies for business presentations, ColorQuick is an affordable and effective choice. ■

Tom Thompson is a BYTE senior technical editor at large. He can be reached on BIX as "tom_thompson."

Designed for desktop graphics, priced to be personal.

Drawing Board to Board Room

Plot your designs, present your plans, and illustrate your point with the new HI Image Maker.™ Houston Instrument's newest plotter can improve all your images at a price that makes personal productivity gains affordable.

Precision CAD or Graphic Presentations

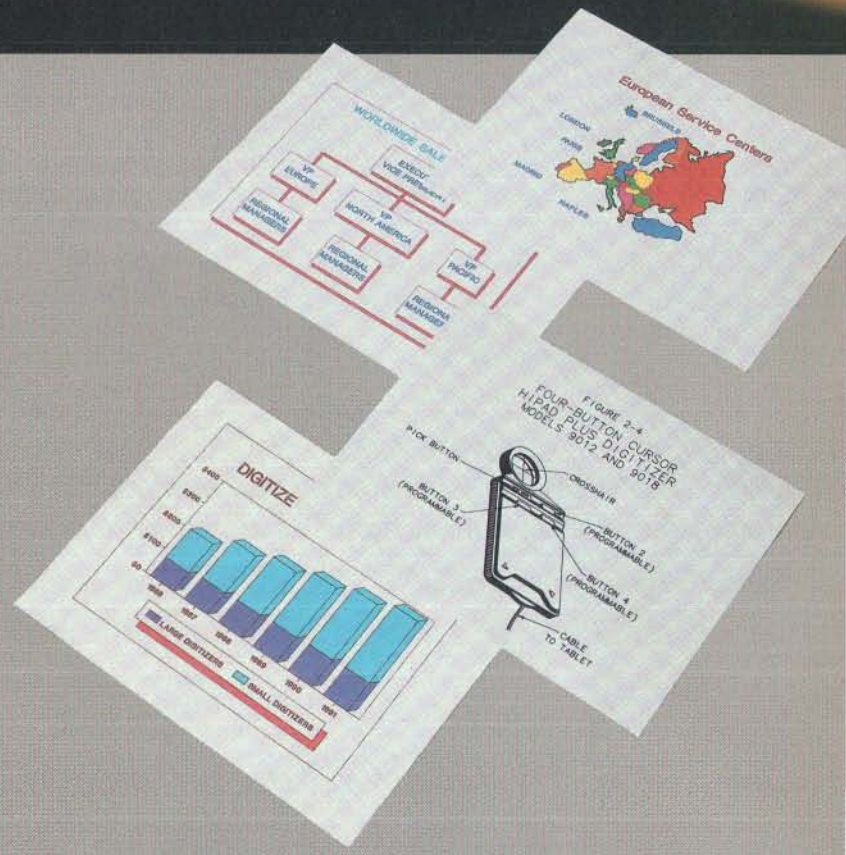
Your HI Image Maker uses a variety of technical pens on vellum or presentation bond—and produces vibrant color graphics on transparencies, paper, or vellum. Drawings on media up to 11×17 inches can be produced quickly and beautifully at a resolution of one thousandth of an inch.

Confidence and Value

Industry experts agree, HI drafting plotters defined the price-performance standard for PC-based CAD plotters. The HI Image Maker is a product you can buy with confidence. Priced at only $1295,* you can use this plotter throughout your company—or keep it for yourself!

For details, call 1-800-444-3425 or 512-835-0900.

**U.S. suggested retail price. Subject to change.*



HOUSTON INSTRUMENT
A DIVISION OF AMETEK
8500 Cameron Road, Austin, TX 78753

Houston Instrument and HI Image Maker are trademarks of AMETEK, Inc.

Circle 122 on Reader Service Card

Intel 80386SX

Micro Channel and AT-bus 386SX Micros --Only From Mitac

Mitac is the first to give you a choice of architectures on the 386SX platform.

Whether you use the "industry standard" (AT) architecture or the up-and-coming Micro Channel of IBM's new PS/2s, Mitac's 386SX-based computers assure you the power of Intel's future-compatible 80386SX microprocessor. The power you need to affordably run today's (and tomorrow's) most advanced 32-bit applications. Of course, you don't need both the MPS2386 and the MPC2386, but whichever system you choose, you get a compact micro with 386 performance and a host of built-in features. On-board VGA-compatible graphics controller, space for both 5-1/4" and 3-1/2" diskette drives, room for four storage devices and a total of six expansion slots assure you maximum flexibility with room for growth.

And, as with all Mitac microcomputers the MPS2386 and MPC2386 are backed by a one-year warranty and Mitac's complete service and support programs. For more information on Mitac's full range of AT- and Micro Channel-compatible computers and the name of your nearest authorized dealer, call today

800-648-2287 Extension 348.

mitac

When reliability is a decisive factor

Mitac's microcomputers are distributed in the U.S. by Microamerica and Schweber Electronics. Canadian distribution is handled through TLS.

Micro Channel, PS/2, AT and IBM are trademarks of International Business Machines Corp. 386SX, 80386 and Intel are trademarks of Intel Corp.

Circle 22 on Reader Service Card

Speed Separates Two Portable Printers

Kodak and Toshiba take different routes to design printers for the road

Wayne Rash Jr.

Portable printing: The Toshiba Expresswriter 301 (left) and the Kodak Diconix 150 Plus.

Kodak and Toshiba recently introduced portable printers for laptop-toting business travelers. Kodak's printer shines as a compact and efficient touring companion; Toshiba's does not.

Kodak's success stems from the ink-jet printer head that it uses with the Diconix 150 Plus, an updated version of the Diconix 150 thermal printer. Toshiba opted for a thermal print mechanism in its Expresswriter 301, and the result is letter-quality output at an almost impractical speed.

To be effective, your portable printer should be as compact as your laptop computer. Ideally, the printer should fit into the computer's carrying case and run on batteries. Its print quality shouldn't embarrass you, even if it falls short of laser printer quality. The Kodak and Toshiba printers each fulfill some of these requirements, but when they're compared for speed and other practical matters, their similarities end.

Slow but Sure

The Expresswriter is misnamed. "Express" implies speed, and that's a quality missing entirely from this, the slowest printer I have ever reviewed.

Clearly, Toshiba optimized the Expresswriter for print quality at the expense of speed and ease of use. Fanfold paper won't work, so you must insert each sheet individually. The paper-out indicator signals before the print head actually reaches the bottom of a page—but that's just as well, because the platen loses its grip on the paper at about that time, so if anything printed, it would be crooked.

The Expresswriter's actual per-line throughput is a dreadful 12.8 characters per second at regular speed, and 16.6 cps at "high" speed (see table 1). (Toshiba claims a high speed of 60 cps.) This rate grinds even more slowly over an entire page, because the head prints only in one direction. At the end of each text line, the head pauses, makes some internal clicking sounds, and then slowly returns to the left margin to begin a new line.

If you can accept this agonizingly slow speed, you'll be pleased with the crisp results from Toshiba's 24-pin thermal print head. It won't outshine a laser printer, but it's acceptable for most business uses. Unfortunately, that's about the only thing I found acceptable in the Expresswriter.

The unit promises Toshiba 321 SL and Epson LQ-850 compatibility. The Epson compatibility worked fine with WordPerfect 5.0 and WordStar 5.5. WordPerfect also handled the Toshiba emulation,

continued

Diconix 150 Plus

Company
Eastman Kodak Co.
Personal Printer Products
901 Elmgrove Rd.
Rochester, NY 14653
(800) 255-3434

Features
IBM Proprinter, Epson FX-80/85, and IBM Graphics emulation; 2000-character buffer; draft, near-letter-quality, and quality modes; condensed superscript/subscript print; noise: 45 dB
Power: AC adapter; five rechargeable C cell batteries (life: 12 hours standby, 1 hour printing)

Size
2 × 6½ × 10¾ inches; 3 pounds

Documentation
User's guide; reference manual

Price
Parallel model: $499
Serial model: $519

Inquiry 852.

Expresswriter 301

Company
Toshiba America Information Systems, Inc.
9740 Irvine Blvd.
Irvine, CA 92718
(714) 583-3000

Features
Toshiba 321 SL/Qume and Epson LQ emulation; 2000-character buffer; 24-dot print head; noise: 47 dB
Power: AC adapter built-in; rechargeable 1 hour of continuous printing

Size
3 × 5½ × 12¼ inches; 4 pounds

Documentation
User's manual

Price
$489

Inquiry 853.

Table 1: *Even at its slowest setting, Kodak's Diconix 150 Plus outpaces the Toshiba Expresswriter 301's printing speed. (Tests consisted of a 1000-character ASCII text file. Measurements are in characters per second for throughput at 10 pitch.)*

Diconix 150 Plus	Expresswriter 301
Draft: 99	Regular speed: 12.8
Near-letter-quality: 33	High speed: 16.6
Quality: 24.2	

but WordStar did not. However, considering that virtually all software accommodates Epson printers in some way, LQ-850 emulation is acceptable.

For this review I used a Zenith SuperSport 286 portable computer. Its carrying case sports a 10- by 12- by 2-inch pocket into which I usually stuff the computer's power supplies, cables, software, LapLink cables, Ethernet cards, a Travis McGee mystery, and, if possible, the printer. Unlike the Diconix, the Expresswriter didn't fit into the pocket. But the Expresswriter is rugged enough to pack into your checked luggage. It survived a rail trip from Washington, D.C., to Philadelphia with no ill effects, although it was inaccessible for any in-transit work.

Jet-Propelled

In contrast to the Expresswriter, Kodak's Diconix 150 Plus is compact, easy to use, and reasonably speedy. Its acceptable print quality falls short of the Expresswriter's, but the text prints a great deal faster. The Diconix's ink-jet printing head provides the speed and size advantages. The updated Diconix also accepts single-sheet or continuous-form paper, so I didn't have to hover over the machine during an extended printout.

The printer appears to be a direct descendant of the old Hewlett-Packard ThinkJet. While the original had problems, such as ink splattering and an appetite for special paper, Kodak's version overcomes these shortcomings. Still irritating, however, is the Diconix's tendency not to print the last line of a text file unless it's followed by a formfeed character. This command, common for laser printers, is unusual for dot-matrix models. It proved tedious when I sent ASCII text to the printer using the MS-DOS COPY command. The command was unnecessary when I used word processor or spreadsheet applications.

Overall, the Diconix 150 Plus behaves well and prints quietly. It supports WordStar and WordPerfect, and both the Epson FX-80 and the IBM Proprinter emulation modes worked properly.

In draft mode, the Diconix runs at 99 cps average throughput for 10-pitch printing (Kodak promises 97 cps average). Draft mode is just that: The print is clearly ink-jet dot-matrix quality, which is fine for draft memos but not business letters.

Diconix also offers near-letter-quality and "quality" printing. Each adds printhead passes, so speed slows accordingly compared to draft printing. But the quality-mode output looks nearly as good as the Expresswriter's text, which takes nearly twice as long to print. More important, you don't suffer with a slower speed unless you choose higher-quality results.

The Diconix performs admirably as a travel printer. I took one to Honolulu, where I used it to create documents that I then faxed to my Washington, D.C., office. The printer was quiet enough to use in my hotel room without concern. Because it fit easily into my laptop's carrying-case pocket, I could work whenever I had the opportunity, including in a Honolulu airport lounge. The larger Toshiba would have been out of reach in my checked baggage.

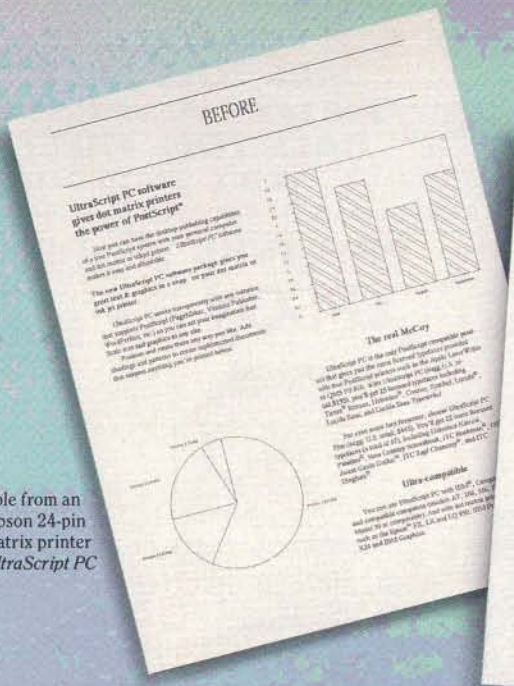
Which Do You Need?

If you're considering buying either of these printers, first decide if you really need letter quality. The Expresswriter offers this, but it asks you to sacrifice performance and easy portability.

With only slightly lower print quality, the Diconix is fast, light, and practical. It travels easily and performs well where you're likely to use it. In short, it works in the real world of business travel, and the Expresswriter does not. ■

Wayne Rash Jr. is a contributing editor for BYTE and a member of the professional staff of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as "waynerash," or in the to.wayne conference.

Sample from an Epson 24-pin dot-matrix printer without *UltraScript PC*



Sample from an Epson 24-pin dot-matrix printer with *UltraScript PC*

Desktop publishing on a dot-matrix budget

UltraScript™ PC software gives dot-matrix printers the power of PostScript® printing at a fraction of the cost.

At last, the power of PostScript printing for thousands less. *UltraScript PC* software runs on your PC and gives ordinary dot-matrix and ink jet printers full desktop publishing capabilities. Create attractive documents that surpass anything you've printed before. It works with software that supports PostScript output, such as PageMaker®, WordPerfect®, Ventura Publisher® and Microsoft® Windows. And it works without forcing you to leave your application to print a document. Use it to scale text and graphics to any size, add shadings and patterns, and position them on the page however you like.

Top-quality typefaces

UltraScript PC is the only PostScript-compatible product that gives you the same licensed typefaces used by professional typesetters and provided with Adobe® PostScript printers such as the Apple® LaserWriter®.

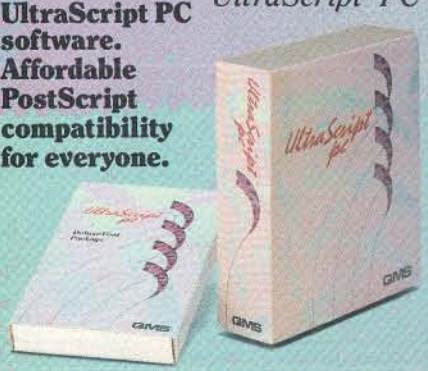
With *UltraScript PC* (U.S. list, $195), you'll get 25 licensed typefaces. For more font firepower, choose *UltraScript PC plus* (U.S. list $445). You'll get 22 more for a total of 47.

Ultracompatible

You can use *UltraScript PC* with most IBM®, Compaq® and compatible computers (80286-based or higher with 1.5 MB of RAM recommended). And with dot-matrix printers such as the Epson® FX, LX and LQ 950, IBM Proprinter® X24 and IBM Graphics. Or ink jet printers such as the HP® DeskJet™ and Canon® BJ-130, or HP LaserJet™ Series II laser printers. And any printer that emulates them.

Join the desktop publishing revolution today—the smart way. Just contact QMS at **1-800-635-3997** and ask about *UltraScript PC*.

UltraScript PC software. Affordable PostScript compatibility for everyone.



QMS®

The following are trademarks or registered trademarks of their respective companies: QMS and UltraScript of QMS, Inc.; Adobe and PostScript of Adobe Systems, Inc. Ventura Publisher of Xerox Corporation; Microsoft of Microsoft Corporation, Epson of Epson America, Inc.; PageMaker of Aldus Corporation; Compaq of Compaq Computer Corporation; IBM and Proprinter of International Business Machines Corporation; WordPerfect of ARTS Computer Products, Inc.; Canon of Canon, USA, Inc.; HP, DeskJet, LaserJet of Hewlett-Packard Company, and Apple and LaserWriter of Apple Computer, Inc. ©1989 QMS, Inc.

Circle 224 on Reader Service Card (DEALERS: 225)

NO ADDED CHARGE ON CREDIT CARDS

EXECUTIVE PHOTO & SUPPLY CORP.

FOR COMPUTER & ACCESSORIES
CALL TOLL FREE: 1-800-882-2802
FOR FAX, TYPEWRITERS & DICTATION EQUIPT.
CALL TOLL FREE: 1-800-223-7323
IN N.Y. STATE CALL: 1-212-947-5290

HOURS: Mon. Tru. Thurs. 9AM Till 6PM, Fri. 9AM Till 2:00PM, Sun. 9:30AM Till 5PM, Closed On Sat.

LAPTOPS

EPSON

Equity LT
10MHz, 640K, 2-3.5 720K Drives, Supertwist Backlit Display w/Free Laplink
1044.95

Equity LT w/20MB Hard Drive..1649.00

SPARK by Datavue
Spark-EL, 640K, 2-3.5 Drives...1019.00
2400 Modem f/Dataview.....CALL

MITSUBISHI
286L w/2-1.4 Drives.....1979.90
286L w/20MB Hard Drive.....2299.00
286L w/40MB Hard Drive.....2859.00

SHARP
PC-4502 w/640K, 2-Floppy Drives & Backlit Monitor.....894.75
New! PC-4641 w/40MB H.D....2396.75

TOSHIBA (sold in Store Only)
T-1000.....CALL T-1200HB...CALL
NEW! T-1600.....CALL
NEW! T-5200.....CALL

ZENITH
184-1....1399.00 184-2....2089.00
Supersport 286 Model 20 w/20MB Hard Drive.....2799.75
286 w/40MB Hard Drive.....3149.75

NEC
PROSPEED 386.....3997.00
ULTRALIGHT 2MB.....2399.75
PROSPEED 286 w/40MB.....CALL

BONDWELL
Bondwell Laptop 286, 10MHz, 20MB Hard Drive w/1200 Modem, Rechargeable Battery & Case.....2149.00

DESKTOPS

COMPAQ

New! DESKPRO 286e, 12MHz, 1.2 Floppy Drive, 40MB Hard Drive w/VGA..2349.00
COMPAQ Portable III with 40MB Hard Drive.....3849.00

AST

AST PREMIUM 286
10 MHz, 512K, 1.2 Floppy Drive, Seagate 40MB Hard Drive (28ms)
1578.75

NEW! AST BRAVO 286 8 MHz, 1.2 Floppy, 40MB Hard Drive (28ms)...1198.75

EPSON
EQUITY II+, 1-1.2 Floppy Drive, 1-40MB Hard Drive.....CALL

COMPATIBLES
IBM-XT Compatible, 1-360 Floppy Drive, 1-20MB Hard Drive.....699.95
IBM-AT Compatible, 12MHz, 512K, 1.2 Floppy Drive, Seagate 40MB Hard Drive (28ms).....1114.75
VENDEX Headstart III.....CALL

Laptop Accessories
WORLD PORT 2400 Modem....235.00
New! DICONIX 150 Plus Printer..309.75
TARGUS Nylon Case.....57.95

PRINTERS

EPSON

FX-1050
9 Pin, Wide Carriage, 290 CPS Draft (10cpi), 60 CPS NLQ, Advanced Paper Handling Capabilities
469.75

New LX-810.....187.95
LQ-850....543.50 LQ-950....542.50
LQ-1050...767.95 LQ-2550...959.99
FX-850....352.00 LQ-510.....CALL

PANASONIC
KX-P 1181..175.75 KX-P 1191..203.75
KX-P 1124.....308.75
PANASONIC Laser Printer.....1319.00

CANON
BJ-80 ..... CALL
LB8-3 Laser ..... CALL

NEC
NEC 2200..307.95 NEC P5200493.95
NEC P5300.....648.95
NEC LC-890 Postscript Laser...3089.00

OKIDATA
OKIDATA 320.....339.00
OKIDATA 393.....1019.00
OKIDATA Laserline 6.....CALL

STAR
NX-1000...157.90 NX-1000C..189.00

PRINTER SALE!
CITIZEN Premiere 35 Daisywheel499.75
DICONIX 300 Narrow Printer....349.75
NEW! H.P. Deskjet Plus.....689.90
H.P. Laserjet II w/Toner.....CALL
APPLE Imagewriter II.....439.00

HARDWARE

LOGITECH

NEW! Logitech Bus Mouse.....69.99
NEW! Logitech PS/2 Mouse.....64.75
Logitech Scanman f/PS2.....199.75
INTEL 80287-10.....214.75
INTEL 80387-20.....369.99
INTEL 80387-33MHz.....569.75
DFI HS-3000 Plus Scanner.....155.75
MICROSOFT Mach 20.....315.75
MICROSOFT Mouse.....99.95
PLUS 20MB Card.....523.75
PLUS Impulse.....CALL
TOSHIBA 3½"720K Drive w/Kit...79.75

Display Cards & Monitors
PARADISE VGA Plus OEM.....199.95
PARADISE VGA Plus 16 OEM...199.95
PARADISE VGA Professional....CALL
VEGA V-Ram VGA 256K.....439.75
VEGA VGA.....245.00
MAGNAVOX VGA Monitor 062...334.75
NEW! NEC Multisync IIA Monitor..496.75
NEC Multisync 3D.....599.00
SEIKO 1430 Monitor.....515.75
SONY 1302 Monitor w/Stand....633.50
SONY 1304 Multiscan Monitor...669.00

Modems/Fax Cards
EVEREX 2400B Modem.....CALL
Zoom 2400 External Modem....117.75
SIERRA (Migent) Pocket Modem..105.00
US Robotics 9600.....679.75
QUADRAM Jt Fax internal 4800..194.75
COMPLETE PC 9600 Fax.....415.75

PRINTER RIBBONS
OKIDATA 292 Ribbon.....5.49
EPSON Orignal EX-800/1000 Color13.99
NEC P7/P3 Ribbon.....4.59

DISKETTES

FUJI MF2/DD Rainbow.....10.49
FUJI MF2 HD.....26.49
MAXELL Disketts.....CALL

SOFTWARE

WORDPERFECT.....223.95
KO-Pilot f/Word Perfect.....56.75
NEW! SAMNA AMI.....116.75
NOTA BENE 3.0.....235.00
WORDSTAR Pro 5.5.....129.95
GRAMMATIK III.....48.99
GO SCRIPT Plus.....234.75
ADOBE Illustrator.....294.75
BITSREAM Fonts.....CALL
SOFTCRAFT Font Solution Pack..384.75
New! PER: FORM Designer....157.75
New! COREL Draw 1.1.....329.95
XEROX Presents.....295.75
ALDUS Pagemaker.....445.00
HARVARD Graphics.....268.75
COMPUTER Support Arts & LettersCALL
PFS First Publisher.....72.75
NEW! LUCID 3D.....59.00
IMPRESS.....77.95
New! LOTUS 1-2-3 3.0.....339.75
LOTUS Agenda.....247.75
SYMANAC Grandview.....173.75
Q & A.....205.75
ASK Sam.....165.00
D'Base IV.....CALL
FOXBASE Plus.....187.75
PARADOX 3.0.....438.75
FRAMEWORK III.....419.00
New! INTUIT Quicken 3.0.....35.95
DAC Easy Accounting 3.0.....57.00
ONE Write Plus.....84.75
WEALTH Builder by Reality....139.75
PROCOM Plus.....42.95
NOLO Will Maker.....30.95
BACK It by Gazelle.....58.75
FASTBACK Plus.....99.75
SPINRITE.....39.95
386 MAX.....39.49
NORTON Advanced Utilities....79.75
MICROSOFT Quick C W/Assembler133.75
BORLAND Turbo C Pro.....157.00
DESKVIEW.....75.00
FAST by Future Computer.....67.75
SUPER PC Kwik.....48.75
TURBO EMS by Lantana.....61.75
HYPERPAD by Brighthall.....56.75
ACCOLADE Grand Prix.....23.75
CHESSMASTER 2100.....29.95
SIERRA Space Quest III.....33.75

***After MFR Rebate of up to $55**

FAX MACHINES

PANAFAX

UF-135.....CALL UF-140.....CALL
UF-145.....CALL UF-150.IN STOCK
UF-250.IN STOCK UF-260.IN STOCK

SHARP
FO-220.....CALL FO-300.....CALL
FO-330.....CALL FO-420.....CALL
FO-510.....CALL FO-700.....CALL

Canon FAXPHONE
FaxPhone 8.CALL FaxPhone 1 CALL
FaxPhone 20 CALL FaxPhone 2.. CALL
FAX 225.....CALL FAX 270.....CALL
FAX 350.....CALL FAX 450.....CALL
FAX 630.....CALL FAX 705.....CALL

RICOH
FAX-25E.....CALL FAX-35.....CALL
FAX-65E.....CALL FAX-75E.....CALL

MURATA
M-900.....CALL M-1200....529.90
M-1400.....CALL M-1600....629.90
M-1800.....CALL

PANASONIC
KX-F 80....CALL KX-F 100...CALL
KX-F 120...CALL KX-F 220...CALL
KX-F 320.....CALL

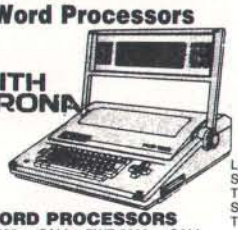
TOSHIBA Price Break
3300.....CALL 3700.....CALL
Model 30100.....CALL

BROTHER
FAX 200.....CALL
FAX 210 w/Answering Machine...CALL

FAX PAPER
8½"x98'....49.95 8½"x164'...59.90
8½"x328'.....74.95
FAX Cleaning Kit.....29.95

TYPEWRITERS & Word Processors

SMITH CORONA



WORD PROCESSORS
PWP-2000..CALL PWP-3000..CALL
PWP-5000..CALL PWP-100C..CALL
PWP-7000LT Laptop.....CALL

TYPEWRITERS
XL-1500.....CALL XL-4600.....CALL
XD-5600.....CALL XD-7600.....CALL

WP & Typerwriter Access.
PWP Start-Rite Kit.....39.95
Typrwriter Start-Rite Kit.....39.95
Printwheels.....ea. 10.95
Multi Strike Film.....Dz. 74.95
Correctable Film.....Dz. 34.95
Lift-Off Correcting Cassette...Dz. 44.95
Cover-Up Correcting Cassette.Dz. 46.95
Data-Disks.....Dz. 34.95
CoronaCalc.....44.95
Sheet Feeder f/PWP-5000.....139.90

Panasonic
KX-W1000 Word Processor.....CALL
KX-W1500 Word Processor..IN STOCK
KX-W1510 WP w/Sheetfeeder....CALL
KX-R430....CALL KX-R440....CALL
KX-R800 Word Processor TypewriterCALL
Accessories.....CALL

brother
WP-60 Word Processor.....CALL
WP-75 Word Processor.....CALL
WP-80 Word Processor.....CALL
AX-26.....CALL AX-28.....CALL
Accessories.....CALL

Dictation Equipment

OLYMPUS Pearlcorder
L-200.....129.90 S-907.....35.90
S-911.....59.90 S-930.....99.90
T-1010 Transcriber.....169.90
S-804.....119.95 S-811.....CALL
T-100.....CALL T-2020.....CALL

PANASONIC
RN-15.....119.90 RN-36.....179.90
RN-89.....79.90 RN-105D....29.90
RN-106D....34.95 RN-115D....39.90
RN-125.....59.90 RR-900.....179.90
RR-970.....249.90 RR-980.....279.90

SANYO
TRC-6100....CALL TRC-5680...79.90
TRC-2550.....149.90
TRC-5200...229.90 TRC-5020...179.90
TRC-4300...227.90 TRC-4030...178.90
TRC-8000A.227.90 TRC-8010A.165.90
TRC-8700...239.90 TRC-8070...185.90
TRC-9100...239.90 TRC-9010...199.90

SONY
M-100B....219.90 M-740.....35.90
M-750V.....49.90 TCM-5000EV.369.90
BM-12.....CALL BM-17.....CALL
BM-560.....CALL BI-500.....CALL
BM-75.....CALL BM-80.....CALL
BM-815T....CALL BM-820.....CALL

NORELCO
585.....99.90 592.....119.90
NT-IIe.....134.95 NT-V.....199.95
NT-VI.....219.90 NT-VII.....247.90
MC-III.....164.95 MC-IV.....199.95
2595.....119.90
205.....287.90 505.....319.90
510.....399.90 805.....629.90
MC-3000....299.90 MC-4000....379.90
2505.....399.90 2510.....334.95

COPIERS

Canon (PC) PERSONAL COPIERS

PC-3 II....349.90 PC-5 II....453.90
PC-5L II Legal Size.....619.90
PC-6.....779.90 PC-6RE....859.90
NEW! PC-7 Zoom Copier.....CALL
Black Cartridges.....79.95
8½x11 Paper (5000 sheets).....49.50

CALCULATORS & DATABANKS

HEWLETT PACKARD

HP-10B Business.....38.45
HP-12C Financial.....59.90
HP-14B Business.....58.90
HP-17B Business.....75.90
HP-19B Business Consultant II..125.90
HP-20S Scientific.....39.90
HP-22S Algebraic Scientific.....43.90
HP-27S Scientific.....74.95
HP-28S Advanced Scientific.....162.90
HP-32S RPN Scientific.....52.95
HP-41CV....119.90 HP-41CX....169.95
HP-42S RPN Scientific.....88.90
HP Infrared Printer.....99.90

PSION

ORGANISER II-XP.....198.90

SHARP
OZ-7000 ***WIZARD***.....IN STOCK
WIZARD Accesories.....CALL
EL-6230 Auto Dialer.....39.90
EL-6250H Dial Master.....53.90

CASIO
SF-4000 32K Digital Diary.....89.90
SF-7000 **B.O.S.S.** 32K Digital Diary179.90
SF-7500 **B.O.S.S.** 64K Digital Diary189.90
SF-8000 **B.O.S.S.** 64K Digital Diary199.90
FC-1000 Financial Consultant....CALL

TELEPHONES

Panasonic

Feature Telephones
KX-T 2335..32.90 KX-T 2365..55.90
Multi-Line Phones
KX-T 3122..56.90 KX-T 3145..67.90
KX-T 3155..75.90 KX-T 3170.139.90
INTEGRATED PHONES
KX-T 2385..62.90 KX-T 2630.105.90
KX-T 2429.135.90 KX-T 2430.108.90
VA-8045.....149.90
Answering Machines Specials
KX-T 1412..59.90 KX-T 1418..69.90
KX-T 1423..65.90 KX-T 1424..69.90
KX-T 1427 LCD w/Time Announce109.90
KX-T 1600..69.90 KX-T 1720.109.90
CORDLESS PHONES
KX-T 3000.119.90 KX-T 3807..59.90
KX-T 3823..70.90 KX-T 3824..89.90
KX-T 3832..93.90 KX-T 3880.125.90
KX-T 3900 w/2-Keypads.....123.90
KX-T 4200 w/Answering Machine.145.90

Freedom Phone
FF-1700 Cordless ***"Top Rated"*** 109.90

Business Key Systems
PANASONIC
2 Line Integrated Intercom System
VA-9200 System (1-9210, 2-9230)369.90
VA-9210 Electronic Controller....124.90
VA-9230 2 Line phone w/Speaker124.90
VA-614 4-Line System
VA-61410 Key Service Unit.....CALL
VA-61421 Phone w/Speakerphone.CALL
VA-61422 Speakerphone w/LCD...CALL
VA-61423 Speakerphone w/BLF...CALL
VA-208 2-Line System
VA-20810 Key System Unit.....CALL
VA-20821 Phone w/Speaker.....CALL
KX-T616 6-Line System
KX-T61610 Control Unit.....CALL
KX-T61620 Phone w/Speaker.....CALL
KX-T61630 Speakerphone w/LCD..CALL
FREEDOM PHONE
FS-246 6-line Service Unit.....CALL
FS-800 Basic Station.....CALL
FS-900 Executive Station.....CALL

VISA, MASTERCARD, AMERICAN EXPRESS, OPTIMA & DISCOVER CARDS ACCEPTED

OUR GUARANTEE: Defective goods will be replaced or repaired if returned within 10 Days in original packing, mint condition, blank warranty card, detailed letter of explanation & copy of invoice. No return privilege on software. If found defective, We will advise customer how to consult manufacturer for warrantee service. **For Customer Service:** Please Call (212) 947-5295. Not Responsible for typographical errors. We reserve the right to limit quantities.
TO ORDER by MAIL: Please send money order or certified check for UPS shipment on most items. Personal check delays your order by 15 days.
Shipping & Handling: Handling Charge; 2% plus 5.95. Shipping Charge; 0.65 per lb. Estimate minimum shipping 5.95. Total charge at time of order. Shipping & Handling charges are not refundable.
INQUIRE about NEXT DAY AIR or 2nd DAY AIR Shipment. N.Y. State Residents add TAX.

EXECUTIVE PHOTO & SUPPLY CORP.

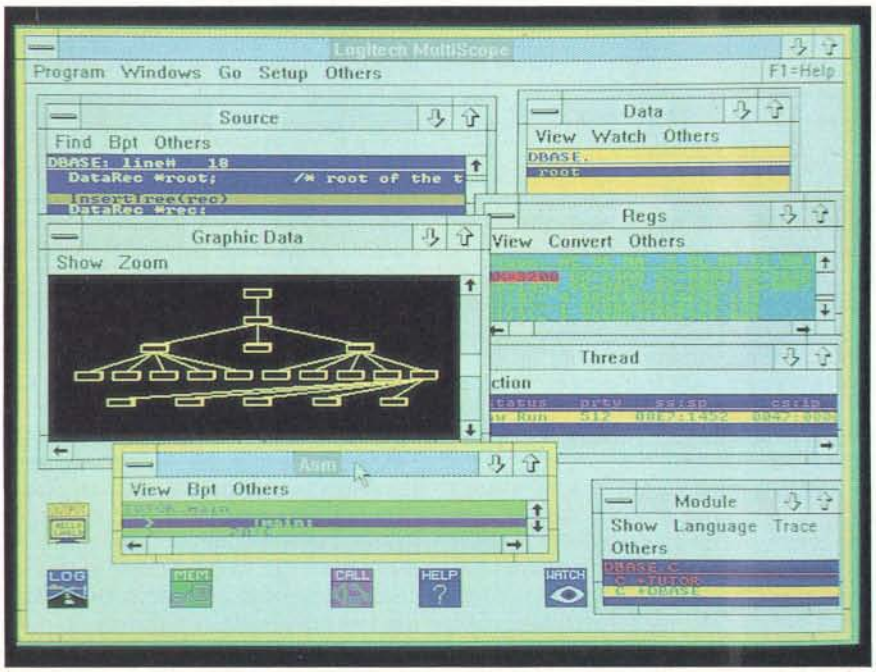
MAIL ORDER: Dept BY,120 West 31st Street, N.Y.,N.Y. 10001 (Tel. 1-212-947-5290)
MANHATTAN STORE: 120 West 31st. Street, N.Y.,N.Y. 10001 (Tel. 1-212-564-3592)
SCARSDALE, NY STORE: 455 Central Ave. (Scarsdale Plaza) SCARSDALE,N.Y. 10538 (Tel. 1-914-723-1331)
N.Y.C. Consumer Affairs License Number: 800193

Circle 98 on Reader Service Card

Four Debuggers in One

Logitech's MultiScope could be the debugging toolkit of choice for professional OS/2 programmers

Martin Heller



MultiScope's Graphic window builds pictures of structured data objects.

Event-driven, multitasking programming environments like the OS/2 Presentation Manager (PM) require good debugging tools. Until now, you had only one choice: Microsoft's CVP, a protected-mode version of the CodeView symbolic debugger. Now there's an alternative: Logitech's MultiScope.

Like CodeView, MultiScope works with multiple languages and helps you debug threads, child processes, and dynamic link libraries (DLLs), but it's more comprehensive. The MultiScope package comprises four debuggers: the PM Run-Time Debugger, PM Post-Mortem Debugger, Text Mode Run-Time Debugger, and Text Mode Post-Mortem Debugger.

The run-time versions, like most debuggers, monitor your program as it executes. The postmortem versions, in conjunction with a special utility that saves your program's state in the event of a crash, let you resurrect and examine the static context of a crashed program. The postmortem debuggers really set MultiScope apart, since you can easily spend hours sneaking up on a protection violation using a run-time debugger.

The MultiScope debuggers work during or after run time, under PM or in character mode, and on the same computer as the program being debugged or on a remote machine. That's quite a feat. Even better, Logitech has made the debuggers all look much the same, so that there is little transition to make when switching among them. Logitech has also kept its debuggers compatible with the format used by CodeView and generated by Microsoft C and Microsoft Link. And you can use MultiScope in conjunction with Logitech's own Modula-2 for OS/2.

The Big Picture Through Small Windows

The MultiScope debuggers are organized into as many as 14 windows. (Some windows don't apply to all situations.) Naturally, things look best under PM, but the windows appear in text mode, too. The Assembly window shows your disassembled and source code. At run time, you can set breakpoints on the assembly code, get statement addresses, and jump to code lines.

The Breakpoint window (available only in the run-time debuggers) lists the line number, module location, and conditional expression for each breakpoint. You can modify breakpoints in this window; for instance, you can add a pass count to create a delayed breakpoint.

The Call window displays the chain of procedure calls in a thread. From the Call window, you can select a procedure to be displayed in the Source and Data windows.

The Data window displays global and local variables for the currently selected procedure in the current thread. It has facilities for modifying values (at run time), exploring arrays and structures, launching the graphical data display

continued

MultiScope

Company
Logitech, Inc.
6505 Kaiser Dr.
Fremont, CA 94555
(800) 231-7717

Hardware Needed
OS/2-capable PS/2 or AT compatible, 4 megabytes of RAM, and a hard disk drive; a mouse is recommended

Software Needed
OS/2 Standard Edition or Extended Edition 1.1 or higher

Price
$299

Inquiry 885.

(under PM), and setting watchpoints (at run time).

The Graphic window displays a box-and-line graph of data structures, showing data objects as boxes and pointers as lines (see photo). In addition, different types of objects are displayed in different colors. As with the Data window, you can use the Graphic window to explore structured objects.

The Log window displays the history of your debugging session. You can save the contents of the Log window to a file if necessary. The Memory window displays memory contents in a variety of formats corresponding to different data types, and it has facilities for adding watchpoints, modifying data, and converting hexadecimal numbers to and from decimal.

The Module window displays the object modules that make up your program. You can set the source language and enable or disable tracing on a module-by-module basis. From the Module window, you can also control the Data and Source window displays.

The Output window displays the screen produced by the program being debugged. The Register window displays the register, flag, and coprocessor register values for the currently selected thread. You can modify the registers (at run time) and do hexadecimal-to-decimal conversions.

The Source window displays the source code of the currently selected module. You can set breakpoints (at run time), search for procedures and lines, jump to lines, and get statement addresses. The Thread window lists your program's threads of execution and their status (e.g., runnable, frozen, blocked, and critical section), priority, stack location, and code location. You can freeze and thaw threads, as well as control the display of the Source, Data, Call, and Register windows.

The Watch window displays your (run-time) watchpoints, which are generally set in the Data or Memory windows. In the Watch window, you can control the "granularity" or frequency of MultiScope's watchpoint checking—each variable watched can be checked at every assembly instruction, every source statement, or every procedure entry. Given the overhead involved in checking data variables without the use of hardware debugging tools, procedure-level granularity is recommended.

Extra Conveniences

The run-time MultiScope debuggers have 11 different Go commands—a much richer set than CodeView provides. Both programs can trace individual assembly instructions and source code lines, trace into or over individual procedure calls, and run until the next breakpoint or watchpoint or the program's end. CodeView's Execute command, which runs your program in slow motion, has no equivalent in MultiScope.

On the other hand, MultiScope adds the ability to execute until the next procedure call, the next procedure return, or the start of a child process or session. It also adds a "go to end" message that ignores breakpoints and watchpoints, saving you the trouble of disabling all your diagnostics when you just want the program to terminate cleanly.

MultiScope's Go commands correspond well to the way I debug, so they save me time compared to the way I use CodeView. But I found the biggest time-saver to be MultiScope's MED (for monitor execution dump) and postmortem debugging facility.

Normally, when a program crashes under OS/2, the user gets a message that says "protection violation," along with some meaningless addresses. Why the program crashed remains a mystery; the OS/2 trap handler doesn't even provide a stack trace, much less a core dump. Sometimes the user can isolate the problem empirically by keeping track of keystrokes and mouse-clicks, but all too often the following dialogue ensues.

User: "Your program crashed."
Developer: "What were you doing?"
User: "Nothing. It just crashed."

With MED, the situation is a little different. The test version of the program is compiled with a call to MED's initialization routine. Until the program crashes, it runs at full speed, with no interference from MED. When the program crashes, MED takes over and saves the full state of the program in a memory-dump file. The user sends the developer a copy of the dump file, which the developer diagnoses with the Post-Mortem Debugger.

Since MultiScope's postmortem debuggers can do everything its real-time debuggers can do except run the program, finding the cause of the crash is fairly easy. For instance, you can unambiguously identify a null pointer (a common error in C programs and a common cause of protection violations) by double-clicking in MultiScope's Call window and then examining the highlighted line in the Data window.

MultiScope's graphical interface makes it much easier to learn than CodeView. You can learn to use MultiScope with a mouse and the menus in an hour or two. Learning all the mouse and keyboard shortcuts will take a little longer, but if you use the program a lot, you'll want to learn them.

With complex data structures, MultiScope again comes up a winner. You can see inside your structures to figure out what's going on by using the Graphic data window. It's a pity the Graphic window only works in the PM versions of the debuggers. I'd like to be able to use it on PM programs, but you can't run the PM debugger on a PM program; if you try, your machine will hang up.

A Few Problems

The conflict between a PM debugger and a PM program is serious, and it may not be soluble under OS/2 1.1. According to Logitech, the problem is that PM's message dispatcher has only one thread. If any PM application fails to respond to a message, the whole PM screen group grinds to a halt. Since the application being debugged *has* to be suspended at a breakpoint or watchpoint, it will not respond to messages. If the debugger is also running in the PM screen group, the debugger will not get any messages. Result: total hang-up. For now, developers can use either MultiScope's character-mode or remote debuggers for debugging PM applications.

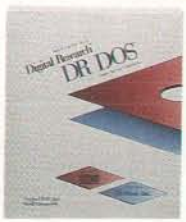
The remote debugger lets you have a PM environment running on both the application and the debugger, but it requires two machines that run PM. It would be nice to do this with less of a hardware investment.

continued

DR DOS.
THE CHOICE IS OBVIOUS, MORE OR LESS.

DR DOS	THE OTHER DOS
▪ Full DOS application support	▪ Full DOS application support
▪ Large disk partitions - greater than 32 megabytes	▪ Large disk partitions - greater than 32 megabytes (DOS 4 only)
▪ LIM 4.0 expanded memory support	▪ LIM 4.0 expanded memory support (DOS 4 only)
▪ Graphical icon-based user interface	▪ Graphical character-based user interface (DOS 4 only)
▪ Fully executable from ROM	
▪ Quick and easy installation	
▪ Password protection for files and directories	
▪ Full screen text editor	
▪ Multiple command line recall	
▪ Built-in help for utilities	
▪ Backed by the Digital Research commitment to quality service and support	

You don't have to look too closely to see how DR DOS stacks up against the competition. With an added set of features and capabilities, DR DOS gives you proven capability *and* flexibility in a superior alternative for any system. Whether you use a hand-held computer, a laptop, a diskless workstation,



a portable or a powerful full-sized system with specialized applications, DR DOS gives you everything you need to make the right choice. Obviously.

For more information: Systems Integrators and OEMs call Digital Research at 800-443-4200.

DIGITAL RESEARCH®

DR DOS™

THE BEST CHOICE.

Digital Research and the Digital Research logo are registered trademarks, and DR DOS is a trademark of Digital Research Inc. Copyright © 1989, Digital Research Inc. All rights reserved.

Circle 83 on Reader Service Card (DEALERS: 84)

Hardware is an issue, too, when simply running the debuggers. With 14 windows to look at, screen real estate is at a premium. Logitech has provided a partial solution in the form of a reduced-size screen font. But anyone who wants to see more than four or five windows at once would do well to look into high-resolution video cards for OS/2, such as the Video Seven VRAM VGA (which can display the PM screen at 800 by 600 pixels on a good multisync monitor) or the IBM 8514/A.

Another problem occurs when viewing variables in local scopes. In the following example, the third instance of `i` is inaccessible:

```
int i,j,k; // globals
main() {
 int i,l,m;
  // local to main()
 (intervening code)
 if(j>k) {
    int i;
  // i inaccessible to debugger
    for(i=0;i<m;i++)
       do_something_with
          (i,j,k,l,m);
    }
(intervening code)
 exit(0);
 }
```

This problem, which isn't serious, comes from the Microsoft C Compiler, which simply doesn't generate debugging information for variables in local scopes. You can always rename your variables and move them up to the function level.

A Worthwhile Investment for Professionals

Perhaps the most serious problem facing MultiScope is not technical at all: CodeView is supplied free with Microsoft C. Occasional OS/2 programmers who got CodeView for free might not want to pay for MultiScope.

On the other hand, serious OS/2 programmers can easily justify the $299 cost of MultiScope by increased productivity. Just one workday saved—for instance, by using MED and postmortem debugging to identify a bug that only happens at a customer's site—should repay the cost of MultiScope. And continued use should pay back handsomely: Logitech has a good set of tools here, which should only improve with time. ■

Martin Heller develops software and writes about technical computer applications. He holds a Ph.D. in physics. He can be reached on BIX as "mheller."

THINK BIG

Phar Lap
Virtual Memory Manager.

It will let you write applications up to 5, 10, 15 megabytes or more for any 386 PC running MS-DOS*. *Forget about RAM limitations.* Your application can run on a machine with as little as 1 or 2 megabytes of memory.

Only Phar Lap 386|VMM* gives you demand-paged virtual memory capability so you can write mainframe-sized applications for the PC. Applications your customers can run on their 386 PCs now with no additional memory. No kidding. All you need is 386|VMM and our family of 386 development tools. Existing programs developed with our 386|DOS-Extender can be easily expanded with 386|VMM too.

Our tools let you take full advantage of the 386 protected mode architecture. Break the DOS 640K limit in the language of your choice; C, Fortran, Pascal, or Assembler.

For fast compact code, use 386|ASM, our 80386 assembler that's upwardly compatible with the MASM* 8086 assembler. Existing DOS and mainframe applications written in a high level language are easily ported by recompiling. And 386|LINK, our 32-bit native mode linker, puts it all together.

Debugging is made easy too. With our 386 symbolic debugger you can debug applications written in assembler or any high level language. Best of all, with Phar Lap's 386|DOS-Extender* you can run your native mode program on any 386-based PC running MS-DOS. And you have full access to DOS system services through INT 21.

NO COMPATIBILITY PROBLEMS

Phar Lap's tools are compatible with the industry's leading systems: DESKPRO 386*, IBM Model 70/80*, 386 clones and accelerator boards. Not only will your new applications be compatible with the leading systems, they'll run alongside all other DOS applications.

NO ROYALTY PAYMENTS

Once your 386 application is complete, all you pay is a low one-time fee to license 386|DOS-Extender for redistribution.

386|VMM is also developer friendly. Call to find out about our flexible runtime pricing.

You can unlock the entire DOS market now. Don't wait for OS/3.

$495	386|ASM/LINK-Package includes 386 assembler, linker, MINIBUG debugger and the developer version of 386|DOS-Extender
$895	MetaWare 80386 High C* compiler
$595	MicroWay NDP Fortran-386* compiler
$195	386|DEBUG symbolic debugger
$295	386|VMM - developer version of the Phar Lap Virtual Memory Manager

(617) 661-1510
PHAR LAP SOFTWARE, INC.
60 Aberdeen Avenue, Cambridge, MA 02138
Fax: (617) 876-2972
"THE 80386 SOFTWARE EXPERTS"

Phar Lap and 386|DOS-Extender and 386|VMM are trademarks of Phar Lap Software, Inc. MS-DOS and MASM are registered trademarks of Microsoft Corp. DESKPRO 386 is a trademark of Compaq Corp. NDP Fortran-386 is a trademark of MicroWay, Inc. High C and Professional Pascal are trademarks of MetaWare Incorporated. IBM Model 70/80 is a trademark of IBM Corp.

Circle 207 on Reader Service Card

NINE REASONS TO BUY CLIPPER WITHOUT A MOMENT'S HESITATION!

The Clipper language offers two compelling reasons to adopt it as your application development standard: open architecture and .EXE file generation. Clipper 5.0 boasts seven more. We think you'll be convinced before you reach number nine.

1 Open Architecture.

Clipper is both powerful and easy to use, with the most comprehensive command and function set available. Want more? Extend the Clipper language with user-defined functions written in Clipper, Assembler, C and other languages.

2 User-defined Commands.

Even more extensibility is available in Clipper 5.0. Support for user-defined commands allows you to tailor your command set to a specific business or industry.

3 .EXE File Generation.

Clipper's compiler yields stand-alone .EXE files for unrestricted distribution, requiring no LAN-PACKs™, no run-time modules and no licenses of any kind!

4 Break the 640K DOS Limit!

Improved memory management in Clipper 5.0, made possible by an exclusive version of Pocket Soft's .RTLink™, lets you run applications larger than 640K, without overlays!

5 Faster Development.

.RTLink features faster linking time and incremental linking, so only the changed object files get re-linked when you compile.

Clipper 5.0

GET IT FIRST, GET IT FREE!

6 Faster, Smaller Code.

Compiler directives allow more efficient execution with less code needed to accomodate varying PC configurations.

7 Multi-dimensional Arrays.

Accurate modelling of actual circumstances is enhanced by the power of multi-dimensional arrays.

8 New Documentation, Including an On-line Guide.

New and expanded documentation will make you immediately productive in Clipper 5.0. And you can access it all on-line through the included Guide to Clipper™ and Norton Guides™ Engine .

9 You Can Get It First!

Buy the current version of Clipper after June 1, 1989, register your copy, and be among the first to get Clipper 5.0—*Free!* You'll even save $100 off the suggested retail price of Clipper 5.0.

So, don't hesitate! Give us a call for the name of your nearest authorized dealer, and make your commitment to Clipper, today.

Clipper®

The Application Development Standard

213/390-7923

Nantucket®

Nantucket Corporation, 12555 West Jefferson Boulevard, Los Angeles, CA 90066. 213/390-7923 FAX: 213/397-5469 TELEX: 650-2574125. Nantucket, the Nantucket logo and Clipper are registered trademarks of Nantucket Corporation. Other brand and product names are used for identification purposes only and may be trademarks or registered trademarks of their respective holders. Entire contents copyright © 1989 Nantucket Corporation.

Software Developers

Now Available
Activator/M™
with
Programmable
Memory

Natural selection provides unique passive protection for the porcupine.

The Activator - Natural Selection For Software Protection

Inventor and entrepreneur Dick Erett explains how "The Activator" provides sane protection for your intellectual property.

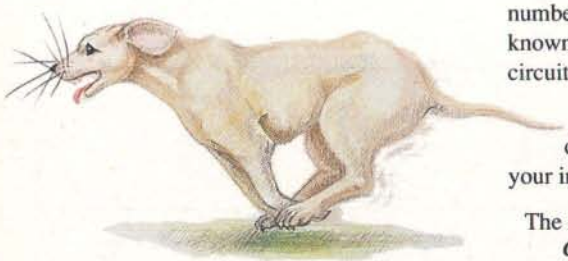
"In any industry, just as in nature, the process of natural selection raises one solution above another. Natural selection is the most elegant of engineers.

In the area of software protection The Block has been selected by the marketplace as the solution that works. Over 500,000 packages are protected by our device.

For the past 4 years our philosophy has been; *'You have the right and obligation to protect your intellectual property.'*

A New Ethic For Software Protection

In allowing end-users unlimited copies of a software package and uninhibited hard disk and LAN operation, The Block has created a new ethic for software protection.



By removing protection from the magnetic media we remove the constraints that have plagued legitimate users.

They simply attach our key to the parallel port and forget it. It is totally transparent, but the software will not run without it.

A New Technology For Software Protection

Our newest model, The Activator, builds on our current patented design, and establishes an unprecedented class of software protection.

We have migrated and enhanced the circuitry of The Block to an ASIC (Application-Specific Integrated Circuit) imbedded in The Activator.

This greatly improves speed and performance, while reducing overall size. Data protection can also be provided.

Programmable Option

The Activator allows the software **developer** the option to program serial numbers, versions, or other pertinent data known only to the developer, into the circuit, and access it from the program.

Once you program your part of the chip, even we have no way to access your information.

The ASIC makes emulation of the device virtually impossible. It also presents an astronomical number of access combinations.

Full 100% Disclosure

Since The Activator is protected by our patent we fully disclose how it works. Once you understand it, endless methods of protection become evident.

Just as no two snowflakes are the same, no two implementations of The Activator are identical. And like the snowflake the simplicity of The Activator is its greatest beauty.

We never cramp your programming style or ingenuity. Make it as simple or complicated as you desire.

Let us help safeguard what's rightfully yours. Please call today for additional information or a demo unit. *It's only natural to protect your software.*"

1-800-333-0407 ext.105
In Connecticut 203-329-8870
Fax 203-329-7428

Software Security inc.
870 High Ridge Road
Stamford, CT 06905

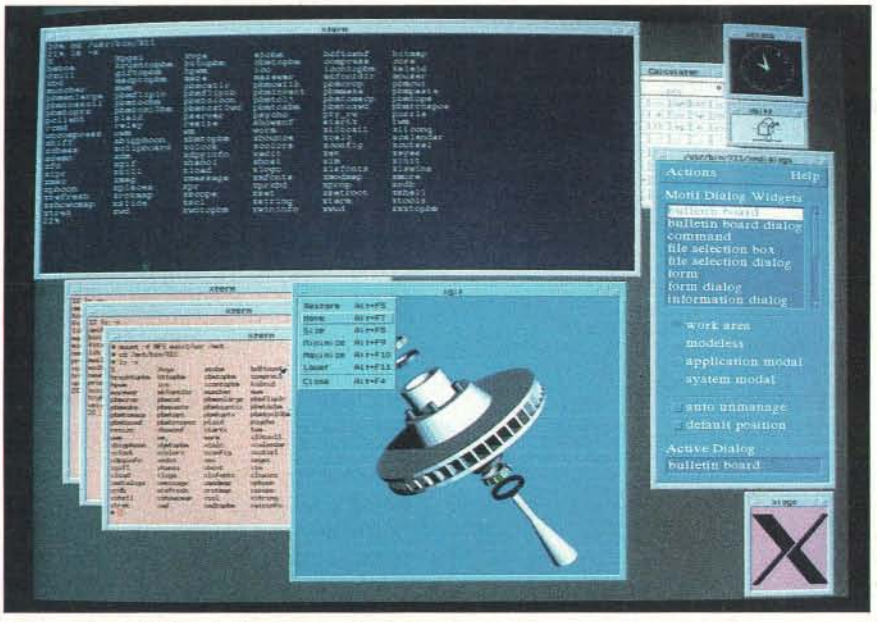
Circle 257 on Reader Service Card

Unlimited Copies • Programmable • No Batteries • Small Size • Fast • Patented • Data Protection

X Window System on the March

Interactive Systems' 386/ix X11 implements the graphical Unix standard with style

Tom Yager



Interactive's 386/ix X11 with the Motif window manager.

The X Window System has emerged as a graphical user interface standard in the Unix world, for all the right reasons. It isn't owned by any one company, and it's highly portable. Interactive Systems Corp.'s X Window System product, 386/ix X11, works in conjunction with ISC's 386/ix, a port of AT&T's Unix System V release 3.2. The 386/ix package was the first commercially available 3.2 Unix for the 80386, and it remains the most widely accepted. It's efficient, stable, and rich with features. The 386/ix X11 package, the layered X Window product reviewed here, shares those qualities.

I tested the system using two SIVA 386/20 PCs from VNS America. Each had 8 megabytes of memory and a 300-megabyte SCSI hard disk drive connected to an Adaptec AHA-1540A/1542A controller. Each machine also had a 16-MHz 80387 math coprocessor. The network connection ran through a pair of Western Digital WD8003 Ethernet adapters.

One system sported an Orchid ProDesigner VGA display adapter with 512K bytes of memory, and the other system had a Matrox PG-1281 34010-based graphics coprocessor. The Orchid VGA adapter drove a Seiko CM-1430 14-inch multifrequency monitor, and the Matrox was hooked to a 19-inch Mitsubishi Diamond Scan Model HL6905. Each system had a Logitech serial three-button mouse.

Taking the Plunge: Installation

Installing 386/ix X11 is simple and automatic. The command `sysadm installpkg` responds with a prompt for the first disk of the series, and then it's easy from there. The X11 package requires kernel (device driver) support, but this poses no difficulty even for the Unix novice. The installation process automatically rebuilds the Unix kernel to accommodate the new devices.

The installation process binds a set of interactive maintenance programs into the `sysadm` utility's menu tree. After the kernel support has been linked in, menus guide the administrator through setting up the environment. The device-dependent portions of the 386/ix X11 servers come in object form. You simply select from a list of supported servers, and each is quickly linked together from the object files. Most can drive a wide range of adapters. The VGA server, for instance, only needs to be built once, even if you plan to use several cards and display geometries. You can build and install new servers anytime, so changing boards is no hassle.

The combination of an X11 server, a keyboard, and a mouse form a logical group called a *display*. The keyboard and mouse types are presented in menus; however, since each server supports so many different graphical configurations, you have to enter a string to identify the screen resolution, the size, and the number of colors.

The manual lists the appropriate configurations for each supported server type. The file `/usr/lib/X11/Xconfig` contains nearly all the specifics as well. Each logical display has one clearly marked adapter, keyboard, and mouse

continued

386/ix X11

Company
Interactive Systems Corp.
2401 Colorado Ave.
Santa Monica, CA 90404
(800) 346-7111
(213) 453-8649

Hardware Needed
80386-based AT compatible or PS/2 with 4 megabytes of RAM, a Hercules or VGA adapter, a two- or three-button mouse, and a 60-megabyte hard disk drive; an Ethernet adapter is required for networking

Price
Various configurations are available:
Workstation Starter (includes the 386/ix operating system and 386/ix X11): $495 (single user); $795 (multiuser)
Workstation Extender (adds the 386/ix TCP/IP, the 386/ix NFS, and the VP/ix): $1095 (single user); $1895 (multiuser)
Workstation Developer (adds development support for 386/ix and 386/ix X11): $1995 (single user); $2995 (multiuser)

Inquiry 883.

entry in this file, and all the configurations under each category appear in commented form.

Two levels of X11 are available from ISC. The most basic, the run-time system, comes with ISC's Run-Time System Guide, which describes the installation procedure and the commands. The development system adds another ISC manual to cover the development libraries, but the largest of the documents are the two Xlib (X function library) manuals. One acts as a guide, and the other is a reference. They both cover the X11 function library completely, and the guide doubles as a fair tutorial.

Starting and Running 386/ix X11

If you're an experienced X11 user, you'll find yourself on familiar ground. If a default server was specified during configuration, you need only type `xinit` to start. The screen clears, leaving an X-shaped mouse cursor in the center of the screen. The default for `xinit` is to create one black-on-white terminal window in the upper left corner of the screen. You can, however, set your own color scheme and start up client programs.

Tailoring your environment is simple. When `xinit` starts, it tries to execute a shell script called `.xinitrc` in your home directory. The default terminal window, along with other terminals, applications, and visual toys, can be started from here.

The X11 server also allows the default server-specific behavior to be overridden through a similar mechanism, the file `.xserverrc`. This one-line script contains the name of the server (such as `Xvga` for the EGA/VGA server) and appropriate command-line arguments. Other X11-related configuration files are supported in the standard fashion, allowing you the freedom to change the appearance and behavior of any conforming X Window System application.

ISC also provides `xdm`, X11's own session manager. This program fires up the server and creates a log-in panel. It prompts for the user name and password and then starts up client programs based on settings in various configuration files located in `/usr/lib/X11/xdm`.

X11 itself does not enforce any policies regarding how to manipulate windows. In fact, the default setup gives you no way to move, resize, or otherwise maneuver them. A special client program, called a window manager, handles these functions, and ISC's X11 distribution supplies three: `uwm`, `wm`, and `twm`.

Of these, the most useful is `twm`. It is highly configurable and builds clean, readable frames around clients. At the top, `twm` adds a title bar with the client's name, along with boxes with symbols for resizing, iconifying (i.e., replacing the application window with a small box containing the client's title and, optionally, a graphical depiction of its purpose), and attaching keyboard input to the window. Optionally, you can create an icon box. This box lists each client program's name, and clicking the mouse's left button on a name toggles the program's iconified/expanded state.

The `twm` is one of dozens of user-contributed programs on seven disks. Many productivity-impeding toys are mixed in with the better utilities, but these programs make X11 a joy to use. In my view, no release would be complete without them. Many vendors ship only the core programs necessary for operating X11, along with a weak assortment of clients. ISC is sure to win points with X11 newcomers by including these programs.

Operation is generally smooth. The VGA server, running with the Orchid board at 1024 by 768 pixels, drove the display with accuracy but with some performance problems. The sluggishness is most severe when moving large terminal or application windows. The window is repainted in its new position very slowly, from top to bottom, taking as much as several seconds to complete. Oddly, other operations involving large areas of display memory are not so slow. In fact, moving a window is the only operation that exhibits this problem. Creating, destroying, iconifying, and deiconifying work very briskly by comparison. It's obviously faster to re-create the window from scratch than it is to move it as an image.

Most of my complaints about X11 concern its performance. It is possible to get more from the hardware than ISC did. The Matrox board does not get pushed near its potential. X11 performs many operations a pixel at a time, rather than telling the board something like "draw a circle of diameter z at position x,y." For example, the `xdemo` program, when drawing ellipses, runs hardly any faster on the Matrox board than on a VGA. Other shapes do better, and ISC designers trusted the Matrox board to handle the most common graphical element, the thin line.

This disparity between the finely tuned and the barely tolerable puzzles me the most. Engineers at ISC explained that they had to work within the boundaries of MIT's X11 server model. This model, they said, dictates that only certain graphics operations can be handled asynchronously, because the server needs to know when an operation is finished. Thin (default width) lines are a special case and can be handled by the hardware. Nearly everything else is drawn, one pixel at a time, by the X server itself.

In a similar vein, the specialized VGA cards are not used to their potential. The most obvious case is ISC's failure to support any VGA board in a 256-color mode. According to ISC, the change from 16- to 256-color mode is so drastic that a new server would have to be written to accommodate it. That's a lot of work, but I think it would be worthwhile for special cases, such as viewing and rendering artwork and for testing advanced user interface designs.

There are other oddities that need to be addressed as this product matures. For example, the servers seem to take up more and more memory as they run, causing problems in other parts of the system. And there's a problem with virtual terminals. The VGA server operates

continued

When 30MB just won't do... Seagate's ST251 Family of 40, 60 and 80MB drives

If 30 megabytes just isn't enough to satisfy your disc storage requirements, then Seagate's 5.25" ST251 family offers the capacity, performance and interface options you need for any operating environment.

The cornerstone of our family is the best-selling ST251. Available in both ST412 and SCSI interfaces, with either 28 or 40 msec access time, this 42MB drive is perfect for demanding applications.

For 50% more capacity, our ST277 features 64MB of formatted storage, with the same access time options as the ST251. And for performance-driven, high-capacity applications, our 84MB ST296 has a 28 msec access time and an SCSI interface.

Each drive in the family comes complete with utility software for easy installation and drive partitioning. You can configure the right solution for your computer system by choosing from Seagate's own line of controllers and adapters for the ST251 family.

No matter which model you choose, you'll receive the same high quality and reliability that have made Seagate the first name in disc drives worldwide. For more information on the ST251 family, contact your authorized Seagate Distributor, or call Seagate at 800-468-DISC.

Seagate

The first name in disc drives

Circle 134 on Reader Service Card

IEEE 488

Interfaces & Software

Hardware
IEEE interfaces for PC, AT, 386, PS/2, Macintosh, HP, SUN & DEC.
Converters from IEEE to RS-232, RS-422, modem, Centronics, SCSI, digital I/O and analog I/O.
IEEE extenders, expanders & buffers.

Software
IEEE device drivers for DOS, UNIX®, Macintosh & SUN.
Drivers for Lotus 1-2-3 & Symphony.
Macintosh IEEE desk accessory.
PC menu-driven analysis.

Support
Free applications support.
30 day money-back guarantee.
Two year warranty.
IEEE seminars available.

Call for your FREE Technical Guide

Demo disks & application notes available

IOtech

(216) 439-4091

Telex 6502820864 • Fax (216) 439-4093
IOtech, Inc. • 25971 Cannon Road • Cleveland, Ohio 44146
London (0734)861287 • Paris (1)348(0)78 • Milan (02)4120360
Brussels (02)3848062 • Linkoping (013)110340 • Helsinki (90)5215288
Munich(089) 710020 • Zurich (01)8219444 • Vienna (0222)253626
Gorinchem (01)83035333 • Oslo (02)649070 • Copenhagen (02)804200
Madrid (91)4027060 • Lisbon (01)4161420
Melbourne (03)5793622 • Toronto (416)6740444

in a virtual terminal, one of several that you can switch to with a hot-key sequence. When the system starts, and for some time after, switching to other virtual terminals is quick and effective. After running for some time, however, and working with many complex clients (like Motif-based ones), the hot-key sequence stops working. The screen goes blank, the disk seeks for several seconds, and then the system beeps and puts the 386/ix X11 screen back up. To regain the ability to switch to virtual terminals, you must stop and restart the server.

Then there are the nits. ISC's servers, when sent a hang-up (HUP) signal, should release all their resources and reset. Instead, they exit, confusing programs such as `xdm` that expect to manipulate the server through this mechanism. Unix full-screen text applications don't resize themselves when the window size is changed. The Matrox server does not handle virtual terminal switching, even though the board is capable of it. Furthermore, it is not possible to run multiple VGA servers on the same machine and console. The hooks are there, and you should be able to switch between multiple X11 sessions with the hot-key sequence.

The Development System

Those who invest in the development system are mostly buying the libraries and header files that give X11 applications their interface to the window system. The simplest of X11 sample programs is the widely distributed `helloworld.c`. It effectively illustrates the basic requirements for every X11 program.

To build it, you link against two libraries: Xlib (`libX11.a`) and Berkeley network sockets (`libinet.a`). The socket library is necessary even on systems that are not networked. While it adds size to every X11 executable file, it enhances portability by adding networking capability to every application. This way, every client program runs just as well over a network connection as it does on the local machine. The combined libraries work together to sense their environment (network or local) and adjust transparently. If the optional TCP/IP networking software is not installed, Unix shared memory will be used instead to handle client-server and client-client communications. If it has been installed, TCP/IP will be used for local connections even if the network is not active (i.e., no other machines are connected).

A special class of window, called a *widget*, can simplify the writing of many kinds of applications. MIT provides the standard set of widgets, the Athena widgets, and these are included with the 386/ix X11 package. By the time you read this, ISC expects to release widget sets to support two emerging interface standards—the Open Software Foundation's Motif and AT&T's Open Look. I experimented with a beta version of ISC's Motif, and I found it to be both attractive and functional.

Making the Connection: Networking

As mentioned before, every client program must have networking support compiled in. Combined with ISC's host-based TCP/IP, the real power of X11 becomes visible. A single command line can direct a client's code to be run on any CPU on the network, with its output directed to any configured screen on the network. This opens up new possibilities in terms of computation and graphics-server systems. The fastest box on the network can handle most of the computation-intensive applications, sending the graphics to whichever device is most convenient or capable.

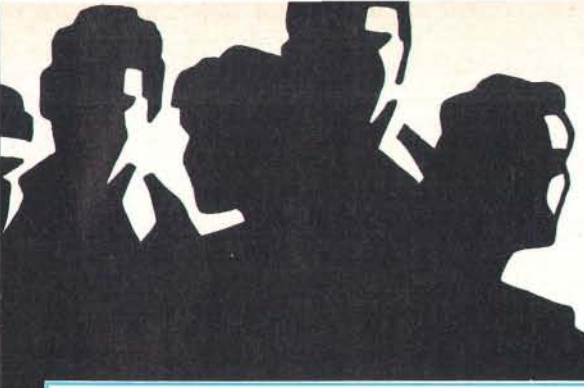
It is all surprisingly easy to configure and manipulate. Any system that has its name listed in a certain host's `/etc/X?.hosts` file (where the ? is replaced by the logical display number described earlier) can use that host's display. Other files control general network access for program execution, but once a network is set up, adding a `-display machine:?` argument to the command line of a conforming client is enough to have that client use the display, keyboard, and mouse of the specified console.

Tests proved that this worked flawlessly. I never had a case where something didn't work right, except that the problems I saw on local connections also prevailed over the network. Extremely complicated programs took slightly longer to start up and display, but not long enough to diminish the network's functionality. X11 applications only need to be directed to a valid logical display; they can be run from any machine on the network, even if that machine is not running X11.

The standards imposed by X11 extend to the format of network traffic, so that dissimilar (heterogeneous) hosts can exchange graphical data and share computing resources with ease. I wasn't able to connect to a network with other than 80386 machines, but colleagues tell me that it's quite a sight to see normally incompatible equipment working quietly together under the mentorship of X11.

A not-so-obvious fringe benefit of

continued



Low Price. Technical Support. Integrity!

. . . Talk to the Reliable Team at Warehouse Data!

HARDWARE

AT MACHINE
Hyundai 10MHz	$839
Hyundai 12MHz	1065
MIT 12MHz 1MB + 1FDD	929
MIT w/40MB Seagate Drive	1359
MIT w/2MB + 40MB Seagate	1419

XT MACHINES
MIT w/640K + 1 FDD	$539
MIT w/20MB Seagate Drive	819
MIT w/40MB Seagate Drive	959

VIDEO CARDS
ATI EGA 800 Wonder	$169
ATI VGA Wonder w/512	345
Generic Color w/PTR	45
Orchid Pro Designer	299
Orchid Pro Designer Plus	385
Paradise EGA 480	179
Paradise VGA 16 Plus	299
Vega Fastwrite VGA	349
Vega VGA	255

MASS STORAGE
Everex 60MB Int Tape AT/PC	$599
Miniscribe 30 MB Kit	289
Miniscribe 322MB ESDI Kit AT	1749
Miniscribe 40MB Kit	320
Refurb Seagate 40MB Kit	350
Refurb Seagate 65MB Kit	387
Refurb Seagate 85MB Kit	535
Seagate 20MB w/Cont	259
Seagate 30MB w/Cont	279
Seagate 40MB ST-251 40ms	369
Seagate 40MB ST-251-1	409

MEMORY BOARDS
AST Rampage 286 w/512K	$339
DFI 2MB Above Board for AT	79
Everex 3MB Above Board AT	89

DIGITIZER
Kurta IS/One 12 × 12	$295

MONITORS
Hyundai 12" Amber w/Tilt	$79
Hyundai 14" CGA w/Tilt	249
Hyundai 14" EGA	335
Hyundai 14" VGA	339
Mitsubishi Diamond Scan	499
NEC Multisync 3D	679
Princeton Ultrasync 16	842
Seiko 1430 VGA	529
Zenith 14" Flat VGA	629

HAND HELD SCANNERS
DFI Handyscanner HS-3000+	$189
Logitech Scanman Hi-Res	179

I/O GAME, MULTI I/O CARDS
C&H XT & AT Game Card	$45
Copy II PC Deluxe Option	109
DFI I/O AT P/S/G	45

386 MACHINES
MIT 33MHz 1MB + 1 FDD	$3719

PRINTERS
Citizen HSP 500	$323
Citizen HSP 550	470
NEC P2200	329
NEC P5200	519
NEC P5300	669
Okidata 182i Turbo	235
Okidata 320	349
Okidata 321	479
Okidata 390	489
Panasonic 1124	329
Panasonic 1180	185
Panasonic 1592	539
Star NX 15	319
Star NX 1000	169
Star NX 1000 Rainbow	229

FLOPPY DRIVES
TEAC ½ HT 360K	$79
TEAC 1.2 Floppy Black	99
Toshiba 3.5" 1.44MB	104
Toshiba 3.5" 720K	89

LAPTOPS
Toshiba T1000	$699
Toshiba T1200 HB w/20MB	1999
Toshiba T1600	3299
Toshiba T3200 w/40MB	3525

MODEMS
Everex 2400B EV-941	$139
Everex 2400B Int	159
Everex 300/1200B Int	69
US Robotics Courier 2400	289
US Robotics Courier HST 9600	609
US Robotics Sportster 1200B	102
US Robotics Sportster 2400B Ext	163

MATH CO-PROCESSORS
80287	$142
80287-8 (8MHz)	212
80287-10	247
80387-16	375
80387-20	427
8087-1 (10MHz)	179
8087-2 (8MHz)	137

SOFTWARE

ACCOUNTING
Dac Easy Accounting 3.0	$59
Managing Your Money 5.0	119
Peachtree Complete	149
Peachtree w/PDQ	220
Quicken	36

CAD AND ENGINEERING
Design Cad 2D 3.0	$219
Design Cad 3D	219
Generic Cad Level 3	159

INTEGRATED
Enable	$415
Microsoft Works	99
PFS First Choice	89
Smart Software	439

WORD PROCESSING
Grammatik III	$49
Microsoft Word 5.0	209
PFS Professional Write 2.1	129
Right Writer	49
WordPerfect 5.0	$219
Wordstar 5.5	229

DOS
Microsoft DOS 3.3	$85
Microsoft DOS 4.1	89

COMMUNICATION PROGRAMS
Carbon Copy PC Plus	$106
Laplink III	79
PC Anywhere III	65
Pro Com Plus	51

DATABASE MANAGERS
Clarion Professional	$379
Clipper	419
dBase IV	469
dBase IV Developer	819
Fox Base+	199
Paradox	439
Power Base	169
Q and A	209
RBase for DOS	459

DESKTOP PUBLISHING
db Publisher	$499
Pagemaker	499
PFS First Publisher	73
Ventura Publisher	519

GRAPHICS
Corel Draw	$275
Harvard Graphics	274
Printshop	34

LANGUAGES
Borland Turbo C 2.0	$95
Borland Turbo C Pro	165
Borland Turbo Pascal 5.5	99
Microsoft Fortran	295
Microsoft Quick Basic	65
Microsoft Quick C	65
Microsoft Macro Assembler	99

PROJECT MANAGERS
Total Harvard Manager 3.01	$369
Super Project Plus	255
Timeline Pro 3.0	364

SPREADSHEETS
Lotus 1-2-3 Ver. 3.0	$349
Microsoft Excel	269
Quattro	159

UTILITIES
Always	$85
Copy II PC	23
Fastback Plus	104
Form Worx	85
Microsoft Windows 286	63
Norton Advanced	79
PC Tools Deluxe 5.5	75
Sideways	39

SPECIAL THIS MONTH!

16 MHz AT COMPUTER

- *1 Year On Site (Home or Office) Warranty, Provided by TRW*
- *30 Day Satisfaction Guarantee*

All Of This For Only

$1,699

SPECS:
- 80286 16 MHz CPU
- 1 MB Ram – Expandable to 8 MB
- 1.2 MB 5.25" Floppy
- *FAST!* 40 MB 28ms Hard Drive
- 8 Expansion Slots
- Parallel, Serial, Game ports included
- 200 Watt Power Supply
- 101 Key Enhanced Keyboard
- 640 × 480 EGA Card
- Entire System Burned in for *4 DAYS!*

Call For Other Models

Order Status
Technical &
Other Info:

1-800-421-3135

Fax (602) 246-7805 / Call for items not shown.

FREE!
Air Express Shipping
You Pay the Ground Shipping
We Pay the Air Difference.

WAREHOUSE DATA PRODUCTS

A DIVISION OF AZ COMPUTER CORP. 2727 W. GLENDALE AVE. PHOENIX, AZ 85051

USER FRIENDLY TERMS & CONDITIONS:
- We welcome international accounts, please call for special pricing.
- Volume discounts for corporate and institutional orders.
- We do not charge your credit card until your order is shipped.
- Shipping minimum is $5.00. Arizona orders + 6.7% sales tax.
- You pay our regular ground shipping rates (1-20 lbs.). We pay the air difference (excludes Alaska and Hawaii.) Free air applies only to orders over $100.
- Personal/company checks allow fourteen (14) days to clear.
- All shipments insured at no extra cost.
- All prices are subject to change without notice.
- We do not guarantee compatibility.
- **No charge for Visa or MasterCard**

Technical Support: (602) 246-2222
FAX (602) 246-7805
Phone Hours:
Monday thru Friday 6:30 a.m.-6:00 p.m. MST
Saturday 9:00 a.m.-5:00 p.m. MST

BY 10

Circle 284 on Reader Service Card

transparent networking is that any computer running an X11 server can connect to the network, even if it isn't able to run any client programs. The recent introduction of X terminals illustrates this. With a minimal operating system and an X11 server in ROM, these terminals use an Ethernet or serial connection to interact with X11. They run nothing but the server and have no other computation capability. They use a specified host to download fonts, and sometimes binary programs (like the server or configuration utilities), so no disk is needed.

X Marks the Spot

ISC's 386/ix X11 arrived a few weeks ago, and it has been that long since I've done anything on an ordinary text display but type `xinit`. It's easy to grow accustomed to, and even dependent on, X11, and the professional manner in which ISC handled its implementation makes it that much more compelling. It is rich with extra features that other vendors have deemed unnecessary. Additional fonts and demo programs have great value even for the experienced user.

Applications developers (and interface hackers) are currently the primary audience for X11, but it has considerable value as an overall environment, too. Those who don't plan to write programs for it will reap benefits just from running it. I expect that, like the Macintosh and Amiga, it will have the effect of turning some users into programmers. Programming under Unix can be enjoyable in itself, but once you add the myriad fonts, colors, and widgets to the mixture, the thrill you feel when first running your own creation is magnified tenfold.

Despite problems that could have sprung from rushing its release, 386/ix X11 is award-winning. The VGA server supports most EGA and VGA cards in all their available resolutions, giving users an inexpensive path to get started with X11, and then to upgrade without sacrificing compatibility. I would like to see a 256-color version, and I expect it will be forthcoming. The VGA support is the heart and soul of 386/ix X11, and it is tremendously well built considering its youth. And there's good support for high-end graphics adapters as well.

Work needs to be done. Functions that hardware can handle without CPU intervention must be removed from the device-independent portion of the server and into the hardware drivers. While the Matrox PG-1281 speeds every operation, only line drawing and blitting (i.e., moving graphics from one area to another) show overwhelming improvement. Matrox's own engineers helped ISC build in support for their hardware, so perhaps the future will bring a more finely tuned server. That tuning will have to include better handling of resources, and some means for telling the server to dump everything and start over.

But 386/ix X11 is a big win for ISC, and the real winners are the users and developers who have been waiting for it. Now the small software house, the student, the consultant, and others who can't afford the big iron can still develop for it, and those that can afford it will have a burgeoning new market for their wares. This may be the best first-release product I've seen, and it will occupy a place of honor in my lab. ■

Tom Yager is a Unix software engineer and freelance technical writer. He maintains a Unix test lab in Westborough, Massachusetts. He can be reached on BIX as "tyager."

The Integrated Software System

docubase™

For the Management, Archiving & Retrieval of: Documents, Computer Output, and information on Optical Disks

● If you use paper, or computers, or computer magnetic tapes,

● If you want to have fast, easy, and selective access to your file and information from any desk,

● If you want to optimize your file storage,

● If you want to benefit from the new dimension that the unerasable (WORM) optical disk brings to office automation,

...then, the docubase software system will provide you with a complete, secure, and extremely easy-to-use information management solution.

Single-user MS-DOS and LAN versions available!

Please come see us at COMDEX in Las Vegas, November 13-17!

For further information, please return the reply coupon with your business card to us at either address below.

docubase™

ARE YOU A:

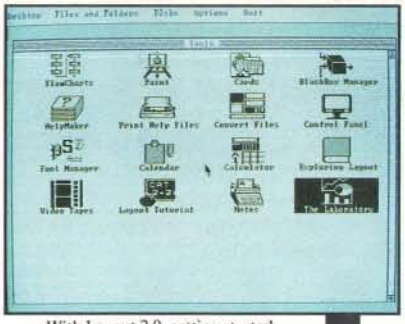
☐ VAR
☐ Systems Integrator
☐ Distributor
☐ Consultant
☐ End-User

Name:
Company Name:
Address:
City:
State or Country:
Zip or postale code:
Phone: Fax:

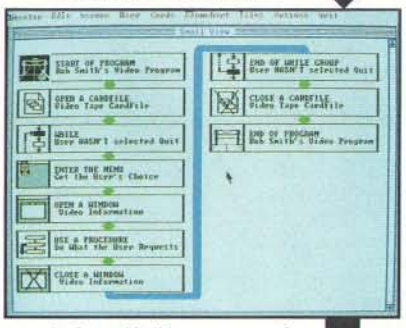
DocuBase Systems, P.O. Box 507, Ashburnham Ma 01430, USA
DocuBase Systems, 16 rue Grand-Bureau, 1227 Geneva, Switzerland

Circle 87 on Reader Service Card

Don't Let the Desktop Programming Revolution Start Without You.

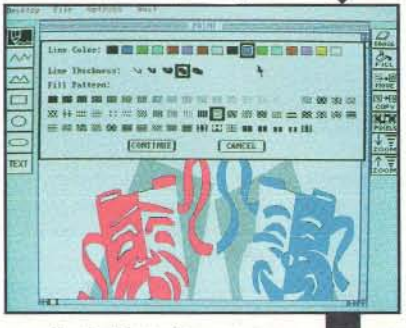


With Layout 2.0, getting started is as easy as choosing a tool.

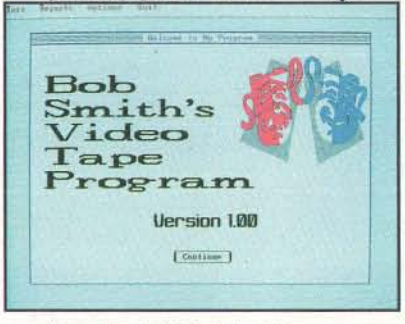


Design and build your programs by using a simple flowchart.

Create Hypercard®-like cards, linked to information in any file.



Use the Paint tool to create powerful graphics and buttons.



Layout creates finished, stand-alone programs for any IBM PC.

Presenting Matrix Layout 2.0

The Desktop Programming revolution has begun. More and more people are maximizing the productivity of their desktop computers without learning to write a line of code. It began with Matrix Layout. And continues with Layout 2.0.

More Power to the People

Matrix invented Desktop Programming to let you create your own programs right on your own PC. Now, Layout 2.0 makes it even easier to create your own powerful, professional-quality applications.

Start with Layout's tools window. Everything you'll need to build your program can be accessed by mouse or keystroke.

Next, use Layout's graphics and text tools to build a flowchart model of your program. Create your own windows, icons, and buttons. Cut and paste functions from other Layout programs. Or use the BlackBox Manager to add a BlackBox—a pre-built capability such as telecommunications or dBase support—to your Layout program. All, without writing a line of code.

Layout 2.0 is also a hypertext tool, allowing you to build Hypercard®-like cards, with text and graphics, and link them to related cards in any file. Use it to create cards for your flowcharts or to create hypertext applications that will run on any IBM-compatible PC.

Power to the Professional

Once your program is complete, Layout 2.0 can automatically create a ready-to-run .EXE file for use by any IBM PC. Or have Layout 2.0 write it in Turbo C, Lattice C, Microsoft C or QuickBASIC. The result: you've got a professional, stand-alone program that does exactly what you want it to. Use it, share it, modify it. You've got the power.

And a Powerful Bargain

For just $199.95 you get the entire Layout 2.0 package, including free technical support, and more programming power than you've ever had on your desktop. For more information, the location of your nearest Matrix dealer, or a copy of the Matrix Layout 2.0 VHS demonstration video (just $9.95 for shipping & handling), call today.

1-800-533-5644
(in Massachusetts, 617-567-0037)

Join the Desktop Programming revolution. Order Matrix Layout 2.0, today!

MATRIX
MATRIX SOFTWARE TECHNOLOGY

BT 89/10

Matrix Software Technology Corporation • One Massachusetts Technology Center • Harborside Drive • Boston, MA 02128 • (617) 567-0037

Matrix Software/UK • Matrix House, Derriford Business Park • Derriford, Plymouth • Devon PL6 5QZ, England • 0752-796-363.
Matrix Software/Europe • Geldenaaksebaan 476 • 3030 Leuven, Belgium • 01620264

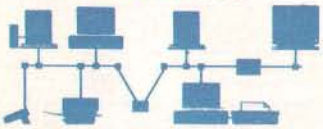
The following are registered and unregistered trademarks of the companies listed: Matrix Layout, Matrix Software Technology Corporation; Hypercard, Apple Computer; IBM, International Business Machines Corporation; dBase, Ashton Tate.

Circle 166 on Reader Service Card

Your Low Price Leader

NETWORKING

CMO HAS THE BEST SOLUTIONS TO YOUR MULTI-USER APPLICATIONS.



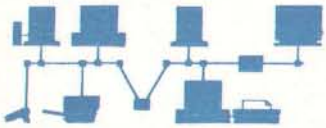
If you are looking for a **Complete Solution**, our trained staff of **Networking Specialists** can assist you in designing your multi-user system. We configure, test and provide on-going support for a full line of Networking software, hardware and connectivity products such as:

Novell Netware	
ELS Level-I 4-User	$499
ELS Level-II V2.15	1099
Advanced NETWARE 286 V2.15	1999
SFT NETWARE 286 V2.15	3099
Orchid	
PCNet Adapater Card	339
Standard Micro Systems	
8-Bit Arcnet PC Boards	179
16-Bit Arcnet Board	399
Tiara	
8-Bit Arcnet Boards	129
16-Bit Arcnet Boards	299
8-Port Active Hub	299
MCA Ethernet Boards	389
Thomas Conrad	
8-Bit Arcnet Boards	179
16-Bit Arcnet Boards	329
16-Port Active Hub	795
Tops	
Tops for Dos 2.1	119
Tops for Mac	149
InBox Starter Kit	339
Western Digital	
EtherCard Plus	249

*Novell trained and authorized sales and support.

Our ACCESS family of 8088, 80286, and 80386 based computers can be configured around your needs for workstations and file servers.

Ask us how to design the ACCESS 386/20 Tower around your networking and/or multi-user application.



MULTIFUNCTION

AST	
Six Pak Plus Board	$129
VGA Plus Adapter	389
Rampage/286 512K	399
Boca Research	
Boca TopHat 128K RAM	119
BocaRam/XT 0-1MB Board	119
BocaRam/AT 0-4MB Board	149
Boca.MCA Serial/Parallel	145
Boca Dual Graphics Adptr	69
Boca MultiEGA	149
DCA	
Irma Convertible 3	469
Irma 2 3278 Emulation	729
Emerald	
3XTwin Local 5251 Emulation	call
Everex	
Ram 3000 Deluxe 0-3MB Board	89
Micro Enhancer EGA	149
View Point VGA 256K	279
5th Generation	
Logical connection 512K	$499
Headland	
Vega VGA Adapter	249
FastWrite 800x600	319
V-RAM VGA Adapter	399
Hercules	
Graphics Card Plus	169
VGA Card	199
Intel	
AboveBoard Plus w/512K	429
AboveBoard Plus I/O w/512K	499
Inboard 386/PC 80386 CPU	579
Visual Edge	449
8087 PC/XT Coprocessor	89
80287-8 8MHz Coprocessor	209
80387-16 16MHz Coprocessor	369
Orchid Technology	
TinyTurbo 286	229
TinyTurbo Xtra 12MHz	279
Designer 800VGA	269
ProDesigner VGA Adapter	319
Renaissance	
VGAI 640x480 256K Pal	179
VGAII 800x600 256K Pal	239
Sysgen	
Omni Board Controller	79

Hot Special

5th Generation Logical Connection 256K $419

STORAGE DEVICES

Archive	
Archive/XL 40MB Internal	$339
Archive VP60 External	979
Micropolis	
159MB 23Msec ESDI	1299
338MB 18Msec ESDI	1899
Miniscribe	
8425 20MB 3.5" 40Msec	249
3650 40MB 5¼" 61Msec	329
6085 70MB 5¼" 28Msec	599
Mountain Computer	
TD-4000 40MB Int. Tape	369
TD-8000 80MB Int. Tape	449
TD-7000 150MB Tape	1499
Plus Development	
20MB HardCard	519
Plus 40MB PassPort	579
Seagate	
ST-225 20MB w/cont	249
ST-238 30MB w/cont	289
ST-251-1 40MB 28ms	349
ST-177N 60MB 24Msec	589
ST-1096N 80MB 24Msec	699
Sysgen	
Bridge-File 5½" External	249
Bridge-Tape 40MB External	449
Reliant Model-215 60MB	469
Reliant Model-519 72MB	499
Toshiba	
1.44MB 3.5" Floppy Drive	99
WELTEC LapTop Sybsystems	
360K 5.25" External Floppy	199
1.2MB 5.25" External Floppy	219
20MB Portable Hard Drive	849

COMPUTERS

AST	
Bravo 286 Model 5	888
Premium 286 Model 140X	1999
Premium 386/25 Model 5	call
Compaq	
DeskPro 286 Model I	1699
Deskpro 386/20e Model-110	5999
SLT-286 Laptop 40MB	4499
IBM	
PS/2 Model-30/286 w/20MB	1999
PS/2 Model-50Z 30MB	2499
PS/2 Model-60 70MB	3899
NEC	
ProSpeed Laptop 286/386	call
UltraLite Laptop	call
Panasonic	
Business Partner 1650	699
Business Partner 1750	839
Toshiba	
T1000 80C86 Laptop	639
T1200 Dual Floppy Backlit	1549
T200 20MB Backlit	2199
T1600 20MB 286	3499
T3200 40MB 12MHz	3599
T5200 40MB 20MHz 386	4999
Zenith	
MiniSport 1MB Laptop	NEW
SuperSport & SuperSport 286	call
Z-248/12Mhz Model-I	1599
Z-386/16MHz Model-40	4999

MONITORS

Amdek	
Video 210Plus TTL Amber	$99
Video 410 TTL Monochrome	145
Color 732 Ps/2 VGA	399
Color 632 14" VGA	379
SmartScan 735 MultiScan	489
1280 15" Hi-Res White	699
Cornerstone	
Single Page Monochrome	699
Dual Page PC 16 Shade	2399
Magnavox	
7BM623 12" TTL Amber	85
7BM749 14" Flatsquare VGA	149
CM8762 14" Comp/RGB	249
8CM515 14" RGB Analog	279
9CM053 14"HiRes EGA	339
9CM062 14" VGA Color	349
9CM080 14" MAC II Color	489
Mitsubishi	
XC-1410C 14" EGA Display	349
XC-1429C 14" PS/2 VGA	439
DiamondScan 13" Display	499
NEC	
Multisync 2A	499
Multisync Plus 960x720	899

Super Special

NEC Multisync XL20" VGA $1899

Packard Bell	
PB-1272 12" TTL Mono	$85
PB-1422EG 14" HiRes EGA	359
PB-1472 14" TTL Mono	99
PB-8541 14" VGA Display	299
Polaroid	
Pallette Plus	2199
Proxima	
EGA Data Display	999
VGA Data Display	1599
Seiko	
CM-1430 14" VGA Display	549
Taxan	
KX-119 12" Amber Comp.	79
Wyse	
Wyse-30 14" ASCII Display	329
Wyse-50 14" ASCII Display	399
Wyse-60 14" 7-page memory	349
Wyse-85 ANSI Data Display	429
Zenith	
ZFM-1490 14" VGA Analog	629

Call Today 800-233-8950

CMO

Computer Mail Order. Since 1981—Low prices, Large Selection, Fast Service.

...For Over 8 Years

COMMUNICATIONS

Anchor	
1200 Baud External	$ 99
2400 Baud External	159
2400 Baud Ext. w/MNP 5	269
Everex	
Evercom 24+ 2400 Baud Int	149
Evercom 24E+2400 Baud Ext	269
Hayes	
Personal Modem 1200	129
SmartModem 1200 Baud	275
SmartModem 2400 Baud	419
Intel	
2400B Classic Internal	169
PS/2 2400B Internal	249
2400EX External	199
Murata	
M1200 Facsimile	599
Panasonic	
UF-140 Panafax	799
Practical Peripherals	
1200 Baud Internal	65
1200 Baud Stand Alone	84
2400 Baud Internal	135

Buyers Special

Practical Peripherals
2400 Baud Stand Alone
$179

Sharp	
FO-220 Facsimile Machine	699
The Complete PC	
Complete Fax 4800 Board	259
Complete Answering Machine	229

I/O DEVICES

Chinon	
DS-3000 Flatbed Scanner	569
Houston Instruments	
9012 HiPad+ 12"x12"	399
PC695 4-Pen A&B Plotter	599
IMSI	
OptiMouse	75
Logitech	
New Logitech Mouse M9	79
ScanMan 400DPI HiRes	189
Microsoft	
Serial or Bus Mouse	119
MSC	
PC Mouse Serial	69
Seiko	
DT-3503 Digitizer	379
The Complete PC	
Complete PC Page Scanner	579

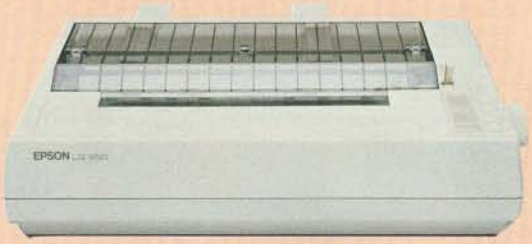
PRINTERS

Alps	
ASP-1000 9-Pin Dot-Matrix	$169
Allegro 24 24-Pin Flatbed	319
P2000 9-Pin 250cps 136 Col.	699
P2100 9-Pin400cps 136 Col.	1099
LPX-600 Laser Printer	1399
Brother	
M-1709 240cps, 132 Col.	369
M-1809 360cps, 80 Col.	399
M-1824L 24-Wire 80 Col.	499
HR-20 20cps Daisywheel	329
HL-8 Laser Printer	1999
Epson	
LX-810 200cps, 80 Col.	179
FX-850 264cps, 80 Col.	339
FX-1050 264cps, 132 Col.	call
LQ-510 180cps, 24-Wire	329
LQ-850 330cps, 24-Wire	call
LQ-1050 330cps, 132 Col.	Call
LQ-2550 500 cps, 24-Wire	call
Hewlett Packard	
ThinkJet 2225	329
Pacific 25-in-One HP Font	279
Pacific 1-2-4 HP-LJ Memory	339
NEC	
P2200 Pinwriter 24-Wire	359
P5200 Pinwriter 265cps	519
P5300 Pinwriter 136 Col.	669
LC-890 PostScript Laser	3295
Okidata	
ML-172 180cps, 80 Col.	199
ML-182 Turbo 220cps	239
ML-320 300cps, 80 Col.	359
ML-390 270cps, 24-Wire	499
ML-393 450cps 24-Wire	1049
Panasonic	
KX-P1180 192cps, 80 Col.	185
KX-P1191 280cps, 80 Col.	239
KX-P1124 192cps, 24-Wire	329
KX-P1524 24-Wire, 132 Col	559
KX-P4450 Laser	1399
Seikosha	
SP1600AI 160cps, 9-Pin	179
SK-3000AI 300 cps, 136 Col.	369
Star Micronics	
NX-1000 140cps, 80 Col.	165
NX-2400 24-Wire 170cps	349
Toshiba	
ExpressWriter 301	349
ExpressWriter 311	439

Hot Special

SummaGraphics
SummaSketch 12x12+
$379

Super Savings Special



Epson LQ-950
254 CPS
24-Wire

$499

SOFTWARE

Aldus PageMaker	$469
Ashton-Tate dBase IV	459
Ashton-Tate MultiMate II	289
BLOC Form Tools	55
Borland Paradox	449
Borland Quattro	159
Borland Turbo Pascal V5.5	99
Broderbund Print Shop	38
Central Pt. PC Tools Deluxe	50
Central Pt. PC-II Opt. Board	119
DAC-EASY Accounting	60
DataStorm ProComm Plus	49
Delrina Per: Form	159
5th Generation FastBack +	98
FoxBase+ Development	199
Funk Sideways	40
Harvard Graphics V2.1	$289
IMSI TurboCAD	59
Intuit Quicken	33
Lotus 1-2-3	299
MECAManaging Your Money	119

SOFTWARE

Microcom CarbonCopy +	119
MicroPro WordStar 5.5	239
Microrim R:BASE For DOS	439
Microsoft Windows 286	70
Microsoft Quick Basic V4.5	69
Nantucket Clipper	419
Nolo Press For The Record	38
PaperBack VP-Planner +	119
Peachtree Accounting	169
Peter Norton Adv. Utilities	80
Peter Norton Commander	89
Quarterdeck DESQView 2.02	80
SPC: 1st Choice 3.0	90
SPC: Professional Write	149
SPC: 1st Publisher 2.0	80
Symantec Q & A	249
Traveling Lap-Link +	85
Lifetree Volkswriter	119
WordPerfect 5.0	219
WordPerfect Office	249
Xerox Ventura Publishing	459

Over 500,000 Satisfied Customers.

MasterCard VISA DISCOVER LEASING

800-233-8950

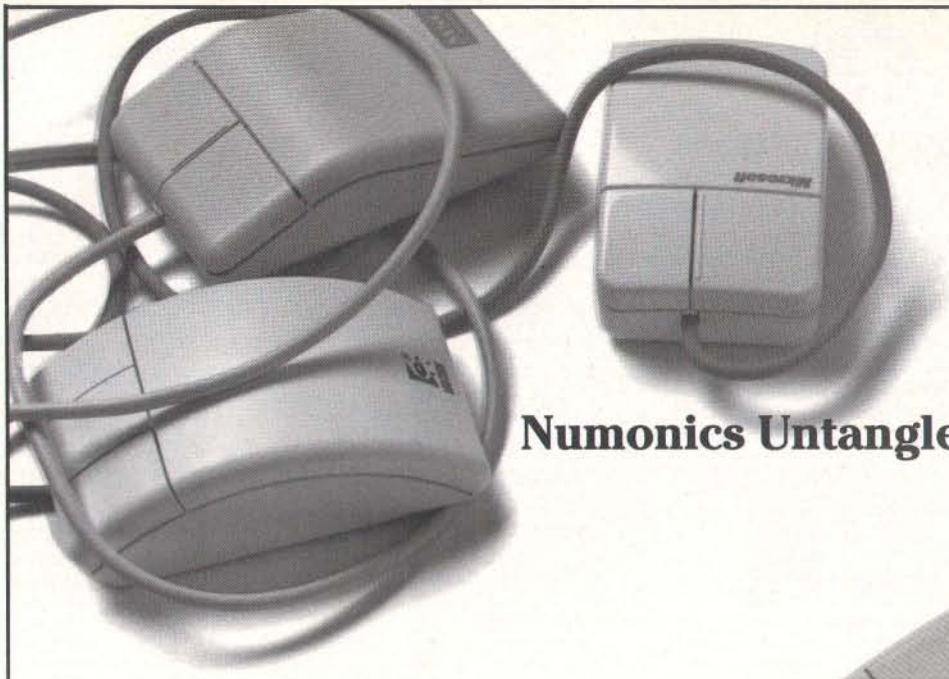
In Canada call: 800-233-8949
All Other Areas call: 717-327-9575 Fax call: 717-327-1217
Educational, Governmental and Corporate Organizations
Call toll-free: 1-800-221-4283
CMO, 101 Reighard Ave., Dept. A1, Williamsport, PA 17701

POLICY: Add 3% (minimum $7.00) shipping and handling. Larger shipments may require additional charges. Personal and company checks require 3 weeks to clear. Credit cards are not charged until we ship. Pennsylvania and Maryland residents add appropriate sales tax. All prices are U.S.A. prices and are subject to change. All items are subject to availability. We cannot guarantee compatibility. We are not responsible for typographic or photographic errors.

MMC MICROCOMPUTER MARKETING COUNCIL

CMO

Computer Mail Order. Since 1981—Low Prices, Large Selection, Fast Service.



Numonics Untangles the Mouse!

The Cordless Manager Mouse

BUY IT...just $149.95 ($175 Value).

The mighty Manager Mouse has no tail to tie you down or hold it back. It's all pure untangled freedom. Plus variable resolution, from 10-1000 dpi, and the maintenance-free performance you'd expect from any well-bred Numonics mouse. Compatible with all popular application software.

BREAK FREE – GET **MANAGER MOUSE!**

Circle 194 on Reader Service Card

NUMONICS

Numonics Corporation, 101 Commerce Drive, Montgomeryville, PA 18936
FAX: (215) 361-0167 or Call: 1-800-247-4517

$149.95

Plus $4.50 shipping & handling per unit.
PA residents add 6% sales tax.

The Cordless Manager Mouse from Numonics

LIMITED OFFER

# of Units_____ Payment: ☐ VISA ☐ MC ☐ AMEX ☐ CHECK
Card No._____ Expiration Date _____
Name_____
Company Name_____
Address_____
City_____ State_____ Zip_____
Daytime Telephone_____ **Amount Enclosed**_____

Visually Map Your Data

MapInfo turns raw data into meaningful presentation graphics

Stan Miastkowski

In today's confusing world of graphics software, MapInfo 4.0 is a unique program. It actually lets you do something eminently useful with any data that contains street addresses or other geographical information. Although its name suggests a simple map generation program, MapInfo is much more. By linking a wide range of data to map files, it gives you a surprisingly new and effective way to look at data.

In a nutshell, MapInfo presents a map (e.g., of a town, county, state, or country) that ties into your database. MapInfo can, for example, pinpoint precisely where a company's customers are located. Or you could have MapInfo show all customers within a 50-mile radius from Chicago, show all customers who bought red widgets, and so on.

Essentially, MapInfo provides a graphical representation of any sort or search you perform on your database. The end result of a MapInfo session is a visualization of "what if." The range of potential applications is almost limitless.

MapInfo's maker, Mapping Information Systems, also offers several hundred different maps onto which you can plot your ASCII or dBASE III data. MapInfo comes with maps of countries, states, and U.S. ZIP codes, and the company also sells digital street maps of thousands of U.S. cities, maps of counties, and demographic/census data. Prices range from $95 to $7000. If you're ambitious, you can even scan in your own map.

MapInfo can produce thematic data maps such as this one of Manhattan showing average household income in various locations around the city.

The Big Map

MapInfo is a large program; the minimum amount of hard disk space you'll need is 3 megabytes. Loading the national ZipInfo file that comes with the package requires another 2.2 megabytes. Then there are the optional maps, if you use them. Even though they're not bitmapped graphical images (MapInfo stores its data in a dBASE-compatible file format), the very amount of data required means lots of megabytes. Individual map files take up as little as 1 megabyte to as much as 100 megabytes.

The basic MapInfo package comes on 10 packed 5¼-inch floppy disks. (Six 720K-byte 3½-inch floppy disks are also included.) MapInfo's automatic installation utility copies, combines, and unpacks the data. By the time I installed a tutorial, a demo package, and two maps of Boston, Massachusetts, and Nashua, New Hampshire, MapInfo took up almost 20 megabytes of hard disk space.

Since MapInfo is a unique package, it takes a good deal of getting used to, and you have to learn many new terms and concepts. MapInfo's tutorial map package is well worth the trip, but it's only a small step along the way to getting comfortable with the package. The tutorial lessons are essential, but many of my questions were left unanswered, and I frequently got the message "This concept isn't covered in the tutorial."

After loading in maps of Boston and Nashua, I started up MapInfo and found that these cities weren't on the list of available maps. That's because MapInfo doesn't make maps available for use until it knows about them. You need to use an

continued

MapInfo 4.0

Company
Mapping Information Systems Corp.
Hendrick Hudson Building
200 Broadway
Troy, NY 12180
(800) 327-8627
(518) 274-8673

Hardware Needed
IBM PC, AT, PS/2, or compatible with 640K bytes of RAM, a hard disk drive with at least 3 megabytes of free space, and a CGA, EGA, VGA, or Hercules graphics adapter; a mouse is highly recommended

Software Needed
DOS 2.0 or higher

Documentation
User's guide; command reference

Price
$750

Inquiry 884.

ADD command that's buried several menu levels down, and then the map will appear on the list. Surely the program's designers could have improved the user interface by having MapInfo automatically make new maps available.

Layers of Complexity

Although you see a complete map on the screen, the package actually stores data in four different kinds of files. More precisely, each map consists of four layers of different information.

Boundary files are areas on the map that are completely enclosed by connected line segments. The most common types of boundary files are states, cities, towns, and counties. But depending on the type of map you're using and what data you've added to it, a boundary file can also contain data such as ZIP code areas, sales territories, or census information (to name a few).

Map files contain information about line segments. Streets, highways, and rivers are the most common; specialized applications can contain segments such as utility lines, cable networks, and railroads.

Point files contain information about related points. You'll use this file regularly when you import your own data to MapInfo; the program uses it to locate a position. Depending on your application, a point can be something as simple as a building, a city, or a customer location; or something more esoteric such as a utility pole or even pothole locations. Point files are stored in dBASE III format; each point is a record, and each field contains the additional data (e.g., a customer name) associated with a record.

Image files are the key to MapInfo's presentation graphics feature. Using MapInfo's image-generating features, you can add titles, legends, icons, identifications, and distance scales to your finished map.

Once all the files are put together, what you see on the screen is a complete map that incorporates all the individual features. Depending on the map, you can move the cursor around on it, magnify sections, and locate points, boundaries, and so forth.

dBASE and Geocoding

Although moving around MapInfo's existing maps is diverting, the key to the package's power is its ability to let you integrate your own data into a map. The MapInfo package includes MBase, a dBASE III–compatible database from FoxBASE. MBase is designed specifically for preparing data for use with MapInfo, and it doesn't include any programming capabilities. You also can't run conventional dBASE III programs in MBase. It does, however, let you use any dBASE III commands individually.

If you're familiar with dBASE III, you won't have any problems with MBase. If you're not, the learning curve for getting useful work out of MapInfo gets steeper. If the database you want to use with MapInfo isn't in dBASE III or ASCII format, you'll need to convert it. I used Paradox 3.0's export utility to convert a newsletter subscriber file to dBASE III format for use by MBase.

Just importing your data into MBase, however, doesn't make it usable by MapInfo. You still need to go through several steps of preparing the data for use with maps. The first step is creating a point file for the database. This involves adding *x*- and *y*-coordinate fields to each of the records in your database. Although the process isn't difficult, you have to be familiar with MBase to do it. (You can also incorporate the fields using your original database before importing it into MBase.)

Once your database contains a point file, the next and most crucial step is to "geocode" the point file. Geocoding, the primary tool for getting your data to actually appear on a map, is the process of assigning a coordinate (either latitude/longitude or *x*-/*y*-coordinates) to each data point. In most cases, MapInfo automatically does the geocoding. Which field you choose to geocode on depends on your context. If you're using one of MapInfo's optional city maps, you'll want to geocode on the street address. But if you have clients scattered around the country, you'll want to geocode on the ZIP code.

Once you've chosen which field to geocode on, MapInfo goes through your database and assigns values to the *x*- and *y*-coordinate fields you created in the database. Then you're ready to use your database. Once I geocoded my newsletter mailing list. I overlayed it on the U.S. map, and it showed me graphically where subscribers were located. I could also locate individual points by typing in other data (such as a subscriber name). Conversely, I could also indicate a point with my mouse and have the full related subscriber data pop up on the screen.

This is just a small example of how you can build and use custom applications with MapInfo. There are numerous variations, and one of the most interesting is thematic mapping. A thematic map displays some kind of data other than geographical locations. MapInfo can represent data themes using a variety of symbols, fill patterns, and colors. The photo shows a MapInfo map of Manhattan giving average household income in various locations around the city.

Once you've created a point file from your own data, you can use a variety of tools to turn a plain-vanilla map into a full-fledged, thematically based presentation graphic. The process is something between using a presentation graphics package and a desktop publishing package. (You can even design your own text fonts and icons or customize the ones that are already included.) But once again, MapInfo's steep learning curve comes into play.

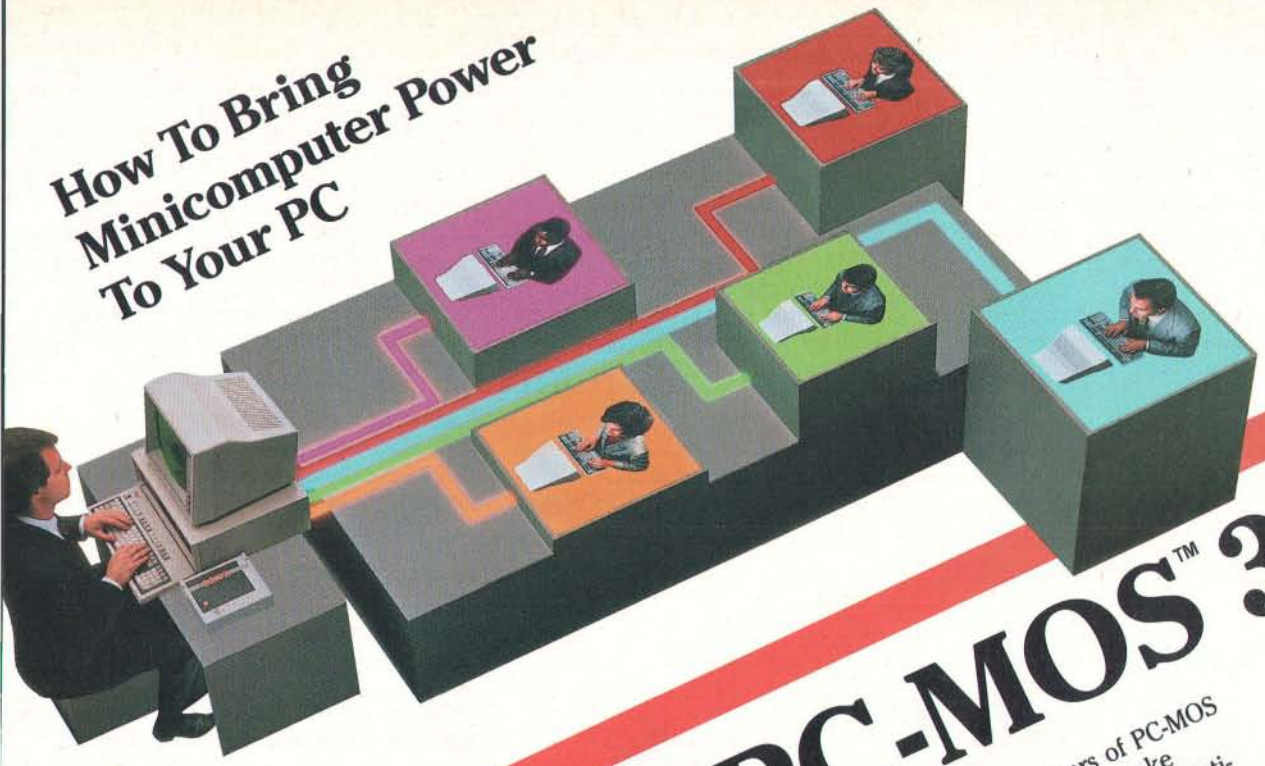
A Resource-Intensive Program

With all the data it has to handle, MapInfo is a very disk- and processor-intensive program. It's especially strenuous on your system's hard disk drive. On my 10-MHz AT clone, I used it with both slow-access (65-millisecond) and fast-access (18-ms) hard disk drives. The difference in performance was very noticeable with the faster drive. On a 33-MHz machine with a fast hard disk drive, MapInfo flew.

MapInfo also uses any extended or expanded memory that it finds in your system. This speeds up the package's response time considerably. But I also found MapInfo to be more than a bit finicky. I used 2 megabytes of extended memory in my AT clone as a disk cache

continued

How To Bring Minicomputer Power To Your PC



Introducing PC-MOS™ 3.0

A multiuser system no longer means only a mainframe or minicomputer. Today's 386- and 286-based PCs are more powerful than the minicomputers of just a few years ago. And they often provide more desktop power than one person can use effectively. That's why you need PC-MOS 3.0. It harnesses the power of your 386- or 286-based PC and turns it into a powerful multiuser, multitasking computer. PC-MOS is the multiuser operating system that lets you run popular DOS applications such as Windows,™ Lotus 1-2-3,™ dBase IV™ or WordPerfect™—without modification.

PC-MOS is the perfect solution for a small business or a department of a large company that needs users to easily and affordably share programs, databases or peripherals. It takes full advantage of the hardware's power—and saves you money in the process! For example, instead of replicating PCs, each user can have an inexpensive terminal or monitor that acts like a PC.

DOS Compatibility Means Minimal Training And Support

Since PC-MOS is DOS compatible—unlike UNIX™ or OS/2™—there's no need for users to learn a "new" operating system or be retrained on the application programs they already know. And unlike most LANs, PC-MOS is easy to install and even easier to maintain. No hassle, no expensive wiring and no network management headaches.

There are now more than 100,000 users of PC-MOS worldwide, but if you haven't seen it lately, take another look. We've broadened our base of compatible applications and added multi-level security, faster disk performance and larger task sizes. Version 3.0 also interfaces with Novell LANs, 3270 mainframe communications products and The Software Link's LANLink™ local area network.

Call us today for more information about PC-MOS 3.0 and the location of your nearest multiuser dealer. We'll show you how to easily and affordably turn your PC into a powerful multiuser system.

Terminals and Workstations Supported
Wyse 150,™ Link MC5;™ Kimtron KT-70™; IBM 3151™; AT&T 605 Business Communications Terminal™; Sun River Cygna/386™; Video Network Adapter™ and others.

THE SOFTWARE LINK
3577 Parkway Lane Norcross, GA 30092
1-800-451-LINK (404) 448-5465
Fax: (404) 263-6474 Telex: 4996147 SWLINK

PC-MOS and LANLink are trademarks of The Software Link, Inc.
All other products referenced are trademarks of their respective companies.

Your connection to advanced technology

Circle 255 on Reader Service Card (DEALERS: 256)

controlled by Future Computing Systems' Fast, and MapInfo repeatedly locked up. When I turned off the cache, I had no problems.

MapInfo works with a wide variety of graphics hardware. Software drivers are included for everything from Hercules monochrome graphics through CGA (in black-and-white mode) all the way up to EGA and VGA. But although you can use it with older graphics standards, I found that VGA is really the only choice for serious MapInfo work. Additional drivers are available for the ultrahigh-resolution IBM 8514/A and other not-so-standard graphics adapters.

On the output side, printer drivers are included for industry-standard dot-matrix and laser printers, including PostScript devices. Since mapping applications lend themselves especially well to plotters, drivers are included for most popular pen plotters, including those from Houston Instrument, IBM, and Hewlett-Packard. Like the graphics drivers, MapInfo also has a wide range of additional printer and plotter drivers available at an extra charge.

The company has announced a network node pack ($595) that lets multiple users work on maps at the same time.

Following the Road Map

MapInfo is a unique and surprising package whose potential applications are limited only by the imagination. But like so many large applications, it is complex. One important difference between MapInfo and other applications is that it's virtually impossible to use just a part of it. To use MapInfo effectively, you must become familiar with the whole shooting match. That's not an easy job.

The program's designers could have made the learning process a bit simpler. There's no on-line help facility, and it's badly needed. In addition, MapInfo's user interface is quirky. Although some of the terms used in menus are initially daunting, they are necessary because of the singular nature of mapping concepts. However, main menus would be more useful if they dropped down instead of continually taking a large portion of the left side of the screen. (There's a full-screen option, but it's useful only for viewing a finished map.) A mouse isn't required for using MapInfo, but I found it a necessity for speeding up work.

The paradox of MapInfo is that the people who will find it the most useful are also the ones who are least likely to have the time and patience to live with its learning curve. A sales manager or city planner wants results immediately. Consequently, any office that's a serious MapInfo user will be better served by having one person who becomes the resident expert. For these real-world applications, MapInfo also sells MapCode ($395), a programming package and compiler that can be used to generate custom (and easier to use) MapInfo applications. It could be the logical solution to MapInfo's problem.

Still, if you're willing to get past the learning curve and other oddities, you'll find MapInfo one of the most useful applications around. Early versions have found a loyal following in various fields. MapInfo has the capability of turning graphical "what if" into "that's it." ■

Stan Miastkowski is a BYTE consulting editor, managing director of K+S Concepts (a documentation and consulting firm) and editor of the OS Report *newsletter. He can be reached on BIX as "stanm."*

Circle 267 on Reader Service Card

Rupp Corporation Presents
Power Products Showcase No. 21

Circle 245 on Reader Service Card

XIRCOM

The Xircom Pocket Ethernet Adapter allows you to conveniently connect any IBM compatible personal computer to an Ethernet or IEEE 802.3 local area network. This adapter connects externally to any parallel printer port, eliminating the hassles of installing an internal Ethernet adapter.

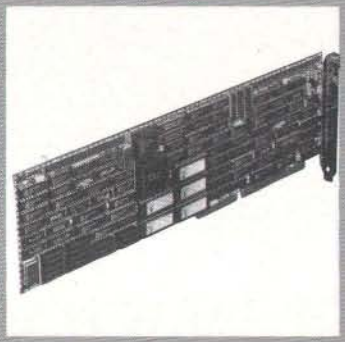
It's the only adapter that can easily be used with laptop computers and is also an ideal choice for workstations where board slots or power are at a premium.

The Pocket Ethernet Adapter is also an economical choice for a group of infrequent network users because it can be quickly and easily moved from computer to computer. It contains no configuration switches, completely avoiding the problems of address and interrupt conflicts common with other Ethernet adapters. Drivers for Novell Netware version 2.0 and 2.1 are included.

Features:
Uses LPT port.
For all IBM compatibles.
Netware 2.x compatible.
IEEE 802.3 standard.

PRICE **$695**

Circle 244 on Reader Service Card



PM3011 CACHING CONTROLLER

Up to 16MB of hardware implemented cache for ESDI, RLL of ST506 drives.

Product Profile: The PM3011 caching controller is the single most effective performance improvement tool available for disk-intensive applications. The PM3011 accesses data in as little as 0.5ms; that's 50 to 150 times faster than a random disk access.

Advanced Caching Algorithms: Such advanced caching features as disk read ahead and elevator sorting during cache write-back increase disk performance to levels unattainable by non-caching controllers. The controller's on-board 68000 microprocessor enables it to access the disk drive at the same time as the computer reads or writes to the controller cache.

Compatibility: Since PM3011 caching controllers operate transparently to the operating system, special software drivers or ROM BIOS changes are not required.

Up to 16MB of Cache: The PM3011 Cache RAM is expandable from the on-board 512KB to 16MB with the optional Cache Expansion board. The cache is totally independent from system memory and does not require device drivers.

PM3011/70 Caching Controller With 512KB cache. **$1150**

Circle 243 on Reader Service Card

FAX LineShare

Why dedicate a phone line for your FAX when FAX LineShare will automatically route incoming voice and FAX calls on one line to their proper destinations?

Product Profile: FAX LineShare works by automatically answering all incoming calls and sending a ringback tone to the caller. In the first few seconds, FAX LineShare looks for fax prefix tone. If fax tone is detected, FAX LineShare rings the fax port. Otherwise ringing is applied to the voice port. Once the ringing port is answered, the ringback tone is removed and a connection is made.

Manual fax calls, which do not contain a fax prefix tone, can be easily transferred to the fax port by either the calling or answering person after FAX LineShare answers the call. Unattended modes are provided and should the A.C. power fail, FAX LineShare operates in the voice phone mode.

The need to install a dedicated FAX line is over. The FAX LineShare is the solution to dealing with the Telephone Company.

FAX LineShare **$219**

*For pricing on RLL, ST506 controllers and other options please call

(303) 494-8078
Dealer Inquiries Welcome
Charge Cards Accepted: Amex, Visa, MC
Hours (EST) 9:00 to 5:00

RUPP CORPORATION **Exceptional Computer Products**

Rupp Corporation
835 Madison Avenue
New York City, NY 10021

Some of the smartest business decisions are made in the dark.

More and more business people are seeing the light and using the GEnie™ service during non-prime time. That's the way to put GEnie to work for just $6 an hour. Which is less than half of what CompuServe® charges to access many of the same business features.

GEnie, for example, lets you book hotel and airline reservations using the Official Airlines Guide.™ Get financial news with Dow Jones News/Retrieval. Plus you'll get real-time quotes, fast on-line trading and discount commissions, all with Charles Schwab Brokerage Services. A valuable new package that's available on GEnie.

And GEnie makes signing up easy.

(1) Set your modem for local echo (half duplex), 300 or 1200 baud.
(2) Dial 1-800-638-8369. When connected, you just enter HHH.
(3) At the U#= prompt simply enter XTX99634,GEnie then RETURN.

And have a major credit card or your checking account number ready. For information in the U.S. or Canada, call 1-800-638-9636. Or write GE Information Services, 401 North Washington St., Rockville, MD 20850.

We bring good things to life.

**Applies only to 1200 baud access in U.S. Mon.-Fri. 6PM-8AM local time and all day Sat., Sun., and nat'l holidays. Subject to service availability. Some services may be subject to a surcharge. Prices effective May 1, 1989.*

Circle 110 on Reader Service Card

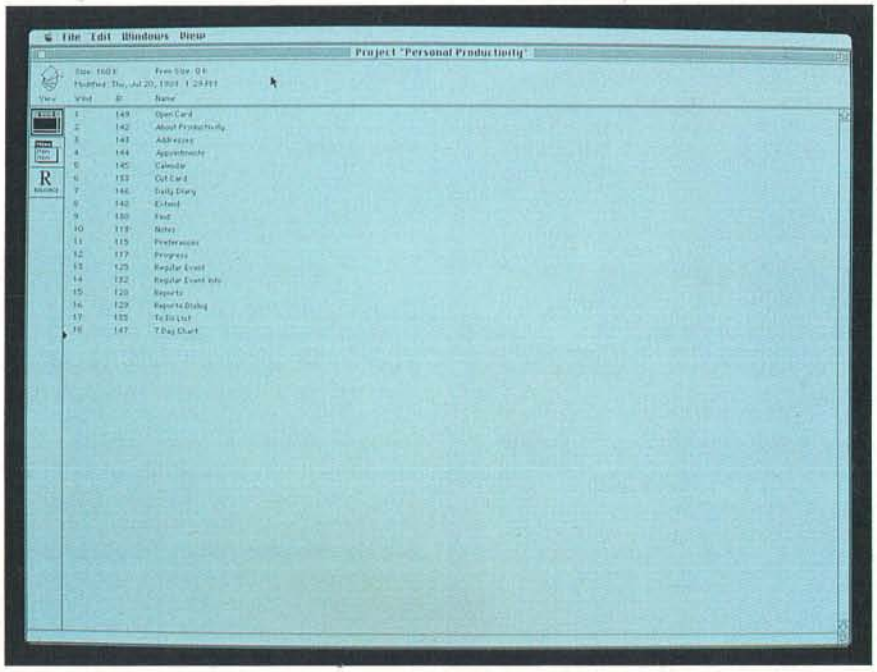
How Super Is SuperCard?

It has more features than HyperCard, but performance is slow

Richard D. Lasky

It sounded too good to be true. Here was a program that took HyperCard as a starting point and added on a veritable wish list of features: color support, multiple windows, object-oriented graphics, irregular button shapes, and even the ability to create stand-alone applications.

That's what Silicon Beach promised of its SuperCard, and it does, in fact, deliver all those enhancements and then some. Unfortunately, those enhancements come at the expense of performance. The trade-off may be worthwhile for some people, and for others, SuperCard's bounty of features is at least worth considering.



The user interface of SuperCard's SuperEdit is reminiscent of Apple's ResEdit.

Like HyperCard, Only Different

The basic file unit in SuperCard is a *project*, and each project contains at least one window. Windows can be any size, and SuperCard supports all the common Macintosh window types. A SuperCard window is the equivalent of a HyperCard stack. Each window has one or more backgrounds, and each background has at least one card.

Cards may be any size, unlike those of HyperCard, which are limited to only what fits into the 9-inch Macintosh display. In HyperCard, for example, you might have to divide a large map among several different cards. With SuperCard, the whole map is on a single large card that you can view through a scrolling window.

Another major difference between SuperCard and Apple's product is the way graphics are handled. HyperCard has just two graphics layers; both are paint-type bit maps. SuperCard supports both paint- and draw-type graphics, and each graphics image is treated as a separate object with its own properties and script. Also, instead of a Home card, SuperCard has a file called `SharedFile` to store common resources.

Two Programs in One

The SuperCard package actually consists of two applications, SuperEdit and SuperCard. You use SuperEdit to create new projects, and you use SuperCard to run them. SuperEdit's user interface is reminiscent of that of ResEdit, Apple's resource editing program (see photo).

Each project displays a list of the windows, menus, or resources contained in the project. The objects in the list are displayed by name, number, and ID number.

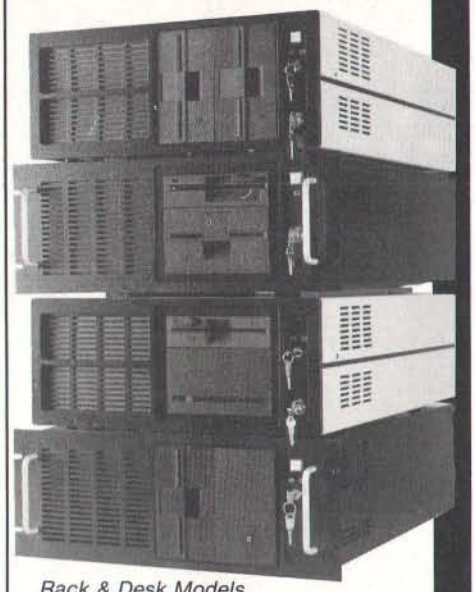
You can open any card in a window to get a visual display of the card's layout. Along the left side of the card layout window is a column of tool icons. You can toggle back and forth between card and background views.

Users familiar with HyperCard's treatment of background objects should be aware that SuperEdit handles things a bit differently. For example, in HyperCard's card view mode, you can move background buttons, but in SuperEdit—unless you explicitly select the background view—background objects remain inanimate. Although this takes getting used to, it's probably a good idea. I've often worked on a button or field in HyperCard and forgotten that it was in

continued

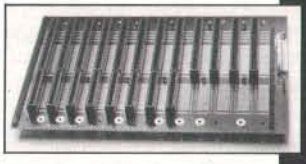
Rack & Desk PC/AT Chassis

Integrand's new Chassis/System is not another IBM mechanical and electrical clone. An entirely fresh packaging design approach has been taken using modular construction. At present, over 40 optional stock modules allow you to customize our standard chassis to nearly any requirement. Integrand offers high quality, advanced design hardware along with applications and technical support *all at prices competitive with imports.* Why settle for less?



Rack & Desk Models
Accepts PC, XT, AT Motherboards and Passive Backplanes
Doesn't Look Like IBM
Rugged, Modular Construction
Excellent Air Flow & Cooling
Optional Card Cage Fan
Designed to meet FCC
204 Watt Supply, UL Recognized
145W & 85W also available
Reasonably Priced

Now Available Passive Backplanes



INTEGRAND RESEARCH CORP.

Call or write for descriptive brochure and prices:
8620 Roosevelt Ave. • Visalia, CA 93291
209/651-1203
TELEX 5106012830 (INTEGRAND UD)
FAX 209/651-1353
We accept Bank Americard/VISA and MasterCard

IBM, PC, XT, AT trademarks of International Business Machines. Drives and computer boards not included.

SuperCard 1.0

Company
Silicon Beach Software, Inc.
9770 Carroll Center Rd., Suite J
San Diego, CA 92126
(619) 695-6956

Hardware Needed
Mac Plus or higher with two 800K-byte floppy disk drives or a hard disk drive; 2 megabytes of RAM is required for color

Software Needed
System 6.0 or higher

Documentation
User manual; language guide

Price
$199

Inquiry 886.

the background domain. Background fields in SuperEdit also have visible text when the background view is chosen, unlike in HyperCard. I liked this feature as well.

Every object can have a script, which you can edit in SuperEdit. In fact, you can have several scripts open at once. Another nice feature is the use of script editing aids provided in the editing window of each script. When you click on one of five buttons, a menu pops up containing all the reserved words in the SuperTalk language. For example, selecting `mouseUp` from the Sys Messages menu inserts the `on mouseUp...end mouseUp` message handler into the script window. The script-editing window is not modal, as it is in HyperCard. You have access to the menu bar as well as any other open windows, which I found very convenient and a big improvement over HyperCard.

You can also convert HyperCard stacks to new SuperCard projects using SuperEdit. It places the cards of the stack into a single window in the new project. (SuperEdit supports all the common button types found in HyperCard, and a few more to boot.) I converted two of my stacks. The first was a simple address-type stack of my customer base. This converted quite well and was fully functional (if a bit slower) in SuperCard. The second stack I converted was a demo version of a stack I developed for nutritional analysis. The calculations worked, but there was a major problem in the portion of the stack that created a bar graph. That's when I learned that I could not convert HyperCard's drawing commands to SuperCard without some modification.

SuperCard has some nice features that make work easy for the project designer. When you're working in the background mode, for example, choosing the `Gray Card` command from the view menu causes SuperEdit to display a grayed image of card objects behind the background objects that you are editing. This is a great help in aligning objects in the background mode with card objects.

The text field types are identical to those found in HyperCard. However, the opaque field type found in HyperCard is not available. Text within a field may contain several different fonts and styles, a significant feature lacking in HyperCard. However, a card with many font styles on it may take significantly longer to open.

SuperCard supports 8-bit color on the Macintosh II models. This requires at least 1.5 megabytes of RAM. A total of 256 colors (out of a possible 16.8 million) are available at one time. The available colors are contained in a resource called CLUT, which stands for "color lookup table." The system supplies a default CLUT, but you can create a new CLUT resource.

For graphics objects, you can set the "ink effects," which determine what happens to the bit pattern when one object is on top of another. Combining various ink effects with different fill patterns can yield some interesting visual effects. Seven ink effects are available for colored objects.

Unlike most applications, SuperCard stores resources in the data fork of the program. You can create three kinds of resources in SuperEdit: icons, cursors, and CLUTS. In addition, you can import sounds, XCMDs, and XFCNs (external commands and functions).

Running Projects

To run a project created with SuperEdit, you can go directly into SuperCard by choosing the `Run` command under the File menu in SuperEdit. When you subsequently quit SuperCard, you are returned to SuperEdit. However, this doesn't work when running MultiFinder; SuperCard dumps you back to the Finder instead.

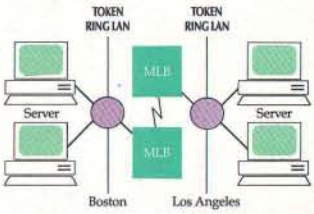
SuperCard has some limited editing abilities that make it a useful environment for fine-tuning your project once it is near completion. You can create and alter objects and their scripts, but the

continued

WHAT OUR REMOTE LAN BRIDGE CAN DO FOR YOUR WORLD.

Bringing people and information together is what a Microcom LAN Bridge is all about. And, with our unique MNP® Data Compression feature, remote LANs can be connected at unprecedented performance levels. MNP squeezes twice the performance out of your wide-area link compared to other bridges at a fraction of the price.

In fact, the Microcom LAN Bridge is the only remote bridge on earth that uses data compression to move oceans of data between LANs. And, it's the first



to support Token Ring networks, in addition to the Ethernet LAN standard.

Think about it. A fully integrated transparent MAC-level bridge built around the IBM PC/AT bus. In four fully upgradeable, multi-line models with speeds from 9600 bps to 1.544 Mbps (T-1). And with prices beginning at $6,198, the only thing a Microcom LAN Bridge can't squeeze is your budget.

The Microcom LAN Bridge. It brings information and people closer together, no matter where in the world they are.

Call toll-free, 800-822-8224 for more information.

500 River Ridge Drive
Norwood, MA 02062
Telex:
710-336-7802 Microcom NWD.
U.S. FAX: 617-551-1006
Worldwide Distribution.
International FAX: 617-551-1007

Microcom

MNP is a registered trademark of Microcom, Inc. Microcom LAN Bridge and MNP Data Compression are trademarks of Microcom, Inc. IBM Token Ring and IBM/AT are trademarks of International Business Machines Corp. Ethernet is a trademark of Xerox, Inc.

Circle 175 on Reader Service Card.

Circle 8 on Reader Service Card (DEALERS: 9)

EZ-DOS

An alternative, user-friendly Disk Operating System for PCs.

There is no comparison

	EZ-DOS	DOS 3.3	DOS 4.01
INSTALL generates CONFIG/AUTOEXEC files	Yes	No	Yes
File & directory password protection	Yes	No	No
On-line help for command syntax & usage	Yes	No	No
True graphic user interface (GEM Desktop)	Yes	No	No
Command line editing	Yes	No	No
Command history buffer up to 4K bytes deep	Yes	No	No
Full screen text editor with on-line Help	Yes	No	No
Maximum partition size (in megabytes)	512	32	512

EZ-DOS 4.0 ..... **$79.00**
plus True BASIC..... **$99.00**
plus serial Mouse..... **$129.00**
plus T.BASIC & Mouse... **$149.00**

2001 Sales, Inc.
16580 Harbor Blvd., Ste. D
Fountain Valley, CA 92708.
Tel: (714) 531-6551
Fax: (714) 531-8546
Dealer, Distributor & OEM inquiries welcome.
VISA and Master Card accepted.

program lacks any advanced editing features. For example, you can reshape a polygon in SuperCard, but if you want to change its ink effect, you must use SuperEdit.

Instead of simply having SuperCard run your project, you can convert your project into a stand-alone application. The advantage is that its distribution is not limited to those people who already use SuperCard. The other side of the coin is that creating a stand-alone application adds some 350K bytes of SuperCard run-time code to the size of the project file. The resulting application works just as if you were running the project with SuperCard; there is no noticeable gain in performance.

You can edit an application in SuperEdit, but you cannot convert it back into a SuperCard project. Unfortunately, SuperCard does not give you the opportunity to change the name of a project being converted. As a result, the new stand-alone file replaces the project file.

Frustrating Performance

I have two major complaints about SuperCard. The first is its memory requirements and poor handling in low-memory situations. Although the company advertises the minimum memory requirement as 700K bytes, my experience is that even 1 megabyte of RAM is insufficient for getting acceptable performance on a Mac Plus.

When I began reviewing SuperCard, I was chiefly working on a 1-megabyte Mac Plus. My attempts to use the program were fraught with frustration and frozen screens. Even when running one of the tutorial projects, I frequently got the "SuperCard is out of memory" dialog box. What made matters even worse was that half the time the system locked up as soon as I dismissed the warning message.

I upgraded my Mac to 2.5 megabytes of RAM. This let me experiment under MultiFinder. Both SuperCard and SuperEdit are initially set to hog 1600K bytes under MultiFinder, but these values can be reset from the Finder by using the `Get Info` menu command. I set SuperCard's partition for 750K bytes to test the company's claims of a 700K-byte requirement. I opened the "Ramblin' Ruth" project, a cute little tutorial project that comes with SuperCard. When I tried to add a simple menu to the menu bar, I got the familiar "out of memory" dialog box. I clicked "OK," and the screen froze.

Silicon Beach acknowledges that SuperCard has problems with low-memory situations. The company suggested removing my INIT files (such as QuicKeys and Suitcase) from my system folder to free up memory on my 1-megabyte Mac. But the company also agreed that it is unreasonable to expect Mac users to give up all their INIT utilities just to run SuperCard. (At least one INIT, called Boomerang, causes SuperCard to crash. It is the fault of Boomerang, and its author is correcting the problem.)

The other problem with SuperCard is the slowness of the screen refresh. This is most often experienced as a long delay going from card to card. Such a long pause would occur between the time I clicked the button and the time the screen auto-highlighted. Thinking nothing was happening, I would click the button a second or third time.

Even after upgrading my Mac to 2.5 megabytes of RAM, I found the response time unacceptably slow. For example, I compared HyperCard's Address stack and SuperCard's Productivity project—two Rolodex-like programs that let you "flip" through address cards. SuperCard took more than three times longer (nearly 3 seconds) than HyperCard just to go to the next card.

The company points out that SuperCard is not optimized for 342 by 512 bit-mapped cards, as HyperCard is. It suggests using STEP files for animation instead of flipping cards, and avoiding large bit-mapped graphics.

A Super Buy?

Before you rush out to buy SuperCard, carefully consider just what you expect to get. HyperCard users should bear in mind that many of the features in SuperCard are available as add-on XCMD or XFCN programs from third-party developers. For example, HyperWindows from Tulip Software ($59) lets you access multiple windows of any type from within HyperCard, and it also supports color displays.

The bottom line is that Silicon Beach has created a neat Mac erector set. SuperEdit has many exciting and powerful features, but you may be disappointed by SuperCard's slow performance. In addition, SuperCard is not appropriate for a Macintosh with only 1 megabyte of RAM. But if future versions of the program are better optimized for speedy performance, then SuperCard really will be a dream come true. ■

Richard D. Lasky is a biochemist and stackware developer living in Needham, Massachusetts. He can be reached on BIX c/o "editors."

PC BRAND

Chosen# 1 For Customer Service and Support.

"PC BRAND is the LL Bean of the personal computer mail order.
PC BRAND wants no unhappy customers, and it's service and support policies help to insure that."

-Personal Computing's 10 Best Mail Order Companies , Feb, 1989

PC BRAND™

PC BRAND offers you more...

Welcome to PC Brand. Your *first* place to shop. Your *best* place to shop for top quality IBM compatible systems, custom configured to your exact specifications, and thousands of quality name brand peripherals and accessories.

Choose from over 10,000 items in stock... all at unbeatable prices!

Free Freight, Toll-Free Support, 5-Year Warranty and more...

Everyone promises you great service. We deliver the tangibles.

Free freight • Fast delivery
• No credit card surcharges
• A 30-day Money-Back Guarantee on every system we sell
• Toll-Free Customer Service andTechnical Support that will stay with you until your questions are answered and your problem is solved
• And our exclusive 5-Year Warranty on all PC Brand products, call for details.

Call PC Brand today.

For the best selection... the best products...at the best price, you can't do better than PC Brand.

Call PC Brand today!

TURN PAGE
FOR PC BRAND SYSTEMS
...AND NAME BRAND
PERIPHERALS

Circle 218 on Reader Service Card

Outstanding Quality

PC BRAND Chosen #1 For Customer Service and Support.

"PC BRAND is the LL Bean of the personal computer mail order...PC BRAND wants no unhappy customers, and it's service and support policies help to insure that."

-Personal Computing's 10 Best Mail Order Companies, Feb, 1989

PC BRAND

Your Best Choice
for Quality Systems
Toll-Free Support
Toll-Free Service
Free Freight
5-Year Warranty

PCV20 AD-II $539

15 MHz Throughput in an XT. Norton SI 4.0
512K, 360K Drive, 84-Keyboard

Standard System Features:

- 10MHz Nec V20 CPU with 1.5 times the power of the 8088!
- 512K RAM standard. Expandable to 640KB
- One 360K Floppy Drive • 84-key AT Style Keyboard
- 8 Slots. Serial, Parallel, Game Ports, and Clock Standard
- AT Style Case with Keylock, Turbo, Power and Hard Drive LEDs. Accomodates up to 4 HH Mass Storage devices
- Set-up & Operating instructions.

Standard Pre-Built Configurations:

PCV20 AD-II With 512K, Hard Disk Drive, Monitor & Video Card				
Drive / Video	1 Floppy	2 Floppy	40MB-46MS	66MB-25MS
Mono	$664	$739	$944	$1094
VGA/Mono	$824	$899	$1104	$1254
EGA	$1004	$1079	$1284	$1434
VGA/Color	$1054	$1129	$1334	$1484

PC BRAND 286/12 $799

Now Using C & T "Neat" Chip Set

12 MHz Clock, Zero Wait Operation,
Norton SI 15.3 •Landmark™ Speed 15.1MHz
512K, 1.2MB or 1.44MB Drive, 101- Keyboard

Standard System Features:

- 80286-12 Processor Operating at 12MHz with Zero Wait States delivering 15.1MHz Effective Throughput
- 512K RAM expandable to 4MB on the System board using 256K or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive Controller
- Enhanced 101-key AT Style Keyboard
- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- Built-in System Board LIM 4.0 EMS hardware drivers
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- Full size 5 drive case • Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable
- Full or Mini Size Tower® Case

Standard Pre-Built Configurations:

286/12 With 512K, Hard Disk Drive, Monitor & Video Card				
Drives / Video	40MB-46MS 1:1 RLL	66MB-25MS 1:1 RLL	71MB-18MS 1:1 MFM	110MB-25MS 1:1 RLL
Mono	$1207	$1432	$1572	$1672
VGA/Mono	$1402	$1627	$1767	$1867
EGA	$1547	$1772	$1912	$2012
VGA/16Bit	$1637	$1862	$2002	$2102

Unbelievable Price

PC BRAND 286/20 $999

Ideal Novell Server!

20 MHz Clock, Zero Wait Operation
Norton SI 23.0 • Landmark™ 26.7MHz
512K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- 80286 Processor Operating at 20MHz w/Zero Wait States in interleave mode delivering 27MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM, and PCNET compatibility
- Built-in System Board LIM 4.0 EMS hardware drivers
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- Full or Mini Size Tower ® Case • Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable

Standard Pre-Built Configurations:

286/20 w/512K, Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-46MS 1:1RLL	66MB-25MS 1:1 RLL	71MB-18MS 1:1 MFM	110MB-25MS 1:1 RLL	150-17MS 1:1 ESDI	320-16MS 1:1 ESDI
Mono	$1407	$1632	$1737	$1862	$2517	$2817
VGA/Mono	$1602	$1827	$1932	$2057	$2712	$3012
EGA	$1747	$1972	$2077	$2202	$2857	$3157
VGA/16Bit	$1837	$2062	$2167	$2292	$2947	$3247

PC BRAND 386/SX-16 $1099

16 MHz Clock, Zero Wait Operation
Norton SI 18.7 • Landmark™ 18.3MHz
512K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- 80386SX Processor Operating at 16MHz delivering 18MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB 80ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387SX Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM, and PCNET compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays (Shown with optional Mini Size Tower® Case)

Options:

- Full or Mini Size Tower ® Case • Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable

Standard Pre-Built Configurations:

386SX-16 w/512K, Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-46MS 1:1RLL	66MB-25MS 1:1 RLL	71MB-18MS 1:1 MFM	110MB-28MS 1:1 RLL	150-17MS 1:1 ESDI	320-16MS 1:1 ESDI
Mono	$1507	$1732	$1837	$1962	$2617	$2917
VGA/Mono	$1702	$1927	$2032	$2157	$2812	$3112
EGA	$1847	$2072	$2177	$2302	$2957	$3257
VGA/16Bit	$1937	$2162	$2267	$2392	$3047	$3347

TURN PAGE FOR MORE PC BRAND SYSTEMS...
FOR NAME BRAND PERIPHERALS SEE OUR AD ON FOLLOWING PAGES...

To Order Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL.60607 Int'l Fax# 312-226-6841 Int'l Voice# 312-226-5200. Open Mon thru Fri.: 8am to 6pm Central .MasterCard, VISA, Discover, Checks, & Approved P.O.s Accepted. Prices and specifications subject to change. Customer Service Inquiries Call: 1-800-662-SERV **BYTE 14-10**

Amazing Performance

"Faster Than a Speeding Bullet!"

-Computer Shopper *Cover Story Nov, 1988*

"PC Brand offers the best low cost alternative around"

-PC Magazine *Feb.14, 1989*

PC BRAND 386/20 $1649

20 MHz Clock, Zero Wait Operation
Norton SI 23.0 • Landmark Speed 26.1MHz
1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- True 20MHZ Intel 80386-20 CPU Operating with Zero Wait States delivering up to 26.1MHz Effective Throughput
- 1024K RAM standard expandable to 16MB via 32Bit RAM boards using 256K and/or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387 Co-Processor Support
- Phoenix BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- 8 Slot motherboard design (5 16Bit & 1 8Bit & 2 32/8Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- Full or Mini Size Tower ® Case • 8MB 32Bit RAM Card Upgrade
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable • Weitek Co-processor

Standard Pre-Built Configuration:

386/20 With 1024K, Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-46MS 1:1 MFM	66MB-25MS 1:1RLL	71MB-18MS 1:1 MFM	110-25MS 1:1 RLL	150-17MS 1:1ESDI	320-16MS 1:1ESDI
Mono	$2125	$2225	$2350	$2460	$3010	$3455
VGA/Mono	$2310	$2410	$2535	$2645	$3195	$3640
EGA	$2415	$2515	$2640	$2750	$3300	$3745
VGA/16Bit	$2555	$2655	$2780	$2890	$3440	$3885

PC BRAND 386/25 $1849

25 MHz Clock, Zero Wait Operation
Norton SI 28.2 • Landmark Speed 33.6MHz
Norton SI 31.6 • Landmark Speed 43.5 w/Cache
1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- Intel 80386 Processor Operating at 25MHz with Zero Wait States in interleave mode delivering 34 to 44 MHz Effective Throughput
- 1024K RAM standard expandable to 16MB via 32Bit RAM boards using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387 or Weitek Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit & 2 32Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- 32KB or 64KB Cache Processor • Weitek Co-processor • Tower ® Case
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable • 8MB 32Bit RAM Card

Standard Pre-Built Configurations:

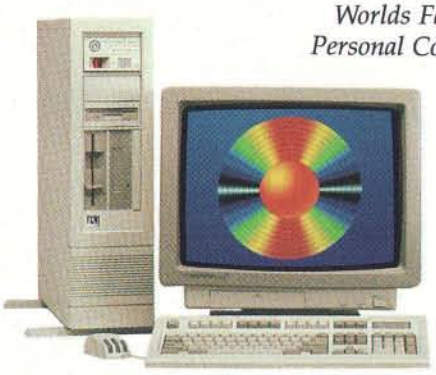
386/25 With Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-46MS 1:1MFM	66MB-25MS 1:1RLL	71MB-18MS 1:1 MFM	110MB-25MS 1:1RLL	150-17MS 1:1ESDI	320-16MS 1:1ESDI
Mono	$2312	$2462	$2592	$2722	$3322	$3572
VGA/Mono	$2527	$2677	$2807	$2937	$3537	$3787
EGA	$2672	$2822	$2952	$3082	$3682	$3932
VGA/16Bit	$2762	$2912	$3042	$3172	$3772	$4022

CRT display is courtesy of RIX Softworks,Inc. Irvine, CA.

Exceptional Support

386/33 CACHE $2799

Worlds Fastest Personal Computer!



33 MHz Clock, Zero Wait Operation

Norton SI 45.9 • Landmark 58.7 MHz w/32K or 64K Cache
1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- True 33 MHz INTEL 80386-33 CPU operating with Zero Wait States Delivering up to 58.7 MHz Effective Throughput
- Intel 82385-33 Cache Processor with 32K 25NS Static RAM Standard, Field Upgradable to 64K
- 1024K RAM Standard Expandable to 16MB
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive Controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387 or Weitek Co-Processor support
- Phoenix BIOS With Full MS/DOS, 0S/2, XENIX, NOVELL, 3COM and PCNET compatibility
- 8 Slot motherboard design
- Full size case with 5 Disk Drive bays (Shown with Optional Full Size Tower ® Case)

Options:

- Custom configurations w/Name Brand peripherals of your choice
- Weitek Co-Processor • Tower® Case • Factory Ram Upgrades

Standard Pre-Built Configuration:

386/33 With Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-46MS 1:1 MFM	66MB-25MS 1:1 RLL	71MB-18MS 1:1 MFM	110MB-25MS 1:1RLL	150MB-17MS 1:1ESDI	320MB-16MS 1:1 ESDI
Mono	$3259	$3454	$3554	$3679	$4334	$4634
VGA/Mono	$3454	$3649	$3749	$3874	$4529	$4829
EGA	$3599	$3794	$3894	$4019	$4674	$4974
VGA/16Bit	$3689	$3884	$3984	$4109	$4764	$5064

+ Norton SI 3.0

CRT display is courtesy of RIX Softworks,Inc. Irvine, CA.

PC BRAND

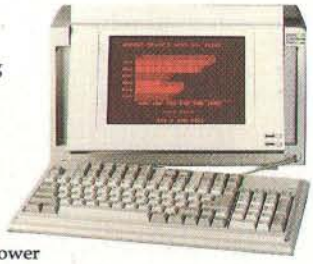
Your Best Choice
for Quality Systems
Toll-Free Support
Toll-Free Service
Free Freight
5-Year Warranty

286/386 PORTABLES from $1745

286 & 386 Systems
*512K,1.2MB Drive,
Combo Controller,
LCD Backlit Display
Optional EGA
Plasma Display

All feature:

- 640 x 400 Backlit Supertwist LCD by TOSHIBA (EGA Plasma version Available)
- Monographic & Color operating modes, EGA Optional
- External Monitor Support
- 2 Available expansion slots
- 86-key keyboard
- Accomodates two 5.25" or 3.5" Floppy/Hard Disk Drives
- 200 Watt 112/220 Autoswitch Power
- Serial, Parallel, Game Port, Clock/Calendar Standard



Standard Pre-Built Configuration:

Portable System Processor and Drive Options					
Drive / CPU	286-12	286-20	386/SX-16	386-20	386-25
1 Floppy	$1745	$1945	$2045	$2595	$2795
40MB	$2175	$2375	$2475	$3025	$3225
66MB	$2275	$2475	$2575	$3125	$3325
150MB	$3140	$3340	$3440	$3990	$4190

*386/20 and 386/25 Systems come with 1024K.

SAVE ON NAME BRAND PERIPHERALS... .SEE OUR AD ON FOLLOWING PAGES...

To Order Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL.60607 Int'l Fax# 312-226-6841 Int'l Voice# 312-226-5200. Open Mon thru Fri.: 8am to 6pm Central .MasterCard, VISA, Discover, Checks, & Approved P.O.s Accepted. Prices and specifications subject to change. Customer Service Inquiries Call: 1-800-662-SERV **BYTE 14-10**

Circle 220 on Reader Service Card

Shop PC Brand Today.

LAPTOP COMPUTERS*

NEC
Multispeed HD $1995
Ultralite w/1MB ..... Call
TOSHIBA
1000; 512K, 80C88, 1 FDD $699
1600 BACKLIT, 80C86-12, 1MG, 20MB HD,FDD ... 3240
3100E GAS PLASMA 80C86-12, !MB, 20MB HD, FDD 2805
3200; EGA, 80286-12, 1MB, 40MB HD, FDD 3595
5200/40 VGA, 80386-20, 2MB, 40MB HD, FDD, ... 6115
ZENITH
Supersport 286,20Meg ..... Call
Supersport 286,40Meg ..... Call
Supersport 88, 20Meg ..... Call

Other Makes and Models Call

MONITORS*

MAGNAVOX
7BM623 12" Amber TTL Monochrome $79
7BM749 14" VGA White Flat Screen 135
CM8762 13" RGB (640x200) Color 230
CM9043 13" EGA (640x400) Color 339
9CM082 14" VGA (640x480) .31DP Color.... . 415
MITSUBISHI
XC-1410 14" EGA (640x350) $369
AUM-1381 14" Diamond Scan 499
HL6605 15" CAD Monitor 1295
HL6905 19" CAD Monitor 2325
NEC
Multisync 2A 14" (800x600) VGA $499
Multisync GS 14" Mono 249
Multisync 3D 14" (1024x768) EGA/VGA ... 679
Multisync XL 19" (1024x768) 2150
Multisync 4D and 5D ..... Call
PRINCETON GRAPHICS
Max 15 15" Multifreq. Monochrome $249
Ultra 16 16" Multifreq. EGA/VGA 879
Ultrasync 14" Multifreq. EGA/VGA 520
PRINCETON PUBLISHING LABS
Multiview 15" Full Page Monitor w/adapt.. $890
RELISYS *(Top Rated by Infoworld and PC World)*
RE-9513 14" VGA(720x480).31DP Color $369
SEIKO
CM1430 14" (1024x768) Dualfreq $549
SONY
CPD1304 14".25DP(1024x768)Multiscan . $689
CPD1320 13" (640 x 480) VGA 485
ZENITH
ZCM-1490 14" Flatscreen Enhanced $619

MODEMS

A.T.I.
2400ETC Internal Modem w/MNP5 ... $165
2400ETC External Modem w/ MNP5 ... 205
HAYES
1200B Int. w/Smartcom $285
2400B Int. w/Smartcom 429
1200 Ext. Modem 285
2400 Ext. Modem 429
PC BRAND 100% Hayes Compatible!
1200 Baud Internal w/Bitcom $49
1200 Baud External 70
2400 Baud Internal w/Bitcom 89
2400 Baud External 129
US ROBOTICS
Courier HST/9600 ..... $599
Courier V.32 9600 Baud Ext.w/MNP5 .. 889
Courier HST Dual Standard Modem..... 995
Courier HST/IX 9600 Modem 925

VIDEO CARDS

ATI
VGA Wonder w/256K $279
VGA Wonder w/ 512K ..... Call
PARADISE
Autoswitch 480 EGA $179
VGA+ 265
VGA+ 16 16 Bit Version NEW 299
VGA Professional w/512K 399
PC BRAND
Mono Graphics w/Printer Port $55
Color Graphics w/Printer Port 49
EGA (640x480) Autoswitch 135
VGA 159
VGA 16 Bit 195
VIDEO SEVEN
Fastwrite VGA $279
VRAM VGA 450
VRAM VGA w/512K ..... Call

DISK DRIVES

FLOPPY DISK DRIVES:
360K 5.25" HH Black $75
720K 3.5" HH w/5.25" Mounting 80
1.2MB 5.25" HH Grey 85
1.44MB 3.5"HH Grey w/5.25" Mounting 95
PS/2 FLOPPY DRIVES
CMS 5.25" 360K/PS/2 Ext.Floppy $199
HARD DISK DRIVES:
IOMEGA
B120I Single 5.25" 20MB Int. $765
B144I Single 5.25" 44MB Int 995
B244X Dual 5.25" 44MB Ext..... 1995
MINISCRIBE
71MB 18MS M3085 ..... $595
150MB 17MS M3180E ESDI 1/2 Hgt .. 1195
320MB 16MS M9380 ESDI Full Hgt. 1550
640MB 16MS M9760 ESDI Full Hgt. 3400
PRIAM
130MB 20MS ID130AT Full Height $1395
160MB 28MS ID160EC ESDI w/CNTRL 1650
330MB 20MS ID330PS INT. for PS/2 ... 1895
330MB 20MS ID330EC ESDI w/CNTRL 2250
SEAGATE
20MB 65MS ST225 w/XT Controller ... $249
20MB 65MS ST225 209
20MB 35MS ST125 w/XT Controller 299
20MB 35MS ST125 245
30MB 65MS ST238 w/XT Controller 269
30MB 35MS ST138 310
30MB 35MS ST138 w/XT Controller 355
40MB 28MS ST251-1 349
40MB 24MS ST151 419
80MB 28MS ST4096 Full Height 590
TOSHIBA
60MB 25MS MK134 RLL $429
110MB 25MS MK72 RLL 669
156MB 23MS MK-156FA ESDI Full Hgt ... 1095

If the drive you require is not listed here please contact our sales department for a quote!

TAPE BACKUPS

60MB Archive Int. or Ext. w/Cntrl. $590
60MB Maynard Maynstream Portable .. 889
150MB Archive Internal 925
150MB Archive External 1250
150MB Maynard Maynstream Portable 1395
2.2GB Maynard Maynstream Portable 4350

Save Time. Save Money.

SCANNERS/DIGITIZERS

Complete PC Half Page Scanner $189
Complete PC Full Page Scanner 575
DFI HS3000 Plus Gray Scale Hand Scan **219**
Hewlett Packard Scanjet Plus ..... Call
Microtek MS II ..... Call
Microtek MSF300G 1785
Microtek MSF300Q w/64 Grey Level 1495
Summasketch 12X12 378
Summasketch 12X18 635

PRINTERS*

BROTHER
HL 8E Laser (HP LJII, HPGL) $1875
EPSON
LX810 180/30.....189 **LQ510** 180/60.....329
FX850 330/88.... 345 **FX1050** 264/54.....445
LQ850 330/88...Call **LQ1050** 330/88....Call
LQ950 264/88...Call **LQ2550** 400/108..Call
KODAK DICONIX
150Plus 150/50..315 **300WP** 310/73 439
HEWLETT PACKARD
Deskjet Plus .....710 **Laserjet II** 1720
LASER JET ACCESSORIES
CPI Superfont Cart. adds 150 fonts.. 295
CPI 1MB Memory Kit. 319 **CPI 2MB** MemoryKit. .549
PRINCETON PUBLISHING
PS-388 Postscript board 2250
Adds Postscript to your HP LASERJET!
NEC
P2200 170/55 ....335 **P9XL** 400/140 1030
P5200 265/90 ....530 **P5300** Wide 675
LC890 Laser ....3190 **LC890XL** Laser ..4495
OKIDATA
ML320 300/62 ..345 **ML321** 300/62 479
ML390 270/90 ..475 **ML391** 270/90 655
ML393 450/120..995 ML393C 450/120..1069
PANASONIC (New Models Listed)
1180 192/38.....189 **1191** 240/48 245
1124 192/63.....339 **1524** 240/80 545
TOSHIBA
321SL 216/72...Call **341SL** Wide Carr ...Call
351SX 360/120 . Call Express 311 ..... Call

EPSON FX 1050

15" Carriage 264 CPS Draft 54 CPS Letter Quality

$445

Other Epson models comparably discounted

PC BRAND- YOUR #1 LAN SOURCE !

Call for Custom Server Configurations

NOVELL NETWORKING

NOVELL
4 User ELS 286 Level 1 ..... $479
8 User ELS Level II (Version 2.15) 939
Advanced Netware 286 (Ver. 2.15) 1850
SFT Netware 286 (Ver. 2.15) 2850
Netware 386 ..... Call
Disc Coprocessor Board 379
NE2000 Ethernet File Server Board 399
NE1000 Ethernet Card 299
GATEWAY *(PC Magazines Editors Choice)*
G/ Ethernet AT $435
G/NET 269
G/ Ethernet for PS/2 ..... Call
STANDARD MICRO
PC130 Arcnet Board $135
PC270 Twisted Pair Arcnet Card 130
PC500-WS 16 Bit Work StationBoard 375
PC550-WS 16 Bit Twisted Pair Work Station Bd 395
PC550-FS 16 Bit Twisted Pair File Server Bd 495
PS110 Arcnet Board for PS/2 439
PC500-FS 16 Bit File Server Board 449
ARCNET Passive Hub 72
ARCNET Active Hub 359
ARCNET Twisted Pair Active Hub 429
TIARA
4 Port Passive Hub $49
8 Port Active Hub 285
Lancard/A 8Bit ARCNET Board 89
Lancard/E 8Bit ETHERNET Board 199
Lancard/E 8Bit Twisted Pair ETHERNET 329
WESTERN DIGITAL
Ethercard+ w/Novell Drivers $219
Ethercard+ Twisted Pair Ethernet Board.....319
Ethercard+ A for PS/2 320
UNINTERRUPTABLE POWER
ELGAR
IDS1100 1000 Watt UPS ..... Call
IPS 500 Watt UPS ..... Call
PTI
DataShield Turbo/2 625 Watt 595

PC BRAND

Free Freight

30-Day Money-Back Guarantee

Toll-Free Service and Support

No Credit Card Surcharges

We carry over 10,000 different hardware and software products, Call for prices on products not listed.

SOFTWARE

ALDUS Pagemaker $479
ASHTON-TATE DBASE IV 449
BORLAND Quattro 149
CENTRAL POINT PC Tools Deluxe 42
FUNK SOFTWARE Sideways 42
LOTUS 123 3.0 295
MICROSOFT Excel 2.1 235
MICROSOFT Windows 386 125
MICROSOFT Word 5.0 205
WORD PERFECT Word Perfect 5.0 220
XEROX Ventura Publisher 2.0 479

SERIAL MOUSE

High Resolution (250DPI) Microsoft Compatible

$35

CO-PROCESSORS/BOARDS

INTEL
Aboveboard Plus w/512K $419
Aboveboard Plus I/O 512K 469
Inboard 386 for PC w/IMB 595
Inboard 386 AT 859
8087-2 ..... 139 **8087-1** **189**
80387-16 ..... 369 **80287-10** 259
80387-25 ..... 559 **80387-20** 449
80387-SX 359 **80387-33** 695
**Oversized Monitors, Laser Printers, Laptops and Plotters are excluded from free freight.*

To Order Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL.60607 Int'l Fax# 312-226-6841 Int'l Voice# 312-226-5200. Open Mon thru Fri : 8am to 6pm Central . MasterCard, VISA, Discover, Checks, & Approved P.O.s Accepted. Prices and specifications subject to change. Customer Service Inquiries Call: 1-800-662-SERV **BYTE 14-10**

IN DEPTH

Optical Technologies

231 **Computing with Light**
by H. John Caulfield

239 **The Nitty Gritty Optical Band:**
Levels of Light
by Joseph W. Goodman
Joining Forces
by Donald J. Channin

249 **Reflected Light**
by Gary T. Forrest

259 **Gigabytes On-Line**
by James J. Burke and Bob Ryan

266 **Read/Write Optical Subsystems**

The mystery of light has puzzled and intrigued man throughout the ages. Light forms the very basis of our existence. For the most part, living things, as evolved on this planet, need light to live. From the beginnings of recorded time, man held the sun, the visible source of light, in deep reverence. Whether you believe that ancient man worshipped the sun or that he worshipped the giver of light as represented by the sun, he obviously sensed his great dependence on light. Solar eclipses terrified him, simply because the light went away.

In our efforts to tame light and make it do our bidding, we have developed myriad light-generating and light-controlling devices from lamps to lasers. We may not fully understand the intricacies of light, but we have found many ways to use it. Today, lasers are stealing the headlines and the show.

This month, we focus on optical technologies and look at some of the ways in which laser light is affecting the computer industry. The concept of computing with nothing but light beams boggles the mind. In "Computing with Light," H. John Caulfield explains the concepts behind optical computing, as well as its limits as currently conceived: what it can and can't do. He also discusses holography and its uses in computers.

Next, a series article looks at the bits and pieces of optical technology that are beginning to come into being. "The Nitty Gritty Optical Band" looks at the inroads made in optical interconnections, packages, signals, and ICs. In the first part, "Levels of Light," Joseph W. Goodman discusses the various levels of interconnections, from the machine level to the on-chip level, and how well optics apply on each level. And in the second part, "Joining Forces," Donald J. Channin examines the marriage between electronics and optics down at the chip level and how this union delivers the best of both worlds.

Then, in "Reflected Light," Gary T. Forrest looks at lasers, the light that makes optics work. Laser technologies are in use for a variety of purposes, and different lasers have different uses. This article discusses the different lasers, how they work, and how they are used.

Although all these areas have elements of the present and the future in them, one optical technology we are all familiar with, if for entertainment only, is optical storage. In "Gigabytes On-Line," James J. Burke and Bob Ryan examine optical disks, from CD-ROMs to WORMs to erasable optical storage, and how they work. Our resource guide this month supports this article, listing sources for some of the read/write optical subsystems available.

Will optics replace electronics? Probably not, at least if present research findings continue to hold true. Will optics have a significant impact on our industry in years to come? Most resoundingly, yes! The advantages of optics over electronics in speed and freedom from interference alone are reason enough to fund its research. In more ways than one, lasers are indeed "the light at the end of the tunnel."

—Jane Morrill Tazelaar
Senior Technical Editor, In Depth

ILLUSTRATION: ROBERT TINNEY © 1989

The New 25 MHz Executive 325ET combines all the latest technologies in the most advanced 386 computer available. And it's transportable.

MAINFRAME TO GO

$10 PER MEGABYTE OF DRAM

The 325ET has a hard drive access speed almost undetectably different from that of dynamic memory. For the first time, the large capacity of a hard drive is accessible at an access time of **one millisecond (1 ms)**. Why limit yourself to 2, 8 or 16 megabytes of fast memory and pay $500 per megabyte, when you can have up to 160 megabytes at a cost as low as $10 per megabyte?

50 TIMES FASTER

Instead of waiting for the 65 millisecond (ms) access time of an MFM drive, or even the 17 ms of an ESDI drive, you can have instantaneous access to your data. The 325ET is blindingly fast with an average disk access time of 1 ms. In addition, the system architecture allows data transfer speeds that match drive capabilities. (That's really fast!). In fact, the overall read/write performance of the 325ET is 50 times faster (5,000%) than the Compaq© 386/25.

53,000 PORTABLE PAGES

The 325ET, when located along side of a monitor, takes little desk space. The compact design of the 325ET lets you carry it onto an airplane and easily stow it under your seat. Imagine bringing the equivalent of seven four-drawer filing cabinets worth of valuable information to your next meeting – accessible in just 1 ms.

The Executive 325ET is small enough and light enough to make it the most powerful transportable ever.

25 Mhz - 80386 1 ms HD ACCESS

EXECUTIVE 325ET

Standard features:

- Intel 80386 processor running at 25 Mhz.
- 0 wait state operation.
- Enhanced intelligent controller for **1 ms hard disk access** time and a transfer rate of 4 MB per second.
- 2 MB of RAM expandable to 16 MB (8 MB on board).
- High performance 16-bit VGA video adaptor.
- 3.5" 1.44 MB diskette drive.
- Sockets for 20 Mhz Intel 80387 coprocessor and 10 Mhz Intel 80287 coprocessor.
- 6 industry standard expansion slots (ISA).

$3799 or just **$114** per month

	Mono VGA	Color VGA
40 MB	**$4295**†	**$4650**†
80 MB	**$4645**†	**$4995**†
160 MB	**$5695**†	**$5995**†

† Includes system, monitor, Hard Disk and on-site warranty.

PRIORITY ONE COMPUTER SUPER STORE LOCATIONS

California: Bakersfield, Burbank, Fullerton, Irvine, San Jose, Sunnyvale, Westminster, Woodland Hills.
Kansas: Lenexa, Wichita
Missouri: St. Louis
Oklahoma: Stillwater
Tennessee: Memphis

AND THERE'S MORE...

1. Toll-Free Technical Support

Our friendly and knowledgeable factory trained engineers are just a phone call away. And we can solve most problems right over the phone.

2. Free on-site service

The 325ET comes with a full year warranty. Supported by Universal Protection Plan with a network of hundreds of service engineers, instant help is just a phone call away. Service is also available at any of our Super Stores, or at any of the hundreds of UPP service centers.

3. Trade up and save more

Now you can put that older and slower IBM©, Compaq©, or Apple© to better use. Your old system may be worth a thousand dollars or more. Our new Trade-Up program allows you to move up to the latest technology for less. Call one of our systems consultants for complete details.

4. 30 day money back guarantee

Your total satisfaction is our goal. If for any reason you are not completely satisfied with the 325ET you may return it within 30 days for a full refund.

5. Easy financing available

We offer both consumer credit for individual purchases, and leasing for business customers. Call us today and find out how easy it is to own the next generation of computers.

To Order or Inquire, Call:

800-423-5922

PRIORITY ONE COMPUTERS

©Copyright 1989 Priority One Computer Corporation. All rights reserved. Executive, 325ET, and the Priority One logo are registered trademarks. IBM is a registered trademark of The IBM Corporation. 386/25 is a registered trademark of Compaq Computer Corporation. 386 is a registered trademark of Intel Corporation. Apple is a registered trademark of Apple Computer, Inc.

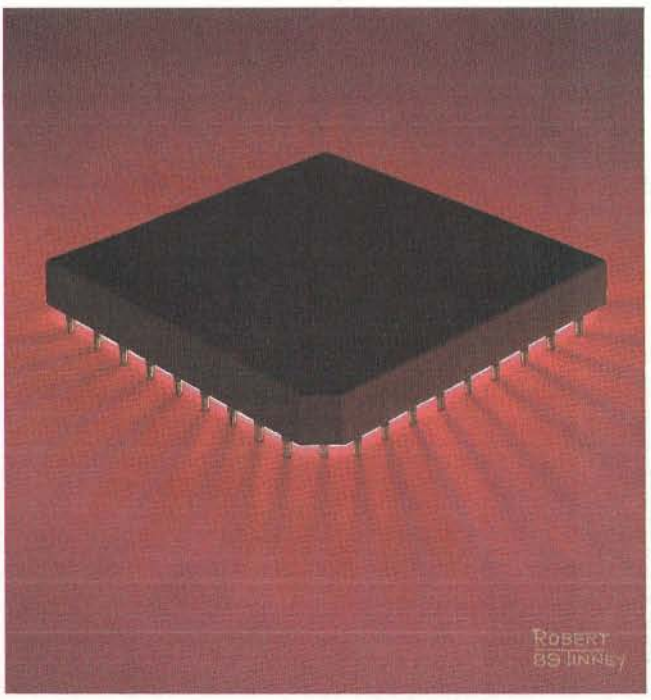
Circle 209 on Reader Service Card

Computing with Light

Optical computers can provide the massively parallel architectures that systems of the next century will need

H. John Caulfield

The eternal search for faster, smaller, more intelligent processors is what drives the development of new technologies. For the past 40 years, advances in computers have depended on advances in electronics, particularly in semiconductor-based electronics. Computers of the next century, however, may require a technology that would seem as radical now as semiconductors were in 1964. Perhaps the Japanese Ministry of International Trade and Industry (MITI) put it best: "Electronics is the science of the twentieth century, and optics is the science of the twenty-first."



The state of optical technology in 1989 resembles that of electronic technology in 1949. It is poorly developed, unreliable, unstandardized, and expensive. Why, then, would you ever dream of replacing ICs with optics? Quite simply, you wouldn't. Optics are so fundamentally different from electronics that they do not compete. However, optics can do important tasks that are impossible with electronics. Using the special and wonderful properties of light, optics can work together with electronics in new hybrid systems that are called (somewhat misleadingly) *optical computers*.

Properties of Light

Light, like electricity, is a quantum phenomenon. As such, you can't really understand it, but you can write equations that will at least partially predict its behavior. Sometimes it's convenient to think of light as a stream of particles; light particles are called *photons* (electricity particles are called *electrons* or *holes*).

When the particle picture fails, you can think of light as a wave. In fact, depending on the experiment that you perform, light will demonstrate properties of either particles or waves, but not both at the same time. Of course, this doesn't exactly make sense, but this is what quantum mechanics tells us.

Although it may be impossible to understand the nature of light, you can—up to a point—get a handle on it mathematically. You can make essentially perfect predictions of average photon arrival rates and positions, but you'll still have no idea how to predict precisely when and where the next photon will arrive.

Photons belong to a class of particles called *bosons*. Bosons do not interact with other bosons. Thus, optical paths can crisscross in space without interfering with one another. Essentially all the strengths and weaknesses of optics come from this observation.

Electrons, on the other hand, are classed as *fermions*—particles that repel one another. Thus, electrons must be

continued

ILLUSTRATION: ROBERT TINNEY © 1989

A Trillion Points of Light

Creating a processor with fan-in and fan-out values of 1 million is possible only with optical computers.

The inputs to such a processor consist of the transmission values (0 to 1) of a 1000- by 1000-element holographic mask. The data is written in real time to a spatial light modulator (SLM)—the actual input device. The output of the processor is a 1000- by 1000-element detector array (see figure A).

The transmission of the k,l element of the SLM is called a_{kl}. Now, at the i,j detector element, you want to form

$$b_{ij} = \sum_{k,l} T_{ijkl} a_{kl}$$

where the sum b_{ij} is over all 1 million (10^6) SLM elements. You want to do this for all 10^6 i,j values. Thus, there will be a trillion (10^{12}) values of T_{ijkl} all in use at the same time. Figure A demonstrates how this is done for one of the b_{ij} patterns. It is important to note, however, that all 10^6 b_{ij} patterns appear simultaneously.

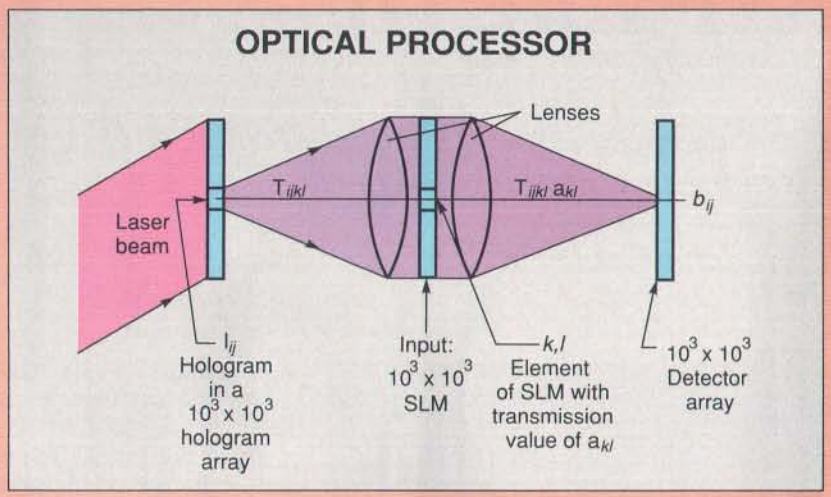


Figure A: *Shown are the interconnections for one of the 1 million* b_{ij} *patterns.*

The i,j hologram produces a pattern of illumination at the SLM input. At the k,l SLM element, you refer to the input intensity as T_{ijkl}. The transmission value of that element is a_{kl}, so the amount of light passing through the k,l SLM element from the i,j hologram is $T_{ijkl}a_{kl}$. The imaging lenses to the left and right of the SLM project the laser light from the i,j hologram onto the i,j detector element. Since it does this for all k,l values, you detect the sum of all $T_{ijkl}a_{kl}$ products at every element of the detector.

All holograms and all detectors in this system work in parallel. Thus, the k,l SLM element has a 10^6 fan-in and a 10^6 fan-out. Furthermore, the optical paths clearly crisscross in space both before and after the SLM without interference. The results are 10^{12} parallel, weighted (i.e., different T_{ijkl} values) interconnections in a single optical processor.

confined in carriers (e.g., wires) to get them from one place to another reliably. These connecting carriers of electricity take up space that other carriers, therefore, cannot use.

Two conclusions follow immediately from these facts. First, optics is a wonderful way to provide large numbers of input connections (called a *fan-in*) and large numbers of output connections (called a *fan-out*) to a processor. Second, since light doesn't interact with light, you need electronics to get information on and off the beams of light.

Light Connections

To make a connection in electronics, you need a wire of some type and a bonding pad. To implement a fan-in and fan-out of 10 is no big trick, but larger numbers of connections are progressively harder to implement. With optics, you could have a million processors, each with a fan-in and fan-out of a million, all operating in parallel. You can't do this with electronics because of the pathways involved.

Imagine a million processing elements, each with 2 million bonding pads. The size of such an implementation would be absurd, as would be the power consumption, cost, and time required to solder the wires. The total number of connections in such a system would be 1 trillion. Electronically, this is silly to even think about. In optics, it is straightforward (see the text box "A Trillion Points of Light" above).

Another advantage of optics over electronics is that optics can operate at an average energy per calculation that is less than the theoretical minimum for a traditional electronic logic gate. Because the quantum mechanical nature of light is manifest when you don't confine it to a carrier (e.g., fiber-optic cable), you can make all intermediate calculations energetically free of charge and pay an energy price only for reading the final result.

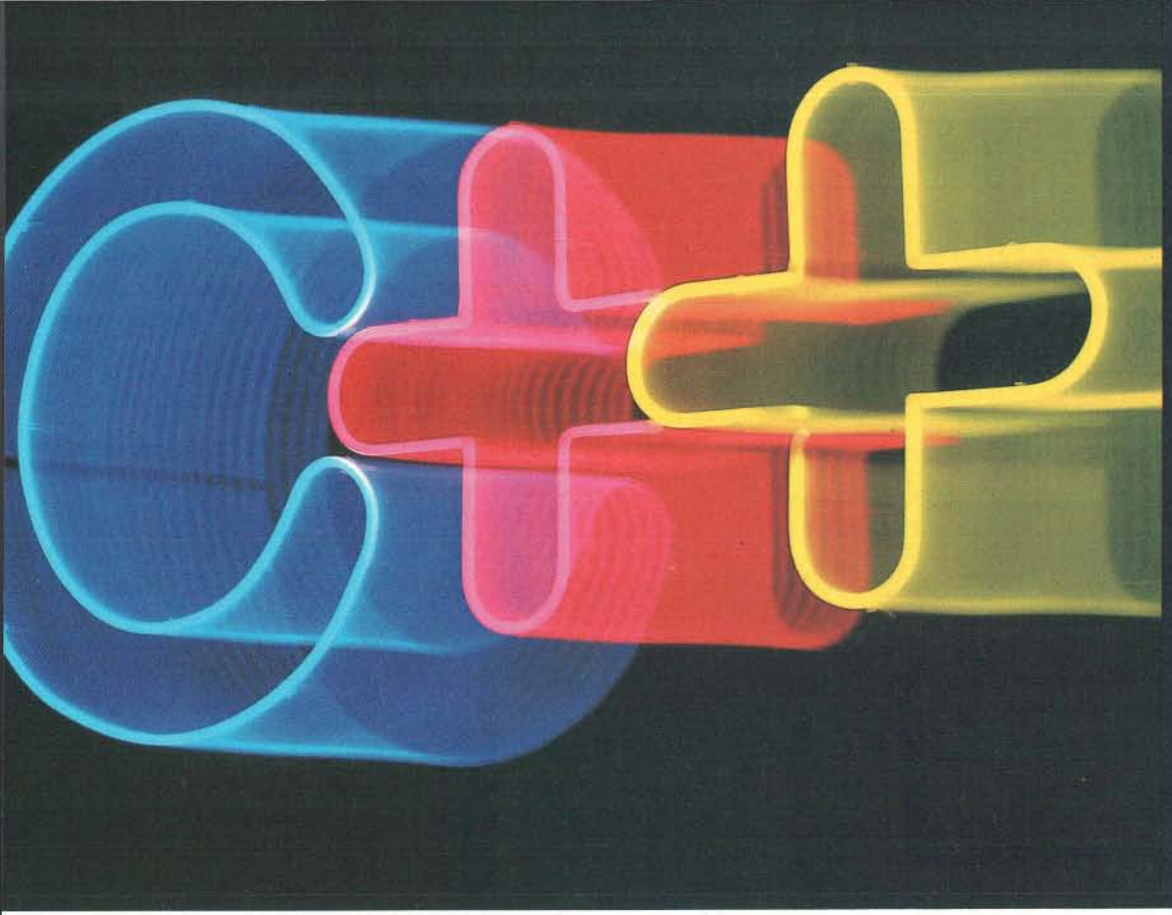
For example, consider the optical calculation of b_{ij} discussed in the text box "A Trillion Points of Light." The calculation consists of 1 million multiplication operations and 1 million addition operations. When you detect the result and apply a threshold function to it, the quantity of information you extract is one bit: $b_{ij} = 0$ or 1. The atoms in the detector are moving with an average energy of kT, where k is the Boltzmann constant and T is the absolute temperature. Clearly, extracting information must require at least an energy of kT per bit. Indeed, kT is often considered the minimum "quantum of information."

To read out b_{ij} reliably, you must overcome "shot noise" by measuring many light particles or photons. For visible light and room temperature, the photon energy is about 100 kT. If you detect 100 photons, you spend about 10^4 kT to read out that one bit. The best low-power electronic computers operate at 10^4 kT per bit. Most operate at 10^7 kT or more.

But wait. You have measured the result of 10^6 calculations with 10^2 photons and only 10^{-2} kT per calculation. How is this possible? If you send even one photon to each of the 10^6 spatial light modulator (SLM) elements, you would need 10^6, not 10^2, photons. Or would you?

The answer to this lies in quantum

continued



ZORTECH

Everyone agrees! C++ is the only logical way forward for the multitude of C programmers faced with the task of developing sophisticated applications for today's "Power Users".

C++ offers many advantages over all other languages, object oriented or not:

- ANSI C compatible
- Object oriented
- Major industry support
- Data-abstraction
- Strong type-checking
- User defined types
- Modular programming
- Data hiding

1988 BYTE

The Award Winning Zortech C++ Compiler has absolutely shaken the roots of the C compiler market by setting a new technological standard. It is the very first and only MS-DOS compiler to produce native code directly from C++ source files.

Zortech is at the forefront of C++ Compiler Technology with an already impressive lead, maintained by continually enhancing product quality and support.

Since the launch of the C++ Compiler, Zortech has brought the power and efficiency of C++ to tens of thousands of users worldwide. We continue to develop tools for programmers of the next generation of high powered applications.

Please call or write for full details of our complete range of C++ products.

Zortech Incorporated 1165 Massachusetts Avenue, Arlington, MA02174
tel: 617-646-6703 fax: 617-643-7969

Zortech Limited 106-108 Powis Street, London SE18 6LU
tel: 01-316-7777 fax: 01-316-4138

VISA MasterCard EUROCARD

Circle 300 on Reader Service Card

Holography and Computers

Holograms have become a common sight. They appear on credit cards, paperback books, greeting cards, camera boxes, children's toys, and even magazine covers. Soon you'll be seeing them on your windshield as they let you check your speedometer without taking your eyes off the road. So just what are holograms, and how do they relate to optical computers?

Before answering these questions, consider another one: How is it that light entering the pupils of your eyes and crudely focused on your retina causes you to see a multicolored, three-dimensional world "out there" and not in your head? While no one can answer this basic question, the fact that you do see "out there" is critical to holography.

What you see is not a direct result of the scene you're viewing, but of the pattern of light the scene creates on your retina. Thus, you don't have to re-create the three-dimensional world in order to re-create a scene; all you need to do is cause the same pattern of light to enter your pupils. You don't need the real world at all—just a way of reconstructing the desired light pattern or *wavefront*.

Holography is a two-step process: wavefront recording and wavefront reconstruction. To reconstruct a pattern of light, you need a source of light. Consider the two wavefronts shown in figure B1. The object wavefront created by the object and the reference wavefront form an interference pattern, which can be recorded on a photographic plate. This recording is the hologram.

The hologram is a transducer from the simple, readily reproduced reference wavefront to the complex object wavefront. The hologram literally selects out of the reference wavefront the portion that looks like the object wavefront (see figure B2). The human eye intercepts this wavefront and sees the original scene behind the hologram.

The light doesn't actually come from where you see the image. This is a *virtual image*, just like the image in a mirror. But, by perfectly reversing the reference wavefront, you can perfectly reverse the object wavefront. Viewable from beyond the object position is an image of the object. This time, the light really does come from where you see the image. This is a *real image*.

This two-step recording and recon-

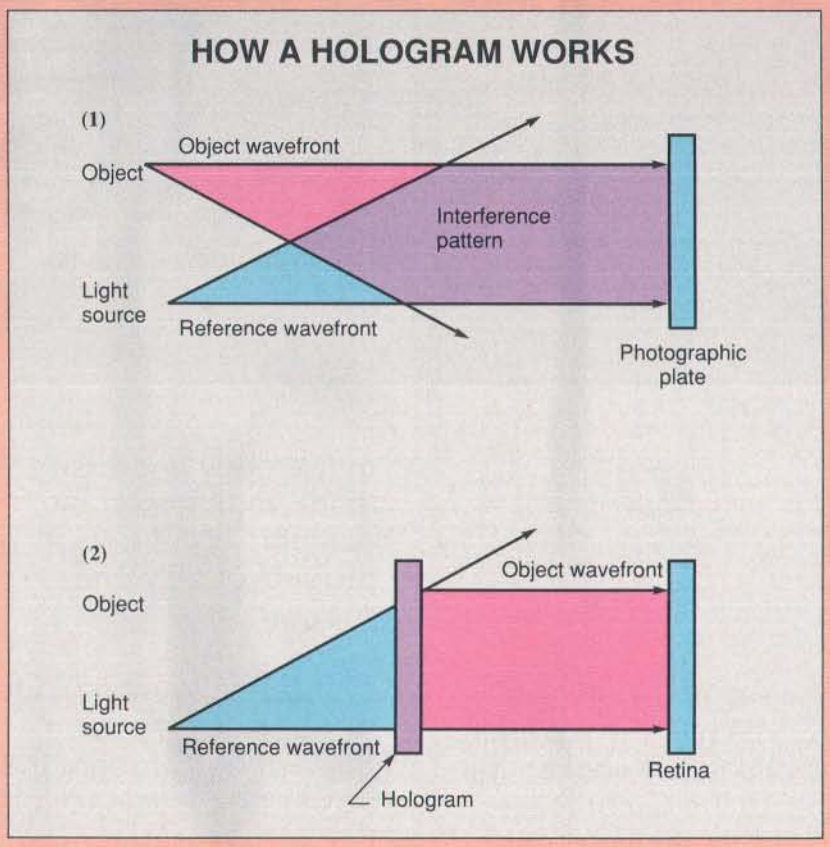


Figure B: (1) *The interference between the reference wavefront and the object wavefront creates the hologram.* (2) *The hologram reconstructs the object wavefront from the reference wavefront.*

mechanics. Each photon explores all 10^6 paths. In the wave domain, the light has no one path. Each photon, in effect, makes all 10^6 calculations! As long as you don't collapse the wave function by asking for the results of intermediate calculations, you can make the intermediate calculations without energy costs.

The average energy per calculation for a complicated calculation is therefore much less than the theoretical minimum for a logic gate. That theoretical minimum, in turn, is much less than the actual energy loss in even the most efficient logic gates.

Due to these properties of light, optical computers can feature massive parallel interconnections that are impossible physically and energetically with electronic computers. A representation of a generic optical computer is shown in figure 1.

Optical Components

The key component of an optical computer is the SLM. It is a discrete or continuous array of light modulators whose reflection or transmission properties can be controlled electronically or optically. This page is an SLM. It reflectively modulates incident light in a spatial pattern. It is not a very useful SLM (at least not for optical computing), because you can't change the reflectivity pattern rapidly. Useful SLMs are changeable by either optical or electrical addressing.

About 25 different SLMs are available commercially (see table 1). SLMs are used as input devices, interconnection devices, scratch-pad memory devices, and processing devices. They are vital to optical computing.

The second most important component of an optical system is a hologram, which provides interconnections as well

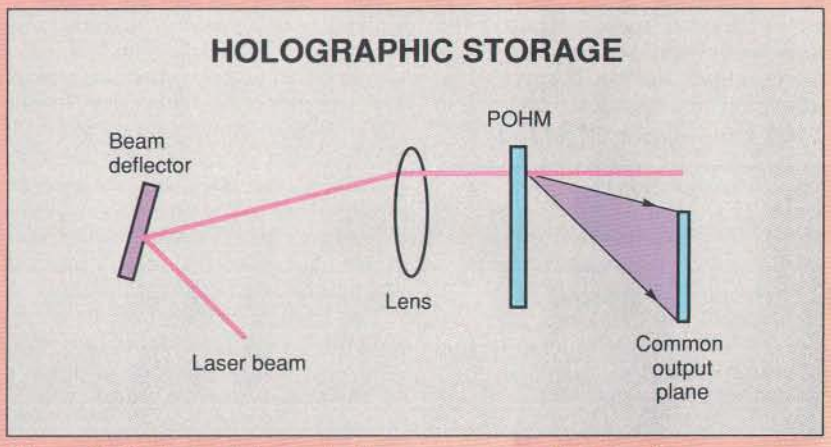


Figure C: *Retrieving information from page-oriented holographic memory (POHM) involves deflecting the output of the read beam onto an output plane.*

struction concept was proposed by Denis Gabor in 1947, winning him a Nobel prize. The technique most used today was invented in the early 1960s by Emmett Leith and Juris Upatnieks. In this recording technique, both wavefronts are derived from a single laser beam split into two beams by a partially reflective, partially transmissive mirror. If you observe several simple precautions, the two beams form an interference pattern where they overlap. That is, where the two beams agree (i.e., are in phase), the light is bright (constructive interference). Where the two beams disagree (i.e., are out of phase), the light becomes dim (destructive interference).

By recording a photographic positive of the interference pattern, you produce exactly the hologram you want. This hologram will pass from the reference wavefront only those parts that could just as easily have come from the object wavefront.

Holography at Work

A hologram is the most versatile of optical elements—it can produce essentially any light pattern you choose. For example, suppose you have a two-dimensional array of small (1 to 2 millimeters) holograms on a single substrate. When illuminated at normal incidence with a collimated reference beam, each hologram can produce a real, two-dimensional image on a fixed output plane. By deflecting the laser beam to the proper hologram, you direct the corresponding "page" of data to the output plane. This is called a page-oriented holographic memory, or POHM (see figure C).

You can store from 10^4 to 10^6 holograms in a POHM, with each output image containing from 10^4 to 10^6 binary bits. Thus, up to a gigabit of memory can be randomly accessed in the time it takes to deflect the beam (normally about a microsecond). This means you can access a gigabit of memory randomly at a rate of from 10^{14} to 10^{18} bits per second! That's serious RAM.

Work at the Georgia Institute of Technology and the Center for Applied Optics at the University of Alabama, Huntsville, is leading to compact, high-density POHMs with a parallel, optically addressable RAM in the output plane. If the output plane contains an optically addressable spatial light modulator (SLM), you can write the whole page onto a laser beam in parallel. Using a modification of the Fourier optical pattern recognizer, you can search that page in parallel for key words. This forms the basis for an optical DBMS that operates on 100,000 bytes at a time. This is a considerable advantage for large databases.

Perhaps the most dramatic application of holography to optical computing is in neural networks. There are two distinctly different research approaches in this area. One exciting possibility is to make a "live" hologram that can continue to learn as it experiences its world. Although this area is quite complex and long-range, considerable advances have been made at Hughes Aerospace, California Institute of Technology, the University of Colorado, and elsewhere. A simpler and perhaps more desirable goal is to use holograms to build neural networks that employ fixed learning.

Even the lenses in optical computers are likely to be computer-generated holograms. They are far lighter and far cheaper than glass lenses and can be computer-optimized to outperform ordinary lenses. This work, pioneered at MIT's Lincoln Laboratory, is now being actively and widely developed.

Holograms are not only items of great wonder and beauty; they are also items of great practical utility in optical computing. They provide the type of storage required by massively parallel optical computing systems.

as memory capabilities. The text box "Holography and Computers" above discusses holograms in depth.

Optical Computations

Although optics is ideal for connections and storage, it is not well suited for computation. In fact, the best you can get from purely optical operations is about a 10 percent accuracy rate. This is the downside of optical computing and the reason that purely optical computers are not a realistic possibility. Hybrid electro-optical computers, however, are another story.

Many types of computations require some sort of nonlinear processing where the output signal intensity, I_o, is related to the input signal intensity, I_i, by a function like the ones shown in figure 2. The operation of all the functions in figure 2 can be performed "optically." (Since light does not operate on light, some hidden or covert electronic manipulation must also be going on within the device or system.)

There is a great deal of worldwide research into the design and construction of two-dimensional arrays of nonlinear optical operators. Of the many diverse approaches being investigated, most involve highly nonlinear feedback arrangements that lead to what mathematicians call *catastrophes*. Here, you create a device whose transmission increases nonlinearly with the incident light intensity. In addition, you couple some of the transmitted light back as input. This combination leads to the sudden onset of high transmission that the representative curves in figure 2 illustrate. Perhaps the most promising research on these nonlinear optical devices is being conducted at Bell Laboratories.

continued

Optical Research

Optical computers must emphasize the strong points of optical technology (e.g., interconnections and low energy) while tolerating or minimizing the bad points (mainly, low analog accuracy). At universities such as Carnegie Mellon, the University of Iowa, and the University of Alabama in Huntsville, the focus of research is on computers that marry a fast, low-accuracy optical processor (for computationally complex tasks) with a slower, higher-accuracy, digital part (to "ratchet" the accuracy). These machines are suited to problems such as algebraic equations (linear and nonlinear), eigenvector problems, matrix inversion, and heuristic linear programming.

For example, consider the simple analog optical multiplier shown in figure 3, which performs a parallel multiplication of an input vector with a matrix. You want to find **x** such that

$$A\mathbf{x}=\mathbf{b}$$

where **b** is a given vector and A is a given matrix.

You can solve this problem crudely in parallel by adjusting x_1 in proportion to y_1-b_1, x_2 in proportion to y_2-b_2, and so on, all at the same time. With proper precautions, you can assure that **x** will relax continuously to the point where for all i, $|b_i-y_i| < \epsilon$, where ϵ is a small positive number.

Now, you read out this analog **x**, digitize it to the accuracy you need for the final result, and call it $\mathbf{x}_0$. You can now evaluate the residual

$$\mathbf{r}_0=\mathbf{b}-A\mathbf{x}_0$$

digitally. If the norm (usually Euclidian) of $\mathbf{r}_0$ is written $||\mathbf{r}_0||$ and if $||\mathbf{r}_0||$ is suitably small, you quit and output $\mathbf{x}_0$. If not, you solve the problem

$$A\Delta\mathbf{x}_0=\mathbf{r}_0$$

optically, then digitize the result, and then calculate

$$\mathbf{x}_1=\mathbf{x}_0+\Delta\mathbf{x}_0$$

and

$$||\mathbf{r}_1||=||\mathbf{b}-A\mathbf{x}_1||$$

digitally. You continue until you achieve the desired accuracy.

This approach fails for hard (ill-conditioned or singular) problems. To achieve guaranteed results, you must replace the given matrix A by a noisy version, A+N, during the optical operations. The system then achieves the desired minimum $||\mathbf{r}||$ for all matrices. In addition, the time taken is independent of the problem size. Both of these features (guaranteed convergence and speed that is independent of problem size) are apparently unique to this bimodal optical computer.

You can also do general-purpose digital computing with optics. One promising approach, symbolic substitution, is being pursued at Bell Laboratories. Another approach, the operator method, is being developed at Opticomp. It amounts to a highly parallel programmable logic array that doesn't need to distinguish among multiple signal levels. It simply makes a light or no-light decision. Even at optical accuracy, this is not hard.

A large number of special-purpose optical computers use Fourier transforms to locate and identify objects in a scene. The systems depend on the fact that two successive Fourier transforms produce an image of the input (albeit upside-down and backward). First, you use a lens to form a two-dimensional display of the Fourier transform of an input pattern.

The interesting thing about the Fourier transform pattern is that its shape and location don't change as you move the input around. If you place a filter in the Fourier transform plane that favors the transform of A and tends to block the

Table 1: *This shows the range of properties of commercially available spatial light modulators. Unfortunately, no single SLM combines all these features.*

Characteristics of spatial light modulators

Mode: Reflection, transmission
Addressing: Optical, electronic
Cost: $100 to $50,000
Information: 64 by 64 elements to 25,000 by 25,000 elements
Cycle time: 10^{-6} seconds to 1 second
Contrast: 2-to-1 to 10^4-to-1
Resolution: 0.002 cm to 0.10 cm
Pattern: Discretized, continuous

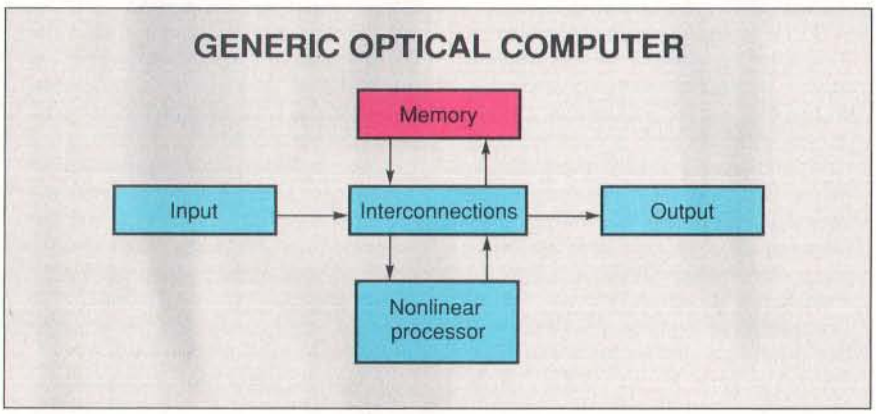


Figure 1: *Holograms provide memory storage and interconnections, while spatial light modulators are commonly used for input, output, and processing units.*

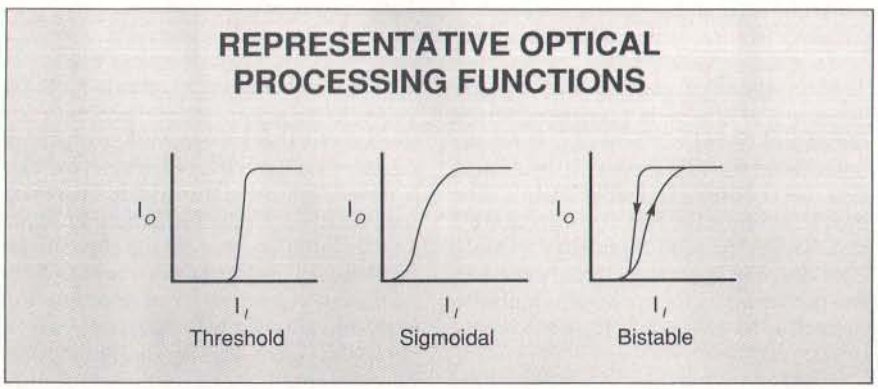


Figure 2: *These functions represent the type easily implemented on optical processors, where I_i is the input signal intensity and I_o is the output signal intensity.*

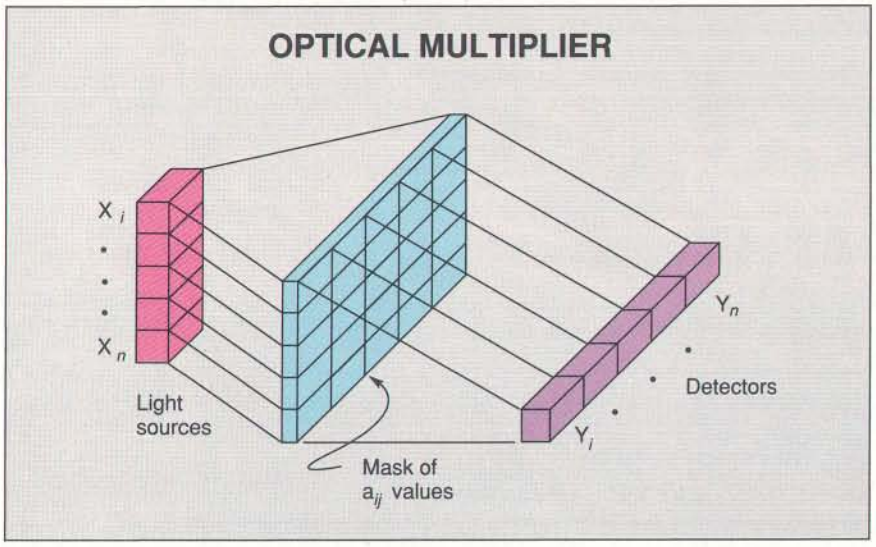


Figure 3: *This analog optical multiplier evaluates the expression* $\mathbf{y} = A\mathbf{x}$.

transform of B, you will distort both images, but there will be much more light in the blurred A image than in the blurred B image. You use this difference to identify and locate objects in a scene.

Optics and Neural Networks

Of all the optical computing paradigms, the one that uses the interconnection and energy advantages of optics best is neural networks. (For more information on neural networks, see the In Depth section, August BYTE.)

Neural networks are attempts to build processors that work like the human brain. (Digital computers are not much like the brain.) You don't program a neural network; you train it to connect a certain output with a certain input. Unlike the deterministic, discrete, linear logic of digital computers, neural networks display traits like inference and intuition.

Neural networks use processing elements called *neurons*. These are found in layers and are connected to many neurons in both the layer above and the layer below. Thus, neural networks depend on large numbers of interconnections.

If you have n neurons in a layer of a fully connected neural network, each input neuron has a fan-out of n differently weighted interconnections, and each output neuron has a fan-in of n differently weighted neurons. When n approaches 30 or 40, for example, these fan-ins and fan-outs strain the capabilities of electronics. Biological neurons can have much higher fan-in and fan-out, about 10,000. With holography, you can connect a million neurons to each other in parallel with independently chosen weights. That's an incredible 1 trillion independent, parallel interconnections.

Although neural networks are unlike digital computers, most current implementations are actually software simulations running on digital computers. Analog-electronic and optical neural networks will likely prove far more useful than these simulations in the future.

Some optical neural networks combine the learning and reaction in the same hardware like the brain does. These can be very powerful, but they are also very difficult to make. Other optical neural networks do the learning off-line in a digital computer and embody what is learned in a fixed hologram. These are simpler and therefore likely to be useful sooner.

Don't Throw Away Your Micro

These are but a few examples of optical computing. There are many more, with many applications of each.

Optical computers will add to, rather than replace, your microcomputer. The new applications they engender will affect your daily life early in the next century as the Information Age unfolds. ■

BIBLIOGRAPHY

Caulfield, H. J., and J. Shamir. "Wave-Particle Duality Considerations in Optical Computing." *Applied Optics*, vol. 28, 1989.

Yovits, M. C., ed. "Optical and Optoelectronic Computing." *Advances in Computers*, vol. 28, 1989.

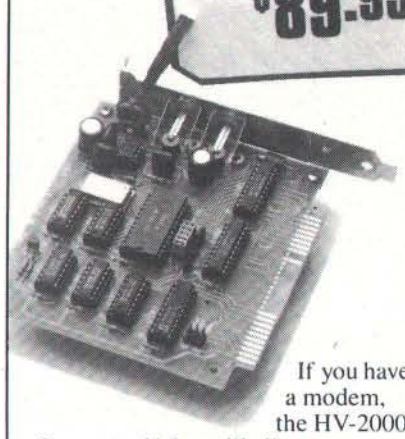
H. John Caulfield is director of the Center for Applied Optics at the University of Alabama in Huntsville. He can be reached on BIX c/o "editors."

TALK IS CHEAP.

Have you heard? For less than $90 your AT or XT-compatible computer can talk! All it needs is the HV-2000 Computer Voice Kit from Heathkit.

Reading letters, transcriptions and computerized instruction can be easier and quicker than you ever thought possible. Computer games gain a new dimension. Your computer can even entertain children with stories and songs.

$89.95



If you have a modem, the HV-2000 Computer Voice will allow your computer to recite reference and research information from time-sharing services. Or, speak radio transmitted ASCII information.

The HV-2000 Computer Voice Card, containing speech synthesizer and audio amplifier, plugs into any AT or XT-compatible computer's expansion slot. An external speaker is also included. Versatile, Heath-developed software gives you a wide variety of voices and easy interface to high and low level languages.

The HV-2000 Computer Voice. At less than $90, talk IS cheap. To order, call toll-free **1-800-253-0570.** Use your Visa, MasterCard, American Express or Heath Revolving Charge card. Use order code 218-001

For your **FREE** Heathkit Catalog call 1-800-44-HEATH

Heath Company

A subsidiary of Zenith Electronics Corporation

Prices, product availability and specifications are subject to change without notice.

COREL OPTICAL SOFTWARE FOR ALL THE LEADING OPTICAL DISK DRIVES

SONY · PIONEER · Panasonic · WANG · Maxtor · MITSUBISHI · HARRIS · RICOH · CHEROKEE DATA SYSTEMS, INC. · LASER MAGNETIC STORAGE INTERNATIONAL COMPANY · TOSHIBA

Optical Drives Supported
- WORM Drives
- ERASEABLE Drives
- JUKEBOXES

Platforms Supported
- IBM PC
- Macintosh
- Novell Fileservers

Choice of Configuration
- Software Interface Kits
- Complete Optical Subsystems

Corel OptiStar software is renowned for making optical disks as easy to use as floppy disks while maximizing speed and versatility. It is the top choice of the leading optical disk drive manufacturers and received the highest 5 star rating from PC Digest.

Make sure you get the most out of your optical disk system by using OptiStar software which is available as interface kits or in complete Corel optical disk subsystems.

Call us today.

COREL
(613) 728-8200

Circle 70 on Reader Service Card

The Nitty Gritty Optical Band

Optical packaging, interconnections, ICs, and signaling

Right now, we are bumping against the edges of the capabilities of electronics. We need to go beyond our electronic domain into a world that is faster, more secure, more parallel, and more densely interconnected but has less interference. Photonics has significant strengths in these areas.

Optical technology can help pull us into the next generation of computing. It is more secure than electronics: Generally, optical communications don't suffer from crosstalk. It is faster: Light travels faster than electricity and isn't constrained by factors, such as capacitance, that slow down signals in conductors. It is more parallel: Since thousands of dedicated light beams can simultaneously travel through a lens, an optical device can accept multiple inputs at the same time. And it provides advantages for interconnections because light rays do not interfere with each other.

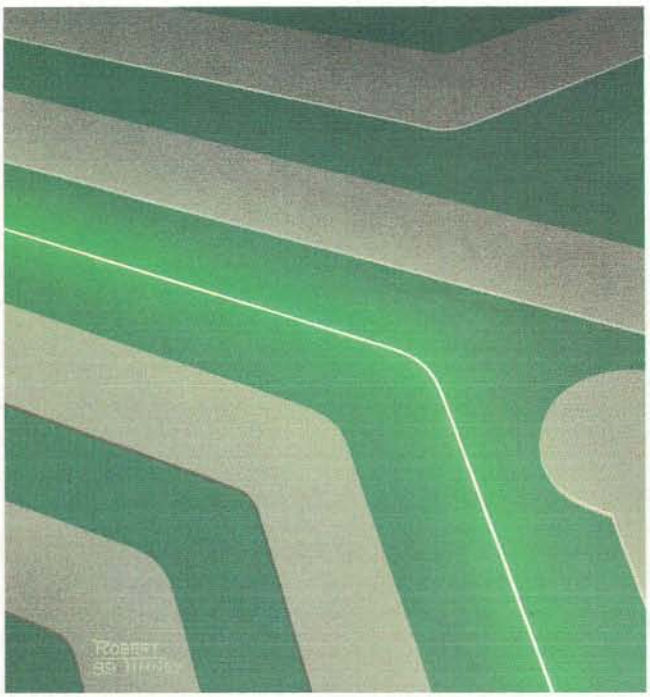


ILLUSTRATION: ROBERT TINNEY © 1989

Optoelectronics

Between the optical and nonoptical environments exists a hybrid domain called optoelectronics with one foot in electronics and the other in photonics. The combination of these two technologies brings us advantages and performance capabilities that are not possible with either of them alone.

Here are some possible applications of new optoelectronic techniques: optical communications networks that rapidly transmit signals around the world and into outer space; optical ICs that promise to be able to combine serial and parallel processing in a three-dimensional computer that can handle massive AI applications; and optical computers and other devices that can perform a thousand times faster than today's supercomputers.

These devices can take different forms: computers that think like we believe humans do, for example, and optical data storage disks that can hold orders of magnitude more information than their magnetic counterparts. In addition, other kinds of devices can easily and rapidly outperform current systems in areas such as pattern recognition, image processing, communications signal processing, voice recognition, and matrix manipulation.

Essential Elements

Domains like optical packaging, interconnections, ICs, and signaling are key to the future of computing. The technologies are essential elements in the progress of the overall optical environment.

Optical packaging encompasses the issues surrounding the various combinations of components on chips and boards and their interconnections and integration. Generally speaking, the major

continued

components all optical systems share are the transmitter, the receiver, and the medium. Overall, the aim is to embed more fundamental electronic functions into the light transmitter and receiver modules to create smaller packages that are easier to implement and use.

Packaging priorities are usually application-specific. The connection between the various components is a prime factor in whether or not the packaging is successful for that particular application. A recent development in *pigtail* technology has eliminated some of the interconnection problems in the packaging area. A pigtail is the optical fiber that is permanently attached to the active area of the LED or laser.

Cost is a constraining issue in optical packaging. Components and connections are still much more expensive than their electronic counterparts. But with improvements in, and wider use of, molded plastic optical elements (one of the developments that will make optical techniques viable), the economics of optical technology are gradually migrating into the range of affordability.

New Directions

Years of research are now paying off, and scientists in the areas of semiconductor, circuit, switching, and holographic technologies are beginning to see some outstanding results. These potentially viable results include the use of materials such as gallium arsenide, copper chloride, indium antimonide, zinc selenide, and multiple quantum wells for semiconductors.

A new technology called optoelectronic integrated circuit (OEIC) uses elements such as diode lasers and optical photodetectors fabricated on the same chips that contain electronic circuit functions.

Self electro-optic effect devices (SEED) and quantum-well devices are being considered for switches. In addition, earlier this year, scientists at British Telecom's Research Laboratories achieved the first complete optical self-switching of ultrashort light pulses, known as *solitons*. The success of this process promises that optical fibers will play a major role in fundamental optical-processing elements of the future.

Holography is the basis not only for optical computing, but also for other applications such as storage using optical associative memory. Other interesting experiments are being carried out on holographic look-up tables in the digital optical-computing domain, holographic interconnections, architectures employing real-time holography media (e.g., photorefractive materials), holograms as a technique for connecting the neurons in a neural network, and even holograms as communications links.

Optical devices and components have improved tremendously, as has the fiber we use as a medium. Researchers believe photonics will be of use in the AI field in the areas of optical database and knowledge-based machines, perception, and learning. Optical technology also appears to have a significant role in the emergence of neural networks.

Optical architectures useful for processing two-dimensional signals using acousto-optic (AO) devices have been developed and demonstrated for several applications. AO devices are one-dimensional spatial light modulators (SLMs). The areas of architectural considerations and scaling of algorithms and computation for the optical computing environment are also being studied.

Still a Few Years Away

When will we see an optical computer? Some working models already exist in today's research environments. At least one company has a digital optical computer up and running, and another firm has one on the drawing board, but a commercial model of an optical computer is still a few years away. In the meantime, better optical communications, optical storage, and optical displays and many optical techniques are already being incorporated into existing systems.

—Janet J. Barron
Technical Editor

Levels of Light

Are photons inherently superior to electrons in providing interconnections?

Joseph W. Goodman

On a fundamental level, a digital computer consists of a collection of nonlinear elements (the *gates*) within which signals interact, and interconnections among these elements or among groups of these elements. While attention most often focuses on the gates and their properties (e.g., switching speed and power dissipation), the interconnections are no less important. In fact, as the speed of transistors on chips increases, the interconnections become the limiting factor in overall chip performance.

Interconnections appear within a computer not only between gates at the chip level, but also at many other levels of an entire interconnect hierarchy:

Level 1: Machine-to-machine interconnections. Examples of interconnections at this level include the coaxial electrical cable of Ethernet, which transmits data at a rate of 10 million bps, and the optical fiber of the Fiber Distributed Data Interface (FDDI), which will soon replace Ethernet in many high-speed applications, at a data rate of 100 million bps.

Level 2: Module-to-module interconnections within a single computer, where a module may consist of a unit of memory or a processor. With the increasing emphasis on multiprocessor computers as an architecture of choice, these interconnections are becoming more important.

Level 3: Backplane-to-backplane interconnections. Large computers typically consist of a multitude of backplanes into which electronic boards are inserted. These backplanes must exchange infor-

mation, and therefore must be interconnected.

Level 4: Board-to-board interconnections on a backplane. The backplane supplies the bus or communications channel through which the boards communicate.

Level 5: Chip-to-chip interconnections on a board. A typical printed circuit board may contain a hundred or more chips. Data usually flows between these chips via metallic lines embedded in the board.

Level 6: Gate-to-gate interconnections on a single chip, representing the lowest level of the interconnect hierarchy. Interconnections at the chip level are part of the chip design and are typically achieved through extremely fine lines of polysilicon or metal fabricated on the chip itself.

Photons vs. Electrons

Physically, there is reason to believe that photons are inherently superior to electrons in providing interconnections. Electrons are charged particles and therefore influence one another through the forces that electrical fields exert. On the other hand, a photon carries no charge and therefore exerts no influence on other photons. Thus, optical beams in a linear medium pass through one another without interaction, an attribute that is ideal for interconnections.

As the speeds of electronic circuits increase, greater and greater difficulties are encountered in providing the required interconnections at all levels. Photonics has come to the rescue at level 1 of the hierarchy, with many large computer companies accepting the new FDDI standard; the prospect of a tenfold improvement over Ethernet speeds in the near future is now a certainty.

The success of photonics in interconnections stems from the low attenuation of optical fiber, which allows using long spans of fibers without repeaters, and the freedom of optical signals from electromagnetic interference. Equally important are the extremely high data transmission rates possible in optics. These rates are often limited not by the fiber itself, but by the electronic devices that convert electrons to photons at the optical transmitting end and photons back to electrons at the receiving end. The inherent bandwidth of the best fiber is sufficient in principle to allow digital data transmission at rates greater than 10 *trillion* bps, if only we could access that bandwidth through suitable optoelectronic devices.

A photonic interconnection requires converting electronic signals flowing on wires to optical signals flowing on an optical channel. Electronic signals are most commonly converted to optical form with LEDs or semiconductor laser diodes, the latter being more efficient than LEDs but also having poorer reliability. Unfortunately, no efficient and practical method exists for generating light using silicon as the device material; virtually all semiconductor optical sources are based on gallium arsenide (GaAs) technology or its relatives. Photodetectors perform the actual conversion of optical signals to electronic form. Both silicon and GaAs make efficient detectors. Each of the conversion steps has less than perfect efficiency, but the detection step is generally far more efficient than the light-generation step.

Optical fibers provide the most widely recognized medium for transporting optical signals. However, when the interconnect distances are short, as they are within a single computer, other possibilities exist. You can construct optical waveguides in planar form on silicon or GaAs chips, and use them to carry optical signals at level 6 (gate to gate) of the hierarchy. Other types of optical waveguides can be fabricated at level 5 (chip to chip). You can also use holographic optical elements to transmit or reflect light to a prescribed set of locations, thereby creating a *free-space* optical channel. Each approach has its own particular strengths, with fibers generally being preferred at the higher levels of the hierarchy, and waveguides or possibly free-space interconnections at the lower levels.

The use of photonics to provide the highest-level interconnections (i.e., between computers, or between computers and high-speed peripherals) is already a proven technology, although many improvements are possible. At the opposite extreme, photonics is unlikely to provide a viable interconnect technology at level 6 (gate to gate), the lowest level of the hierarchy. The reason is complex, but to put it simply, the power efficiency of a photonic interconnection compares favorably with that of an electronic interconnection at the machine-to-machine level; however, the photonic solution compares unfavorably with the electronic solution at the gate-to-gate level.

On the Level

Connecting computers with optical fiber (level 1) is the purpose of the new FDDI standard. It is a proven technology.

One of the earliest examples of the use of photonic interconnections *within* a computer is the so-called Dialog.H computer constructed at the Electrotechnical Laboratory in Tsukuba, Japan (which is funded by the Japanese Ministry of International Trade and Industry). This computer consists of a multitude of electronic processors (level 2), each having its own local memory. The processors are arranged like the spokes of a wheel around a central hub (see figure 1).

Each processor has an optical source and a photodetector. When one processor wishes to communicate with another, it broadcasts an optical signal through free space toward a convex mirror located at the hub of the wheel. The mirror spreads the light so that a portion of it falls on the photodetectors of all processors. Each message contains a header indicating its intended destination. Only the proper destination accepts the message, and when it does, another processor can use the optical channel. Thus, a time-shared communications bus is realized within the computer.

A second early example is the 5-ESS switching computer made by AT&T. This type of computer supplies, at many locations through the communications network in the U.S., the computational power needed to route messages to their proper destinations. The 5-ESS computer uses photonics and optical fibers to supply interconnections between its several backplanes (level 3). Optics was chosen for this task because of its ability to eliminate troublesome *ground loops*, or unwanted stray electrical paths that plague large electronic systems.

Several industrial organizations have active research projects investigating the use of optics for interconnecting multiple electronic boards (level 4). The so-called *optical backplane* must be capable of providing data rates in the range of 1 Gbps to 10 Gbps (1 gigabit per second = 1000 million bits per second) or higher.

Both industrial research laboratories and universities are investigating the use of optics at the lower levels of the interconnect hierarchy, including chip-to-chip interconnections on a board (level 5). Several U.S. companies, including Honeywell, Rockwell, and IBM, have significant development efforts to provide multi-Gbps optical channels into and out of GaAs chips. Many Japanese companies have similar efforts.

The one intrachip (level 6) interconnection where optics may provide a viable alternative to electronics is in clock distribution. Virtually all electronic chips must widely distribute a synchronizing signal called the clock, which serves as a time reference for the many

continued

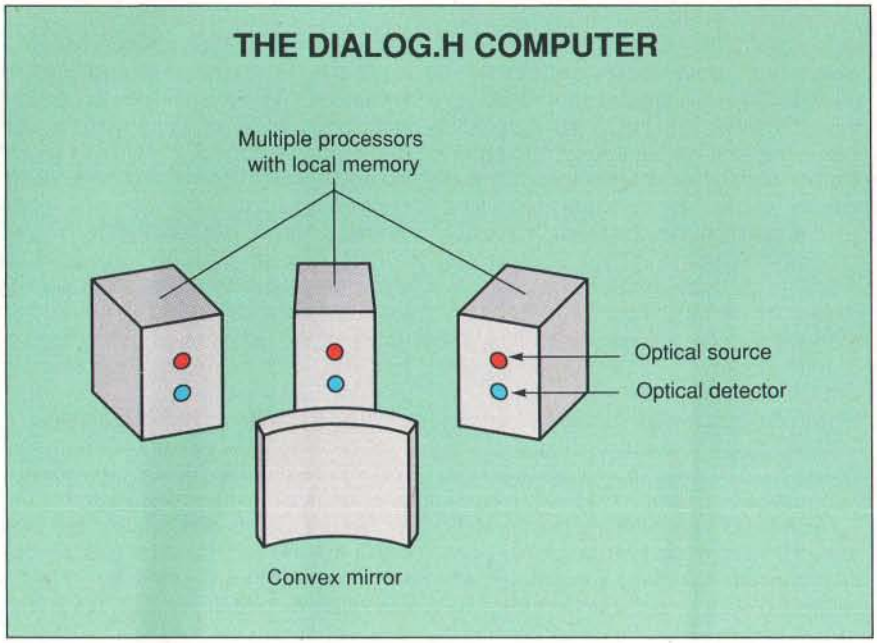


Figure 1: *The Dialog.H computer is one of the earliest examples of using photonic interconnections within a computer. It consists of a multitude of electronic processors, each with its own local memory.*

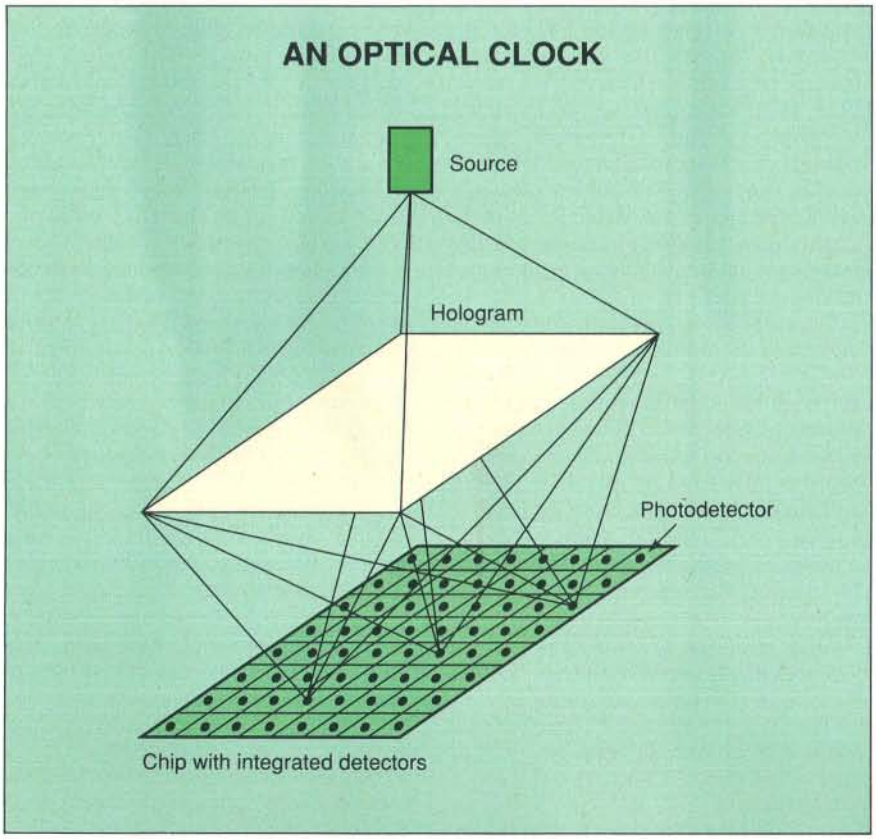


Figure 2: *Optical clock distribution to a chip via a holographic optical element. An off-chip semiconductor laser source generates an optical timing signal, which a holographic optical element then efficiently broadcasts to many photodetectors embedded in the chip.*

devices on the chip. The clock signal must be delivered to virtually all devices on the chip, and therefore suffers a high level of *fan-out*. That is, it is split many times so it can reach all the devices. Such splitting loads the clock lines so that it becomes hard to drive them with a high-speed electronic signal.

Stanford University has been working for several years on designing and fabricating chips that are clocked optically. As shown in figure 2, an off-chip semiconductor laser source generates an optical timing signal, which a holographic optical element then efficiently broadcasts to many photodetectors embedded in the chip. The optical signal is then converted to electronic form at many locations, and conventional chip wiring distributes each locally detected clock signal to nearby devices. Variations of this scheme incorporate many free-running clock oscillators on the chip, which an optical signal then synchronizes.

The Breaking Point

The use of photonics as an interconnect technology remains in its infancy. Electronic-systems designers have a natural tendency to select electronic (rather than photonic) solutions to problems simply because they are unfamiliar with the photonic approach.

However, in fairness, photonic devices need a great deal more development before they will be as reliable and flexible as electronic devices. Driven by the requirements of long-distance fiber-optic communications, this development will surely occur. When it does, photonics will gradually be incorporated into lower and lower levels of the interconnect hierarchy, especially in applications where the highest possible speed is essential.

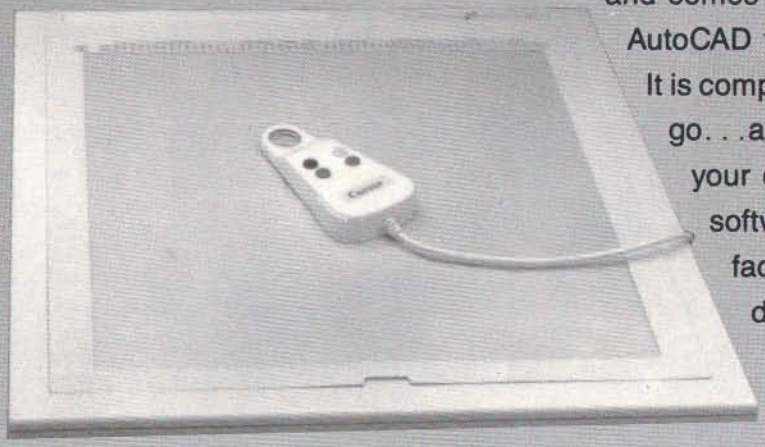
The implication is that optics will probably provide viable interconnect solutions for the higher levels of the interconnect hierarchy but will eventually fall behind in competition with electronics on the lower levels. Where the breaking point will actually occur is at present the subject of considerable research. It appears highly likely that the typical computer of the future will depend on photonics, certainly for external interconnections, and probably for at least some of its internal interconnections.

Joseph W. Goodman is a professor and chairman of the department of electrical engineering at Stanford University, from which he also holds a Ph.D. He can be reached on BIX c/o "editors."

continued

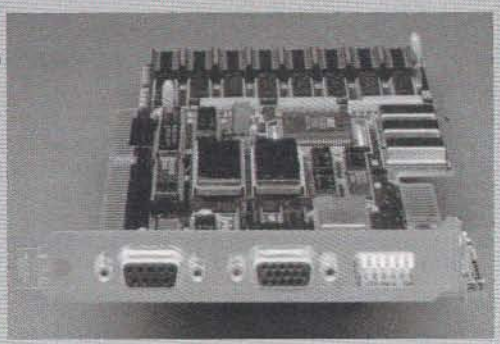
$299* GRAPHIC RESOLUTION SOLUTIONS.

1000 LPI. For CAD and other graphics applications, nothing beats the IO DT-1000 graphics tablet. It emulates nine of the most popular tablets and out-performs any mouse. The DT-1000 is an "absolute" pointing device . . .draw and trace as naturally as with pen and paper.



The DT-1000 is compatible with today's top CAD and paint software and comes with its own AutoCAD template. It is complete and ready to go. . .all you provide are your computer and software. It interfaces with standard RS-232C ports. Best of all, the IO DT-1000 gives you twice the features at less than half the price of tablets offered in the past.

1024 x 768.† Let us open your eyes to a whole new world of color and resolution. The IO VGA 16 graphics card delivers resolutions, colors and features far beyond standard VGA. It offers truly hardware register-level compatibility with all popular graphics modes, 16-Bit Data Bus, and both 9-Pin TTL and 15-Pin Analog output.



Included are software drivers for:

AutoCAD
Framework II
GEM Desktop
Lotus 1-2-3
Symphony
Microsoft Windows
286/Version 2.0
386/Version 2.1
Ventura Publisher
WordPerfect
WordStar

CALL NOW!

Dealer and distributor inquiries welcome.

*Each. Manufacturer's suggested retail price.
†With optional use of 512K DRAMS.
Specifications subject to change without notice.

IO COMM.
A TRI-KOR COMPANY
12700 Yukon Avenue
Hawthorne, CA 90250
Phone (213) 644-6100 Fax (213) 644-6068

Circle 133 on Reader Service Card

Joining Forces

Optics and electronics each have their shortcomings, but together they combine the best of both worlds

Donald J. Channin

As clock speeds push toward 100 MHz and beyond, and as word lengths increase beyond 32 bits, conventional electronic means of interconnection will be severely tested. Without an alternative, copper, not silicon, will limit the performance and cost of future advanced workstations and processors.

The integration of optics with electronics offers an alternate interconnection technology called optoelectronic integrated circuit (OEIC) technology. Optoelectronic elements such as diode lasers and optical photodetectors are fabricated together on the same chips with electronic-circuit functions.

What can we expect from computers based on these chips?

- Faster, more economical machinery.
- Broadband interconnections for high-density graphics and ultimately real-time video, as part of the workstation environment.
- New architectures for computing, as optics liberate interconnections from the confines of computer and backplane wiring.
- Processors whose architectures can be custom-configured by electrically controlled beam interconnections.

Silicon-based logic and memory offer so much flexibility and potential for future development that optical systems will probably replace them only in specialized applications. The more general use of optics won't be to replace silicon but to support it. Ultimately, the OEIC technology could look like this:

- Chips in which optoelectronic devices replace the conventional I/O pads and associated line drivers for sending and receiving optical signals.
- Signal connections based on beams of light, fiber-optic lightguides, or planar optical waveguides embedded in printed wiring boards, or combinations of these elements.
- Economical packaging that supports the chips with their optical connections but doesn't need the hundreds of pins that now surround complex chips.

Why Go Optical?

The most obvious reason for these optical refinements is simply the number of pins on complex chips. Three hundred pins are common on processors today, and computer designers are anticipating packages with over a thousand pins in the early 1990s. This growth is a direct result of increasing complexity on the chip, which requires more I/O capability to support it.

Rent's Rule, an empirical rule for logic circuits, tells us that $N_c = K(N_g)^s$. N_c is the number of connections to a chip, and N_g is the number of gates the chip has. K and s are constants whose values are typically 2.5 and 0.6, respectively. If you put more logic on a chip, you must support it with more connections.

The use of optics won't be to replace silicon but to support it.

Packages with many pins devote most of their real estate to fan-out from the chip itself to the pins. Reliability drops and costs rise rapidly with increasing numbers of mechanical elements. By going to optics, single optical links can replace multiple pin connections.

Present printed wiring boards can handle current clock frequencies of about 30 MHz with little difficulty. But when clock speeds reach 100 MHz and beyond, as they undoubtedly will, the electrical characteristics of the board traces will degrade and ultimately limit system performance.

Low-speed systems use unmatched electrical impedances and expend power-charging line capacitance. This power grows with frequency. To avoid committing excessive chip power to driving these capacitances, you must shift to matched impedances for transmission lines and terminations. This step turns system design into an exercise in radio-frequency (RF) engineering. Electromagnetic interference and compatibility become major design issues.

All these problems spell increasing cost and lower system reliability. Optical links, however, offer the multi-gigahertz bandwidths and noise immunity that have given them a commanding position in fiber-optic telecommunications.

Geometry, Plain and Simple

While the very architectures of present computers are based on the geometries of multilayer boards and backplanes, light is not limited to these geometries. Beams of light can pass through each other and don't need a controlling medium. Such a beam can use the shortest path between two points in a system as a signal path. Changing the direction of such beams can amount to rewiring the machine.

Guided propagation of light in fibers or films is not as flexible, but it can still support layouts and system geometries impossible with conventional interconnections. New computing methods, such as massively parallel and pipelined processing, appear well suited for implementation on machines with the architectural freedom optics can offer.

To make these optically connected computers possible, you will need a CMOS processor, DRAM, or other typical computer chip. However, one or more optical-interconnect subchips would replace the hundreds of bonding pads that normally surround such chips. These subchips act as transmitters and receivers for optical data that otherwise would pass to and from the circuit

through electrical connections.

Figure 1 shows the detail of the optical subchip. It is fabricated on GaAs, a semiconductor with properties different from those of silicon but capable of being grown directly on the silicon chip.

Data is sent in parallel to the subchip, converted to serial form by the signal processor, and used to drive a laser transmitter. Laser light modulated by the data is sent to another chip as an unguided beam or through an optical fiber. The receiver element accepts optical signals from other chips and converts them to electrical signals. Then the received signals are converted to parallel form and sent to the silicon master chip.

Signal Processing

Optoelectronic technology is based on using semiconductor devices for generating light signals from electrical inputs, transmitting them, receiving them, and converting them back into electrical form. Certain semiconductors, such as aluminum gallium arsenide (AlGaAs) for wavelengths of 0.8 to 0.9 micrometers (μm) and indium gallium arsenide (InGaAs) for wavelengths of 1.1 to 1.6 μm, generate these light signals by applying forward bias (i.e., low electrical resistance) to specially fabricated junctions.

Electrons and holes injected into the junction recombine there to create photons of light. These photons may be emitted directly to form incoherent light. Such a device (e.g., an LED) is easy to make but is slow and inefficient.

Laser diodes are made by incorporating the semiconductor junction into an optical cavity produced in the same material, so that optical feedback stimulates lasing action. Laser diodes can be efficient (more than 60 percent) and fast (more than 10-GHz bandwidth over which light intensity follows current modulation), and they use little current and power (less than 10 milliamps and less than 20 milliwatts). You can couple light from laser diodes into optical fibers for transmission or direct them into beams traveling in free space.

On the receiver side, photodiodes based on reverse-biased (i.e., with high electrical resistance) semiconductor junctions detect the light signals. Photons absorbed within the depleted regions of these junctions create electron-hole pairs that are swept out to create a small current that varies with the intensity of the light.

Simply switching the laser on and off with the drive current imposes information on the light beam. The photodetector current tracks this signal and can drive subsequent electronic stages.

A complete transmitter or receiver combines the lasers and photodetectors with electronic circuits that control their operation and provide an interface between them and the digital circuitry. You can also add digital circuitry to convert the parallel data into a single serial data stream to be transmitted over the optical link, and to reconvert the data to parallel form at the receiver. These multiplexing and demultiplexing (MUX/DEMUX) operations let you trade off the high-speed capabilities of optoelectronic devices against the greater chip area and power consumption of parallel optical-signal paths.

Assembling the Pieces

OEIC technology puts all these functions on a single semiconductor chip. Figure 2 shows an example of the type of chip now being developed (see reference 1). Conceptually, it makes sense to extend the functions on the chip to include logic, memory, and other signal-processing functions that the application needs. Three main issues are involved:

- Different device functions require different semiconductor materials.

Diode lasers can't be made in silicon, nor can photodetectors for the long wavelength optical bands (1.3 to 1.6 μm).

GaAs is excellent for short-wavelength (0.8 μm) lasers and detectors, and supports a growing field in high-speed logic. Unfortunately, it's not competitive with silicon for large-scale memory or logic.

InGaAs supports long-wavelength lasers and detectors. It also has a potential for even greater electronic speeds than GaAs, but it is still a relatively immature technology.

- Different devices require different and sometimes incompatible processing techniques.

Most laser structures are built up of semiconductor *heterojunctions*, which are crystalline layers of different compositions that are grown on top of each other with demanding requirements on the interface properties of the materials (see reference 2).

Electronic devices, by contrast, are usually made of single-composition materials with electrical properties modified by doping. Not only does fabricating a chip with both types of devices involve different processing for different system elements, but you must do it on a surface that has different elevations for different devices.

- Interfacing optical-transmission media (i.e., fiber optics) limits chip geometry and requires precise mechanical alignment in packaging.

continued

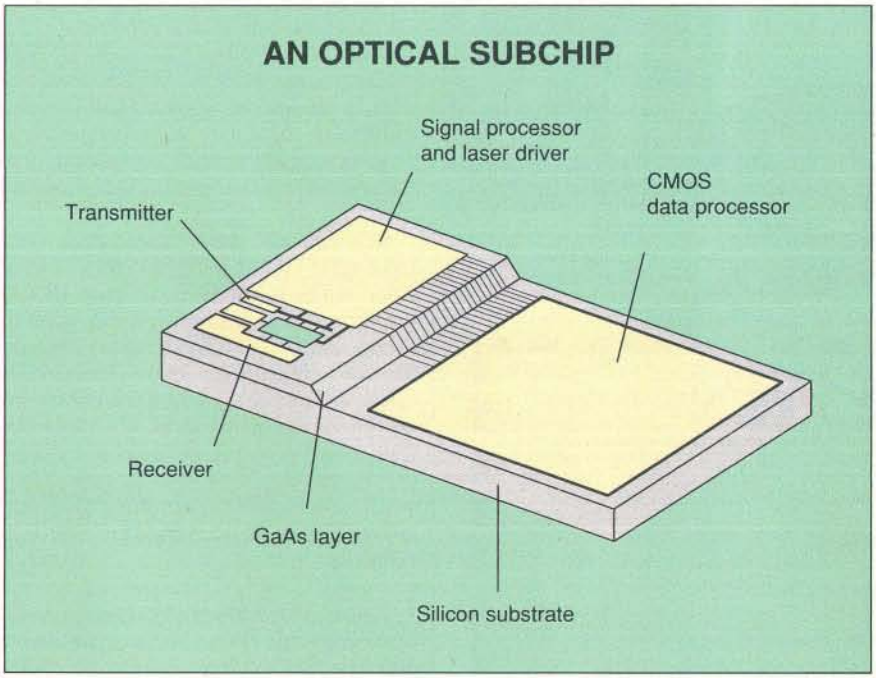


Figure 1: *An optical interconnect subchip. Note that it is fabricated on GaAs, a substance with properties different from those of the silicon substrate but capable of being grown directly on it. The OEIC computer chip itself is fabricated of silicon.*

Circle 150 on Reader Service Card

Why the FREE Inmac catalog is the computer accessory you'll value most.

You get "a store in a drawer."
Page after page of PC products that make work easier, more effective. At your fingertips, when you wish.

Plain talk makes it all easy.
Spacesavers, workstations, cables, disks. All explained in simple language & pictured as you'd use 'em. Call with any questions: Our informed staff helps you get the right item, instant credit, fast delivery.

The final decision is yours.
Unlike some catalog firms, Inmac lets *you* decide when you're satisfied with a product. A promise we back up with ironclad guarantees.

Call now toll free:

1-800-547-5444

Use the resource that gives the world's sharpest business computer users an extra edge.

Call or send coupon to Inmac, 2465 Augustine Dr., Santa Clara, CA 95054.

YES!
Send my first Inmac catalog today!

Name
Title
Company
Street Address/P.O. Box
City State Zip
( )
Area Code Phone No. Code 5555
In Canada, Call Toll Free 1-800-387-2173

Search and Research

The most focused research work has been in the field of monolithic integration of electronic and optoelectronic devices. The first milestone was achieved in 1978 when Caltech reported a basic transceiver chip containing a laser, amplifier, and photodetector on a gallium arsenide (GaAs) substrate.

Progress to more complex chips required planar surfaces for photolithography. To achieve that, Honeywell and other companies developed techniques to grow the laser heteroepitaxial layers in a well that is etched into the GaAs substrate.

Since then, fast (1 gigabit per second) and complex (more than 500 gates) transceiver chips have been developed. Receivers using planar photodiode devices have grown in complexity to more than 2000 devices per chip and in speed to over 5 gigahertz. Extensive work has been done in Japan, culminating with the first commercial part (a receiver) offered in 1988 by Matsushita.

This impressive progress was made despite the lack of a compatible processing technique for all the devices on the chips. Without a compatible process, low-cost products are unlikely to appear. This need has been recognized: Examples of compatible optoelectronic integrations have recently appeared.

Fujitsu has shown an approach in which lasers, detectors, and transistors are processed by implanting a planar material containing a semiconductor multiple quantum well. Such quantum-well structures are examples of how new semiconductor growth technologies can perform "atomic engineering" on materials. These technologies tailor the fundamental energy bands to the needs of the devices, rather than limiting device performance to the capabilities of bulk materials. With these techniques, development paths to economical fabrication of complete and complex optoelectronic IC parts are now open.

Another accomplishment in materials engineering addresses a problem involving computer chips and OEIC functions requiring different semiconductor materials. Now you can grow GaAs layers of device quality directly onto a silicon wafer. Originally, the objective was to provide a better substrate for GaAs electronic devices. But the same technology can allow islands of GaAs grown onto a silicon chip to add optoelectronic functions to conventional logic and memory.

The major technical issue is the crystalline quality of the GaAs as it grows on the different crystalline structure of silicon. Defects in the crystalline structure of the grown layers affect the performance and reliability of the devices fabricated on them. Although the quality of the GaAs must improve before reliable lasers can be manufactured, the goal of complete monolithic integration of optoelectronics to support the interconnection of electronic computing functions is now in sight.

Conventional diode lasers emit light from a tiny (about 2 μm) spot on a cleaved edge of the semiconductor chip (hence the term "edge emitter" for devices of this geometry). Special processing and handling are required, and the need to locate the lasers at the edges is a constraint on the layout of the chip. Coupling the light to an optical fiber requires locating the much larger (120-μm) glass fiber within microns of this emitting spot. Receivers present similar mechanical problems.

These problems make conventional optoelectronic components expensive and ill-suited for high-density computer hardware. However, a group of enabling technologies has emerged that makes OEIC development for computer applications feasible and timely. These technologies have come out of separate research efforts with very different objectives, but together they offer a realistic framework for OEIC design and fabrication (see the text box "Search and Research" above).

In the near term, the concept of multichip packaging now entering systems applications could allow GaAs and silicon chips to share the same package even before the technology for growing GaAs on silicon is perfected. Internal connections between the chips would still require electrical traces, but optics would carry signals outside the packages.

Interfacing OEIC chips for optical transmission has been made much easier with the recent development of surface-emitting diode lasers. Unlike the conventional edge-emitting lasers, these new devices have optical emission perpendicular to the chip surface. No longer must

OEIC layouts be constrained so the laser output comes from the cleaved and processed edge of the chip.

An example of such a device is the grating-surface-emitting (GSE) laser announced by the David Sarnoff Research Center (see figure 3 and reference 3). This device uses a diffraction grating processed into the laser to deflect light from the plane of the chip into a narrow beam. This beam can then go directly into a receiver on another OEIC chip, be redirected with lenses or other optics, or be coupled efficiently into fiber optics. Other approaches to surface-emitting lasers use micromirrors etched into the chip to deflect light, or invert the laser itself so that it is oriented perpendicular to the chip surface.

continued

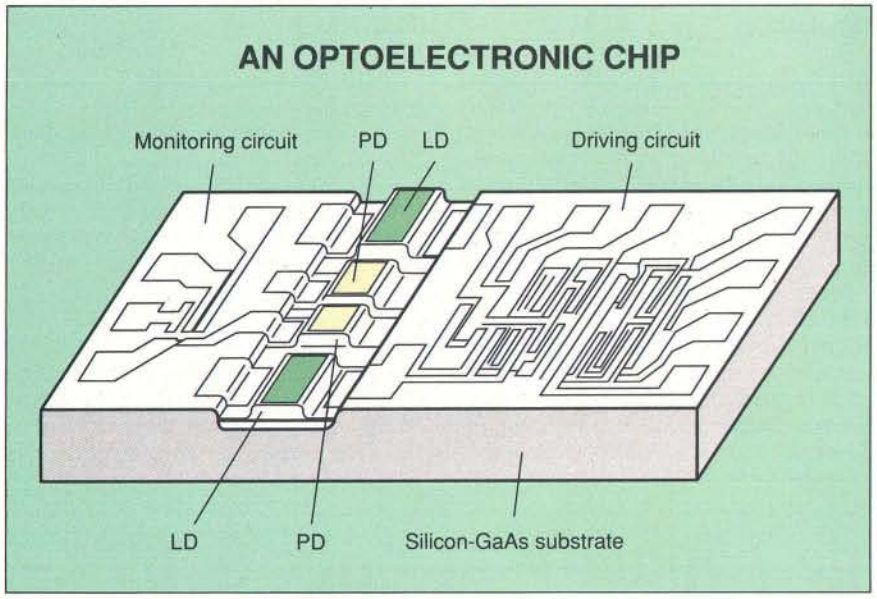


Figure 2: *An example of the type of optoelectronic chip now being developed. It shows a typical OEIC structure containing laser diodes (LDs), photodetectors (PDs), and driving and monitoring circuits.*

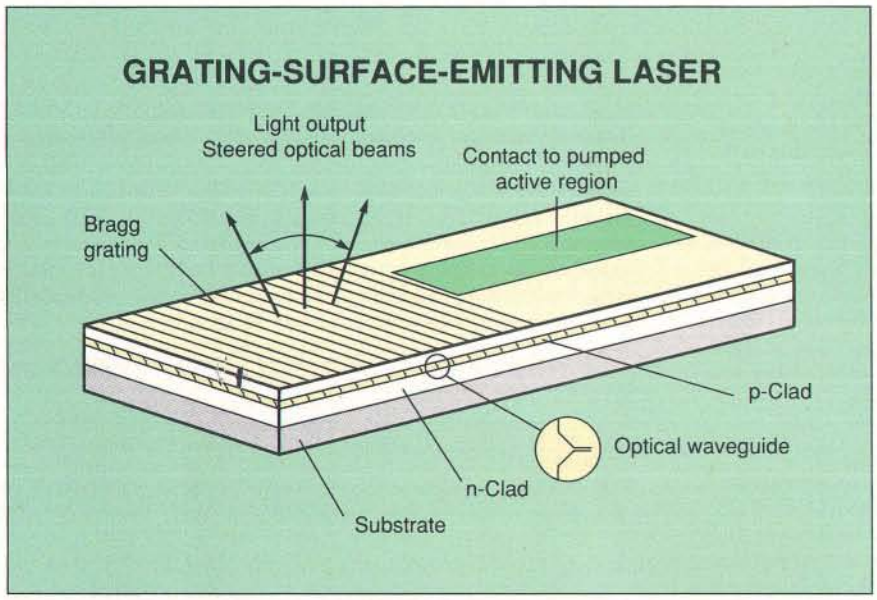


Figure 3: *Grating-surface-emitting (GSE) laser structure. Light output is in the form of steered, focused, narrow optical beams from the surface of the diffraction grating. Current from the contact to pumped active region stimulates optical emission in the optical waveguide.*

MARK 16
286-16 MHz AT
COMPUTER WITH EGA
COLOR MONITOR
LIQUIDATION
FACTORY NEW! FACTORY PERFECT!

Speed though your programs with the computer made for demanding work! This 286-AT Computer with EGA Color Monitor is lightning fast for all of your computing needs. Comes complete with 1 MB of RAM and a high speed 40 MB hard drive.

- 16 MHz 80286 computer.
- 1 MB RAM on motherboard (expandable to 4 MB).
- 14" EGA color monitor with EGA color adapter.
- 40 MB-38 milisecond hard drive.
- 5-1/4" floppy drive with 1.2 MB capacity.
- Six 16-bit and two 8-bit expansion slots.
- 100% IBM compatible.
- 80287 math co-processor socket.
- 4 extra half height disk drive cavities.
- Built-in real time clock/calendar.
- 1 Centronics parallel printer port.
- 1 RS232C serial communication port.
- 101 AT-style keyboard. • 200 watt power supply.
- Includes: MS DOS 3.21 & GW-BASIC 3.22.
- Dim.: 19.3" x 16.7" 6.3".
- **One Year Warranty!**

PUBLIC NOTICE
Due to a special deal, we were able to obtain a large inventory of these fantastic computers. As a result, we can now offer them to you at **HUGE SAVINGS!**

Manufacturer's Suggested Retail **$3,195.00**

DAMARK PRICE:
$1499

Item No. B-1412-126533
Insured Ship/Hand.: $39.00

FOR FASTEST SERVICE CALL TOLL FREE
1-800-729-9000

MasterCard VISA DISCOVER

DAMARK INTERNATIONAL, INC.
6707 Shingle Creek Parkway, Minneapolis, MN 55430
Customer Service • 612-566-4940

Please rush me:
_____Mark 16 Computer(s)
@ $1499 each, plus $39.00 s/h each.
MN res. add 6% sales tax.

Name _____
Address _____
City,State,Zip _____
☐ Check/MO ☐ VISA ☐ Master Card ☐ Discover
Card No. _____
Exp. Date ____/____ Ph. # ( ) _____
Signature _____
Item No.B-1412-126533

DELIVERY TO 48 U.S. STATES ONLY

A special feature of the GSE laser approach is that the light beam can be electronically steered. Two optical processes combine to achieve this effect. First, the deflection angle of light from the grating changes with the light wavelength. Second, the electronic drive to the laser controls the light wavelength. Combining these two effects will make it possible to electronically change where the output beam points.

The Age of Optics?

What could we do with a steerable optical interconnection? To start with, we could eliminate a major bottleneck in processor performance by replacing current data bus architectures with direct connections between processors and memory. Such direct connections make sense only if you can switch them in real time, as you can with electronically steerable optics.

Going further, you could base architectures for parallel-processing machines on direct, equal access among all processing elements, rather than on the restricted access that electronic connections offer. Ultimately, we may have workstations in which the processing system alters itself according to the application it is running or even the specific task it is carrying out.

Will we see such machines soon? Both technology and market issues will set the pace for the development of the OEIC chips around which they must be designed. The first users of OEIC devices will probably be not computer manufacturers but makers of telecommunications equipment.

Replacing present fiber-optic equipment with single chips will reduce the cost and probably improve the performance of high-speed systems. Applications will first come as fiber-optic interconnections between computer-room equipment and high-speed networks to replace the bulky electrical cables now used. Cost reduction is the driving force.

Meanwhile, organizations such as the Microelectronics Computer Consortium are exploring the architectural implications of optical interconnections for existing and new types of computers. Various companies are also working, individually and within industry groups, to advance the basic semiconductor technologies and prepare for production. With this activity, the 1990s should be the decade for introducing optics into computers. ■

REFERENCES

1. Nakano, H., et al. "Monolithic Integration of Laser Diodes, Photomonitors and Laser Driving and Monitoring Circuits on Semi-insulating GaAs." *Journal of Lightwave Technology*, vol. LT-4, page 574. IEEE, June 1986.
2. Kressel, H., et al. "Laser Diodes and LEDs for Fiber Optical Communications." *In Semiconductor Devices for Optical Communications*, edited by H. Kressel. New York, Springer-Verlag, 1980.
3. Evans, G. A., et al. "Two-Dimensional Coherent Laser Arrays Using Grating Surface Emission." *IEEE Journal of Quantum Electronics*, vol. 25, page 1525. IEEE, June 1989.

Donald J. Channin is a program manager at the David Sarnoff Research Center in Princeton, New Jersey. He has a Ph.D. in physics from Cornell University. He can be reached on BIX c/o "editors."

Unlimited storage capacity at only $ 699.–!

New FLOPTICAL technology available now from microtronics Trade Service

One of the first disk drives based on the new FLOPTICAL technology developed by Insite Peripherals, California, is now available from microtronics Trade Service, West Germany: TESS I 325. This disk drive can store up to 20.8 megabytes of data on a 3.5 inch FLOPTICAL diskette. It is also able to read, write and format standard 3.5 inch diskettes in the IBM PS/2 compatible formats. The disk drive itself is physically compatible to the 3.5 inch standard. It contains a standard SCSI interface. The average seek time is as low as 65 ms.

Unlike the usual technology to store great amounts of data on magnetic media by using magnetic servo tracks, the FLOPTICAL technology combines optical and magnetic technologies to create a reliable storage device. Servo tracks are factory prepared on standard 3.5 inch high density diskettes, using a laser device. The servo tracks are burned into the surface of the diskette at a density of 1250 tracks per inch. The magnetic read/write head is positioned by a closed-loop servo following the optical servo tracks with an accuracy within 60 microinches. The optical servo tracks are indelible and not vulnerable to erasure as with magnetic encoded schemes. The care and handling of the FLOPTICAL diskettes is the same as for standard 3.5 inch diskettes. The FLOPTICAL diskette data blocks are written with a proprietary ECC capable of correcting single error bursts of up to 80 bits and multiple bursts of lesser total length.

A single FLOPTICAL diskette costs as little as $ 19.–, that's 91 cents per megabyte media cost! microtronics Trade Service offers the TESS I 325 FLOPTICAL disk drive with one FLOPTICAL diskette for $ 699.–. Several accessories are available, such as a external case with cables, SCSI host adapters for various computers, mounting rails for 5.25 inch form factor drive bays.

"The TESS I 325 FLOPTICAL disk drive will play a major role in the future store device market." a spokesman of microtronics Trade Service said at the presentation of the drives. "It incorporates many advantages over todays technology, is available at a competitive low price, shows a very good performance and has a virtually unlimited storage capacity. The FLOPTICAL technology will fill the gap between the growing needs for more and more storage capacity and the high prices for this capacity today. And unlike other technologies recently announced, FLOPTICAL technology is available in our TESS I 325!"

The TESS I 325 FLOPTICAL disk drive is available at your local computer dealer.

microtronics Trade Service, Bettendorfer Str. 36, 5173 Siersdorf, West Germany, Phone: 49-2464-2147

If you don't know where to buy your TESS I 325 FLOPTICAL disk drive, please contact us. We'll help you!

IBM, PS/2 are trademarks of IBM Corp. Insite, Floptical are trademarks of Insite Peripherals, Inc.

microtronics Trade Service, TESS, TESS I 325 are trademarks of microtronics Trade Service

Idea: H. Bauer, Set by HGB Druck, Jülich

Circle 181 on Reader Service Card

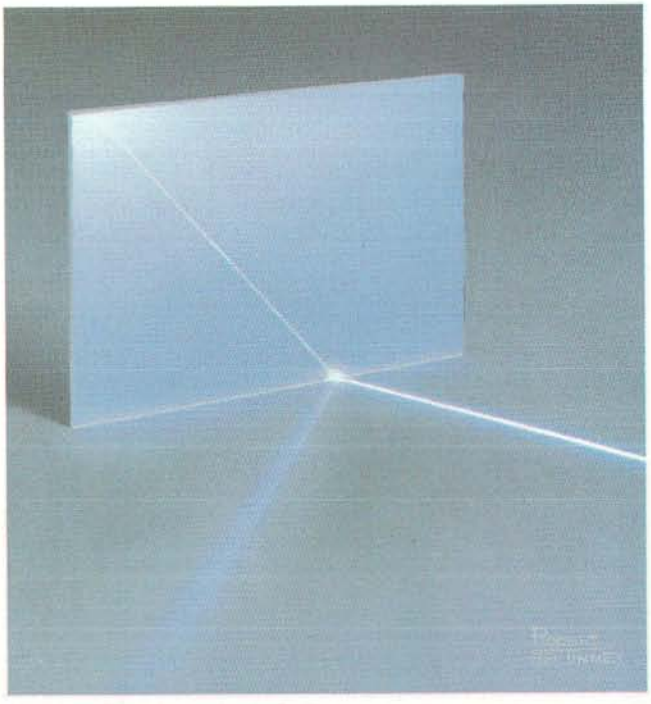
Reflected Light

Lasers are the way to go for brightness and sharpness in a world dominated by speed and resolution

Gary T. Forrest

A spot of light can never be too small or too bright. This emphasizes the two fundamental user advantages of *lasers* (light amplification by stimulated emission of radiation): sharpness and brightness.

Sharpness refers to a laser beam's ability to be focused to a *diffraction limited spot*—that is, a spot limited in size only by the wavelength of the light. *Brightness* refers to the amount of light delivered to a target area. It depends on the spot size and the amount of energy in that spot. With a 100-watt light bulb, you can read a book; with a 100-W laser, you can burn a hole in the book. Lasers come in many forms, including gas, solid-state, and semiconductor designs. Each form has its own range of output wavelengths and power (see figure 1 and the text box "Laser Power" on page 250).



Approaching its thirtieth birthday, laser technology has finally begun to have a major impact on our lives. Lasers are now in many of our homes inside compact disk players (with CD video coming soon). Laser bar code scanners tabulate prices and update inventories in our stores. Laser printers are used for high-quality hard-copy output. And earlier this year, erasable optical data storage received a major boost when NeXT introduced a workstation with the Canon erasable optical disk drive. But these developments are just the beginning.

Resolution vs. Speed

The two fundamental properties, brightness and sharpness, determine the density and speed that a specific application is able to achieve. Take, for example, a laser printer that uses a semiconductor laser, like the one in figure 2. A shorter-wavelength laser diode (say, of 680 nanometers versus the 780 nm presently used) will print a smaller spot size on the paper, thereby increasing the resolution.

But the power delivered to the paper—the brightness—will determine the printing speed. Currently, 680-nm laser diodes are available commercially with up to 5 milliwatts of power; on the other hand, 780-nm laser diodes (a more mature technology), are available with powers of up to 100 mW. So 780-nm diodes currently dominate laser-printer and data-storage applications.

In the past, the available types of lasers often dictated the results of the resolution-versus-speed trade-offs. For example, you can find visible-output gas lasers using krypton gas with powers of several watts that have wavelengths shorter than 780 nm (see figure 1 and table A), so why not use them in laser printers? Gas lasers have been used in printers, but they range in size from a

continued

ILLUSTRATION: ROBERT TINNEY © 1989

Laser Power

Lasers are generally characterized by their output wavelength, measured in nanometers, microns, or angstroms. For a given type of laser, the output wavelength can often be changed by altering the laser medium.

For example, an excimer laser can operate on mixtures of argon fluoride, krypton fluoride, xenon chloride, and xenon fluoride, with corresponding output wavelengths of 193, 248, 308, and 351 nm, respectively.

In other cases, such as argon-ion lasers, there are several possible lasing transitions, which (depending on the reflectivity of the optics coatings) can allow operation at 488 nm, 514.5 nm, and various other ultraviolet and blue/green wavelengths.

In the case of semiconductor lasers, the output wavelength is determined in part by the composition of the active region. The most common laser diodes are those used in compact disk players (780 nm) and for telecommunications (1300 to 1550 nm). Although a wide variety of laser-diode wavelengths is possible, economic considerations often limit those available commercially to relatively few.

Although the most commonly used solid-state lasers are neodymium-doped yttrium aluminum garnet (YAG), you can use other lasing hosts (including glasses and crystals) and dopants. Other hosts are actually preferable when you need specific wavelengths. In addition, you can convert the output of a laser to a different wavelength using various dyes and nonlinear materials.

Among the most popular of these conversions in recent years has been converting the infrared output of solid-state lasers at 1064 nm to 532 nm (in the visible-spectrum region). Another example is generating ultraviolet output starting with frequency-doubled solid-state lasers (converting 532 nm to 266 nm) or argon-ion lasers (converting 488 nm to 244 nm).

In considering a laser for a particular application, the most important criteria are those in table A. (The lasers listed are only a fraction of the nearly 200 models and types of lasers listed in the *1989 Laser Focus World Buyer's Guide* [Tulsa, OK: PennWell Books].) Lasers often require significant adjustments to achieve various output wavelengths.

Similarly, the power available may depend on the specific wavelength. For example, dye lasers (not discussed here) use a liquid lasing medium, pumped by either a laser or a flash lamp. You can operate these lasers in either a pulsed or continuous-wave (CW) fashion with

Table A: *The lasers are listed in order of their low-end wavelength (see figure 1 for a graphical description). Power measurements are given in watts (W) and joules (J), and size is given as small (S), medium (M), and large (L).*

COMPARATIVE PROPERTIES OF COMMON LASERS

Laser	Type	Wavelength	Power	Size
Excimer	Gas	193 to 351 nm	0.01 to 1 J	L
Argon ion	Gas	257 to 514 nm	0.01 to 20 W	M, L
Helium cadmium	Gas	325 to 442 nm	0.001 to 0.075 W	M
Nitrogen	Gas	337 nm	< 0.001 J	M
Doubled diode	Semiconductor	432 nm	0.001 to 0.01 W	M
Copper vapor	Gas	510 to 578 nm	< 0.005 J	L
Doubled YAG[1]	Solid state	532 nm	0.001 to 2 W < 0.001 to 0.5 J	M, L
Gold vapor	Gas	628 nm	< 0.002 J	L
Helium neon	Gas	632 nm	0.001 to 0.1 W	M, L
Krypton ion	Gas	647 to 676 nm	0.1 to 5 W	M, L
Titanium sapphire	Solid state	670 to 1040 nm	0.1 to 3 W	L
InGaAlP[2]	Semiconductor	680 nm	0.001 to 0.01 W	S
Ruby	Solid state	694 nm	1 to 100 J	M, L
GaAlAs[3] diodes	Semiconductor	780 to 880 nm	0.001 to 1 W < 0.001 J	S
GaAs[4] diodes	Semiconductor	890 to 1060 nm	< 0.0001 J	S
Neodymium YLF[5]	Solid state	1047 nm	0.02 to 17 W < 0.001 to 2 J	M, L
Neodymium YAG	Solid state	1064 nm	0.01 to 1000 W < 0.001 to 2 J	M, L
InGaAsP[6] diodes	Semiconductor	1300 to 1550 nm	0.001 to 0.1 W < 0.000001 J	S
Carbon monoxide	Gas	5000 to 7000 nm	3 to 20 W < 0.01 J	M, L
Carbon dioxide	Gas	9000 to 11000 nm	1 to 5000 W 0.1 to 500 J	M, L

[1]Yttrium aluminum garnet
[2]Indium gallium aluminum phosphide
[3]Gallium aluminum arsenide
[4]Gallium arsenide
[5]Yttrium lithium fluoride
[6]Indium gallium arsenide phosphide

foot long to several yards long, and they require air cooling and often water cooling.

Laser diodes have solved this problem. Laser diodes the size of a grain of sand are now packaged in small, hermetically sealed cans less than a centimeter in size. Building on the explosive success of CD players (going from a few hundred units per year to millions in just a few years, and driving the laser-diode price from hundreds of dollars down to single-digit prices), Canon was able to marry small, inexpensive laser diodes with low-cost personal copier designs. The result was the personal computer laser printer.

Designed by Computer

Lasers and computers have entered into a synergistic phase. At the simple mechanical-design level, the laser industry uses CAD/CAM systems to design and fabricate high-tolerance mechanical parts. Lasers require alignment tolerances of mere fractions of a wavelength, so mechanical precision is essential in their construction. For a typical visible laser, this means tolerance on the order of tens of nanometers.

Looking a little deeper, computers are used to optimize laser-cavity designs. This is accomplished by what-if iterative *ray tracing*, following the optical path of the light in the laser cavity as various design parameters change (see figure 3).

For example, one of the main factors contributing to the operating efficiency of a laser is matching the *pump-mode volume* (the area that the pump light illuminates) to the *lasing-mode volume* (the

powers up to 1.5 watts and energies up to 3.5 joules. By changing the lasing dye, you can adjust the output wavelength from 205 nm to 1000 nm, depending on the design of the laser and the pump or lamp used.

To accomplish a specific task, such as welding or writing to an optical disk, the power or energy of the laser is an important characteristic. CW lasers put out a constant power, usually indicated in watts, milliwatts, or microwatts. Pulsed lasers are rated in joules, millijoules, or microjoules.

You can pulse a laser with several different techniques, depending on its design. For example, you can pulse the flashlamp used to pump the laser, resulting in a pulsed laser output. You can also place a high-speed (i.e., where the speed is measured in nanoseconds) shutter inside the laser cavity and use it to periodically interrupt the laser beam. This results in a pulsed output with a duration of a few tens of nanoseconds. For semiconductor laser types, you can pulse the input current with a TTL-type signal or very short picosecond pulses, again resulting in pulsed output.

The primary purpose of pulsing a laser is to achieve higher *peak powers*—that is, greater energy per unit time. Using these techniques, you can achieve gigawatts of peak power; in some specialized lasers (like those used for laser fusion), you can even achieve terawatts of output power. It is common for the same lasing material to come in either a CW or pulsed design. A few of the more common ones that come in both are neodymium YAG, carbon dioxide, and the semiconductor laser diodes.

Finally, the overall size of the laser can be important, as lasers are often built into other equipment. For example, a laser-based air-pollution monitoring system that has to be carried in a small airplane must be small enough to fit in the plane and must be compatible with the electrical and water-cooling utilities available.

In table A, the classification of size is L for large (more than 1 meter in length, usually requiring water cooling and 220- or 440-volt electrical power), M for medium (roughly the size of a shoe box, often 110-V powered and air-cooled), and S for small (typically requiring low voltages for operation and packaged in electronics-type housings with dimensions measured in centimeters or less). The size is often dependent on the output power of the laser, as higher-power lasers require more active lasing area and typically generate more waste heat that needs to be removed.

active region of the lasing material). Design iterations done on a CAD system allow you to optimize these two volumes for maximum overlap and efficiency.

With laser diodes and electro-optic devices, you can model the simultaneous interaction of electric and optical properties. For example, Spectra-Physics (Mountain View, CA) made extensive use of a microcomputer-based CAD system in designing its new titanium-doped sapphire laser.

For their basic operation, lasers require optical coatings that have unique reflective properties. Virtually all lasers have a highly reflective rear-mirror surface as well as a partially reflective front surface that emits part of the laser light (see figure 3). Some surfaces need to be antireflective and allow light to be coupled into the laser or a device efficiently.

If lasers came in only one type and one wavelength, then designing coatings to achieve these reflectivities would be a one-time problem. But the wide range of wavelengths available requires almost as wide a range of materials for both reflective surfaces and coatings. As a result, multiple layers of materials are used to coat optics forming *stacks*. The thickness of each layer is a fraction of the wavelength of the light being reflected.

Computers now let you determine the physical parameters you want and then use a computer model to calculate the required coating geometry. In addition to coatings, CAD-generated optics let you draw and fabricate (by diamond turning)

continued

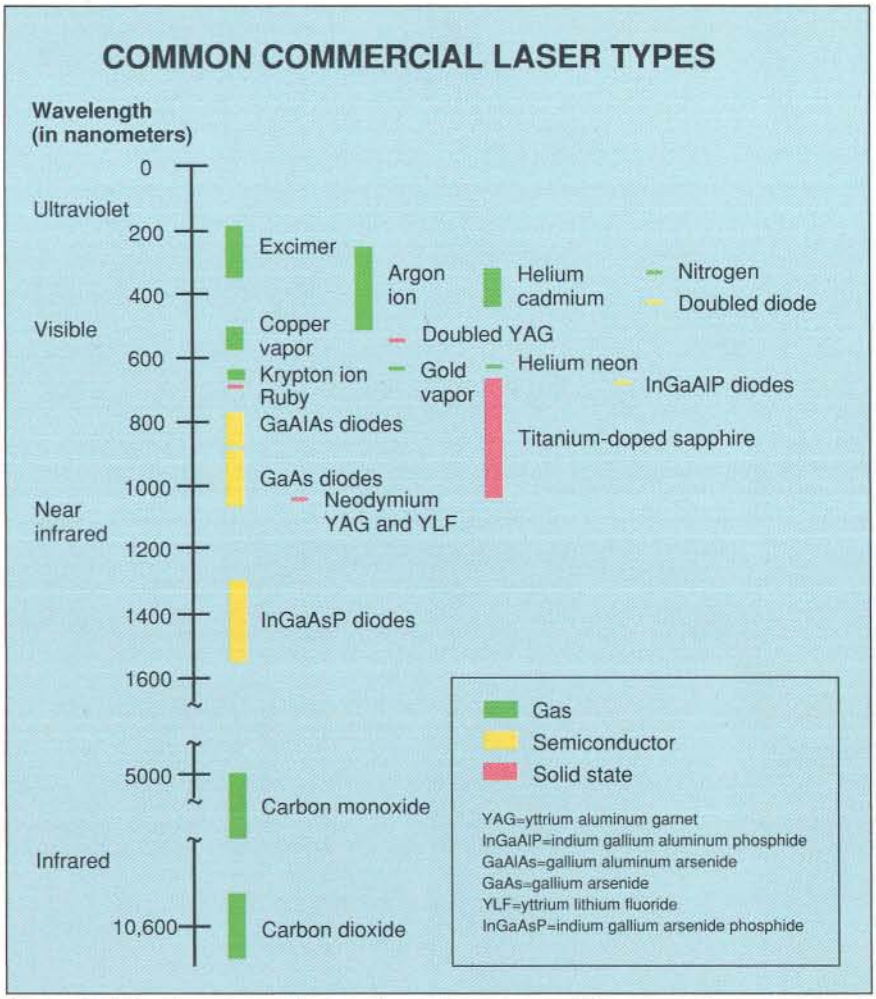


Figure 1: *The three types of lasers shown here—gas, solid-state, and semiconductor—are all capable of generating visible light. (See table A.)*

unique aspheric surfaces completely under computer control.

Controlled by Computer

For the laser's advantages of brightness and sharpness to be useful, you often need to manipulate the direction it points in. In addition to simple fixed and scanning mirrors, scanning galvanometers and electro-optic deflectors are the most common ways of moving laser beams around. Or, instead of moving the laser, you can move the work piece with a motor.

Such computer-controlled systems can be as simple as an AT&T PC 6300 driving a motorized microscope stage under control of CAD Design 3 (see photo 1) or Harvard Graphics for micromachining. Or they can be as sophisticated as using a Personal Iris system from Silicon Graphics (Mountain View, CA) as the CAD/CAM interface to the Stereolithography Apparatus from 3-D Systems (Valencia, CA), which moves an ultraviolet laser beam under computer control through a polymer matrix to fabricate prototype plastic parts. 3-D Systems also offers 80286/DOS- and 80386/Unix-controlled systems for which you provide your own CAD/CAM interface.

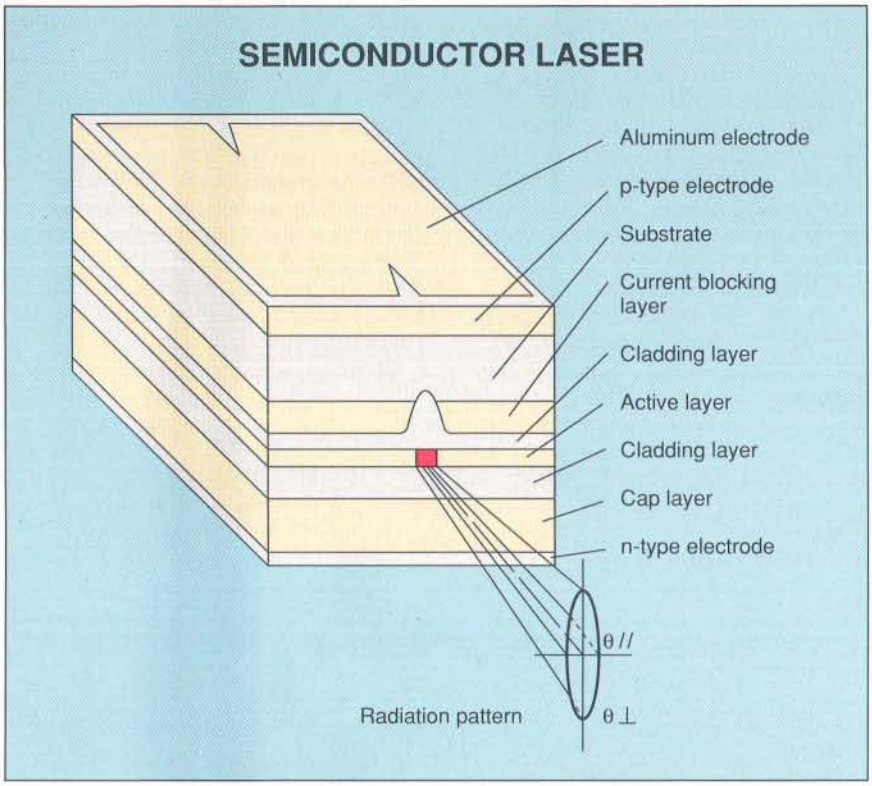


Figure 2: *Illustration of a typical laser-diode cavity design. Reflective surfaces on the front face (shown) and rear face (hidden from view) define a laser cavity. The active layer is composed of gallium aluminum arsenide, with the wavelength determined primarily by the relative amounts of Ga and Al in this active region.*

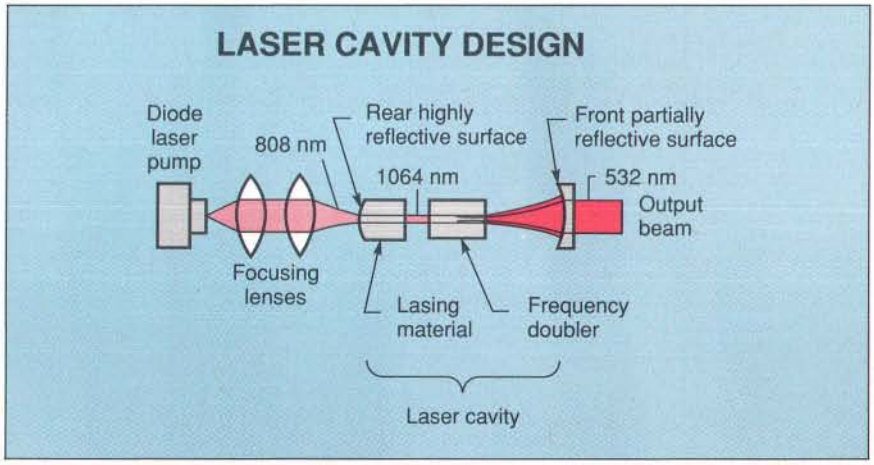


Figure 3: *A CAD-generated, diode-pumped, frequency-doubled laser cavity. It illustrates the conversion of low-quality infrared diode-laser-pump light to high-quality infrared (1064 nm) and visible (532 nm) light in an all-solid-state design.*

In the most general sense of automated control, you can control lasers over conventional RS-232C and general-purpose interface bus interfaces and coordinate their action with other test and fabrication devices. For example, Questek (Billerica, MA) used National Instruments' (NI) LabView software to control the micromachining functions of its excimer-laser system, which you can interface with VersaCAD (see photo 2).

In the laser-equipment field, last year the Newport Corp. (Fountain Valley, CA), the leading optical-equipment catalog-supply company, became the exclusive catalog distributor for LabView and LabWindows (NI's software for optics applications, for Macintosh and IBM PC–compatible computers, respectively). In the laser community, this is tantamount to a major endorsement of computer control and coordination of lasers and test instruments (see photo 3). As a result, laser companies have begun to offer hardware and even customized software interfaces for computer control of laser functions.

At a more subtle level, lasers have had a dramatic impact on workstation performance. In 1988, during the DRAM shortage, availability of 1-megabit DRAMs made the difference between having and not having high-performance workstations. The long-time leader in using lasers for memory repair, Electro-Scientific Industries (ESI) (Portland, OR), dramatically improved chip yields through a process of removing defective memory cells.

ESI uses a new all-solid-state laser technology: Q-switched, diode-pumped, solid-state lasers that operate under the control of proprietary software running on a Hewlett-Packard 9000 Series 300 computer. These lasers cut specific links on the IC with a short laser pulse only tens of nanoseconds long. They have an operating period without maintenance 10 times longer than that of similar flash-lamp-pumped lasers. Using this laser-

repair technology allowed the DRAM supply to catch up with demand.

Lasers have now become the de facto standard in testing IC devices as well; solid-state and xenon gas lasers operating in the infrared and green wavelength regions are preferred. At Semicon West in May in San Mateo, California, lasers appeared in all the failure-analysis stations displayed in the form of manual-probe stations. But powerful new automated computer verification and test software, such as Merlin's Workbench from Knights Technology (Cupertino, CA), allow the full integration of electrical testing and evaluation with laser processing—all operating under SunWindows.

As the electronics industry moves toward higher-resolution linear circuits and mixed analog and digital circuits, lasers are playing a critical role in fabricating thin-film resistors. High-precision resistor trimming allows higher-resolution D/A convertors to be made with greater linearity. The laser trims the device by cutting a continuous groove (thus changing the resistance) during device testing.

In addition to ESI, such thin-film hybrid resistor-trimming systems using long-lived, Q-switched, diode-pumped, solid-state lasers are now offered by Teradyne Laser Systems (Boston, MA) and XRL, Inc. (Norwell, MA). Both of these companies use Sun-3 workstations as the primary user interface. In a closely related application, Micrion Corp. (Peabody, MA) has developed a large-screen LCD thin-film resistor-repair system that uses the same type of all-solid-state infrared laser, but now frequency-doubled from 1064 nm to 532 nm for green-light output. This is accomplished by using a nonlinear frequency-doubling crystal, potassium-titanyl phosphate.

Together with CAD systems, lasers are a major facilitating factor in the evolution of machines that are designed and built by other machines. Other examples include using helium-neon (HeNe) lasers in interferometers for precise distance measurement and in pointers for alignment, excimer lasers for high-density deep-ultraviolet semiconductor lithography, ultrafine printed-circuit-board hole drilling, surface-mount printed-circuit-board component attachment by tape-automated bonding, and laser cutting and soldering. The common element in these areas is the use of computers to precisely position and control the laser beam, allowing the application to make maximum use of the brightness and sharpness of the laser beam.

continued

Photo 1: *A Q-switched, diode-pumped, neodymium yttrium-aluminum-garnet laser from Spectra-Physics, attached to a microscope. Under control of the AT&T PC 6300, a CAD Design 3 image is being scribed onto a coated plate. The two monitors show the CAD image (in color) and a section of the scribed image (in black and white). Nicknamed the "Laser Blade," this system is unique in that the diode laser-beam pump light is transported from a power-supply box to the neodymium YAG laser head via an optical fiber. This results in a very small, pencil-size laser head that you can attach directly to the microscope. (Photo courtesy of W. Scarvie, Spectra-Physics, Inc.)*

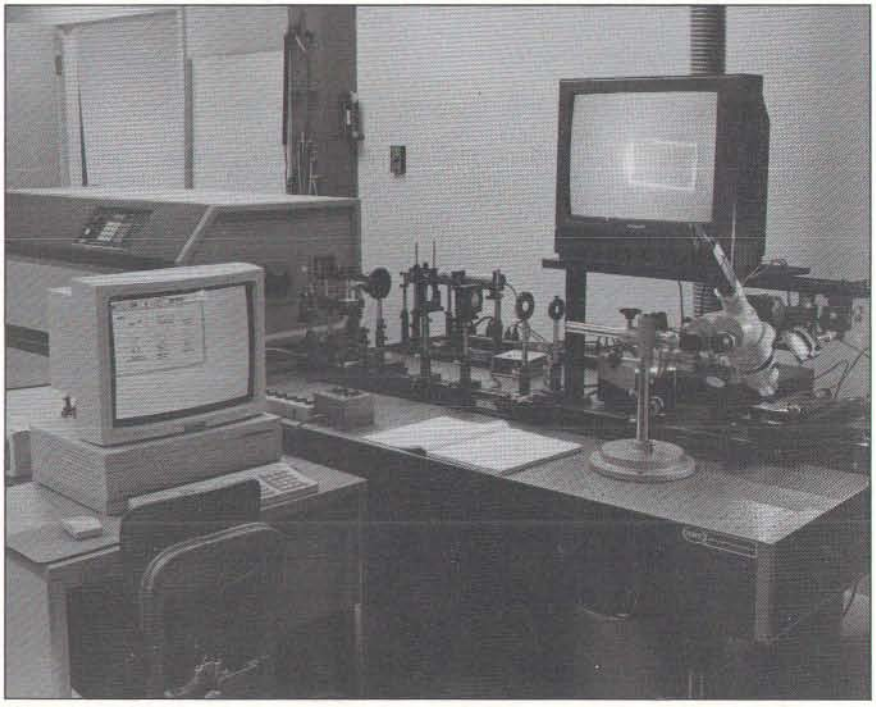


Photo 2: *An excimer laser interfaced with a CAD system, and the same laser controlled by a Mac II under LabView. (Photo courtesy of Questek, Inc.)*

Photo 3: *National Instruments software, controlling instrumentation for testing lasers. Notice the power meter and stage-positioning system integrated with an IBM PC under the control of LabWindows. The CRT display shows the laser-beam intensity. (Photo courtesy of Newport Corp.)*

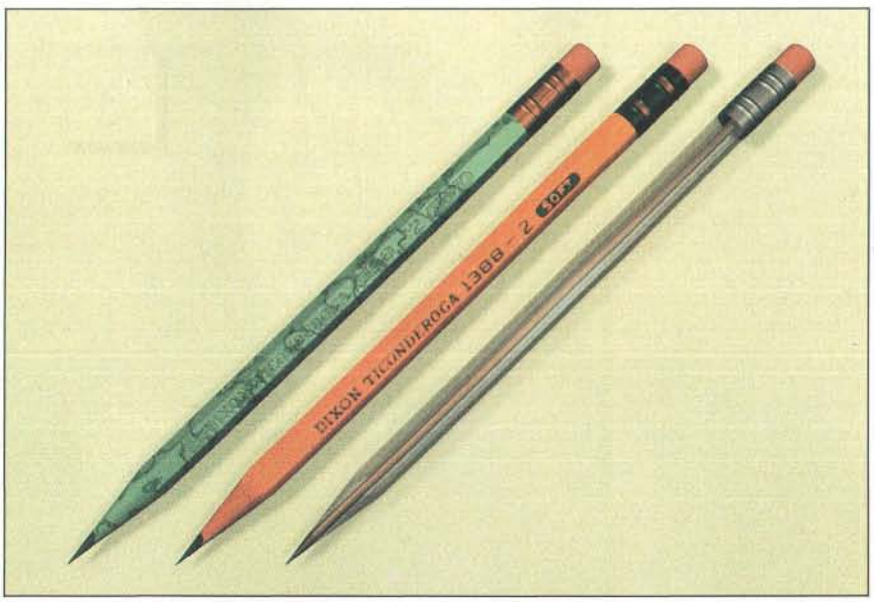


Photo 4: *This image was generated using Pixar's RenderMan software and printed directly on color film using three visible wavelength lasers. (Photo courtesy of Pixar, Inc.)*

Better Performance with Laser I/O

Laser technology has also had a major impact on computer input and output devices. High-resolution input scanners require the sharpness of lasers, and the *monochromaticity*, or single-color nature, of lasers has made them the standard for scanning documents for color separation and digitization. The most popular lasers for these applications have been red (632 nm) HeNe and blue/green (488 nm and 514.5 nm) argon-ion lasers. These lasers have beams that are visible to the human eye, so they are easy to align in scanning systems, and when focused to small spot sizes, printers and scanners can operate at high speeds.

Optical data storage in the form of CD-ROMs, WORMs, and now erasable optical data storage allow huge increases in storage capacity because of the small size of the laser beam spot. In the past, the lack of reliable high-power (more than 30 mW) laser diodes for the erasure cycle held back the development of erasable optical data storage. At lower powers, erasure was too slow for commercial acceptance. Now, high-power lasers (more than 50 mW) are available that can be focused to small spot sizes.

Much-higher-power lasers (over thousands of milliwatts continuously and tens of thousands of milliwatts when pulsed intermittently) are available from laser diodes, but the laser design results in much larger beam sizes, which negates a key reason for using the laser in the first place—a small spot size.

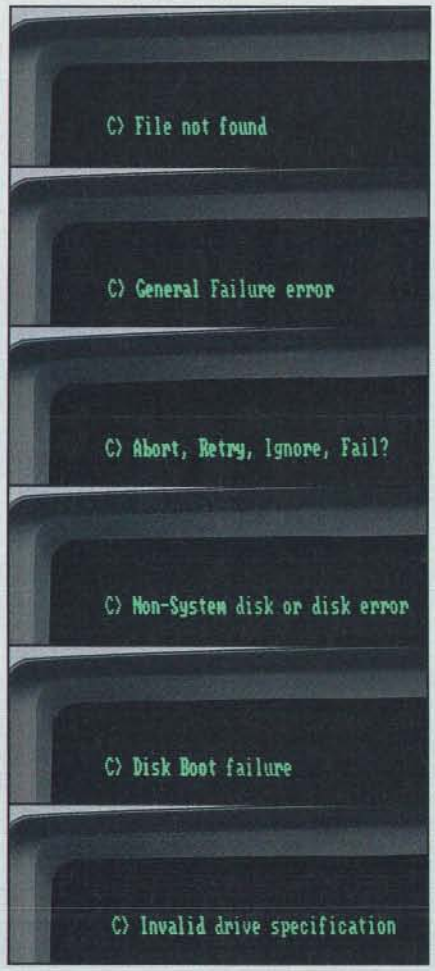
The next revolution in optical data storage is likely to occur quickly, with 680-nm laser diodes replacing 780-nm laser diodes to increase storage density. Although the shorter 680-nm wavelength can achieve a smaller spot, the output power of the 680-nm devices is currently limited to about 30 mW (and most suppliers will guarantee the lasers up to only about 5 mW).

One of the most easily recognized laser applications is bar code scanning: both the slot scanners used in stores and the hand-held scanners used for inventory control. Historically, these scanners, which measure the light reflected from the patterns of bars, have used HeNe gas lasers emitting at 632 nm.

The bars encode price and other information tied into an inventory-control system. Virtually all products sold to the U.S. government must have bar code identification labels. Manufacturers are upgrading production lines to track parts by bar codes and to automate warehouse storage of assembled products.

continued

The end of the terror message.



Each one of these PC screens is saying something different. But they're all telling you the same thing.

You and your data are in a whole lot of trouble.

Perhaps someone hit the wrong key and deleted your data by accident.

Perhaps it's simply lost somewhere on your disk.

Or perhaps the disk is corrupted and everything is lost.

The Standard Edition gives you UnErase, File Find and a range of features, functions and enhancements—at an even more reasonable price.

Perhaps you should get the new Norton Utilities®.

Because only the Norton Utilities can take the terror out of all these error messages.

If someone has accidentally deleted your data, fear not. Our legendary *UnErase*® can resurrect it with a few simple keystrokes.

If you've misplaced it—which, when you're dealing with a hard disk, is terrifyingly easy to do—our *File Find* will come to the rescue.

And what if worse comes to worst and your whole disk goes down?

Cheer up.

The extraordinary new *Norton Disk Doctor*™ will determine the exact nature of the problem, report it and, in most cases, fix it for you.

All by itself.

In fact, if the Doctor can't cure your corrupted floppy or hard disk, then Buster, you've got one corrupt disk.

In which case, you'll need to refer to *The Norton Trouble-shooter*, a 158-page guide to finding and fixing most anything that could go wrong.

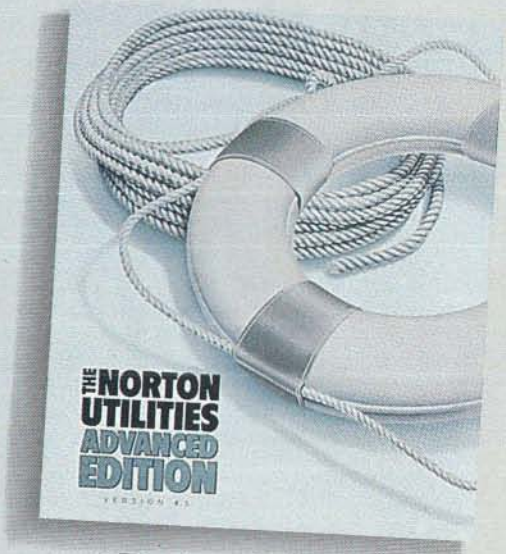
Don't worry, you don't have to go to the library or the bookstore to refer to it, because it's included in the Advanced Edition.

Along with 24 more organizational and disk management utilities we don't have space to mention.

PC Magazine calls the Norton Utilities "indispensable."

You'll want to call your local software dealer. Or call us at 1-800-365-1010.

Then you'll have nothing to fear but fear itself.



Peter Norton
COMPUTING

Designed for the IBM® PS/2® and PC families and 100% compatibles. © 1989 Peter Norton Computing, Inc. All rights reserved.

Circle 319 on Reader Service Card

New red (680-nm) laser diodes are having a profound impact on hand-held bar code scanners. Laser diodes operate at much lower currents than HeNe lasers, making hand-held bar code readers possible. (780-nm laser diodes can read the bar codes, but some colors show poor contrast at this longer wavelength.) This change in technology will probably lead to using bar codes on even more products as bar code scanners become smaller and less expensive.

Color Is Coming

Perhaps the biggest change of all is yet to come: full-color laser-printed images. Pixar (San Rafael, CA) and Kodak (Rochester, NY) have invested in several levels of laser technology to demonstrate that three primary-color lasers can generate high-resolution color output.

Several years ago, the only lasers available were large, often water-cooled, gas lasers. Now, laser diodes have generated three new classes of laser devices: red (680 nm) laser diodes, frequency-doubled green (532 nm) diode-pumped solid-state lasers, and directly doubled blue-output (432 nm) laser diodes.

More recently, Kodak has pursued a pure infrared laser diode design, in which each laser diode represents the intensity information for one of the three primary colors. But the need for three closely spaced wavelengths in the 780-nm to 880-nm range severely limits this approach.

Pixar has used a more conventional concept based on three visible lasers, with a 532-nm frequency-doubled solid-state laser replacing the previous 528-nm argon-ion gas laser. The new solid-state laser occupies about one-tenth the space. More important, it has an output wavelength with less *spectral overlap* with the red light response of typical photographic film and papers. This means that the green exposure has less effect on the red emulsion layer, and the final result is a purer red color tone in the photograph (see photo 4).

The remaining missing link is a blue solid-state laser, but IBM, Amoco Laser (Naperville, IL), and Spectra-Physics have shown in the past year that such lasers can be made with powers of several milliwatts—and potentially much higher power.

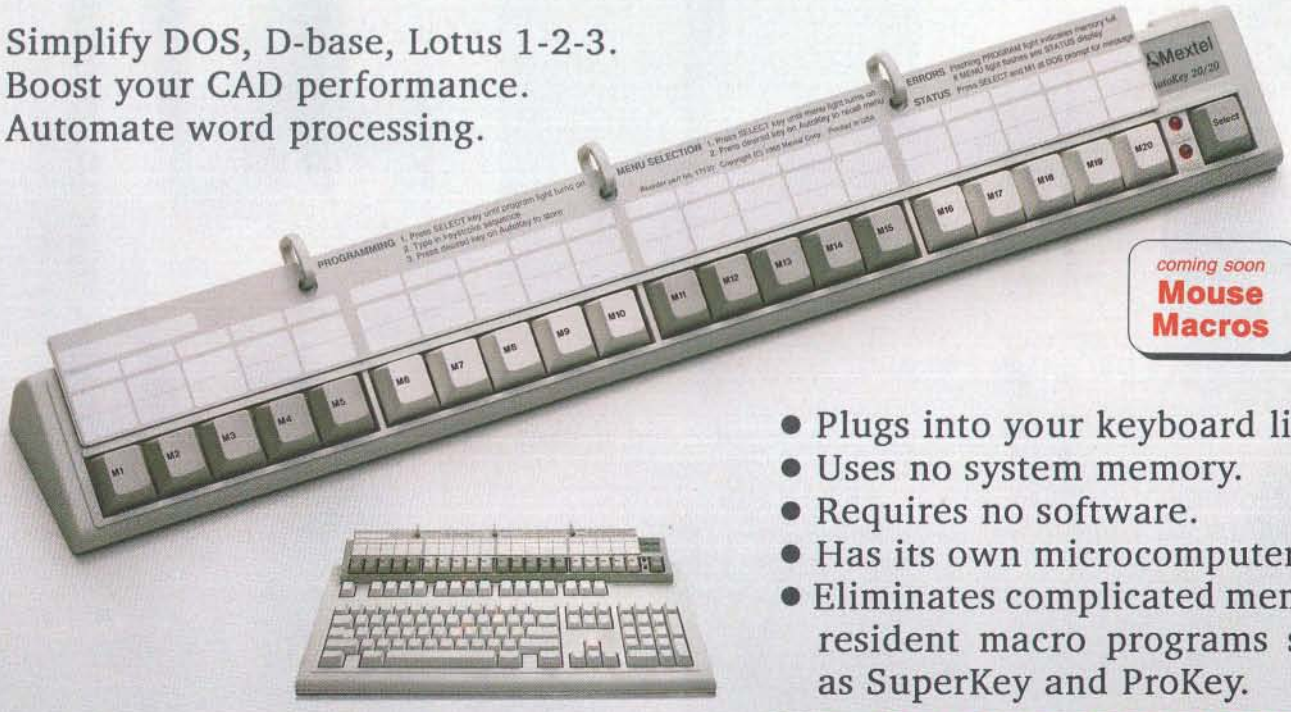
Originally developed in the Industrial Light and Magic group at LucasFilm, the laser scanner (which can be used as both an input scanner and an output printer) is now part of the Pixar electronic-darkroom project. The system operates by simultaneously scanning three laser beams across the film to write (or read) information about the color tone and intensity at each pixel.

The premise is very simple: Whether the image is completely computer-generated (in the case of the Pixar RenderMan software) or originates from an electronic camera, at some point you'll want to show the results to someone else. The solution is hard-copy output that retains the color fidelity and sharpness of the original image. Of course, if you didn't like the original image, changes are only a few keystrokes away. ■

Gary T. Forrest is president of FYI Reports and provides writing and consulting services to companies in the laser and optoelectronics fields. He has a Ph.D. in chemistry from MIT, where he used lasers for biomolecular research. He can be reached on BIX c/o "editors."

AutoKey 400 programmable macro keys !

Simplify DOS, D-base, Lotus 1-2-3.
Boost your CAD performance.
Automate word processing.



coming soon
Mouse
Macros

- Plugs into your keyboard line.
- Uses no system memory.
- Requires no software.
- Has its own microcomputer.
- Eliminates complicated memory resident macro programs such as SuperKey and ProKey.

Mextel Corp. 159 Beeline Road
Bensenville, Illinois 60106

AutoKey is trademark of Mextel Corp. All other product names are trademarks of their respective manufacturers. ©1989 MEXTEL CORP.

Call 1-800-888-4146
(inside IL call 312-595-4146)
AutoKey 40 ..... $139.00
AutoKey 20/20 ..... $289.00
Visa/MC/AmEx.

Circle 172 on Reader Service Card (DEALERS: 173)

Things To Do, People To See, Places To Go.

Make friends. Buy a cockatoo. Make a million. Fly to Tahiti. Phone home. Shop 'til you drop. Get rich quick. Make a good impression. Get married. Fall in love. Go for broke. Meet "Sagebrush Sally." Improve yourself. Learn to cook. Bargain hunt. Invest wisely. Get smart. Talk back. Name that tune. Lighten up. Pontificate. Talk turkey. Get involved. Dress for success. Name drop.

When you join CompuServe, your computer becomes a time-saving, money-making, life-enhancing tool. Because CompuServe gives you access to a long list of services and resources that can help make your life easier, more profitable, and a whole lot of fun.

With CompuServe you can shop in over 100 stores from the comfort of your favorite easy chair. We have personal investment information to help you feather your nest, and travel services to make it easier to fly south for the winter. We even have over 500,000 other CompuServe members for you to talk to (in your newly acquired spare time).

So become a member of CompuServe. And turn the time you spend with your computer into quality time.

To join CompuServe, see your computer dealer. To order direct or for more information, call 800 848-8199.

CompuServe

Circle 59 on Reader Service Card

REMOVABLE. ERASABLE. OPTICAL. REMARKABLE!

REO-650 single-drive system
$4,995
REO-1300 dual-drive system
$9,990
650/600 Meg optical cartridges:
$250 each
Interface kits for Macintosh.
Sun. HP. IBM-AT, XT, PS/2
and compatibles:
$995 each

Pinnacle Micro is the world's leader in removable, erasable, optical storage systems for personal and workstation computers.

The REO-650 is a single drive, SCSI system. The REO-1300 is a dual-drive system. Up to 1.3 gigabytes of facts and figures at your fingertips!

Each optical cartridge holds up to 650 megabytes of precious memories. Graphics. CAD files. Databases. Images.

You can write, erase and rewrite data... file by file... a million times or more.

Interface kits give you the flexibility to use Pinnacle drives with the computer of your choice: Macintosh. Sun Microsystems. Hewlett Packard. IBM-AT, XT, PS/2 and compatibles.

Software provided with each kit supports a host of working environments: UNIX, Xenix, Novell Netware 2.1, and many more.

Removable, erasable, optical. The new standard in mass storage. Available now from Pinnacle Micro.

Call today for the location of your sales representative or authorized dealer.

(800) 553-7070

Trademark owners: REO-650, REO-1300 and Pinnacle Micro of Pinnacle Micro, Inc. Sun of Sun Microsystems. HP of Hewlett Packard. AT, Xenix, IBM, PS/2 of International Business Machines Corporation. Netware of Novell. Macintosh of Apple Computer Inc.

PINNACLE MICRO

15265 Alton Parkway • Irvine, CA 92718 • In CA (714) 727-3300 • FAX (714) 727-1913

THE ERASABLE OPTICAL STORAGE COMPANY™

Circle 312 on Reader Service Card (DEALERS: 313)

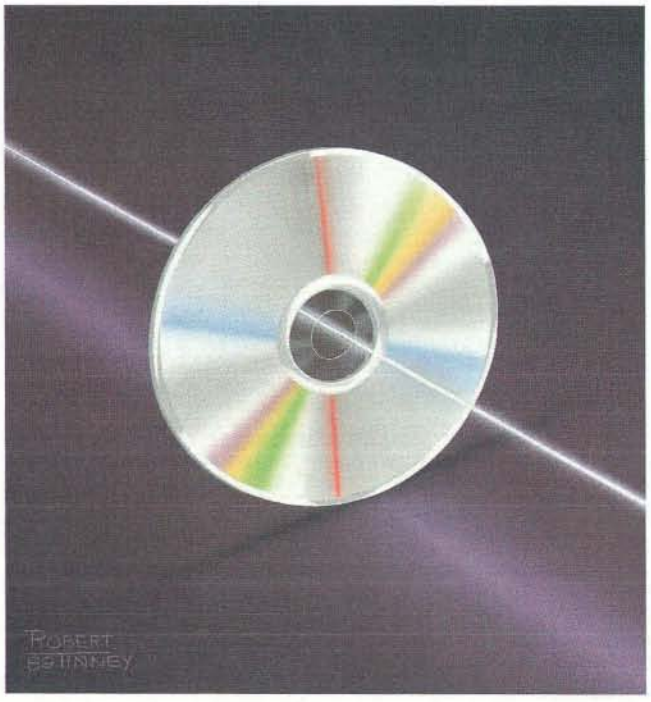
Gigabytes On-Line

Erasable optical storage brings mass storage to the masses

James J. Burke and Bob Ryan

Although backed by the likes of Sony, Philips, and Microsoft, optical storage has yet to catch on with most personal computer users, mainly due to the lack of a read/write capability. Now, with the introduction of rewritable optical disks, optical storage has become a potent rival to magnetic storage.

Rewritable optical technology is the most recent addition to the line of optical-storage products. CD-ROM—the original read-only optical-storage technology—has been available since the mid-1980s. And more recently, WORM (write once, read many times) technology has made an impact in areas requiring the random-access retrieval of permanent, nonerasable data and images. WORM "jukeboxes" with more than 1 terabyte (1 million megabytes) of storage have found their way into large government and business operations. With such a device, you can access any business document or engineering drawing in 10 seconds or less.



The Optical Advantage

All types of optical storage have certain advantages over magnetic storage. The primary advantage is storage density: You can get a lot more information on an optical disk than on a comparably sized magnetic disk. Due to the precision with which a laser can be focused, recording tracks on an optical disk are much closer together than tracks on a magnetic disk. Also, the amount of space needed to record an optical bit is much smaller than that used by magnetic media.

Another advantage of optical recording is that it is a great deal less sensitive to deterioration or contamination than magnetic recording media. This is because nothing touches the active recording layer except for the beam of light. The transparent substrate keeps dust and dirt from the focal spot so they cannot change the reflected signal substantially.

Optical disks are also far less susceptible to head crashes than are magnetic disks. Typically, an optical disk head comes no closer than 1 millimeter from the disk substrate. In contrast, the high-performance head of the IBM 3380 magnetic drive flies just 0.25 micrometer (μm) from the surface of the disk.

It has taken 30 years of research and development to learn how to produce reliable devices with such flying heights. Even at that, head crashes still occur. For obvious reasons, any attempt to remove a high-performance hard disk from its drive would be the end of the useful life of both. Optical disks, on the other hand, are easily loaded and removed, thus enabling the massive storage capacity of jukeboxes.

continued

ILLUSTRATION: ROBERT TINNEY © 1989

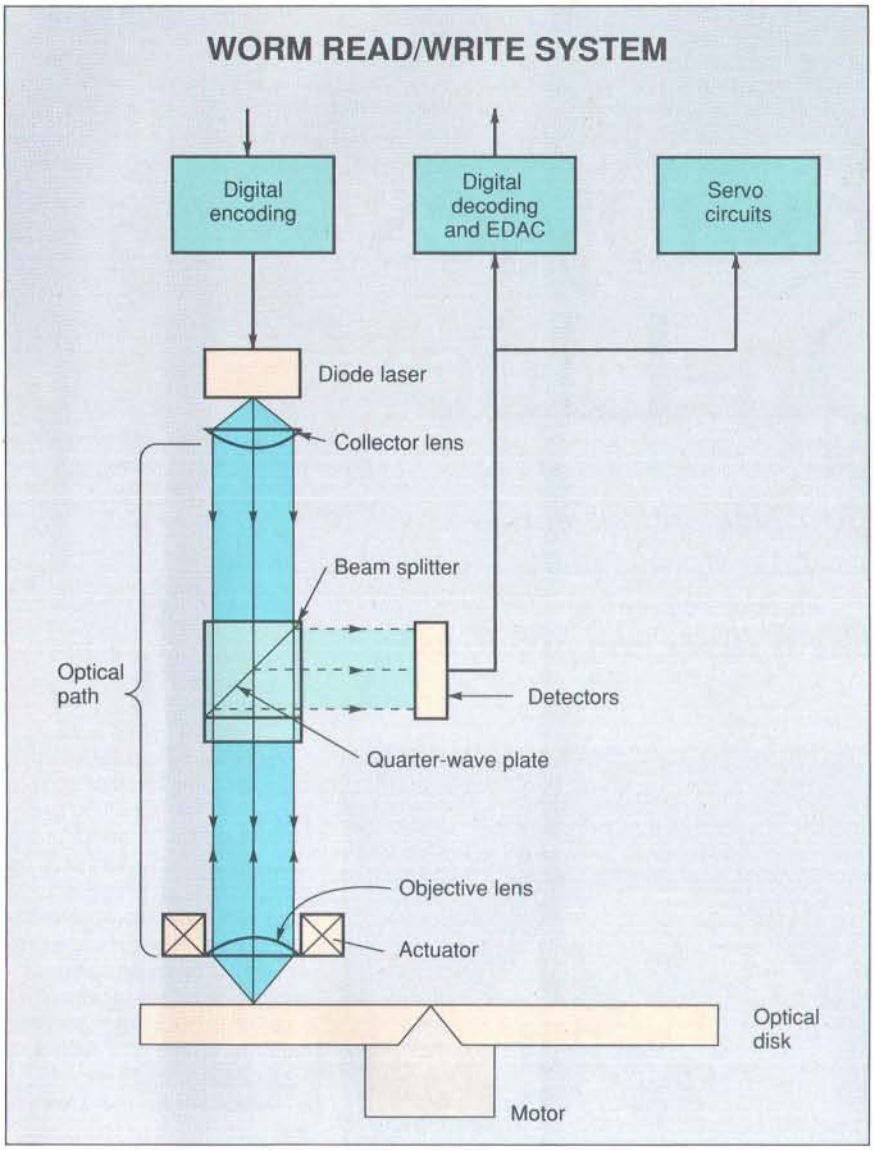


Figure 1: *A strong laser pulse writes by creating a pit (or a bubble) at the recording layer. The reflectivity of the weaker read beam is analyzed to detect the presence or absence of pits. Compact-disk systems are very similar, except, of course, that they are read-only. (Figure courtesy of Paul Y. Hu)*

Standards

Optical disks come in a variety of sizes and constitutions. You can buy 5¼-, 8-, 12-, and 14-inch WORM drives. Compact-disk media, whether carrying digitized audio, computer data, or both, are standardized to 120 mm (4.724 inches). Thanks to standards defined by Philips and Sony, CD-ROM disks from all suppliers use the same protocols and are thus readable in all players. They are becoming the medium of choice for publishing extensive documentation. The opposite is true with WORM drives: Data written on one vendor's WORM drive usually cannot be read by another's.

Most of the rewritable optical products announced thus far use 5¼-inch disks and promise to be interchangeable. It's too early to judge whether experience will bear this out. In addition, erasable optical disks with 3½- and 2-inch formats are also under development. Standards in this area are not as well developed as compact-disk standards.

Storage Variety

CD-ROM is the oldest and best-defined optical-storage technology. It is used primarily for publishing large amounts of information that don't require constant updating. Its major limitation, of course, is that it is a read-only medium.

Compact disks are replicated in much the same way as phonograph records. The disks are injection-molded in dies wherein all the format and data marks appear as raised ridges or hills on one of the interior faces. The original (also called the *master*) disk is written with great precision in photoresist by an argon-ion laser. After development of the master, a negative *father* disk is formed by electroplating. The father is used as a stamper to form a *mother* disk, whose negative *sons* become one face of the dies used in the injection-molding process that yields the final product. Polycarbonate is the material of choice because of its strength and durability.

WORM technology is a step beyond compact disks. You can write your own data to a WORM disk, although you can't change what you have written. WORM storage is ideal for storing custom data that is not updated often.

WORM drives feature many different designs. In some, absorption of a strong laser pulse causes local vaporization on dye-polymer media (organic films containing absorbing dyes). This forms a bubble in a thin absorbing layer above the active layer. In other designs, the laser ablates a pit in the material, exposing a highly reflective metal film below the active layer. The resultant change in reflectivity experienced by the weaker read beam is used to sense the presence or absence of a pit or bubble.

Another common active material used in WORM media is semimetallic tellurium. A strong laser pulse writes in tellurium by melting it; the attendant surface tension opens a hole (or pit) in the film, which freezes when it cools.

Other material systems are in use and under study today as the industry looks for ways to produce media less expensively. WORM disks cost about $100 in 5¼-inch format. Capacity varies from 300 to 600 megabytes per side. On 12-inch disks, capacity is typically 1 gigabyte per side. The 14-inch disks can hold more than 3 gigabytes per side.

Read/Write Technology

Figure 1 is a schematic illustration of the major components of a WORM read/write system. The left side of the figure shows the optical pathway. The read/write head contains a laser diode whose current is modulated electronically during writing to produce pulses of light. The beam of pulses travels through collimating optics, a polarizing beam splitter, and a quarter-wave plate to a focusing objective lens. The beam splitter is

designed to transmit light polarized in one direction and to reflect light polarized in the perpendicular direction. The quarter-wave plate changes the polarization of the beam; two passes through the plate produce a polarization that is perpendicular to the original.

The objective lens focuses the laser beam through a transparent plastic (usually polycarbonate) substrate onto the thin (100-nanometer [nm]) recording layer. Servo signals drive a mechanical actuator that moves the objective lens to keep the beam in focus and on track. The servo signals are derived from the reflected light received at the quadrant photodetector and converted to electrical signals delivered to the controlling servo circuits.

The reflected light collected by all four elements of the quadrant detector generates the signals to be decoded by the EDAC (for error detection and correction) and modulation-decoding circuits. The reflected beam reads binary 1s and 0s according to the presence or absence of a pit, bump, or reversed magnetic domain at a particular position. Most disks have thin (0.8-μm-wide) concentric grooves, spaced 1.6 μm apart, to enable optical tracking. The laser writes and reads in the "lands" between the grooves.

New Kid on the Block

Although ideal for certain applications, CD-ROM and WORM drives are not general-purpose storage devices. The first optical storage device to earn that distinction is the erasable optical disk.

You can now purchase rewritable magneto-optical (MO) disk drives that store up to 650 megabytes of information. You can even buy optical-disk jukeboxes that typically provide 30 to 50 gigabytes of on-line storage and provide access to any file in 10 seconds or less.

Rewritable optical disk drives use the standard 5¼-inch form factor and store data on optical media housed in removable cartridges. Although access times for rewritable disks are two to six times slower than those of high-performance (17-millisecond) hard disks, data rates are comparable because the disk spins at up to 3600 revolutions per second. The media should last at least 10 years without reconditioning and provide unlimited rewrites. Currently, rewritable disk drives cost in the neighborhood of $5000 to $6000, and disk cartridges sell for about $250. These prices are steep, but you can expect them to come down as the technology matures. In fact, one manufacturer expects the prices of drives to drop by a factor of 10 by 1995.

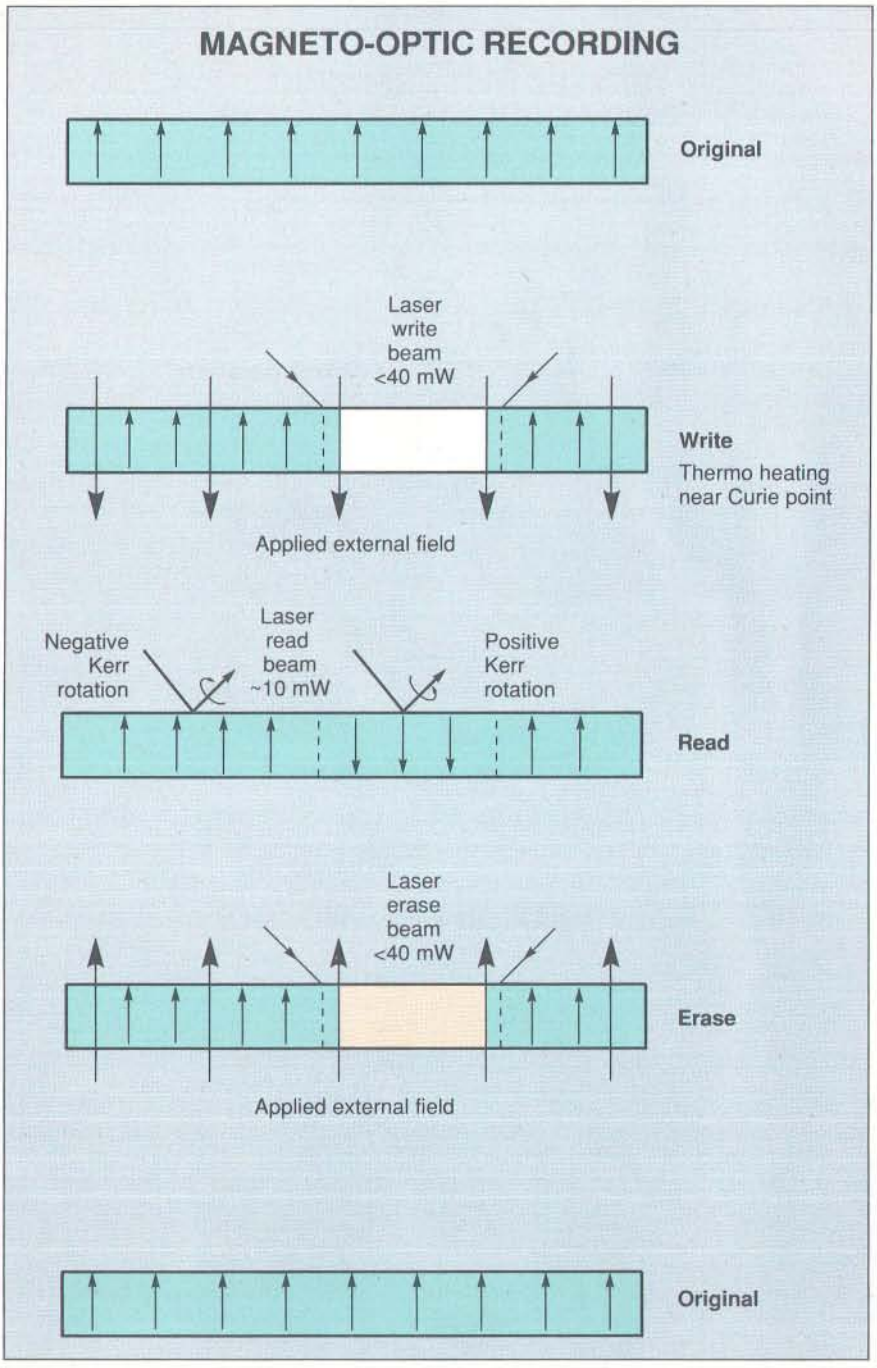


Figure 2: *In synchrony with an external magnet, the strong write pulse fixes the magnetic orientation of a spot on the recording layer. The local magnetization imparts a positive or negative Kerr rotation to the reflection of the weak read beam. The magneto-optic head detects this rotation. (Figure courtesy of Paul Y. Hu)*

Erasable optical disk drives hardly spell the end of magnetic storage. With their speed advantage, magnetic hard disks have the clear edge for large, multiuser applications, while magnetic tape is still the least expensive form of storage. For the foreseeable future, you will still need a minimum amount of fast-access storage (perhaps 90 megabytes) to hold your computer's operating system and the applications that you use frequently, as well as workspace for those applications. Rewritable optical storage is ideal if you need a lot of on-line, random-

continued

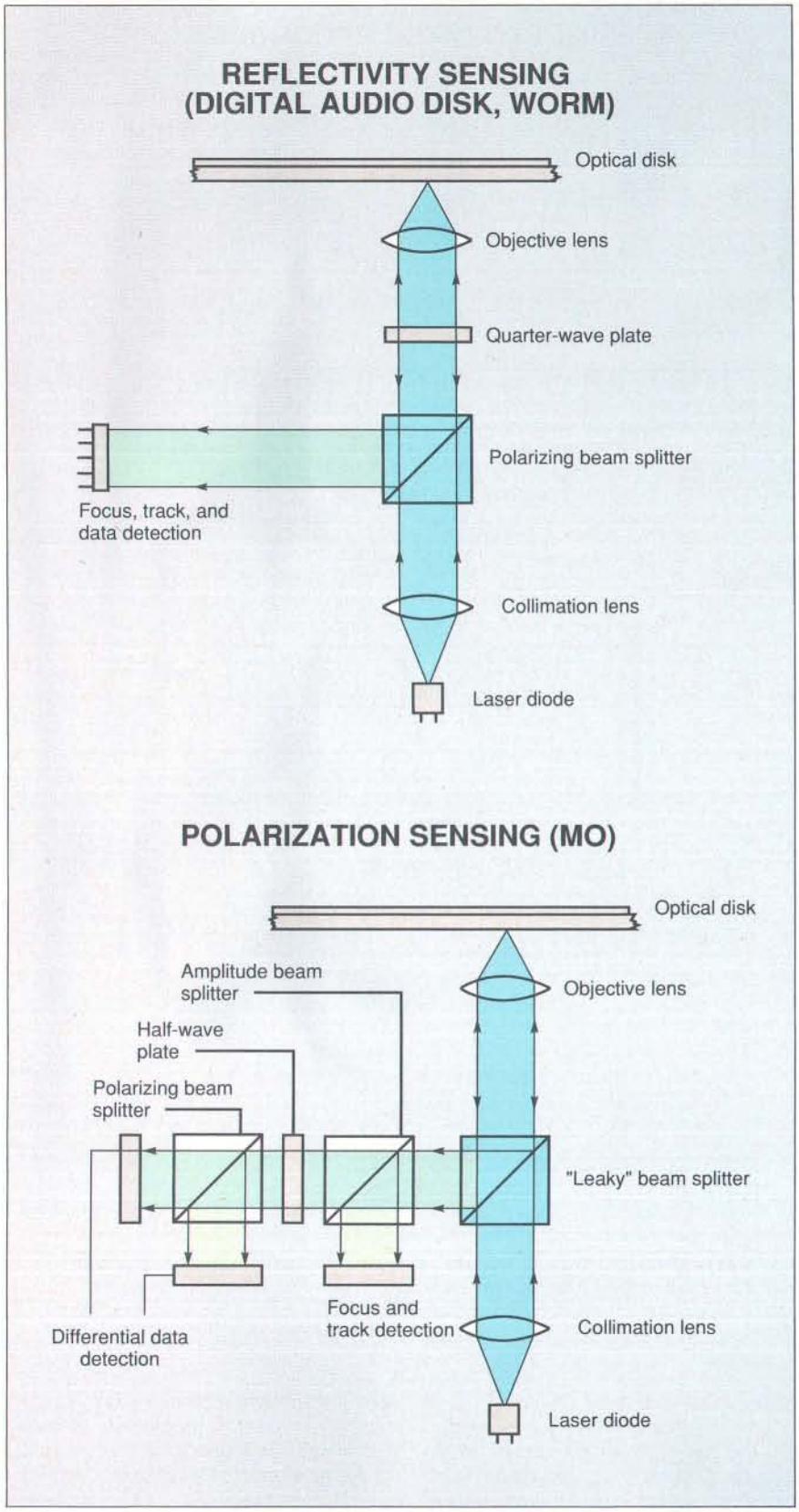


Figure 3: *The size and complexity of magneto-optic heads result in their relatively slow access times. (Figure courtesy of Paul Y. Hu)*

access storage at reasonable cost. Optical storage typically costs 25 cents per megabyte, or about 100 times less than magnetic disk storage.

Rewritable Media

Erasable disks typically have polycarbonate substrates, although some developers prefer hardened glass. With glass substrates, a layer of photopolymer, stamped with grooves and other formatting marks, covers the substrate. For polycarbonate disks, the grooves are formed in the injection-molding process that produces the substrate.

Above the grooves are three or four additional layers. One is the active recording layer, which usually consists of a rare earth/transition metal alloy such as terbium iron cobalt (TbFeCo). This layer is sandwiched between two transparent dielectric layers that provide optical enhancement of the polarization rotation as well as protection from oxygen and hydroxide ions, which would attack the metal alloy.

The active recording layer of an erasable optical disk is magnetized. The rotation of polarization of light reflected by this magnetic layer is known as the magnetic Kerr effect. Figure 2 illustrates how this effect is used in MO storage. Prior to its first use, an unwritten disk has a spatially uniform net magnetization illustrated by the upward-pointing arrows in the figure. These represent 0s at all bit positions.

To write a binary 1 at a particular location (or domain), you focus a 100-nanosecond pulse of laser light on the layer while a small magnet on the opposite side of the disk produces an external magnetic field opposite in direction to the original magnetization. The layer absorbs most of the laser pulse, which rapidly raises its temperature hundreds of degrees. At the locally high temperatures achieved, the magnetization of the layer is instantly reversed and then fixed with equally rapid cooling.

To erase a written domain, the field of the small magnet is reversed and the domain is pulsed a second time, returning the domain to its original magnetization. Note that written domains must be erased before they can be rewritten. This makes typical write times twice as long as read times.

To read a read/write disk, a weaker linearly polarized laser beam is focused on the recording layer. When reflected, this beam has its polarization rotated slightly (about 1 degree) clockwise or counterclockwise, depending on whether the local magnetization is pointing up or

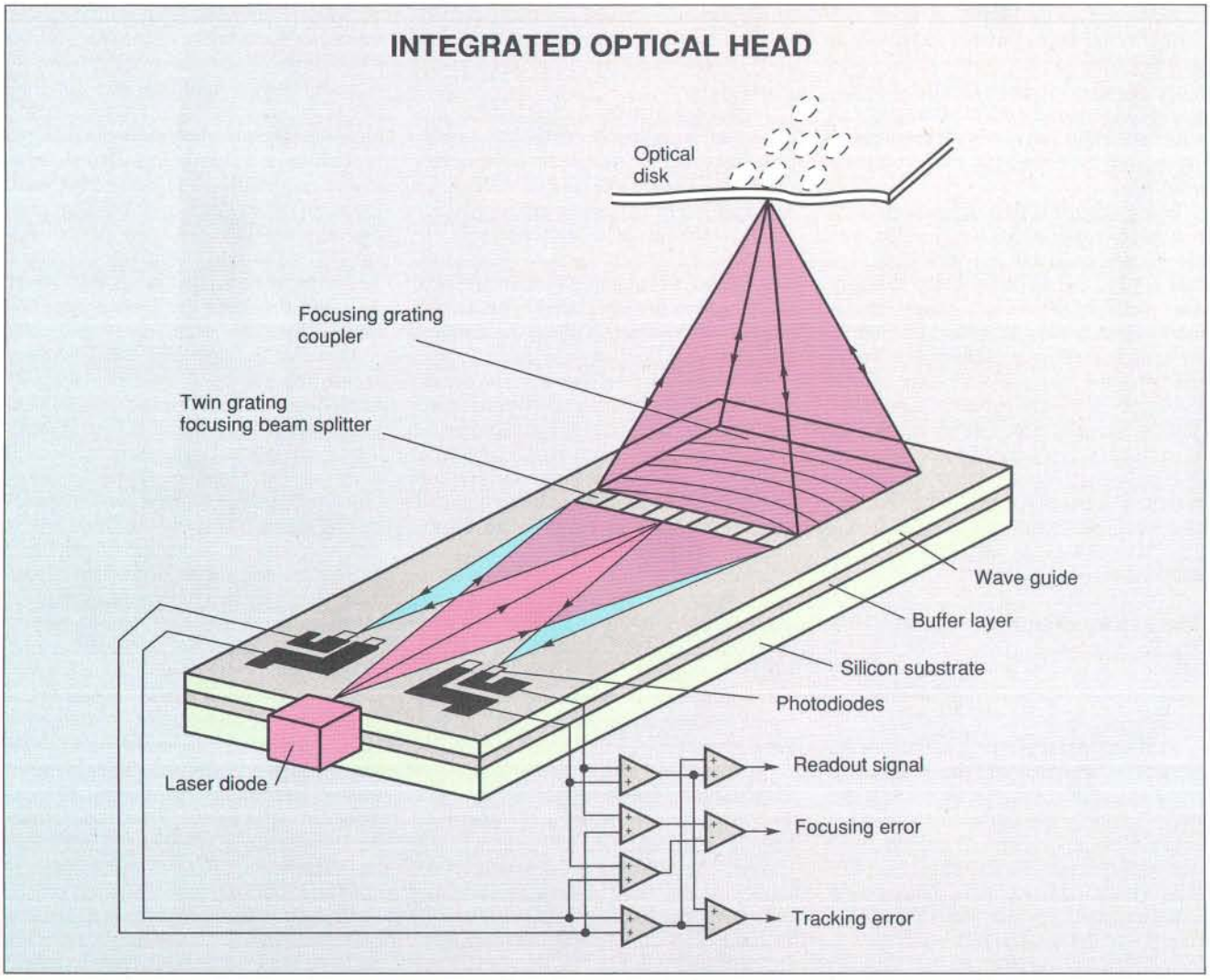


Figure 4: *Developed at Osaka University, this device is substantially less massive than conventional optical heads. Work continues to improve its resolution. (Figure courtesy of Paul Y. Hu)*

down. The direction of rotation indicates whether the bit read is a 1 or a 0.

Read/Write Heads

Most optical heads (containing the laser, beam splitter, wave plate, objective, and detectors) actually sit in a compact package below, rather than above, the disk. The head is moved from track to track by voice-coil linear actuators similar to those used in magnetic disk drives. The comparatively slow (about 100-ms) access times of optical disk drives is a consequence of the relative massiveness (100 grams) of the optical head. Research into integrated optical heads is expected to solve this problem.

Figure 3 illustrates the difference between MO heads and those used in digital-audio disk and WORM drives. In the MO head, the first beam splitter reflects all light polarized perpendicular to the page, but it transmits only about 80 percent of the orthogonal polarization, reflecting the rest. Thus, light with both polarizations is reflected to the left after interacting with the media. The second beam splitter picks off a portion of this light to provide signals for the focus and track servos. Most of the light continues to the left, passing through a half-wave plate that rotates the polarization by 45 degrees, and then through a third polarizing beam splitter to two detectors whose photocurrents are differentiated electronically. This differential detection scheme removes the comparatively large DC photocurrent common to both detectors and sums their small AC currents, whose sign (positive or negative) indicates whether the MO layer imparted positive or negative rotation to the beam.

New Media

Because the optics that are needed to detect the small Kerr rotation in MO systems are much more complicated than those used in CD-ROM and WORM heads, research continues into substances that produce larger, easier-to-detect Kerr rotations. Bismuth-doped-garnet films and metal multilayers (or superlattices) are among the substances being developed for MO recording. At present, the garnets are too grainy (or noisy) to compete with rare earth/transition metal alloys. However, because they provide larger Kerr rotation and are much less susceptible to corrosion, work continues to improve their performance.

Other promising materials for rewritable optical media include *phase-change* layers that are made of amorphous alloys

continued

of tellurium, selenium, and other elements. When heated with a focused laser pulse of appropriate power and duration, these alloys crystallize locally, forming a spot of increased optical reflectivity. A more powerful pulse of shorter duration erases (or amorphizes) the crystalline mark.

Phase-change media are attractive for rewritable applications because the optical head required is simpler than with MO drives, and the signals are stronger. The problem with most phase-change media is that only a limited number of write and erase cycles are possible before performance degrades to unacceptable levels. At least one company has apparently overcome this limitation: Matsushita Electric has announced the introduction of a commercial phase-change system in Japan. Dye-polymer media are also being developed for rewritable storage. No working products have reached the market yet.

The Future of Optical Storage

The key technologies that are driving the advances in optical recording are media, lasers, optics, the recording channel, and electronics.

In the near term, the most important subject for research into media is how to achieve direct overwrite in MO recording. Currently available media must be erased before being rewritten, creating a two-pass process. Promising areas of research involve bilayer and trilayer combinations of active media. Direct overwrite has been demonstrated with phase-change media, although so far there are no products available in North America.

Lasers and Channels

The semiconductor laser diode has been central to all advances in both communication and recording (see "Reflected Light" on page 249). These tiny devices, 200 to 300 μm on a side, deliver up to 40 milliwatts of optical power into the optical path of MO drives. The wavelength of their emissions is typically 830 nm, although 780-nm lasers are also in use.

The wavelength and the focusing power of the objective lens determine the spot size at the active layer. In today's systems, the spot size is slightly larger than one wavelength. Obviously, shorter wavelength lasers would yield greater disk capacity.

Researchers have demonstrated 670-nm lasers in the gallium indium aluminum arsenide (GaInAlAs) system, and they are attempting to make blue lasers with group II-VI semiconductors. Optical frequency-doubling and frequency-mixing devices have also been demonstrated, though not with the efficiency and compactness required for optical heads.

Surface-emitting diode lasers, and arrays of such lasers on a single chip, have been demonstrated by several laboratories. These lasers are candidates for multiple-beam optical recording, which is currently the most direct way of increasing data rates. In fact, edge-emitting arrays of four and five elements have already been demonstrated in multitrack reading and writing with a single objective lens.

Servo and channel technologies are essential to both optical and magnetic recording and continue to be advanced in both arenas, with each borrowing from the other. The optical channel presents problems not encountered in magnetic hard disks, such as burst errors associated with disk contamination during manufacture. Because marks are only about one wavelength apart on a track, and the tracks are separated by 1.6 μm, a particle of dust or dirt at the active layer can mask many contiguous bits. Thus, sophisticated modulation codes have been developed, and research continues to find better codes.

Downsized Heads

The most important area of optical research today is the optical head. At 100 grams, it is much too massive to meet the challenge of 17-ms random access. Integrated optical heads, such as the one illustrated in figure 4, may one day solve this problem.

The compact-disk head in the figure was proposed and constructed by Professor Hiroshi Nishihara and his colleagues at Osaka University in Japan. Although devices of this kind had been proposed before, this was the first functional demonstration. The device is built up on a 5-mm by 10-mm silicon chip that has an oxidized upper surface. A thin dielectric layer of a higher refractive index is deposited on the upper layer and serves as an optical wave guide. It confines the diode laser light introduced at its edge to within its walls and their immediate surroundings.

The laser beam expands laterally as it propagates toward a focusing grating coupler. The shallow curved grooves of the FGC are spaced closer together along its length. This changes the direction of the light radiated from them and focuses the light at the disk. Reflected light from the disk is diffracted back into the wave guide. There, a second wave-guide grating diverts it to tracking, focusing, and signal detectors, built up on the silicon substrate by conventional semiconductor processing techniques. Although the device works, the smallest spot size that has been achieved thus far has been 2 μm—too large to read a compact disk.

Nishihara's group has also demonstrated a partially integrated MO head. Light reflected from a disk is launched into adjacent wave guides by three different FGCs and sent to separate detectors. The objective lens that sends light to the disk and the laser itself were not integrated, however.

The seminal work of the Nishihara group has provoked related studies in many laboratories. Applications of integrated optics to communications systems have been under development since the early 1970s. Thus, much of the wave-guide technology needed for integrated optical heads is already available, as are grating couplers, a common component in any guided-wave laboratory. However, focusing grating couplers that are efficient and yield high-quality beams with good polarization properties need to be developed or appropriately combined with other "micro-optic" elements to yield the necessary quality. Additionally, gratings are very sensitive to wavelength shifts. Diode laser manufacturers cannot control the wavelength of peak emission accurately. Thus, techniques for compensating wavelength shift must be developed.

While there is much research still to be done, it is likely that you will one day see optical drives with multiple disks and multiple integrated optical heads, incorporating multiple lasers. The prospects of matching, and even exceeding, the performance of today's hard disks are excellent. Of course, magnetic technology will improve as well. You can expect to see both technologies working side by side in the foreseeable future. ■

ACKNOWLEDGMENT

We would like to thank Paul Y. Hu for the use of the figures. Paul is an adjunct professor in the Optical Sciences Center at the University of Arizona and a senior engineer at IBM's general products division in Tucson, Arizona.

James J. Burke is a professor in the Optical Sciences Center at the University of Arizona in Tucson and director of the Optical Data Storage Center there. He has a Ph.D. in optical sciences from the University of Arizona and can be reached on BIX c/o "editors." Bob Ryan is a BYTE technical editor. He can be reached on BIX as "b.ryan."

The Ultimate Business Computers

Model 325CT 80386-25MHz

Model 325C 80386-25MHz

Model 320 80386-20MHz

"...When it comes to the basics, price, performance...capacity...CLUB American Technologies...delivers outrageous value."

PC WORLD September 1989

NOVELL® Certified

Model 212D 80286-12MHz / **Model 210D** 80286-10MHz
Model 316SX 80386SX-16MHz

Sparrow I/16
80286-16MHz

The Ultimate Business Computers

In 1986, CLUB American Technologies introduced the first personal computers designed for heavy industrial and commercial use. Since then, over 175,000 CLUB computers have been installed worldwide and have been well accepted by the **Fortune 500, Government Institutions and thousands of small businesses.**

This overwhelming success in CLUB's computers is a result of excellence in engineering during which no details are overlooked from the initial design to the final product. Also during manufacturing, each system is subject to an intensive **SCBI** process followed by In-Circuit Simulation Field Testing.

If your business is looking for a computer that can give you the edge in today's competitive marketplace, call today and find out more about the Ultimate Business Computers from CLUB American Technologies.

(415) 683-6600

In Canada, PC Centre: **(416) 470-0560**
International: **(415) 683-6659**
Technical Support: **(415) 683-6580**

CLUB American Technologies, Inc.

Corporate P.O's Welcome. Government and OEM VARS Welcome. CLUB American Technologies Inc. 3401 West Warren Avenue, Fremont, CA 94539 Club Ad6 v.1 7/89

Circle 318 on Reader Service Card

Read/Write Optical Subsystems

Unlike CD-ROM, WORMs and erasable optical disks let you write and store massive amounts of your own data. The following is a list of WORM- and erasable disk–drive systems available to end users (as opposed to OEMs). Note that the capacity given combines the capacities of both sides of the media. For the amount of storage on-line at one time, divide the capacity by 2.

Advanced Graphic Applications, Inc.
90 Fifth Ave.
New York, NY 10011
(212) 337-4200
DISCUS Rewritable DR650-SE $6495
650-megabyte erasable optical disk system for the AT and PS/2s.
Inquiry 1181.

Alphatronics, Inc.
P.O. Box 13687
Research Triangle Park
Durham, NC 27713
(919) 544-0001
Inspire Desktop Dual Drive $13,900
1300-megabyte erasable optical disk drive for the AT. Also available for DEC and Sun systems.
Inspire Desktop Single Drive $7900
650-megabyte erasable optical disk drive for the AT. Also available for DEC and Sun systems.
Inquiry 1182.

Aquidneck Systems International, Inc.
650 Ten Rod Rd.
North Kingston, RI 02852
(401) 295-2691
Optical Archiving System ..... from $23,000
Sophisticated read/write system capable of storing up to 1 terabyte of data. Supports many mainframes, minicomputers, and workstations.
Inquiry 1183.

Computer Upgrade Corp.
2910 East La Palma Ave.,
Suite A
Anaheim, CA 92806
(714) 630-3457
Optical Storage Subsystems
5¼-inch drives (450 to 1200 megabytes) ..... from $1595
12-inch drives (1000 to 6000 megabytes) ..... from $5995
Jukebox subsystems (25 to 141 platters per unit)..... from $15,000
Complete line of optical storage systems for Macintosh, Apollo, DEC, Data General, IBM, Perkin/Elmer, and Sun computers.
Inquiry 1184.

Corel Systems Corp.
1600 Carling Ave.,
Suite 190
Ottawa, Ontario, Canada K1Z 8R7
(613) 728-8200
Corel 400
IBM PC and Macintosh version $2895
Novell NetWare version $3995
400-megabyte SCSI WORM drive subsystem.
Corel 650
IBM PC and Macintosh version $3975
Novell NetWare version $4995
654-megabyte SCSI WORM drive subsystem.
Corel 800 ..... $3645
800-megabyte SCSI WORM drive subsystem for the IBM PC and Macintosh.
Corel 940 ..... $3845
940-megabyte SCSI WORM drive subsystem for the IBM PC and Macintosh.
Inquiry 1185.

Delta Microsystems, Inc.
5039 Preston Ave.
Livermore, CA 94550
(415) 449-6881
SCSI WORM Subsystem ..... from $6000
567-megabyte to 2000-megabyte optical disk drives for Sun systems.
Inquiry 1186.

Deltaic Systems
1977 O'Toole Ave.,
Suite B206
San Jose, CA 95131
(408) 954-1055
OptiServer 600 ..... $4499
594-megabyte SCSI erasable optical disk drive for the Macintosh. Conforms to ISO standard.
WORMServer 1000 ..... $3599
940-megabyte SCSI WORM subsystem for the Macintosh. Also uses 400-megabyte disks.
Inquiry 1187.

Information Storage, Inc.
2768 Janitell Rd.
Colorado Springs, CO 80906
(719) 579-0460
ISi 525GB $6288
1280-megabyte internal WORM drive subsystem; external version also available for the AT.
Inquiry 1188.

Laserdrive Ltd.
1101 Space Park Dr.
Santa Clara, CA 95054
(408) 970-3600
810-111 (DOS version) $5495
820-011 (Macintosh version).. $5995
810-megabyte WORM drive subsystem.
Inquiry 1189.

Maximum Storage, Inc.
5025 Centennial Blvd.
Colorado Springs, CO 80919
(719) 531-6888
APX-4200 ..... $4450
760-megabyte WORM optical disk drive subsystem for DOS machines.
Inquiry 1190.

Micro Design International, Inc.
6985 University Blvd.
Winter Park, FL 32792
(407) 677-8333
LaserBank 400 ..... $2995
400-megabyte WORM drive system for DOS systems. Also available for Xenix and Unix.
LaserBank 940 ..... $4095
940-megabyte SCSI WORM drive system for DOS systems. Also available for Xenix and Unix systems.
LaserBank 600 R $6995
600-megabyte erasable optical disk drive for DOS systems. Also available running under Xenix and Novell NetWare.
Inquiry 1191.

Mitsubishi Electronics America, Inc.
Computer Peripherals Division
991 Knox St.
Torrance, CA 90502
(213) 217-5732
MW-5D1 ..... $3400
600-megabyte internal SCSI WORM drive system for the IBM PC.
MW-5U1 ..... $4300
600-megabyte external SCSI WORM drive system for the IBM PC.
Inquiry 1192.

N/Hance Systems
908 Providence Hwy.
Dedham, MA 02062
(617) 461-1970
N/Hance 525
Internal version..... $2750
External version..... $2950
240-megabyte WORM drive system for DOS systems includes interface, driver, and Text.Scan software.
N/Hance 565
DOS versions:
Internal..... $4295
External..... $4495
Xenix versions:
Internal..... $4975
External..... $4995
654-megabyte SCSI WORM drive system with host adapter, driver, Text.Scan software, and Write Once File System (WOFS) software.
N/Hance 5120
PC versions:
Internal..... $6188
External..... $6388
2560-megabyte double drive..... $11,695
Xenix versions:
External..... $8195
2560-megabyte double drive..... $13,495
1280-megabyte WORM drive with interface and driver.
Inquiry 1193.

Online Computer Systems, Inc.
20251 Century Blvd.
Germantown, MD 20874
(301) 428-3700
MDU .....from $6000
Multimedia storage unit for DOS systems includes 400-megabyte WORM drive plus CD-ROM, hard disks, tape backup, and SCSI connector. Also supports OS/2, Unix, and VAX/VMS.
Inquiry 1194.

Panasonic Industrial Co.
2 Panasonic Way
Secaucus, NJ 07094
(201) 348-7000
LF-5010..... $3299
940-megabyte external SCSI WORM drive system for the IBM PC and the Macintosh.
LF-5014..... $2999
940-megabyte internal SCSI WORM drive system for the IBM PC.
Inquiry 1195.

Peripheral Land, Inc.
47421 Bayside Pkwy.
Fremont, CA 94538
(415) 657-2211
Infinity Optical..... $5695
635-megabyte erasable optical disk drive for the Macintosh.
Infinity Optical 1.2..... $11,995
1270-megabyte erasable optical disk subsystem (two drives).
Inquiry 1196.

Pioneer Communications of America, Inc.
Optical Memory Products Division
Sherbrooke Plaza
600 East Crescent Ave.
Upper Saddle River, NJ 07458
(201) 327-6400
DD-S5001
PC version..... $3895
Macintosh version..... $3695
654-megabyte WORM drive subsystem.
Inquiry 1197.

RACET computes Ltd.
3150 East Birch St.
Brea, CA 92621
(714) 579-1725
Cosmos 600
AT version..... $5690
Macintosh version..... $5190
594-megabyte erasable optical disk subsystem.
Inquiry 1198.

Storage Dimensions
2145 Hamilton Ave.
San Jose, CA 95125
(408) 879-0300
LaserStor
AT and PS/2 version..... $4495
Macintosh version..... $4995
786-megabyte WORM drive subsystem.
LaserStor Erasable Optical..... $7995
876-megabyte SCSI erasable optical disk drive system for the AT, PS/2s, Macintosh, and Novell NetWare. Also uses 574-megabyte ISO-compatible cartridge.
Inquiry 1199.

Sumo Systems
1580 Old Oakland Rd.,
Suite C103
San Jose, CA 95131
(408) 453-5744
RSSM600-B..... $4500
594-megabyte erasable optical disk system for the Macintosh.
Inquiry 1200.

Summus Computer Systems
17171 Park Row,
Suite 300
Houston, TX 77084
(713) 492-6611
Lightdisk-650
AT version..... $6495
Macintosh version..... $5495
594-megabyte erasable optical disk system. Also available for DEC and Sun machines.
Inquiry 980.

United Systems Co.
14701-B Myford Rd.
Tustin, CA 92680
(714) 832-3613
Spark L1200.....$19,000
2000-megabyte WORM storage system. Includes a powerful proprietary operating system that works in conjunction with MS-DOS.
Inquiry 981.

This resource guide is intended to provide a reasonable cross-section of available products, companies, and services; due to space limitations, we cannot list all companies and products. Inclusion in the resource guide should not be taken as a BYTE endorsement or recommendation. Likewise, omission from the guide should not be taken negatively. The information here was believed to be accurate at the time of writing, but BYTE cannot be responsible for omissions, errors, or changes that occur after compilation of the guide.

THE 25TH BIRTHDAY OF BASIC

Everybody's first language is a quarter century old: You've come a long way, BASIC

Bill Gates

Since the first program ran on an English-built computer in 1948, computing has evolved by several orders of magnitude. In just 15 years, personal computers have grown from 8-bit, 4K-byte toys to powerful 32-bit, 16-megabyte tools for science and industry.

Amid all this growth in hardware, the BASIC language has quietly turned 25 years old, and the BASIC interpreter that opened up the microcomputer to millions of people has entered its fifteenth year.

BASIC didn't become the best-known and most accessible computer language simply because it comes free with every machine. BASIC's strengths—the simplicity of using an interpreter, its powerful string handling, the richness of the language, its English-like keywords and syntax, and the freedom it gives programmers to experiment—make it the ideal way for computer novices to explore the intricacies of their computers.

During this milestone year for BASIC, you can see how it may evolve by looking at the technology of operating systems like OS/2 and the promise of object-oriented programming.

BASIC was born out of a need to give nontechnical people a simple way to interact with a computer. In 1962, a math professor at Dartmouth College, Thomas Kurtz, proposed to the department chairman, John Kemeny, the radical idea that all Dartmouth students should learn about computers during their four-year stay. But the batch-oriented computers of the day made that prospect impossible, since it often took days to find out if a simple program would compile properly. Even then, the program could only calculate a result and return an answer; the person who wrote the program never actually saw it run.

Kemeny and Kurtz, expanding on research going on at MIT and Bell Labs, built a time-sharing operating system for a new computer that Dartmouth was about to receive. In the process, they decided that giving students a way to share the computer's hardware was of little use without a simple language for talking with the machine. FORTRAN and ALGOL didn't fill the bill for ease of use, so they created the Beginner's All-purpose Symbolic Instruction Code as a simplified blend of the best of FORTRAN and ALGOL.

On May 1, 1964, Dartmouth students, greeted by the now famous READY > prompt on their teletype terminals, could write simple programs and send them off to be compiled and run. Listing 1 shows a simple program (a multiplication table) written in that first BASIC. Kemeny and Kurtz recount the birth of BASIC in their book *Back to BASIC* (Addison-Wesley, 1985).

And Then There Were Micros

The first microcomputers, sporting very small memories, came on the scene in 1975 from companies like MITS and Southwest Technical Products. These machines understood only machine language. Paul Allen and I sensed an opportunity and wrote a version of BASIC to run in those small memory spaces. Our first BASIC for the MITS Altair allowed a user to run programs on a 4K-byte machine. Memory was so precious that we even replaced the READY > prompt with OK > to save a few bytes. We built this BASIC as an interpreter.

Memory constraints partly guided our decision to implement BASIC as an interpreter. But another factor was our fascination with interpreters, and the immediacy and ease of use they give to the programming art. An interpreter lets a programmer tell the computer to perform a job, and then the computer gives immediate feedback and results, including the reporting of errors. This immediacy comes from the interpreter's being built as part of the language, not as a separate program like a compiler. First-time users would find working with a compiler difficult.

Drawing on experience I had obtained writing a BASIC interpreter for a PDP-8 while in high school, Paul and I made our original microcomputer BASIC a single-representation interpreter. This means that rather than storing the exact source code in text form, we translated it into a more compact form because of the memory constraints we faced.

We did tricks to let the programmer see his or her program

continued

ILLUSTRATION: RANDY LYHUS © 1989

exactly as he or she keyed it in while executing the program at a reasonable speed. Using the lower values of a byte and the upper 128 ASCII values to tokenize BASIC keywords was an innovation in that interpreter. We also coined the short commands TRON and TROFF to turn on and off BASIC's earliest built-in debugging tool, a trace facility. Fitting the language's reserved words, error messages, and floating-point library to run programs in a 4K-byte machine required a lot of tricks—it's still my favorite piece of code because it is so refined.

We chose to write a BASIC interpreter for several reasons. First, BASIC was simple enough that we thought we could squeeze it, plus user programs, into 4K bytes. We also liked being able to write a meaningful one-line program in BASIC; with other languages, you had so many variable and environment definitions to worry about, you had to write several lines of code just to print "hello" on the screen. And we liked BASIC's powerful variable-length string-handling functions.

Listing 1: *The 1964 BASIC had no INPUT statement. Instead, you had to assign data to a variable with the LET or READ DATA statements.*

```
10 REM 1964 BASIC
20 LET N = 355/113
30 PRINT "MULTIPLICATION TABLE FOR",N
40 FOR I = 1 TO 10
50 PRINT I, N * I
60 NEXT I
70 PRINT "---------------"
80 END
```

Listing 2: *The 1977 8K-byte BASIC had longer variable names, the INPUT statement, strings, and the IF. . . GOTO statement. This is a more flexible version of the program in listing 1.*

```
10 REM 1977 8K BASIC
15 PRINT "ENTER NUMBER FOR MULTIPLICATION TABLE"
20 INPUT NUMBER
25 INPUT "ENTER NUMBER OF LINES"; LINES
26 IF LINES <1 GOTO 120>
30 PRINT "MULTIPLICATION TABLE FOR",NUMBER
40 FOR I = 1 TO LINES
50 PRINT I, NUMBER * I
60 NEXT I
70 PRINT "---------------"
80 PRINT "DO YOU WANT ANOTHER Y/N";
90 INPUT C$
100 IF C$ = "Y" GOTO 15
115 REM
120 REM ERROR HANDLING
130 PRINT "WRONG NUMBER OF LINES"
140 END
```

Listing 3: *The 1985 Microsoft QuickBASIC. It and other BASICs of the period eliminated line numbers and added subroutines and IF. . . THEN. . . ELSE statements.*

```
INPUT "File tb be searched";F$
INPUT "Pattern to search for";P$
OPEN F$ FOR INPUT AS #1
WHILE NOT EOF
   LINE INPUT #1, TEST$
   CALL LINESEARCH(TEST$,P$)
WEND

SUB LINESEARCH(TEST,P$) STATIC
    STATIC NUM
    NUM = NUM = 1
    X = INSTR(TEST$,P$)
    IF X = 0 THEN
       EXIT SUB
    ELSEIF X > 0 THEN
       PRINT "Line #";NUM;":";TEST$
    END IF
END SUB
```

Why Use BASIC?

We convinced the makers of the early microcomputers that they needed BASIC in their machines to let people use them. Otherwise, you could turn on the machine, but you couldn't do much with it. And until disk operating systems came along in about 1979, BASIC was the only way most people could use a personal computer. Our BASIC caught on because we encouraged people to write books about BASIC programming that contained lots of source code listings. We also promoted the idea of people writing programs in our BASIC and then selling or giving away those programs.

Other people were writing BASICs at that time: Li Chen Wang (Tiny BASIC), Steve Leininger (Radio Shack Level 1 BASIC), Steve Wozniak (Apple Integer BASIC), and Gordon Eubanks (BASICe and CBASIC). But Microsoft BASIC eventually appeared in the ROMs of over 50 types of machines and became a de facto standard.

That early BASIC was primitive compared to today's language. It forced you to use only two-letter variable names and required line numbers (see listing 2). But it proved to be an acceptable way to create useful programs for computers. It gave you instant feedback as you wrote a program, and its string-handling features let people write fairly sophisticated text-oriented applications. We invented new BASIC verbs like PEEK and POKE, and INP and OUT, to let people get at the resources of the machine. We devised a way to let programmers call machine language routines from BASIC so they could make critical parts of their programs faster.

Interpreters can be extended quite easily, so we frequently added new features to BASIC. We developed the music and graphics-string macro languages that used the verbs PLAY and DRAW. Many features that ended up in GWBASIC (short for Gee Whiz) came from our experience writing interpreters for Japanese machines.

BASIC hit a plateau when GWBASIC was put into the IBM PC ROM. Without IBM's updating the ROM, it was hard to popularize BASIC extensions beyond the interpreter. This BASIC became extremely popular, of course, and even today I'm amazed at what a high percentage of PC users have experimented with that BASIC because it is so simple to learn and use.

When BASIC faltered on the plateau of being an IBM PC–compatible standard, we created QuickBASIC. Other companies were extending BASIC, too—for example, BASIC's inventors, Kemeny and Kurtz, with True BASIC.

Not So Basic

When I show programmers the BASIC I use today, they say something like, "That looks a lot like Pascal." People who think of BASIC as the IBM PC's BASICA are surprised that it doesn't have to be a line-oriented language with little structure. BASIC has become very modern since 1983 (see listing 3).

In the mid-1980s, BASIC improved on three fronts: as a language, with the addition of long variable and label names, record structures, and better block-structuring tools; as an environment, with a built-in editor, debugger, and compile-run facility; and as a compiled language, with faster response in the classic compile/debug/edit/compile cycle while generating fast, high-quality code. BASIC also gained the ability to run

continued

Circle 96 on Reader Service Card →

High Performance Systems

Starting Price: $2480

Enjoy extra performance from your computer with Eltech!

"One of the best numeric performers of the bunch"
-----MIPS Magazine, August 1989

The Eltech 9870 386 computer utilizes the best technology available today. Featuring the Floating Point Processor 80387-25/Weitek 3167, Eltech is now offering one of the fastest affordable computers that can be shipped to you TODAY! The 9870 also includes Cache Memory: 64 or 256KB S-RAM ; Expansion RAM: 4 or 8MB on 32-bit Board; Maximum RAM: 16MB Data Bus Width: 32-bit; Zero Wait States and 1 Serial and 1 Parallel Ports.

30-Day Money-Back Guarantee.
Next Day Free On-Site Service.
Next day delivery available.

- One year free on-site service
- Consulting service program
- Leasing and financing program

ELTECH RESEARCH INC.

1725 McCandless Drive
Milpitas, CA 95035
Telephone: 408-942-0990
FAX: 408-942-1410 Technical Support: 408-942-1067

Distributors & VAR inquiries welcome
Call for details.

~~Seven~~ ~~Six~~ ~~Five~~ easy ways to boost your BASIC

UPDATED!

PRO BAS™ Basic Programming Library

So who cares that BYTE magazine calls **PRO BAS** a "Supercharger for QuickBASIC" or that PC Tech Journal says that **PRO BAS** is a "high-quality, high-quantity package"? Who buys a product just because Jerry Pournelle said "Anyone doing serious QuickBASIC programming would do well to get [**PRO BAS**]"? And who cares that Wayne Hammerly calls **PRO BAS** "The greatest thing since sliced bread"?

Who?--Only those who want to write better, faster, slicker programs and save hundreds of programming hours in the process. With all of that hoopla out of the way, we are formally announcing the momentous release of **PRO BAS** Version 3.1, now with over 400 assembly routines to make BASIC programs faster and more powerful than you ever dreamed with features like:

- A 1,000-page two-volume manual
- Full mouse support
- Extended and EMS memory support
- Full-featured windowing
- Moveable, resizable windows
- Screen snapshots (text & graphics)
- Virtual screens in memory
- Lightning-fast file I/O
- Critical error handling
- String, array, and pointer sorts
- Search directories and archives

Create dazzling screens in text, CGA, EGA, VGA, and Hercules graphics modes with windows that can overlay one another and be moved and resized on the fly. Store megabytes of string, data, or screen snapshots in extended or EMS memory. Draw complex text or graphic screens to memory and snap them on in an eyeblink. The **PRO BAS** file I/O routines allow you to read or write huge chunks of data at a clip, far faster than with BASIC.

PRO BAS also has over 300 other essential services, including handy string, date, time, directory, and array manipulation routines; string, screen, and data compression routines; valuable equipment and input routines; and faster replacements for many BASIC commands.

Whether you are a professional or a novice, **PRO BAS** will boost your BASIC in ways you never thought possible. **PRO BAS** allows the professional to write faster, tighter code in much less time and allows novices to quickly and easily write professional-quality programs that would be impossible with BASIC alone. The bottom line is **PRO BAS** adds power and saves time. After all, how much is a few hundred hours of your time really worth?

For all DOS versions of QuickBASIC and BASCOM. ***Just $149.00!***

UPDATED!

PRO REF™ On-Line Help For PRO BAS

PRO REF provides on-line help for the routines in the **PRO BAS** library. This hypertext manual links directly to the QB Advisor in QuickBASIC 4.5 so that the **PRO BAS** reference becomes an integral part of your QuickBASIC on-line manual. Includes information and examples on **PRO BAS** routines and helpful hints on programming in BASIC. ***Just $50.00!***

UPDATED!

PRO SCREEN™ Screen Management

PRO SCREEN is a full-featured screen generator/editor that will save you more design and coding time than you ever thought possible. **PRO SCREEN** treats screens like a word processor treats text to provide complete control over characters, colors, and placement. Design input screens with up to 130 fields, 19 predefined and 2 user-defined masks. Save screens to screen files or .OBJ files and use the tight BASIC/Assembly code that comes with **PRO SCREEN** to access the screens. There's no kludgy code generator here! Access hundreds of input screens with less than 25k of total code. ***Just $99.00!***

PRO MATH™ Mathematics Library

PRO MATH is a collection of over 150 high-level routines that provide mathematical functions and operations for programmers who often work in mathematics, science, or engineering. Complex variables, real and complex matrices, real and complex trigonometric and hyperbolic functions and their inverses, solution of linear equations, integration, differential equations, Fast Fourier transforms, graphics support, and many other useful routines are provided.

For years Fortran has been the language of choice for scientific and engineering applications, but it lacks many of the useful features of QuickBASIC. **PRO MATH** contains most of the Fortran mathematical and numeric functions and allows you to easily translate Fortran code to BASIC or write new programs in BASIC, while retaining Fortran's numerical prowess.

The **PRO MATH** manual is over 200 pages and provides a complete description of each routine, including any algorithm and the mathematical formula the routine uses, shown in standard notation. For QuickBASIC 4 and BASCOM 6 only. ***Just $99.00!***

UPDATED!

PRO BAS™ TOOLKIT

The **TOOLKIT** is a collection of high-level BASIC and assembly modules that use the routines in the **PRO BAS** library to save you even more hours of grunt work. Why spend hundreds of hours re-inventing the wheel when you can just plug in **TOOLKIT** modules like:

- Super-fast B-Tree indexing
- Ring, Bar, Pop-Up, Pull-Down menus
- Scroll-bar tag windows
- Dialog boxes with radio buttons
- Two mini-editors with word wrap
- BCD math routines
- Julian date & calendar routines
- Patch .EXE files
- Protected memory storage area

The **TOOLKIT** now supports EGA and VGA graphics modes for menus, windows, editors, calendars, and more. Complete with BASIC source code and an all-new comprehensive manual. The **TOOLKIT** requires the **PRO BAS** library and helps conserve your greatest asset of all—time! ***Just $99.00!***

PRO BAS™ TELECOMM TOOLKIT

The **PRO BAS TELECOMM TOOLKIT** is a collection of high-level communications modules that you plug into your code to provide popular file transfer protocols, terminal emulations, login scripts and baud rates up to 115,200 baud. You get:

- Xmodem/Modem7/Xmodem-1k
- Ymodem (single and batch)
- CRC-16 and Checksum
- VT52, VT100, ANSI, BBS etc.
- Auto Dialer & data base
- Documented BASIC source

Why use clumsy SHELLs to complex terminal programs when you can plug just the communications routines you need into your code? Implement just the features and commands you want. Requires **PRO BAS**. ***Just $75.00!***

Our thirty-day, money-back guarantee assures you the highest quality and our technical support staff is always ready to help.

HAMMERLY
COMPUTER SERVICES, INC.

9309 JASMINE COURT • LAUREL, MD 20707

(800) 343-7484

INT'L. ORDERS: (301) 953-2191 FAX: (301) 725-8147
BBS: (301) 953-7738

Add $5.00 per item ($8.00 Canada) for shipping per order. Europe: $39.00 for 1st item plus $5.00 for each additional item. Visa, M/C, C.O.D. (US Only) checks and approved POs accepted. Trademarks **PRO BAS**, **PRO REF**, **PRO SCREEN** **PRO MATH**: Hammerly Computer Services, Inc. QuickBASIC, BASCOM: Microsoft Corp.

Circle 113 on Reader Service Card

recursive routines, to handle sophisticated structures such as B-trees, and to deal better with graphics.

About this time, BASIC became more structured, with the addition of DO WHILE, WHILE...WEND, DO UNTIL, LOOP WHILE, and LOOP UNTIL loops, and SELECT CASE constructs. BASIC today has facilities that permit creating data structures as rich as those of C or Pascal. BASIC also shed the

That early BASIC was primitive compared to today's BASIC.

shackles of 64K-byte limits on program size; today's BASIC programs are limited only by memory, and even individual arrays can be up to the limits of memory in size.

You can also use long (32-bit) integers in your programs. Record structures added the capability to let you define your own data structures, combining many different individual data types, such as strings and numbers.

The environment for BASIC programming has changed, too. In QuickBASIC 4.0 and 4.5, for instance, a built-in full-screen editor with automatic syntax editing, a built-in debugger, and context-sensitive help makes the program-creation process as fast and easy as possible. Borland also integrated a full-screen editor into Turbo Basic.

Another important change in the modern BASICs was a move from interpreters back to compilers: Indeed, Dartmouth BASIC has remained a compiled language since its inception. BASIC compilers for microcomputers appeared soon after disk operating systems became available, and were made possible, in part, by the availability of up to 64K bytes of memory.

These compilers included Microsoft products and Digital Research's CBASIC-86 compiler. Later, Better BASIC, QuickBASIC, True BASIC, ZBasic, and Turbo Basic were developed. But the major move to compilers needed to be made without sacrificing the instant feedback and quick detection of errors, features that made the BASIC interpreter so successful.

Advancements in compiler technology enabled the development of a BASIC compiler that gave the appearance of an interpreter, thus offering the best of both worlds. Single-pass compilers that could compile first hundreds—and then thousands—of lines of code in just a few seconds gave BASIC the appearance of an interpreter but let programs execute faster.

Later, we invented an in-memory scheme combining the features of an interpreter and a compiler. It uses a special intermediate threaded pseudocode that, when combined with an environment like the QuickBASIC editor, lets you write, debug, and change the code just like in an interpreter. When you are ready, you can compile the finished product to get maximum speed and compact size in an executable file.

Compiling BASIC also made it easier to call routines written in other languages from within BASIC. Because the compiler generates standard intermediate .OBJ files, you can link C or FORTRAN .OBJ files with your BASIC .OBJ files and call

continued

NEW PRODUCT!

Unleash the BASIC Power of Hypertext!

Our latest BASIC-booster includes the first hypertext engine designed to be called from BASIC. With the **ProBas HyperHelp ToolKit** you can use the hypertext engine to put one or more manuals on-line with full hypertext search facilities. Imagine having one or more manuals on-line with all of the fantastic hypertext abilities in the QuickBASIC 4.5 compiler and then some:

- Choose single- or multi-window display
- Specify window colors and placement
- Move and resize windows with mouse or keys
- Sophisticated mouse and keyboard interface
- Up to 40 bookmarks to move between hyperlinks

In less than a dozen lines of code you can pop-up context-sensitive help at any time. Your users can then jump to related help, examples, or just browse the manual(s) in one or more windows that they can move or resize at will. The text will automatically wrap within the window to stay fully visible!

Create HyperCard Applications

Use the **HyperHelp** engine to create full-blown hypercard applications. Create sophisticated multi-window, multi-thread hypercard stacks. Mix cards and manuals for total data integration. Moving from link-to-link or card-to-card is instantaneous and the speed will amaze you.

Adding hypertext to your applications takes less than about a dozen lines of BASIC code. Converting ASCII text to hypertext is just as easy—just put delimiters around keywords, hyperlinks, and items you want to display in boldface.

Multiple Help Subsystems

The hypertext engine is just a part of the **HyperHelp ToolKit.** There is a wide selection of help subsystems with various displays, user interfaces, and memory requirements to suit almost any need. Want a small, window-oriented, keyword help system? It's in there! Need a Terminate & Stay Resident help system? It's in there! How about a lightbar indexing system that then pops-up the selected text? It's in there!

The **HyperHelp ToolKit** gets it's blinding speed by using the low-level routine in our **ProBas** Professional Basic Programming Library. **HyperHelp** requires the **ProBas** Library. See our ad on the opposite page for information on **ProBas,** shipping rates, and our thirty-day money-back guarantee.

Special Introductory Price—For a short time this powerful hypertext engine and collection of help subsystems is available for ***just $99.00!***

HAMMERLY
COMPUTER SERVICES, INC.
9309 JASMINE COURT • LAUREL, MD 20707
(800) 343-7484
INT'L. ORDERS: (301) 953-2191 FAX: (301) 725-8147
BBS: (301) 953-7738

Add $5.00 per item ($8.00 Canada) for shipping per order. Europe: $39.00 for 1st item plus $5.00 for each additional item. Visa, M/C, C.O.D. (US Only) checks and approved POs accepted. Trademarks **ProBas, ProRef, ProScreen ProMath:** Hammerly Computer Services, Inc. QuickBASIC, BASCOM: Microsoft Corp.

those "foreign" language routines from within your BASIC program.

With these improvements in compiler technology, BASIC's longtime reputation as a slowly executing language fell by the wayside. Today, many popular commercial applications are written in BASIC. For example, there's a speaker-design program called AccoustaCADD, a radio station playlist manager called Music Scan, and even a program for molecular biologists called DNA Inspector. Modern compiled BASIC programs run as fast as programs compiled in Pascal or C.

I'm still a big fan of BASIC. It handles many of the overhead tasks that other languages force you to deal with, thereby unleashing your programming creativity. I have challenged programmers to write code to solve any problem using any tool they choose; I wager that I can write the same program faster using QuickBASIC. In fact, there is a joke around Microsoft that says when an application is falling behind schedule, "Just give it to Bill and he'll write it in BASIC over the weekend."

Still, as powerful as BASIC is today, there are ways to make it even better.

The BASIC Clairvoyant

Even though BASIC gives you great freedom for writing programs, it still forces you to think procedurally; your programs become a series of linked, step-by-step procedures to perform certain actions. Programming this way becomes an exercise in project management: First do this, then do that if something else happens, and so on.

As programs become more complex, these "projects" get harder to manage. Structured programming concepts deal with this complexity by encouraging programmers to break up code into small chunks, and then tie the chunks together with the unfortunately error-prone convention of function calls within, and across, module and file boundaries. Object-oriented programming puts a new twist on that idea: Make each program chunk a self-contained package of data and the procedures for manipulating that data, and then have the chunks send and receive messages to interact with other chunks.

This scheme provides a "black-box" mentality for program pieces—the pieces become objects whose internal complexity stays hidden from other objects. But why do you need to think of programs as collections of objects?

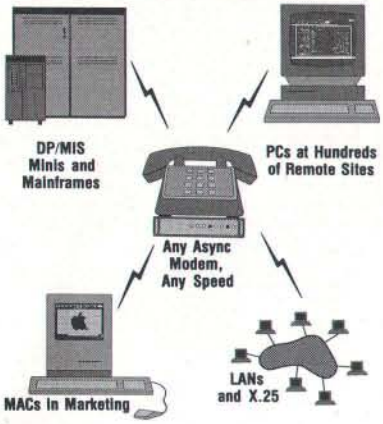
The visual environments that are used on computers today give a clue as to why thinking about program objects is important and different. In a visual environment, you choose an action or event after you choose the data that is the target of the action or event. For example, `delete character`, `delete word`, `delete paragraph`, and `delete page` are simply one command applied to different objects. You must choose the object—a character, word, paragraph, or page—before you select the command `delete`.

Object-oriented design techniques package data and the methods of manipulating that data together: The package becomes an object. If you want an object to do things that it doesn't currently know how to do, you create a new object that inherits the capabilities of the old object and then add the new capabilities you want to define. In traditional procedural programming, you set up the action first and then identify the data and supervise every step in the action's manipulation of that data.

Object-oriented programming will influence the development of all languages, including BASIC, over the next several years. Objects contain both code and data, and they manage their own behavior while hiding their internal complexity.

continued

BLAST...
Complete Communications, ONE Software Package.



PC, MAC, UNIX, XENIX, VAX,
and more. 30 popular operating systems. Connect and manage file transfers around the office or around the world.

RIGHT OUT OF THE BOX
Use regular modems, V.32, new high speed modems, X.25,LANs . . .
BLAST makes them all compatible.

FOR INSTANT NETWORKS
Link two computers or 2000 . . . with
- One easy, identical interface
- One set of commands
- One powerful script language
- One reliable program

WITH ALL THE FEATURES
- Bulletproof file transfer
- Terminal Emulators – VT 100/220, etc.
- Scripting for customized routines
- PC to PC Remote Control
- Fully automated operation
- Unbeatable noise resistance

IN GOOD COMPANY
- Over 50,000 users worldwide
- Top-Notch technical support

***Call* 800-24-BLAST**

APPLE	MACINTOSH
IBM PC-XT,AT,PS/2	MS-DOS,SCO XENIX, UNIX V
UNIX Systems	UNIX V.3,4.2,386
DEC	VMS,RSX,RT-11, ULTRIX
DATA GENERAL	DOS,MPOS,RDOS,AOS/VS
HARRIS	VOS,UNIX, XENIX
HEWLETT-PACKARD	MPE,RTE,UNIX
IBM	VM/CMS/MVS/TSO
PRIME	PRIMOS
UNISYS	BTOS,CTOS,UNIX
WANG	VS OS, MS-DOS

. . . plus many more

BLAST
Communications Research Group
5615 Corporate Blvd. • Baton Rouge, Louisiana 70808
(504) 923-0888

Circle 53 on Reader Service Card (DEALERS: 54)
Circle 182 on Reader Service Card →

Discover Parallel Processing!

Monoputer/2™

The World's Most Popular Transputer Development System

Since 1986, the MicroWay **Monoputer** has become the favorite transputer development system, with thousands in use worldwide. Monoputer/2 extends the original design from 2 to 16 megabytes and adds an enhanced DMA powered interface. The board can be used to develop code for transputer networks or can be linked with other Monoputers or Quadputers to build a transputer network. It can be powered by the 20 MHz T414 or T800 or the new 25 MHz T425 or T800.

Parallel Languages

Fortran and C Make Porting a Snap!

Microway stocks parallel languages from 3L, Logical Systems and Inmos. These include one Fortran, two Cs, Occam, Pascal, and our own Prolog. We also stock the NAG libraries for the T800 and Rockfield's structural and thermal finite element package. A single T800 node costs $2,000, yet has the power of a $10,000 386/1167 system. Isn't it time you considered porting your Fortran or C application to the transputer?

Quadputer™

Mainframe Power For Your PC!

MicroWay's **Quadputer** is the most versatile multiple transputer board on the market today. Each processor can have 1, 4 or 8 megabytes of local memory. In addition, two or more Quadputers can be linked together with ribbon cables to build large systems. One MicroWay customer reduced an 8 hour mainframe analysis to 15 minutes with five Quadputers, giving him realtime control of his business.

For further information, please call MicroWay's Technical Support staff at (508) 746-7341.

MicroWay

World Leader in PC Numerics

P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, U.K., 01-541-5466
USA FAX 617-934-2414 Australia 02-439-8400 Germany 069-75-1428

Objects interact with other objects by passing messages back and forth. That way, any object can be changed without affecting other objects. Any programmer can create an object that can interact with any other object; all the programmer has to know is the message-passing syntax.

To adapt to this object-oriented emphasis in programming, BASIC will need the ability to create and manipulate classes and subclasses, which are the principal data abstraction devices of object-oriented programming. BASIC will also need a visual component. After all, the best way to design a form is to draw the form, not write code to reproduce it. With a mouse and a palette of predrawn graphics images, you should be able to combine lines, boxes, and buttons interactively on a screen to design a form for a program. That kind of interactive design of objects should also let you attach to or combine your creations within a program.

Future versions of BASIC will increasingly provide support for this kind of programming. The programs will look different from the BASIC we're used to. A visual BASIC program will be a mixture of code, programmer-written objects, and visually specified objects. With separate windows, you would be able to edit both the visual and code parts of the program.

HyperCard provides an interesting example of this combination of visual and more standard procedural programming. The screen display of the card, with its buttons and display areas, provides the visual field; the script language, HyperTalk, lets you create procedures that relate to the card and the information that the card links with. Although HyperCard is only a partial implementation of object-oriented programming, it forms an understandable intermediate step between procedural and object-level programming.

Another major change in BASIC's future will be its universality. This change will result from BASIC's becoming part of the overall computing environment. BASIC may soon become the equivalent of today's MS-DOS command interpreter, COMMAND.COM. If this happens, BASIC will play a role similar to the one it played in the earliest personal computers—as a universal "macro" language through which users interact with their computers and all the applications they run.

A universal BASIC would come in different flavors. One flavor would serve as a central control language for the computing environment. As an environment control tool, BASIC would be a command-line adjunct to a visual user interface. Another flavor would serve as an embedded language within application programs. Embedded BASIC would allow power users to embellish the performance of their applications, as Lotus 1-2-3 users do today, without having to learn a new macro language for each application they use.

You would be able to use BASIC syntax to tell your application programs to perform their various functions in the order you want them performed. For example, if you needed a certain report each month, you'd be able to write a short BASIC program that tells the application to gather the relevant data, format it properly, and have it waiting for you at the appointed hour. BASIC can provide this power while remaining easy to learn and use. These kinds of changes will keep BASIC vibrant for a long time.

Perpetually Young

The next 25 years in BASIC's life will probably be even more exciting than the first 25. BASIC's development has mirrored the explosive growth of the personal computer industry: When the hardware was weak, BASIC was pretty cramped, too. The rapid improvements in hardware in the last 15 years have been matched by the growth of BASIC in both power and flexibility. If you haven't looked at BASIC in the last few years, you'll be surprised by how it's changed. Compare listings 1, 2, and 3 to see the evolution of BASIC from 1964 through 1985.

In the late 1970s, when C started becoming very popular, many people predicted the demise of the COBOL and FORTRAN languages. Pascal was supposed to sound the death knell for BASIC. But all these languages continue to survive. I believe that in the case of BASIC, the language is flourishing. If BASIC becomes a universal macro language, as I think it will, it may outlive all the procedural languages. BASIC may, in fact, outlive us all. ■

Bill Gates is chairman and CEO of Microsoft Corp. in Bellevue, Washington. He cofounded the company in 1975 with Paul Allen. He can be reached on BIX c/o "editors."

EDC Electronic Design Center

High Tech in Perfection
Transputer Products

Transputer Boards

EDC-B016	Motherboard for 1-16 TRAM
EDC-4T4MB-T414	Transputer board with 4 x T414
EDC-4T4MB-T800	Transputer board with 4 x T800
EDC-4T4MB-ITEM	Rack for 10 EDC-4T4MB cards
EDC-4T4MB-TDS	Software Development System

Transputer Module Series 501

EDC-501-128KS*	Transputer module with T414 or T800 and 128K SRAM
EDC-501-256KS*	Transputer module with T414 or T800 and 256K SRAM
EDC-501-1MD-T414-70	Transputer module with T414 and 1MB DRAM (70ns)
EDC-501-1MD-T414-100	Transputer module with T414 and 1MB DRAM (100ns)
EDC-501-1MD-T800-70	Transputer module with T800 and 1MB DRAM (70ns)
EDC-501-1MD-T800-100	Transputer module with T800 and 1MB DRAM (100ns)

All transputer modules pin-compatible with INMOS TRAMS.

Transputer Interface Module

EDC-UBX1	UNIBUS interface card
EDC-TVM1	VME-Bus interface card
EDC-TQB1	Q-Bus interface card.

Transputer Software

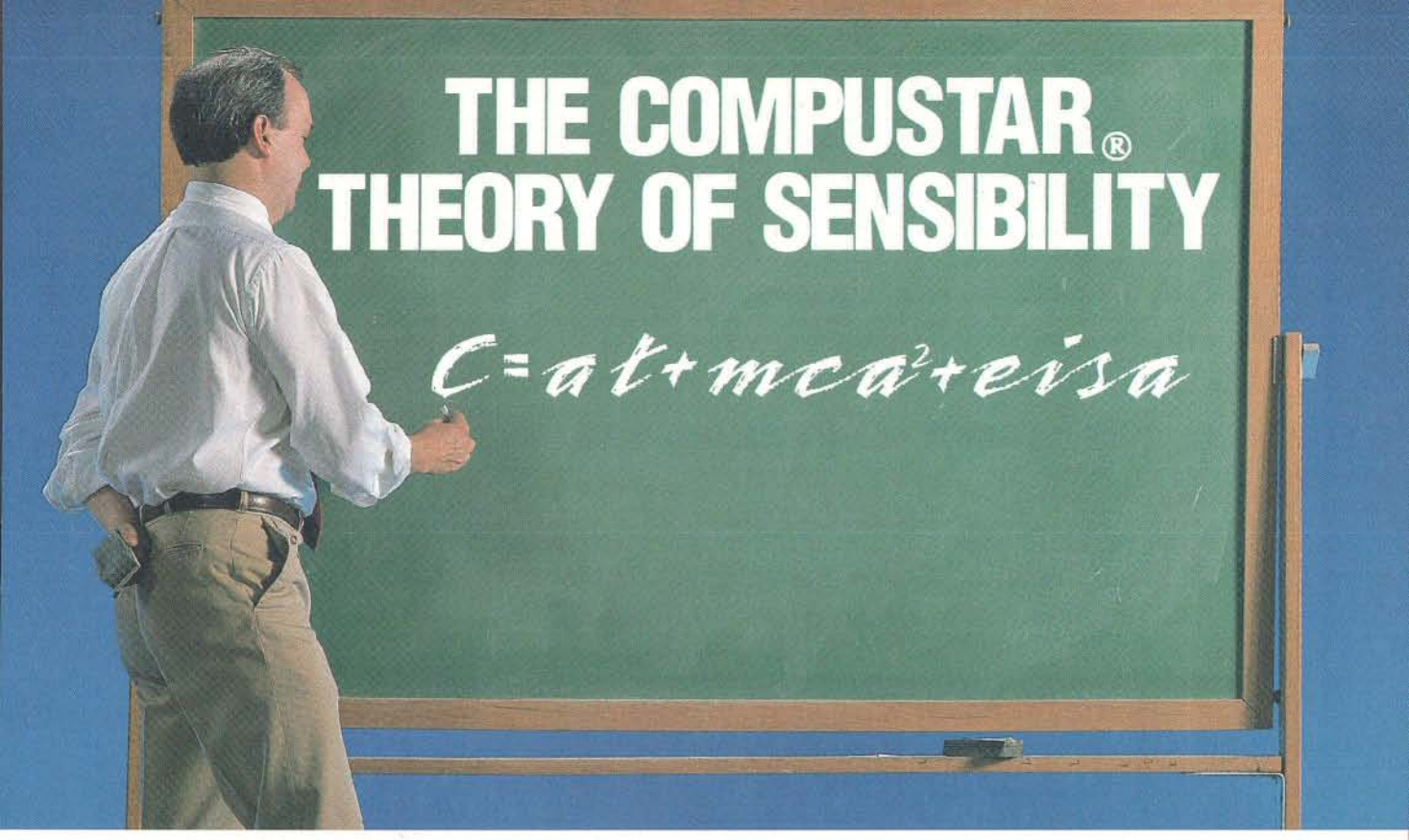
EDC-SWMS1	Mathematical and statistical package in OCCAM
EDC-SWVDOT	RAM-Disk for Transputer boards

EDC Memory Module

EDC-SX32-064	64K x 8 SRAM module
EDC-SX32-256	64K x 32 SRAM module
EDC-DX32-256	256K x 32 DRAM module
EDC-DX40-256	256K x 40 DRAM module

EDC GmbH, Taunusstr. 51/III, 8000 Munchen 40 Tel.: (89) 350 70 76 Fax: (89) 359-61-80 Tx.: 521 25 99

Circle 92 on Reader Service Card



Okay, we admit it may not be as profound as Einstein's Theory of Relativity. But, if you're a computer user, we bet it's a bit more, shall we say, "relative" — not to mention a whole lot more sensible.

The "C" stands for CompuStar® — the world's first and only multi-processor, *convertible* bus™ microcomputer. And, as the theory states, CompuStar means AT, MCA *and* EISA compatibility — all in a single system.

A CONVERTIBLE BUS?

Each CompuStar features snap-in bus "modules" that let you convert from one bus standard to another — a PC/AT[1] bus, a PS/2 (MCA) bus. . .or both!

SNAP-IN PS/2 AND AT BUS MODULES.

Depending on configuration, you can have up to *13* AT and/or PS/2 bus expansion slots. Plus, when the new EISA bus becomes popular, we're licensed to offer it as well.

THREE COMPUTERS IN ONE.

Buses are not the only thing you can reconfigure in a CompuStar. Each system can be equipped with any of *three* CPU Modules — an 8086, an 80286 or an 80386. Since the modules are interchangeable, you won't have to worry about buying the *wrong* computer system. We'll even let you trade-in your CPU Module toward the purchase of any of the other more powerful modules.* But that's not all. CompuStar features an incredible *seven* disk/tape compartments that we'll gladly custom configure for you at the factory. No matter what your application, we can tailor fit a CompuStar to match it precisely.

CPU MODULES ARE INTERCHANGEABLE.

IT'S NUMBER ONE RATED.

If you're thinking a computer with as much flexibility as CompuStar would have to compromise *something,* like performance — think again. The CompuStar is one of the fastest, most powerful systems available. In fact, CompuStar's performance and flexibility so impressed *InfoWorld* magazine they gave it the highest rating of all hardware products tested in 1988! That's astonishing when you consider you can buy a CompuStar for *thousands* of dollars *less* than a comparably equipped system from IBM or Compaq.

If you're shopping for the next generation in personal computers, why not call us today at 803/796-7800 to arrange an on-site no obligation 30 day CompuStar® trial in your office.* Relatively speaking, it's the only *sensible* thing to do.

Wells American.

Circle 288 on Reader Service Card (DEALERS: 289)

Corporate Headquarters: 3243 Sunset Boulevard • West Columbia, SC 29169 • 803/796-7800 • FAX 803/796-7029

[1]Personal Computer AT, AT, PS/2 and IBM are trademarks of International Business Machines Corporation. [2] MCA is a trademark of IBM.
*Some restrictions may apply. Call us for details on our trade-in and total customer satisfaction programs.

Top Performers.

H.I.M.S. 386SX/16 MHz

- INTEL 80386SX MICROPROCESSOR RUNNING AT 16 MHz
- SOCKET FOR 16 MHz 80387SX MATH COPROCESSOR
- 5.25" 1.2 MB OR 3.5" 1.44 MB DISKETTE DRIVE
- DUAL DISKETTE AND HARD DISK DRIVE CONTROLLER (1:1 INTERLEAVE)
- 1 MB 80 NS MEMORY (OR 2 MB, 4 MB EXPANDABLE TO 16 MB)
- 40 MB HARD DISK 38 MS, 800 KB DATA TRANSFER RATE
- HI-SPEED 2 SERIAL PORT(S), 1 PARALLEL PORT
- 101 ENHANCED TACTILE "CLICK" TOUCH KEYBOARD
- 200 WATT SWITCHING POWER SUPPLY
- 8 EXPANSION SLOTS (2=FAST SLOTS/8 BIT, 1=8BIT, 5=16 BIT)
- HI-PERFORMANCE 16-BIT VGA CARD (800 x 600) OR OPTIONAL (1024 x 768)
- 6 LAYER H.I.M.S. (U.S.A.) MOTHER BOARD
- LATEST AMI 386 BIOS (BUILT-IN DIAGNOSTICS, SETUP, AND HARD DISK FORMATTING UTILITY SOFTWARE)
- 10 YEAR BATTERY WITH CLOCK CALENDAR
- DISK CACHE AND EMS UTILITY SOFTWARE
- H.I.M.S. SMALL FOOT PRINT, 4 BAYS CASE

$1895

HIMS 386SX 16 MHz WITH NO MONITOR

HARD DISK DRIVE	1 MB	2 MB	4 MB
66 MB 22 MS (800KB DTR)	1995	2150	2395
100 MB 22 MS (800KB DTR)	2195	2375	2595
120 MB 28 MS ESDI 1MB DTR	2650	2795	3050

H.I.M.S. PAGE MODE SERIES 16 AND 20 MHz 386

- INTEL 80386 MICROPROCESSOR RUNNING AT 16 MHz (OR 20 MHz)
- SOCKET FOR 20 MHz INTEL 80387 OR 20 MHz WEITEK 3167 MATH COPROCESSOR
- 5.25" 1.2 MB OR 3.5" 1.44 MB DISKETTE DRIVE
- DUAL DISKETTE AND HARD DISK DRIVE CONTROLLER (1:1 INTERLEAVE)
- 1 MB OR (4 MB OPTIONAL) 80 NS PAGE MODE MEMORY
- 66 MB 23 MS HARD DISK, 800 KB DATA TRANSFER RATE
- HI-SPEED 2 SERIAL PORT(S), 1 PARALLEL PORT
- 101 ENHANCED TACTILE "CLICK" TOUCH KEYBOARD
- 230 WATT POWER SUPPLY (110/220) FCC, UL, CSA, TUV APPROVED
- 8 EXPANSION SLOTS (2=32/8-BIT, 1=8-BIT, 6=16-BIT)
- HI-PERFORMANCE 16-BIT VGA CARD (800 x 600) OR OPTIONAL (1024 x 768)
- 6 LAYER H.I.M.S. (U.S.A.) MOTHER BOARD
- LATEST AMI 386 BIOS (BUILT-IN DIAGNOSTICS, SETUP, AND HARD DISK FORMATTING UTILITY SOFTWARE)
- 10 YEAR BATTERY WITH CLOCK CALENDAR
- DISK CACHE AND EMS UTILITY SOFTWARE
- 5-BAY STURDY DESKTOP CASE (6 BAY VERTICAL CASE OPTIONAL)
- FCC CLASS B ON TOWER & DESKTOP

$2295 ADD $150 FOR 20 MHz

HIMS PAGE MODE 386/16 MHz WITH NO MONITOR

HARD DISK DRIVE	1 MB	4 MB
100 MB 22 MS 800 KB DTR.	2395	2895
120 MB 28 MS 1 MB DTR. ESDI	2750	3250
150 MB 16 MS 1 MB DTR. ESDI	3095	3595
330 MB ESDI 14 MS 1 MB DTR.	3950	4450

H.I.M.S. PROFESSIONAL SERIES CACHE PRO 386 20, 25 AND 33 MHz

- INTEL 80386 MICROPROCESSOR RUNNING AT 20 MHz (OR 25 AND 33 MHz OPTIONAL)
- SOCKET FOR 80387 OR WEITEK 3167 MATH CO-PROCESSOR
- 64 K 25 NS CACHE UPGRADEABLE TO 256 K, READ AND WRITE CACHE WITH WRITE BACK CACHE
- PAGE MODE MEMORY ARCHITECTURE
- 1 MB 80 NS MEMORY UPGRADEABLE TO 2, 4, 8 MB ON MOTHER BOARD, 16 MB WITH 32-BIT MEMORY CARD
- 5.25" 1.2 MB OR 3.5" 1.44 MB DISKETTE DRIVE
- DUAL DISKETTE AND HARD DISK DRIVE CONTROLLER, 1:1 INTERLEAVE
- HI-SPEED, 2 SERIAL, 1 PARALLEL PORT
- 250 WATT HEAVY DUTY POWER SUPPLY
- 101 ENHANCED TACTILE "CLICK" TOUCH KEYBOARD
- 8 EXPANSION SLOTS (1=32 BIT, 1=8 BIT, 6=16 BIT)
- LATEST AMI 386 BIOS (BUILT-IN DIAGNOSTICS, SETUP, AND HARD DISK FORMATING UTILITY SOFTWARE)
- HIGH PERFORMANCE 16-BIT VGA CARD (800 X 600) OR OPTIONAL (1024 X 768)
- 6 LAYER H.I.M.S. 64/256 CACHE MOTHER BOARD
- 66 MB 23 MS HARD DISK 800KB DATA TRANSFER RATE.
- 6 BAY VERTICAL OR 5 BAY DESKTOP CHASIS (SUPER VERTICAL 10 BAY WITH 375 WATT POWER SUPPLY OPTIONAL)
- FCC CLASS B ON DESKTOP OR TOWER
- DISK CACHE, EMS UTILITY SOFTWARE

20 MHz $2695 • 25 MHz ADD $495 33 MHz ADD $1295

CACHE PRO 386/20 MHz WITH NO MONITOR

HARD DISK DRIVE	1 MB	4 MB
100 MB 22 MS 800 KB DTR.	2950	3495
120 MB (ESDI) 28 MS 1 MB DTR.	3350	3895
150 MB (ESDI) 16 MS 1 MB DTR.	3695	4450
330 MB (ESDI) 14 MS 1 MB DTR.	4550	5150

COMPANY

H.I.M.S. TECHNOLOGIES has been manufacturing hi-performance computers in California under private label for a number of years; and now H.I.M.S. is manufacturing under its own label the same hi-performance computers, 286, 386SX, 386 Page Mode and Cache 386 to satisfy your needs in price, performance and after the sale service, which seems to be a missing feature with most of our competitors. Just compare our competition and you will find the obvious, then add our One Year On-Site Service at no extra cost.....SURPRISE!!

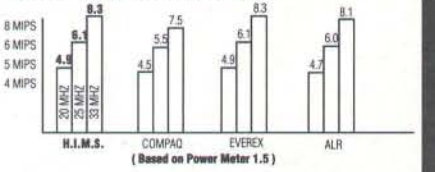
PRODUCT

H.I.M.S. manufactures a complete breadth of 286, 386SX, Page Mode 386 and Cache 386 systems. H.I.M.S. is the only company currently supplying the industry with 386 Cache Pro in verticle, super verticle or desktop with FCC Class "B" approval. How about our 256K Write Back Cache Design at down to earth pricing? You can actually afford the high speed luxury! All the H.I.M.S. Systems can be custom configured to fit your needs, so call our expert sales executives to discuss your specifications. All H.I.M.S. Systems come assembled, tested and burned-in from the Factory for 72 hours at 60º Centigrade. The Hard Disk is pre-compsurfed and formatted. H.I.M.S. carries a wide variety of options like: Video Cards for CAD/CAM and desktop publishing, printers, monitor's 14" to 25", Opto magneto drives, math coprocessors, ploters, pointing devices and software.

SERVICE

All H.I.M.S. computers come with a One-Year On-Site Service included. This gives you an immediate back-up just in case a problem may arise a technician can be in your location within 4 to 8 hours from our 414 service locations, including Puerto Rico and Canada.
All products are made in the U.S.A.!!!

H.I.M.S. TECHNOLOGIES is the Price, Performance and after sales service leader in the Fast Group.



(Based on Power Meter 1.5)

800-367-2924

H.I.M.S. TECHNOLOGIES
368 Montague Expressway • Milpitas, CA 95035
Phone: (408) 946-9711 • FAX: (408) 946-9744

IBM, COMPAQ, ALR, EVEREX, UNIX, XENIX, NOVELL ARE TRADEMARKS OF THEIR RESPECTIVE COMPANIES.

Circle 125 on Reader Service Card

Rock Solid. HIMS TECHNOLOGIES

OCCAM II

Companion and counterpart of the INMOS transputer, the Occam II programming language is designed for parallel processing

Dick Pountain

In the fourteenth century, the English philosopher/monk William of Occam gave science his famous "Occam's razor" principle, which states that assumptions should be kept to the minimum (or the simplest explanation is best). The literal translation of the Latin *Entia non sunt multiplicanda praeter necessitatem* is "Entities should not be multiplied beyond necessity," which is still good advice even now in the era of floating-point coprocessors.

In the 1980s, INMOS introduced the transputer, a high-speed microprocessor designed for parallel processing. With it came Occam, the programming language designed especially for parallel programming on the transputer. Occam II is the latest version of Occam.

An Occam Machine

INMOS developed Occam and the transputer together in a way that few hardware/software combinations have been developed before. The transputer's hardware features (e.g., the on-chip serial links) were chosen to support the Occam model of concurrency, and the instruction set was devised to optimize execution of Occam programs. In turn, the features of the Occam language compiler were shaped by the hardware operations and performance, given the state of VLSI technology in the early 1980s. Although the transputer is perfectly capable of running programs written in C, FORTRAN, Pascal, or assembly language, it is an "Occam machine" in a real sense. To be more precise, the transputer embodies in hardware the Occam model of computation.

The Occam Philosophy

Since their inception in the 1940s, digital computers have been rather "introverted" entities. John von Neumann's great insight that a single memory space can hold both the data and the program that manipulates the data has governed the design of all computers to this day and, indirectly, of programming languages as well. A digital computer carries out its processing activity in the small enclosed world of its RAM space. The outside world impinges only by exceptional means. The single-closed-world concept is the essential simplification that has allowed the science of computing to flourish so remarkably over the last 40 years. Only now is the computing community in a position to risk stepping away from it.

The demand for computing power, driven by applications like weather forecasting, real-time three-dimensional graphics, and numerical simulations, is growing exponentially. The pursuit of this extra power has made it clear that the basic von Neumann concept can be pushed only so far. The idea of a single (faster and faster) processor talking to a single (larger and larger) memory no longer has validity; the processor spends more time fetching instructions and data than it does processing. The speed of the bus that connects the memory and the processor has become a crucial bottleneck. Ever more elaborate layers of caching only postpone the inevitable crunch. It is generally agreed that the way to greater power and performance involves splitting up computations so they run on more than one processor concurrently—in other words, parallel processing. (See the In Depth section of the November 1988 BYTE.)

Unfortunately, while the von Neumann architecture has allowed the industry to make enormous strides in hardware optimization, it has also restricted the evolution of programming languages for distributed networks of processors. Conventional programming languages assume that the data is stored in main memory (if the data is stored externally, on magnetic disk, it must be brought into memory before it can be used). Languages like C and Modula-2 don't even have I/O instructions in their core language. They implement I/O operations as separate library routines. I/O instructions tend to be different in kind from the arithmetic and logical instructions that perform the processing. They frequently display complicated, ad hoc semantics imposed by the idiosyncrasies of communicating with external devices. What's more, the instructions for disk I/O are

continued

often different from those for screen I/O or serial port I/O. Consider, for example, the contortions involved in establishing an RS-232C link in BASICA.

The von Neumann architecture has also constrained programming language design in another way. It assumes a single processor sequentially executing a single list of instructions from the main memory. The most widely used programming languages display this assumption in their design fundamentals. Some languages, such as Modula-2, have added features to support concurrent execution, but, except perhaps in the case of Ada, these features feel more like optional extensions than integral parts of the language. When writing a concurrent program in these languages, the programmer often must become involved in the detailed mechanism of process synchronization.

Interprocess Communication and Concurrent Execution

In Occam the concepts of communication and concurrent execution are built into the core of the language itself rather than tacked on as afterthoughts. David May designed Occam at the INMOS research center in Bristol, England. Professor Tony Hoare of Oxford University greatly influenced the design of the Occam channel through his seminal paper "Communicating Sequential Processes" (*Communications of the ACM*, 1978). The key idea of CSP is that parallel computations can be implemented by a number of purely sequential von Neumann machines communicating with each other over a network of self-synchronizing channels.

The CSP idea infuses both the transputer hardware and the Occam language. The transputer acts as a whole computer-on-a-chip, complete with memory and four fast serial communication links. A network can be constructed by joining the links of several chips together. These links run concurrently with the main processor and have built-in hardware handshaking for synchronization. The transputer hardware also features an efficient time-slicing process scheduler that lets multiple processes run on the same chip. As I'll show below, it is crucial to the design that the same multiple processes can run *either* on multiple transputers *or* on a single one. (See "T800 and Counting," November 1988 BYTE, for more information on transputer hardware.)

In Occam, the abstract concepts of a *process* and a *channel* are equivalent to the elements of the CSP model; that is, the programmer can build closely linked multiprocessor networks by linking processes with channels. Occam channels support the underlying handshaking mechanism of the transputer *links* in a way that is totally transparent to the programmer. The crucial point is that an Occam program makes no initial assumptions about the actual hardware network it will run on. An Occam channel can eventually be implemented either as a real transputer link joining the separate memory spaces of two processors or as a shared memory location on the same processor without altering the program's logic. When coding a parallel-process algorithm, you can concentrate solely on getting the logic correct and ignore hardware issues.

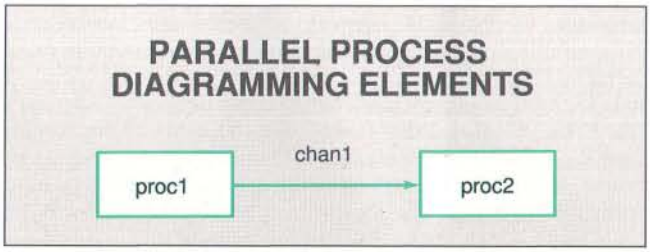


Figure 1: *A process diagram of the simple program structure where* `proc1` *communicates to* `proc2` *through* `chan1`.

Multiprocessor development can actually take place on a single transputer. When the program logic is correct, you can map it onto a real network of transputers (of sufficient number to achieve the required performance) without altering its logical behavior. This intimate connection between Occam and the transputer hardware has given rise to much confusion about how "high-level" a language Occam is meant to be. I have devoted a section below to this issue.

Processes and Channels

The fundamental program element in Occam is the *process*. By definition, "a process starts, performs actions, and then terminates." This sounds very much like the definition of any computer program, but it forces you to think about things normally taken for granted, such as what is meant by "terminates." An Occam program can consist of many concurrent processes, and they can all terminate at different times; indeed, some may not terminate at all.

In Occam, there are only three primitive actions that a process can perform—namely, *assignment*, *input*, and *output*. Assignment is the same as it is in BASIC, C, or Pascal: It changes the value of a variable:

```
fred := 2 + x
```

Input and output involve passing a value to or from a *channel*. Channels are program entities that behave in some ways like variables; for example, they have a name and a type and must be declared before use (Occam II is a strongly typed language). A channel connects exactly two processes in only one direction; a bidirectional connection requires two channels. If a channel, `chan1`, connects two processes, `proc1` and `proc2`, that are running in parallel, then `proc1` may contain an output statement like this:

```
chan1 ! fred + 3
```

This means "output the value of variable `fred + 3` on the channel `chan1`." The process `proc2` may contain an input statement like this:

```
chan1 ? tom
```

which means "input from channel `chan1` to the variable `tom`."

At first, it may help to think of input and output over channels as a way of assigning a value to a variable in another process. The net effect of the two statements above is rather like `tom := fred + 3`, except that `tom` exists inside a different process from `fred`. Shared global variables are forbidden in Occam. If a variable is assigned in process A, Occam will not allow you to use that variable in any other process running in parallel with A. (Compiler checks enforce this prohibition.) The only legal way to transfer a value from one parallel process to another is via a channel. You use variables only to store values, not transfer them. The rationale for this should become clear after some reflection. Logically it is the same problem as that of several users on a LAN accessing the same file—without record locking, chaos results. Occam uses the channel communication process instead of variable locking.

Both input and output processes are "patient"—that is, each will wait until the other is ready. So it is immaterial whether `proc1` reaches its output statement before or after `proc2` reaches its input statement; whichever arrives first waits for the

other. A parallel Occam process runs completely asynchronously (i.e., at its own speed) until it must communicate with another process, at which point the two processes are forced into step while they exchange data, after which they go their separate ways again. Basically, this is the same idea as the "rendezvous" in Ada, but in Occam it is implicit and totally transparent to the programmer.

Because channels and processes are so fundamental to Occam, it's often useful to draw process diagrams that describe a program's structure rather than flowcharts. Figure 1 shows how you might diagram the simple situation described above.

Because Occam permits parallel execution, sequential execution cannot be taken for granted as it is in ordinary languages.

Occam Programs

Occam programs are built up from the three primitive processes just described (i.e., assignment, input, and output) by combining them into more complex processes. Or, looking at it the other way around, Occam lets you hierarchically decompose a problem into a collection of concurrent processes communicating via channels.

The syntax of Occam looks fairly conventional to anyone who is used to Algol-derived languages such as Pascal. Only two things immediately stand out as being unusual. First, Occam uses indentation not just for increased readability, as in C and Pascal, but also as the sole delimiter of subprocesses; there is no equivalent of BEGIN...END or {..}. Second, because Occam permits parallel execution, sequential execution cannot be taken for granted as it is in ordinary languages. In Pascal or BASIC, if you write statements one after the other, you expect them to be executed one after the other. In Occam, if you want a sequence, you have to ask explicitly for a sequence. Suppose you have three processes called A, B, and C. Then, in the Occam construct

```
SEQ
  A
  B
  C
```

indenting A, B, and C by two spaces under the keyword SEQ, defines a compound process consisting of the sequence A followed by B followed by C. This process terminates when C terminates, much as in BASIC or Pascal. However, if you say

```
PAR
  A
  B
  C
```

you have specified a new process consisting of A, B, and C running *at the same time*. This process terminates when the slowest of A, B, and C terminates. You neither know nor care which process that may be. The simple communication example above looks like this when fully declared in Occam:

```
CHAN OF INT chan1:
INT fred, tom, jane:
PAR
  SEQ
    fred := 3
    chan1 ! fred + 2
  SEQ
    chan1 ? tom
    jane := tom * 20
```

The channel chan1 is declared to be able to carry integer values only (i.e., of type INT), and INT is said to be its protocol. This program results in fred=3, tom=5, and jane=100. Had you tried to use fred in the second SEQ as well, the compiler would have reported an illegal shared variable in a PAR. You could instead have declared the variables as local to their SEQs, in which case the problem can't even arise:

```
CHAN OF INT chan1:
PAR
  INT fred:
  SEQ
    fred := 3
    chan1 ! fred + 2
  INT tom, jane:
  SEQ
    chan1 ? tom
    jane := tom * 20
```

As a rule in Occam, it's best to keep all data local unless there's a pressing reason not to. You can name processes and give them parameters just as in C or Pascal, so you can go on to say

```
CHAN OF INT chan1:
PROC proc1(INT x)
  INT fred:
  SEQ
    fred := 3
    chan1 ! fred + x
:
PROC proc2(INT y)
  INT tom, jane:
  SEQ
    chan1 ? tom
    jane := tom * y
:
PAR             -- main process starts here
  proc1(3)
  proc2(20)
```

Other Control Processes

In Occam, you have several other ways of combining primitive processes besides PAR and SEQ—for example, IF, WHILE, CASE, and ALT. The conditional process IF executes the first process whose test is true. The selection process CASE operates similarly but uses literal selector values instead of tests. WHILE provides a conditional loop like that of C and Pascal. The most interesting control process of all is ALT, the alternative process, which has no equivalent in sequential languages. Consider the following program fragment:

continued

```
ALT
  right ? x
    out ! x
  left ? x
    out ! x
```

The ALT process watches channels left and right and executes the subprocess associated with whichever one produces a result first; it's like a first-past-the-post race between the channels. Here, the subprocess is the same for both, merely outputting the received value on the single channel out. If you iterate the ALT process, it has the effect of merging or time-multiplexing two input streams into one output stream. The process below merges two streams of complex numbers until you stop it by sending the Boolean value FALSE on channel shutoff:

```
PROTOCOL COMPLEX IS REAL64;REAL64:
PROC merge(CHAN OF COMPLEX right,
           left, out;
           CHAN OF BOOL shutoff)
  REAL64 x.real, x.imag:
  BOOL running:
  SEQ
    running := TRUE
    WHILE running
      ALT
        shutoff ? running
          SKIP
        right ? x.real; x.imag
          out ! x.real; x.imag
        left ?  x.real; x.imag
          out ! x.real; x.imag
:
```

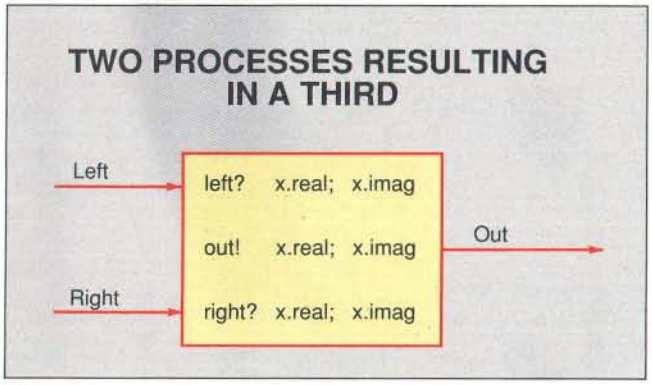


Figure 2: *A process diagram of two input streams multiplexed into a single output stream. The Boolean value* FALSE *on channel* shutoff *will terminate the program.*

Table 1: *Occam II supports a full range of type conversion and IEEE rounding and the following data types:*

BYTE
INT (size defined by executing hardware)
INT16
INT32
INT64
REAL32
REAL64
BOOL

Figure 2 shows the process diagram for this example.

This process illustrates several further points about Occam: It supports a 64-bit ANSI/IEEE floating-point data type REAL64 (other supported data types are shown in table 1); channels can have structured rather than simple protocols; more than one variable can be changed by a single input or output; although Occam has structured channel protocols, it does not have corresponding structured variables or records, so a sequence of simple variables has to suffice.

Arrays

Occam supports arrays of both processes and channels in addition to plain data arrays. An array of SEQ processes is just a way of describing a counted loop similar to Pascal's for loop. To illustrate, here's a process that prints strings to a screen:

```
PLACE screen AT 8:

PROC writestr(CHAN OF BYTE stream; VAL []BYTE
      string)
  SEQ i := 0 FOR SIZE string
    stream ! string[i] : SEQ
  writestr(screen, "Hello world!")
```

SIZE is a built-in Occam function that returns the size of an array. Note that Occam does not support separate character or string types but treats them as bytes and arrays of bytes. The process uses PLACE to make *screen* a physical hardware channel (see below).

An array of PAR processes is a central construct in the Occam style of programming. It describes a pipeline of processes in which you can pass data from one process to another and subject it to the same operation at each stage. The simplest example of the use of such a "replicated" PAR is to implement a queue or buffer structure such as this terminal type-ahead buffer:

```
[21]CHAN OF BYTE buffer:
PROC keyboard.input()
  WHILE TRUE
    BYTE char:
    SEQ
      keyboard ? char      -- get a character from
                              the keyboard
      buffer[0] ! char     -- put it into the
                              pipeline
:
PROC terminal.output()
  WHILE TRUE
    BYTE char:
    SEQ
      buffer[20] ? char    -- get a character from
                              the pipeline
      screen ! char        -- display it
:
PROC type.ahead()
  PAR i := 0 FOR 20        -- 20 parallel
                              processes
    WHILE TRUE             -- all like this...
      BYTE char:
      SEQ
        buffer[i] ? char       -- pass the
                                  character
                                  on to...
        buffer[i+1] ! char     -- ...the next stage
:
```

```
PAR
  keyboard.input()
  type.ahead()
  terminal.output()
```

The main process, type.ahead, is a replicated PAR that simply passes characters along the line of channels called buffer from the keyboard input process to the screen output process. All three processes run in parallel. The buffer is self-regulating thanks to the nature of Occam channel communication; it can't overflow or underflow but waits patiently in either case.

You can use an array of parallel processes for parallel sorting, vector arithmetic, or graphics ray tracing by performing computations on the data rather than just passing it along. Of course, to reap any performance benefit, you must assign a physical processor to each component of the replicated PAR, although you can develop and test the program by time slicing on a single processor.

Real-Time and Hardware Matters

Once you have debugged an Occam program to the point where the logic is correct, you can turn to matters of configuration and performance. Occam provides the means to assign processes to physical transputers and channels to physical transputer links. It also supports I/O ports (so you can write device drivers for conventional peripheral chips) and the absolute location of program objects in memory (for memory-mapped devices).

You use the keywords PLACE and PLACED to associate channels and processes with physical devices. The body of a pipelined ray-tracing program may contain declarations of this kind when configured to run on several transputers:

```
VAL number.transputers IS 50 :
PROTOCOL PIXELPACK IS INT::[]INT :
[number.transputers]CHAN OF PIXELPACK forward,
        return :
........

PLACED PAR i := 0 FOR number.transputers
  PROCESSOR i T8
    PLACE forward[i]   AT link0in :
    PLACE forward[i+1] AT link1out:
    PLACE return[i]    AT link1in :
    PLACE return[i]    AT link0out:
    calculate(forward[i], forward[i+1],
        return[i], return[i+1])
```

The user-defined process calculate performs ray-tracing computations on batches of "raw" pixels that are sent outward on the array of channels named forward; the processed results are sent back along the return channels. The protocol PIXELPACK is a 16-bit count followed by an array containing that number of 16-bit pixels. The PLACED PAR assigns an array of 50 parallel calculating processes to a pipeline of 50 T800 transputers (PROCESSOR i T8), and the PLACE statements assign the Occam channel names (forward[i], and so on) to real transputer links (link1in, and so on). Figure 3 diagrams this process.

I have simplified this example drastically—a real ray-tracing program is much more complex. You can also use PLACE to put variables or arrays at absolute memory addresses, just like absolute variables in Turbo Pascal.

Performance in Occam programs is not just a matter of the number of processors employed; process priority can become an issue, too. In general, Occam discourages the use of priority, preferring to allow channels to self-synchronize. Although you can develop most programs without prioritization, it may become unavoidable in real-time applications. The keyword PRI can be applied to both PAR and ALT processes to establish one component's priority over all the others. Thus, in

```
PRI PAR
  A
  B
  C
```

process A has priority, and processes B and C can proceed only when A is waiting on an input or output. A good example of the use of a PRI ALT is to mix a stream of serial data from a UART chip with data from an Occam channel; the UART is an "impatient" external device that can lose data if kept waiting:

```
TIMER clock:
... more declarations
SEQ
  clock ? time              -- get start time
  WHILE active
    SEQ
      time := time PLUS interval
      PRI ALT
        clock ? AFTER time -- is it time to check
                              the UART yet?
          SEQ
            get.UART(char)
            to.buffer ! char
        source ? char       -- otherwise get from
                              channel
          to.buffer ! char
```

The user-defined process get.UART checks the UART's status register and gets a character if one is ready; clock demonstrates another kind of Occam object, a timer that acts like a channel that delivers the current time. The operators PLUS and AFTER are used to do modulo arithmetic on time values. The value of interval would be set just short of the shortest possible time in which a new serial character can arrive (that time, in seconds, is about 10 divided by the baud rate). Thus, processor time is not wasted in a "busy wait" when no UART data is due.

Limitations of Occam

There has been much misunderstanding about how high-level the Occam language is. Occam is very intimately linked to the transputer instruction set, to the point where many Occam constructs compile to single instructions. In fact, INMOS intended Occam to be the assembly language of the transputer, the lowest level at which it can be programmed. Some assemblers are now available for the transputer, but parallel assembly pro-

continued

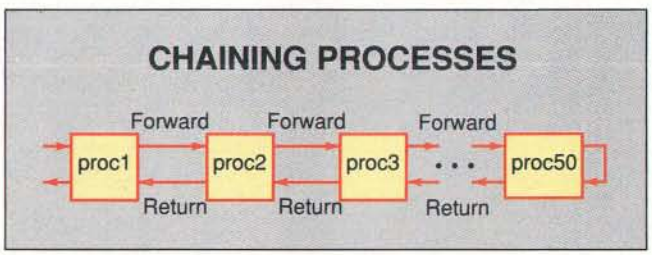


Figure 3: *A simplified diagram of ray tracing using 50 parallel T80 transputers.*

Protects while you type!

- **Remains in Place** while you use your computer.
- **Avoids Costly Repairs.** Protects delicate electronics from dust, spills, smoke, ashes, staples.
- **Soft, Flexible,** retains normal keyboard feel.
- **Washable, Durable High-Tech Polymer** lasts years.
- **Hundreds of Models.** SafeSkin is available for most PCs, laptops, workstations and clone keyboards.
- **Office • Home • Factory • Classroom • Laboratory**

List Price $29.95. Please call or write for free color brochure. Dealer inquiries encouraged.

SafeSkin™
KEYBOARD PROTECTOR

Merritt Computer Products, Inc. 5565 Red Bird Center Drive
Suite 150, Dallas, Texas 75234/(214) 339-0753 • FAX (214) 339-1313
In Canada call 1-800-663-1061

W&T interfaces are so small that they match the following office furniture perfectly:

Stuart,
Victorian,
European,
Chinese,
Italian,
...

If interfaces don't match, that doesn't mean you have to start tinkering. W&T interfaces are almost invisible because they're integrated into the connector and look like a regular data cable or a stylish pocket calculator. Built-in simplicity and brief but fully detailed instructions ensure straightforward installation.

PC & UNIX compatible products. Bus System, Error Correction, Interfaces, Line Drivers, Optical Isolators, Printer Buffers, T-Switches. 20mA, C64, Centronics, IEEE488, RS232, RS422, 410, 485, Monitor

Wiesemann & Theis
Winchenbachstr. 3-5
D-5600 Wuppertal 2
West Germany
Tel.:++49 202 505077
Fax:++49 202 511050

(A) Basic Merton (0222) 9736360 (B) Brother Int. (02) 4674211 (CAN) Sicotel (416) 670 1650 (CH) Weber & Co (01) 9302003 (D) Wiesemann & Theis (0202) 505077 (DK) Jatec (86) 479139 (F) Neol 88.62.37.52 (IS) Thor (01) 681500 (MEX) Telsa 5184500 (N) RamTec (09) 224620 (NL) Cal & Korsh (010) 4507696 (SF) Moretec (9)1626812 (SGP) Overseas Trade 2726077

W&T INTERFACES®

gramming is strictly for heroes. Viewed as an assembly language and compared to 8086 or 68000 assembly languages, Occam is very high-level indeed. But compared to Pascal or C, it is rather low-level, lacking, for example, record types and structures. Moreover, it is a static language (like FORTRAN), in which all the resources a program needs must be known and allocated at compile time. This means that it does not support a stack or a heap and so does not permit recursive procedures.

This was a deliberate, if radical, design decision by INMOS. The transputer was not designed to compete head-on with the Intel and Motorola chips as a general-purpose single CPU, but rather to be a programmable component for very high-performance parallel applications, often of the embedded type. Typical transputer applications have been distributed control systems, laser printer engines, graphics processors, image-processing arrays, and signal processors. For such applications, Occam needs to be efficient and secure. It must also be capable of running without an operating system, on the raw hardware, and, perhaps, using only the on-chip memory.

It would have been possible to make Occam a stack-based, block-structured language like C, but then every parallel process would have to have its own stack, which requires a dynamic memory-allocation scheme (like that in Unix) for which the transputer provides no hardware support. Such schemes mean large memory overheads and degraded context switching; a raw Occam process can be switched in about 1 microsecond compared to about 100 microseconds for Unix tasks.

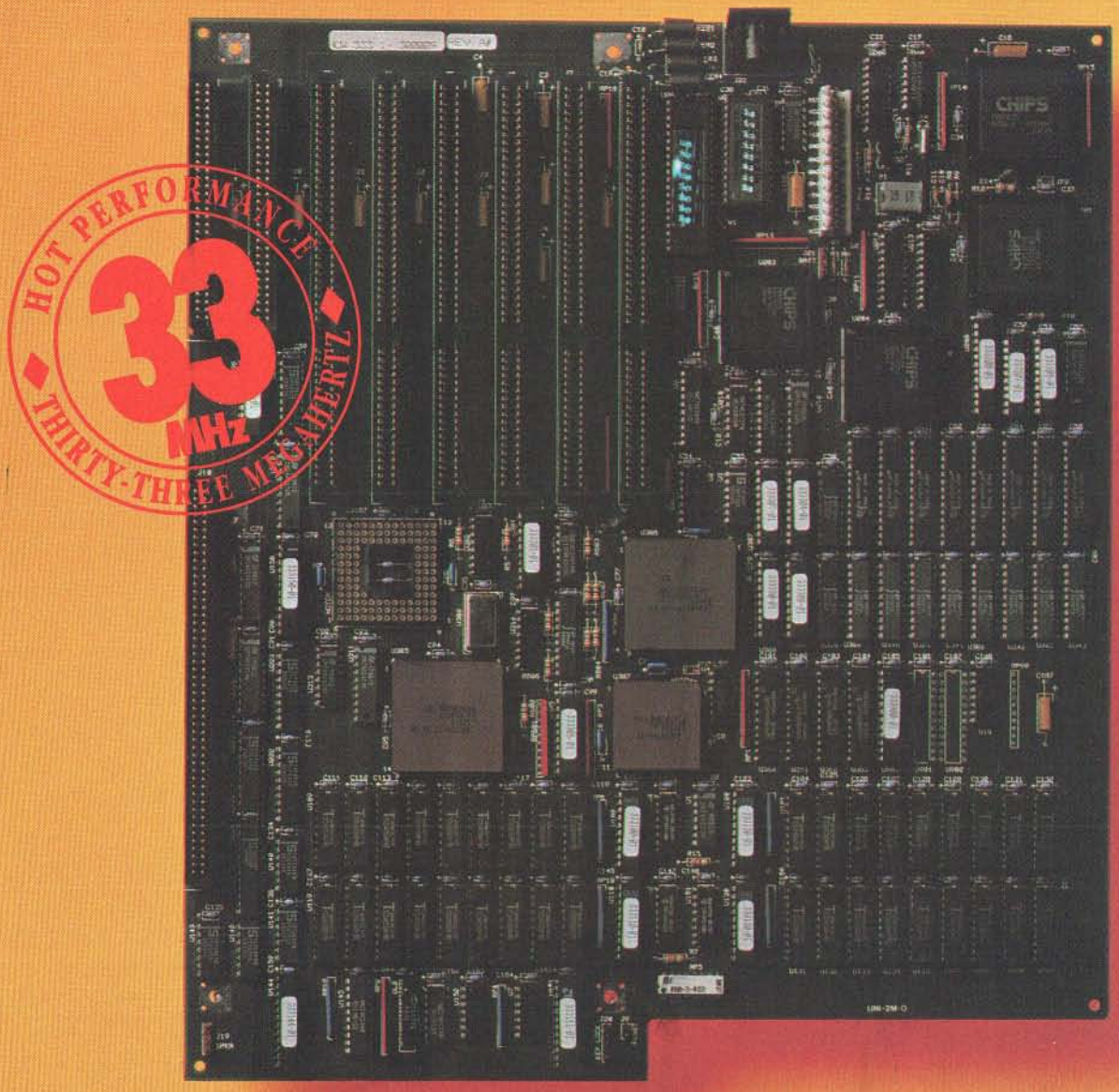
Another point is that the static nature of Occam allows compiler checks to catch most logic errors (apart from deadlock) at compile time while reducing the number of possible run-time errors and making them cheaper to detect—important benefits for high-security applications. It seems likely that transputer users will be split into two camps for some time. Some will want a fuller operating system, such as the Helios system (see "A Personal Transputer," June 1988 BYTE). They'll also want a C compiler but will be prepared to accept reduced performance. Others will need the minimalism of Occam. Eventually, the camps could be reunited if INMOS is ready to produce a dynamic version of Occam when the next generation of transputers provides the needed hardware memory management.

A "Novel Calculus"

These few examples, I hope, have conveyed some of the feel of Occam programming. Designing Occam programs is certainly different from designing sequential programs; often it is more like designing electronic circuits where you "wire" together a number of active components, the wire being channels and the components being parallel processes.

While Occam is a safe, elegant, and efficient way to program transputer networks, it is also something more; it's a novel calculus or way of thinking about concurrent systems. The clean syntax of Pascal has made it the textbook language in which to express sequential algorithms. I believe that Occam can fulfill the same role for parallel algorithms. Occam has well-defined algebraic semantics that allows accuracy-preserving transformations to be performed on program text. INMOS design engineers have used a specification written in high-level Occam, via a transformation system, to verify the accuracy of the microcode that implements the FPU of the T800 transputer. In future designs for hardware, this microcode may be "compiled into silicon" from the Occam descriptions. ■

Dick Pountain is a BYTE consulting editor, technical author, and software consultant living in London, England. You can contact him on BIX as "dickp."



IT Hz SO GOOD!

INTRODUCING HAUPPAUGE'S 33MHz SYSTEM BOARDS.
If your computer feels slow, we know where it hertz. For a fast cure, get our new 386 MotherBoard/33MHz. We've built in 4 Megabytes of high speed RAM, 64K of RAM cache, and both 387 Weitek math coprocessor sockets. This board makes your 386 computer the fastest PC available!

Network Savvy. With the 386 MotherBoard/33MHz, you can build a file server or workstation that makes Novell networks *scream*. Enjoy compatibility with Token Ring, Arcnet, Ethernet, and other network cards.

The UNIX Engine. Great for VARS, Systems Integrators and UNIX OEMs, the Hauppauge 386 MotherBoard/33MHz runs SCO Xenix, Interactive 386/ix and AT&T's UNIX System V. With its PC/AT compatible I/O system, our 33MHz board accommodates the latest in disk control, graphics, and network I/O cards.

CAD Capability. Do your AutoCAD and other CAD programs seem slow? The 386 MotherBoard/33MHz boosts your math and graphics applications, and supports the high speed 387-33 and 33MHz Weitek math coprocessors.

Technical Features. The 386 MotherBoard/33MHz includes:
▪ 4 Megabytes of high speed 32-bit memory, expandable to 64 Megabytes ▪ 64K of 20 nsec cache memory ▪ Six 16-bit expansion slots, one 8-bit and one 8-bit/32-bit slot ▪ PC/AT compatible I/O system for support of OS/2 and UNIX.

Trademarks: IBM PC, XT, AT, PS2 and OS/2: IBM. Intel 386: Intel Corp.; Windows/386: Microsoft Corp. DESQview: Quarterdeck

Yes, send me your product information!

Name_____

Company_____

Address_____

City, State, Country_____

Telephone_____ Zip Code_____

Mail Coupon to:

Hauppauge Computer Works, Inc.
175 Commerce Drive
Hauppauge, New York 11788, U.S.A.
Tel: 01-516-434-1600
Fax: 01-516-434-3198

or:

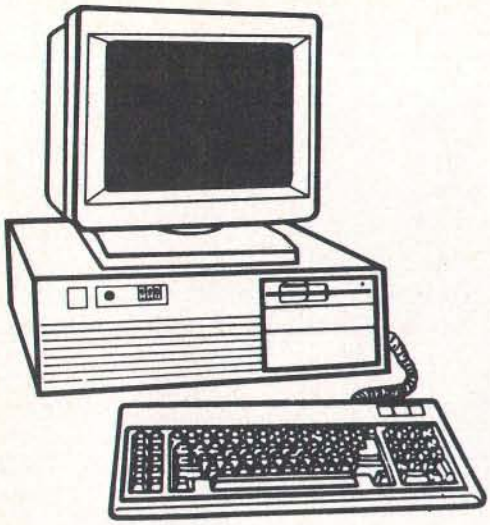
Hauppauge Computer Works, GmbH
Hansaallee 201
4000 Dusseldorf 11, West Germany
Tel: 0211-594320
Fax: 0211-593908

For more information call Hauppauge, (516) 434-1600. In Europe: (49) 211-594320.

Hauppauge!

Hauppauge Computer Works
Your high performance 386 Supplier

Circle 303 on Reader Service Card



S Systems 10 MHz XT

- Intel 8088-1 CPU
- Phoenix BIOS
- 640K on board
- TEAC 360K floppy drive
- Multi I/O w/1P, 1S, 1G, fdc, clock
- Enhanced 101 key keyboard
- XT style case
- 165W power supply

XT/10 Drives	Video Options Mono	CGA	EGA	VGA
Single	650	775	1045	1115
Dual	675	855	1125	1195
20MB	975	1150	1425	1495
40MB	1125	1305	1575	1645

S Systems 286/12

- Intel 80286-12 CPU
- Ami or Phoenix BIOS
- 1MB RAM on board
- TEAC 1.44 3.5" floppy drive
- Hard/floppy drive controller
- Enhanced 101 key keyboard
- Baby AT style case
- 200W power supply
- Multi I/O card w/1P, 2S ports

AT 286-12 Drives	Video options Mono	EGA	VGA
Single	855	1305	1375
20MB	1190	1640	1715
40MB	1345	1795	1865

S Systems 286-16

- Intel 80286-16 CPU
- Award BIOS
- 1MB RAM on board
- TEAC 1.44MB floppy drive
- Hard/floppy drive controller
- Enhanced 101 key keyboard
- Baby AT style case
- 200W power supply
- 1P, 1S Port

AT 286-16 Drives	Video options Mono	EGA	VGA
Single	1010	1455	1530
20MB	1345	1795	1865
40MB	1500	1950	2020
80MB	1765	2215	2285

S Systems 386-20

- Intel 80386-20 CPU
- Ami BIOS
- 1MB on board
- TEAC 1.44 & 1.2MB floppy drives
- Hard/floppy controller (1:1)
- Enhanced 101 key keyboard
- AT full style case
- 220W power supply
- 1P, 2S ports

AT 386-20 Drives	Video options Mono	EGA	VGA
	1795	2225	2305
20MB	2028	2475	2545
40MB	2325	2625	2700
80MB	2450	2885	2965

Monochrome Monitors

Amdek V210A	$85
Amdek V410A	150
NEC Multisync GS	220
Samsung mono-12 flat	105
Samsung mono 14	105

Color/EGA Monitors

Amdek C732	$445
Amdek C722	515
AST EGA	515
Mitsubishi 1410C	345
Mitsubishi 1430C	405
Samsung EGA 14	375

VGA/CAD Monitors

Mitsubishi 1381A	$515
NEC Multisync 11A	505
NEC Multisync 3D	695
NEC Multisync plus	965
NEC Macsync	625
Sony 1302P	Call

Printers

NEC P2200	$330
NEC P5200	525
NEC P5300	695
Okidata 320P	375
Okidata 321P	520
Okidata 390	520
Okidata 391	705
Okidata 393	1105
Okidata 393C	1185
Toshiba 301	315
Toshiba 311	380
Toshiba 341SL	650
Toshiba 351SX	985

Laser Printers

NEC LC 890	$3405
Toshiba Pagelaser	2785
HP Laserjet 11/11D	Call

Plotters

HI DMP-52	$2495
HI DMP-52MP	2945
HI DMP-61	3245
HI DMP-62	4000

Video Boards

Hercules Colorcard	$155
Hercules Incolorcard	210
Hercules VGA	189
Paradise EGA-350	195
Paradise EGA-480	210
Paradise VGA-Plus	280
Paradise VGA-Plus-16	320
Paradise VGA-Prof	470
Quadram Quadega	250
Video 7 Vega Deluxe	225
Video 7 Vega VGA	300
Video 7 Fastwrite VGA	380
Video VRAM-VGA	475

Multifunction/Memory Boards

AST Rampage 2-256	$290
AST Rampage-286	Call
AST Rampage Plus-286	420
Intel Above 286-Plus	435
Intel Above PS286 Plus	485

Floppy Drives

Toshiba 360K	$70
Toshiba 1.2MB	85
Toshiba 720K	75
Toshiba 1.44MB	90
TEAC 360K	75
TEAC 1.2MB	90
TEAC 720K	80
TEAC 1.44MB	90

Accelerator Boards

AST Fastboard-386	Call
Intel Inboard 386-PC	650
Intel Inboard 386	900
Quadram Quad 386XT	Call

Hard Drives

Seagate 20MB	$225
Seagate 40MB	410
Seagate 80MB	600
Plus Hardcard-20	535
Plus Hardcard-40	670
Plus Passport-20	415
Plus Passport-40	560

Tape Drives

Archive 5240	$325
Archive 5540	345
Archive VP601	675
Mountain 4340	400

Math Co-processors

Intel 80287-8	$225
Intel 80287-10	260
Intel 80387-16	415
Intel 80387-20	470
Intel 80387-25	590
Intel 80387SX	375
Intel 80c287	315

Software

Aldus Pagemaker	$455
dBASEIV	450
Lotus 1-2-3 v. 2.01	295
Lotus Symphony	415
Microsoft Windows 286	70
Microsoft Windows 386	130
Microsoft Excell	285
Microsoft Word	215
Microsoft Works	105
Paradox 3.0	415
PFS First Publisher	70
Ventura Publisher	485
Word Perfect 5.0	220
Symantac Q&A 3.0	215
Symantac Q&A 386	Call

Mice

Logitech Serial Mouse	Call
Logitech Bus Mouse	Call
Microsoft Mice	Call

Modems

US Robotics 1200	Call
US Robotics 2400	Call
Okitel 1200B int	125
Okitel 2400B int	200
Okitel 2400B Plus int	285

Laptop Computers

Toshiba 1600	$3250
Toshiba 3100E	2800
Toshiba 3200	3500
Toshiba 5200-40	Call
Zenith Supersport 286	Call

Scanners

HP Scanjet	Call
Logitech Scan Man	225
Niscan OCR	395

Surge Protectors

Curtis Diamond	Call
Curtis Emerald	Call
Curtis Ruby	Call
Kensington Masterpiece	100

Fax Machines

Sharp FO-220	$750
Sharp FO-300	1025
Sharp FO-330	Call
Murata 1200	650
Murata 1600	875

To order call 1-800-837-3573; Fax # 312-495-2629

- Lease Available
- COD under $500.00
- Certified & Cashiers Check
- Wire-Transfer, Money Orders
- Personal & Co. checks allow 10 days to clear.
- No returns without RMA#
- 30 Day Return Policy
- No returns on Software
- Prices subject to change without notice.

ELS ENTERPRISES, LTD.
15 E. Madison, Lombard, IL 60148

Hours: M-F, 8am-6pm
Saturday 10am-4pm

Circle 304 on Reader Service Card

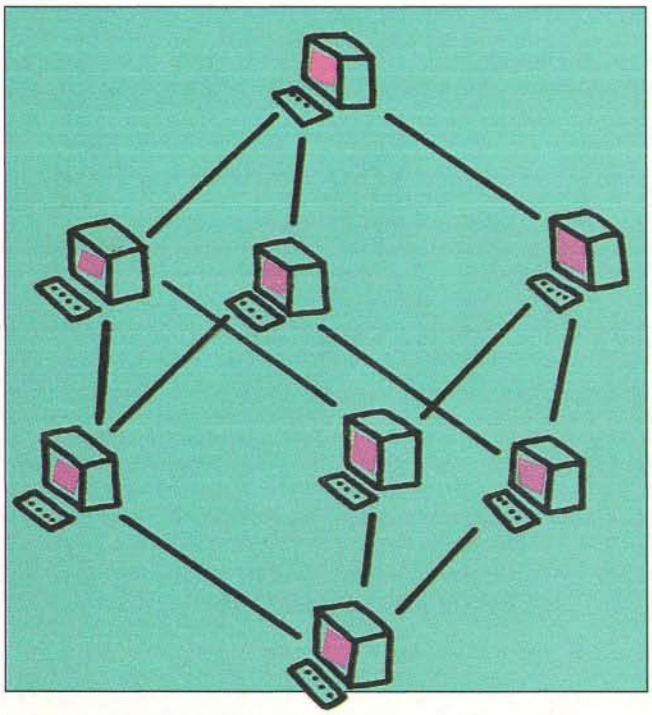
HANDS-ON PARALLEL PROCESSING

An inexpensive way to set up your own hypercube system using Macs and AppleTalk

Geoffrey C. Fox, Alex W. Ho, Paul Messina, and Terry Cole

The promise of parallel computing is performance: unprecedented performance in large configurations and a better price/performance even in small systems. However, programming parallel systems to perform concurrent computations requires new techniques best learned through hands-on experience on real parallel computers.

Many wishing to learn or teach parallel programming cannot afford to buy a commercial parallel computer. We'll describe how to create a parallel computer (of a type known as a hypercube) using an ensemble of Apple Macintosh computers and AppleTalk. For more information about parallel computers in general, refer to the text box "The Drive for Parallel Systems" on page 288.



The Hypercube

A p-dimensional hypercube computer, also called a p-cube, has 2^p processors that can be thought of as being located at the vertices of a p-dimensional cube (see figure 1). The physical connections among the node processors lie along the edges of the hypercube. Each node processor of a p-cube is connected to p other processors. In the case of a three-dimensional cube, the total number of node processors is eight and each node is connected to three other nodes. Higher-dimensional cubes can be formed recursively from lower-dimensional cubes. The maximum number of stages a message might have to traverse in a p-dimensional hypercube is p, as opposed to $2^{(p-1)}$ steps for a physical ring connection.

The hypercube architecture has the added advantage of being able to map conveniently to a wide range of simple topologies, such as a ring, a grid, a pyramid, or a binary tree, while requiring a modest number of physical connections at each node. In a 1024-node system, for example, 10 communication channels are needed. Currently available hypercube systems include the Caltech/JPL Mark Series computers and the commercial systems of Intel Personal Scientific Computer (iPSC), NCUBE, and Ametek.

In most of the current hypercube systems, the node processors are not connected to any I/O peripheral devices. To provide them with I/O capability, a computer called a control processor (CP) or cube manager is connected to one or more node processors (see figure 1).

A CP is a conventional computer with ordinary I/O devices. It is the only path from the outside world to the hypercube, and vice versa. Programmers can interact with the hypercube only via the CP. To run an application program on a hypercube, the program must be downloaded from the CP. When data has

continued

ILLUSTRATION: CATHARINE BENNETT © 1989

The Drive for Parallel Systems

Scientists, researchers, and engineers all over the world are clamoring for computer systems that will enable them to approach and solve large-scale problems realistically. For instance, to carry out a meaningful numerical study of quantum chromodynamics (a theory of fundamental particles) would require repeated recalculation of about 100 million values representing various field strengths in the four-dimensional space-time region near a proton. In the field of computational fluid dynamics, to adequately model the fine structures of three-dimensional high-Reynolds-number (turbulent) flow would consume an enormous number of computer cycles.

The demand for higher-performance computers is rising. But the performance of conventional supercomputers is approaching its fundamental physical limit, which is imposed by the speed of light (about 1 foot per nanosecond), the fastest possible speed a signal would be able to travel from one part of the computer to another (see reference 7 in the main text). Even if the physical size of a single-processor computer could be made very small and its components could send signals at the speed of light, such a computer still could not achieve more than a few billion instructions per second, which is not enough for applications that are derived from various contexts such as physics, fluid dynamics, or real-time image and natural-language processing, just to name a few.

The advancement of semiconductor and VLSI technology will make individual processing units substantially cheaper but cannot improve their performance to a comparable extent. To obtain an appreciable increase in the throughput rate of a computer system, the system must be able to overcome the sequential bottleneck of the Von Neumann architecture.

To address this issue, new computer architectures are required that use many processors to work on the same problem at the same time. In other words, what we need is concurrent or parallel processing.

Most computers have only one processing unit, the CPU, that performs all the computational work. Computer programs, written in languages such as C or FORTRAN, are compiled (i.e., translated) into a sequence of machine instructions. These instructions must be executed sequentially by the computer. However, many applications are inherently parallel, as in most real-world phenomena. If we can capitalize on the parallelism of these applications by using concurrent processing to overcome the sequential bottleneck of the conventional design, we can achieve faster execution and increase throughput.

In addition to providing a path to unprecedented speed, another strong motivation for designing and using parallel computers is the hope for better price/performance than sequential systems offer. Microprocessors of moderate speed are produced by the millions for personal computers and other applications. Their internal speeds and feature sizes do not require the most expensive fabrication techniques. While one microprocessor is not terribly powerful, dozens or hundreds of microprocessors organized as one computing system can perform sizable computations.

Combining 20 5-MIPS microcomputers could yield an equivalent of 100 MIPS, a speed that few sequential computers can achieve. The price of the components in the microcomputer-based system is much less than that of a sequential computer of comparable speed. Of course, programming the parallel system efficiently may be more difficult than programming the sequential one, particularly for those who have grown up in a serial programming environment.

to be written onto disk or tape, say at the end of a hypercube application, the node processors have to be programmed to send their data to the CP, where file I/O is possible.

Programming a hypercube concurrent computer isn't difficult, but it's also not as straightforward as programming a sequential machine, especially for those of us who have programmed sequentially for years. Hands-on experience in programming a hypercube is extremely valuable for learning and understanding how concurrent computers and programs work.

It may be extravagant to buy a small commercial hypercube computer just to learn about parallel processing or to teach a class in advanced computer architectures. One alternative is to assemble your own hypercube, the Mac-Cube, using the Macintosh family. This is especially desirable for academic and research environments in which Macs are already abundant.

The Mac-Cube

We have designed and fabricated a Mac-based hypercube with a companion operating system and named the group the Mac-Cube (see reference 1). It uses LocalTalk hardware and AppleTalk software as the medium for the nodal connections. Hypercube connectivity is emulated on the AppleTalk LAN, while the hypercube communications protocol is integrated with the AppleTalk software.

Available for use with the Mac-Cube is Mac-CrOS, an MPW C and assembly language implementation of the Caltech/JPL Crystalline Operating System, also known as CrOS III (see reference 2). Software based on Mac-CrOS is portable across all commercial hypercubes running CrOS III. [Editor's note: *The Mac-CrOS software is available from several sources. See the text box "Parallel-Processing Resources" on page 293 for details on obtaining resources from Caltech. Also see page 5 for information about files available on BIX.*]

Requirements

The required hardware and software for setting up a Mac-Cube is separated into two parts: the CP and the node processors. A CP requires a Macintosh Plus, SE, or II; a 10-megabyte hard disk drive (minimum configuration); System 4.1 and Finder 5.5 (Mac-Cube has been tested with these versions, though later versions should be compatible); MPW 2.0; and the C^{3P} Mac-Cube software library (which contains Mac-CrOS and a configuration program).

Node processors require a Mac Plus, SE, or II; one 800K-byte floppy disk drive; System 4.1 and Finder 5.5; and a start-up disk with C^{3P} Mac-Cube configuration software.

A functional Mac-Cube hypercube consists of $2^p + 1$ Macs, where p is the dimension of the hypercube. For the implementation discussed here, the p dimension is between 0 and 4, which corresponds to one to 16 Macs. Of the total $2^p + 1$ machines, 2^p serve as the nodes of the hypercube and can be any member of the Macintosh family except the Mac 128K. The additional

Parallel Processors

The performance of parallel processors is related to the underlying architecture of the system and the mode of processor coordination. There are two major categories of parallel architecture. In the SIMD (single instruction and multiple data stream) system, the processors perform the same instruction at each cycle, but each operates on different data. In an MIMD (multiple instruction and multiple data stream) system, the processors can run independently. Each processor can execute different portions of the same program or completely different programs.

An important aspect of multiple-processor architectures is how the processors are associated with memory. In *shared-memory* systems, all processors access the common physical memory by direct connections, by a network of connections, or by a memory bus. Shared-memory systems enable each processor to operate on data that is also accessible to other processors. Because all processors can modify stored data, care must be taken to avoid attempts by processors to gain access to data before the appropriate value has been stored.

One limitation of shared-memory architecture is that it appears to be expensive and difficult to produce massively parallel systems—that is, systems with hundreds or thousands of processors. Examples of shared-memory parallel computers are Cray's Cray-2, ETA's ETA 10, Bolt Beranek and Newman's Butterfly, ELXSI's System 6400, and IBM's RP3, among others.

In contrast to the shared-memory model, there are the *distributed-memory* or *local-memory* systems. This form of processor/memory relationship exists when some amount of memory (local memory) is attached to each processor, and connections are established among the processor-memory pairs (also designated as node processors, or simply nodes). In a distributed-memory system, each processor has direct access to only its own local memory.

If a processor has to access or modify the value of a piece of data that does not exist in its local memory, message-passing via communication channels is the mechanism required to achieve the task. The communication channels are the actual physical linkages of the individual processors and can be arranged in an arbitrary network topology. A disadvantage of network communication is an increase in latency of memory access, because a request for information by a processor may have to traverse several stages of the connection network to get to the particular memory unit that has the data.

Some Network Topologies

A simple scheme for connecting distributed processors is the ring topology in which each node processor is connected to two other processors. Another simple scheme is a rectangular grid. In this configuration, each processor is connected to the four other processors that are its nearest neighbors. A significant drawback of simple topologies such as these is that the number of processors involved in coordinating the sending of a message from one node processor to another could be very large. In the case of a ring, as many as half the total processors could be involved. The resources of a node processor will be wasted if it has nothing to do while waiting for a message to arrive.

In designing high-performance distributed-memory parallel processors, several criteria must be satisfied by the connection network: fast communication among nodes, simple connectivity for each node, and a connection topology that matches the natural geometry of applications. The hypercube topology discussed in this article is used by several vendors of commercial distributed-memory systems to meet these criteria.

Macintosh is used as the CP. Usually, the CP is used for developing applications. If this is the case, the CP must be capable of running the MPW. Mac-CrOS applications can be developed using C or Pascal inside the MPW environment. The minimum recommended configuration for the CP doing development work is a Mac Plus with a 20-megabyte hard disk drive.

All nodes of a Mac-Cube must be in the same AppleTalk zone. Any number of other Macs, as well as AppleTalk gateways, can also be in the same local zone without interfering with Mac-CrOS. Multiple Mac-Cubes can coexist in the same AppleTalk zone, as shown in figure 2. A 2-cube, five-Mac system (four nodes and a CP) and a 3-cube, nine-Mac system (eight nodes and a CP) are illustrated.

Mac-Cube as an Instructional Tool

Mac-Cube has several advantages over commercial hypercubes as an instructional or experimental tool for parallel processing. One major advantage is its low setup cost. Most university computer laboratories or research laboratories have numerous Macs in close proximity; very likely, they are already connected using the AppleTalk LAN. In this case, no additional hardware is needed to assemble a Mac-Cube. Using some of the Macs on the local AppleTalk network does not disturb other computers on the same network. In other words, while some students are using several Macs on an AppleTalk network in the normal sequential mode, others can configure a few of the remaining Macs into a single or multiple Mac-Cube(s).

A second advantage is its ease of use. Nodes of commercial hypercubes are not equipped with I/O devices such as display monitors, yet each node of a Mac-Cube (i.e., a Macintosh computer) always has a graphics display monitor and input devices such as a mouse and a keyboard. The availability of a display device at each node enables users to see and to demonstrate how parallel algorithms function. Graphics display capability at the nodes has high educational value, as applications can display information in a spatially intuitive and descriptive manner. Moreover, Macintosh graphics are superior to those typically found on mainframe or minicomputer terminals.

Viewing the actions of an application at each node actually facilitates debugging, because errors can be pinpointed to specific nodes. In addition, taking advantage of the availability of I/O devices at each node makes it possible to implement multiuser applications, such as distributed expert systems and databases.

A Closer Look at CrOS

CrOS is a loosely synchronous message-passing system for hypercube-connected or hypercube-emulated environments. It is a channel-based, point-to-point *polled* communication system that enables directly connected nodes of a hypercube to communicate with each other. CrOS is efficient and well suited for

continued

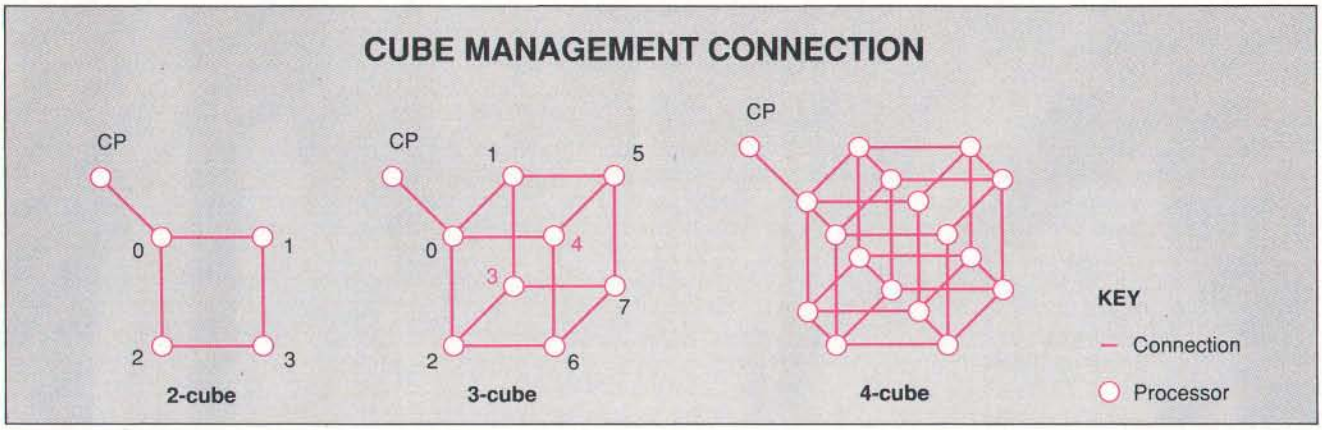


Figure 1: *Hypercubes of dimensions 2, 3, and 4. Each cube has 2^p processing nodes and a single control processor, and each node is connected to* p *other processors. Thus, a 2-cube has four processing nodes and one control processor, and each processing node is connected to two other nodes.*

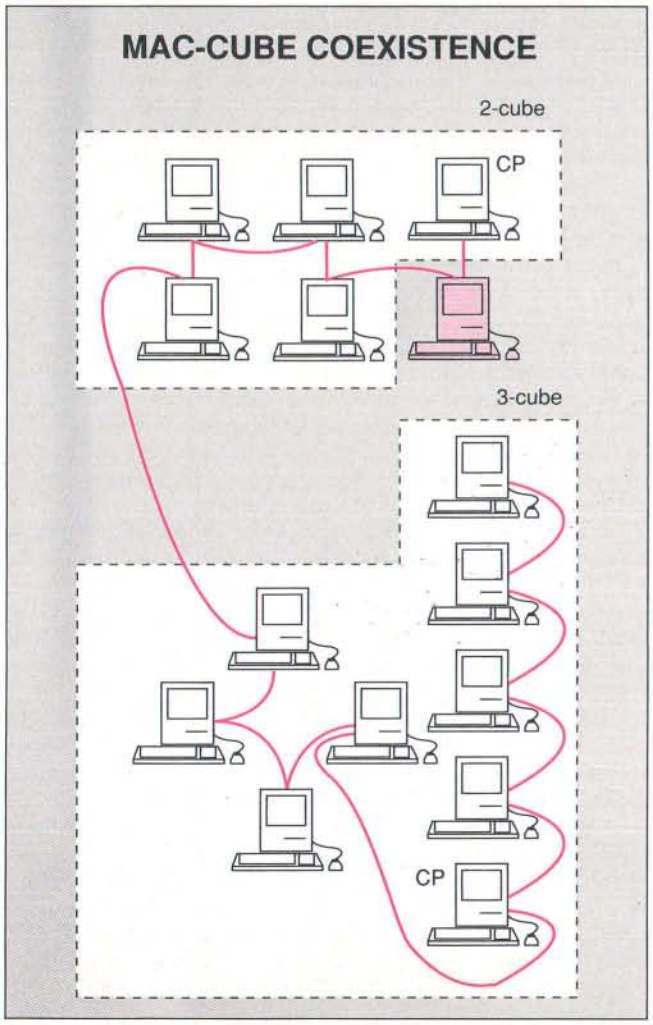


Figure 2: *Sample Mac-Cube hypercubes on an AppleTalk network. Note that there are 2-cube and 3-cube systems on the same network and that the lone (shaded) user is undisturbed except for the network loading added by the Mac-Cubes. Also, the Macs that make up each cube do not need to be contiguous.*

problems with regular or homogeneous domains—hence the name "Crystalline."

When polled communication is used, the application program contains explicit read and write command pairs. For example, let's assume that node 1 needs to write to node 3. When node 1 is ready to write to node 3, it must issue a "write to node 3" command. But before the write can proceed, node 3 must issue a "read from node 1" command. If node 3 is operating on other instructions when node 1 sends its request to write, node 1 will halt until node 3 finishes the instructions it already has. Only when node 3 replies with a "read from node 1" command can node 1 actually perform the write.

The reverse is also true. Should node 3 want to read from node 1, it will issue a "read from node 1" command, but it cannot continue until it receives a reply. Because the nodes cannot proceed until the write and read command pairs are exchanged, they move in lockstep through their programs, with each read and write command resynchronizing the processors.

Listings 1a and 1b show examples of the command pairing previously described. Listing 1a runs on the nodes and implements `dumpelt()`, which is a command that dumps data from the nodes to the CP. Listing 1b runs on the CP and implements `mdumpcp()`, which also requests a data dump from the nodes to the CP.

Examples of rigorous scientific applications using CrOS on hypercubes can be found in fields such as neural-circuit simulation, protein dynamics, chemical reactions, chaos, computational fluid dynamics, earthquake engineering, convolution decoding, ray tracing in computer graphics, seismic waves, geodynamics, tomography, computational astrophysics, lattice gauge theory in high-energy physics, condensed matter, and granular physics (see reference 3). These algorithms are described in an excellent set of application papers (see reference 4), which contains 180 papers, including over 30 Caltech CrOS applications. Reference 5 contains public domain software with source code for the algorithms described in reference 3.

Developing CrOS applications for Mac-Cube is similar to developing applications for other commercial hypercubes. A CrOS application always contains a CP program and a node program pair. Generally, the CP program is used to download the node program—which is developed and compiled on the control processor—to the node processors. The CP program also distributes initial data to the appropriate node processors. Major computation, which can mostly be parallelized, takes

place on the node program running on the node processors. The CP will then receive computational results from the node processors and display them or save them for later analysis.

Executing CrOS Applications

Before starting an application, you must decide which computers will be the node computers and which computer will be the CP. It doesn't matter in what order the node and CP computers are connected by AppleTalk. The only requirement is that they are all on the same AppleTalk network. Not all computers on the network have to be assigned to one Mac-Cube or multiple Mac-Cubes; the unassigned computers can operate normally while some cubes are running.

Before running a CrOS application, you must "collect a hypercube" by running `boot` and `bootelt` on the CP and the nodes, respectively. These programs tell the CP computer how many node computers are available on the network and their addresses. After this procedure collects enough Macs and configures them as a Mac-Cube of a known dimension, the parallel application can be executed inside or outside the MPW shell.

The configured Mac-Cube remains intact after the execution of a program, so you can execute other applications without reconfiguring or rebooting for each application. If you want to change the dimension of a configured Mac-Cube (i.e., add or delete some nodes or change the CP), the Cube must first be "uncollected" by running the unboot program. To "re-collect" a new Mac-Cube configuration, the same procedures as described above apply. A sample Mac-Cube configuration session is displayed in figure 3.

Debugging CrOS Applications

Debugging concurrent applications on most commercial hypercubes can be difficult. Fortunately, having a graphics display monitor on each node makes debugging on Mac-Cube easier. Moreover, by virtue of the physical ring structure of LocalTalk, all the communications on a Mac-Cube can be easily monitored by watching the one LocalTalk line that physically connects all the nodes.

Two tools have proved useful in debugging CrOS applications: a Macintosh assembly-level debugger and AppleTalk Peek (from Apple Computer Network Systems Development). As distributed, Mac-CrOS code has been compiled with the source names option so that the name of the routine currently being executed is available from the debugger. It's easy to get some idea of what happens in a program by using a debugger. Breakpoints also can be inserted at key places in the programs.

AppleTalk Peek is a program that monitors packet activity at the lowest level. Each CrOS packet corresponds to at least four of the low-level AppleTalk packets. Additionally, each CrOS communication routine will use one or more of the CrOS packets. With a knowledge of the packet structure used by low-level CrOS routines (as documented in the CrOS source code), as well as a knowledge of which actual CrOS packets are sent, you can often determine the state of communications fairly easily.

AppleTalk Communications

Communication in Mac-Cube is implemented using LocalTalk, a baseband, ring-topology network that is inexpensive and widely used. Unfortunately, because only one message travels on the bus at a time, LocalTalk is ill-suited to efficiently emulate the hypercube topology that enables messages to travel in concurrent pathways. As a consequence, the Mac-Cube is a less efficient implementation than the PC-Cube (see reference 6), which is another "build-it-yourself" educational hypercube

continued

Listing 1: (a) *This program runs on the Mac-Cube nodes to dump specific memory locations in each node to the control processor (CP).* **(b)** *This memory-dump code runs on the CP and is a complement to listing 1a. Both node and CP programs must run and be acknowledged by each other for the requested memory dump to occur.*

(a)

```
/*
 * crosnode.c
 *
 * example CrOS NODE program : all the nodes do a
 * dumpelt() and check for errors. dumpelt() is a CrOS
 * function that dumps data from nodes to the CP. A call to
 * dumpelt() must be complemented by a call to mdumpcp() or
 * fdumpcp() in the CP.
 *
 */

#include "croselt.h"

main()
{
     struct Cubenv env;
     int OKflag, isize;

     cparam(&env);  /* gets run-time parameters */
     isize = sizeof(int);
     OKflag  = dumpelt(&env.procnum, isize); /* dumps
                                     processor ID to CP */
     if (OKflag >= 0)
         printf("Communication OK.\n");
     else
         printf("Communication error.\n");
}
```

(b)

```
/*
 * croscp.c
 *
 * Example CrOS CP program: The CP does mdumpcp() and checks
 * for errors. mdumpcp() is a CrOS function that dumps
 * data from nodes to CP's memory. A call to mdumpcp() on
 * the CP must be complemented with a call to dumpelt() on
 * all the nodes.
 *
 */

#include "croscp.h"

main()
{
     struct Cubenv env;  /* contains run-time parameters */
     int OKflag, i, isize;
     int data[32], buf[32];

     printf("Downloading to Cube...\n");
     cubeld(2, "crosnode");  /* downloads node program to a
                                2-cube */
    (Press RETURN for more or ESC to cancel)
     printf("Downloading done.\n");
     cparam(&env);  /* fills structure env */
     isize = sizeof(int);
     OKflag = mdumpcp(buffer, isize, buf);
     if (env.nproc != buf[0]) OKflag = -1;
     for (i = 0; i < env.nproc; ++i)
         if ((buf[i+1] != sizeof(int)) || (data[i] != i))
            OKflag = -1;
     if (OKflag >= 0)
         printf("Communication OK.\n");
     else          printf("Communication error.\n");
}
```

Figure 3: *Procedures to configure a Mac-Cube of dimension 2 (four Macs, one CP) and execute a program named* `TestProgram`. *Then the nodes are released and used to configure a 1-cube (two Macs, one CP), execute* `TestProgram` *again on the 1-cube, and release all the nodes completely.*

File Edit Find Mark Window Directory Build

Server:MPW:Worksheet

```
boot -d 2                       # Gather four nodes for the cube.
This is Node 119 Net 14337      # The node numbers are the Appletalk
node is 39.                     # ID numbers.  They are only for diagnostic
node is 66.                     # purposes.
node is 77.
node is 68.

TestProgram                     # A test program that gets a message from
Hello from 0.                   # each node.
Hello from 1.
Hello from 2.
Hello from 3.

boot -f                         # Free the nodes used in the cube.
                                # They can still be used for another cube.

boot -d 1                       # Gather two of them for another cube.
This is node 119 Net 14337
node is 66.
node is 68.

TestProgram
Hello from 0.
Hello from 1.

boot -q                         # Release the nodes for good.
```

MPW Shell

system, based on IBM PCs or compatibles.

Communications under AppleTalk were designed with the International Standards Organization standard for network communications in mind. The highest level (called the transport level in the ISO model) of "guaranteed datagram delivery" is implemented through the AppleTalk Transaction Protocol. It would be easy to implement hypercube communications using ATP. However, ATP is designed to handle a more sophisticated networking environment than is needed for CrOS, and thus it would introduce an additional level of inefficiency into an already inefficient environment.

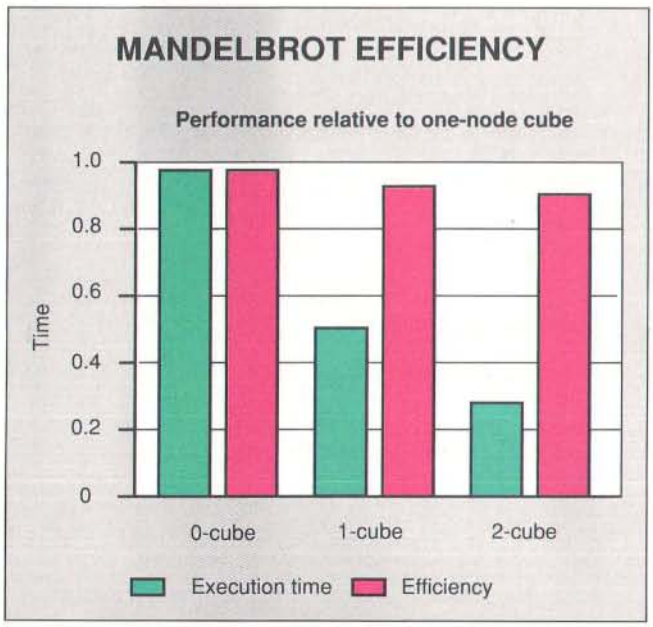


Figure 4: *Efficiency versus execution time of a 0-, 1-, and 2-cube Mac-Cube, which translates to one, two, and four Macs, respectively. Because the communication overhead also increases as nodes are added, the efficiency declines slightly. For example, adding three more processors to a single-processor node (for a total of four) reduces execution time to a little more than one-fourth of the single processor's time.*

In order to get higher communication efficiency, the ATP routines were bypassed for CrOS, and communication was implemented using the AppleTalk Link Access Protocol. At this level, next to the physical or hardware level, communication is streamlined, but packets are no longer "guaranteed" to reach their destinations. Because of this, the implementation of Mac-CrOS software is intelligent in its interactions with the hardware and the operating system to monitor packet activity. It is also more efficient.

Mac-CrOS is implemented in terms of the low-level, Mac-Cube-specific `cread()`, `cwrite()`, `vread()`, and `vwrite()`, in addition to the generic higher-level routines. The low-level Mac-CrOS routines consist of assembly language code that interacts in real time with the asynchronous AppleTalk drivers at a very low level. Global data structures are used to share information between this low-level code and the higher-level, synchronous C language codes that are used to implement the other Mac-Cube-specific CrOS routines.

Certain global data structures are initialized when the first Mac-CrOS routine in a program is called. However, basic information, such as the maximum hypercube dimension, the registered name of the CP, the AppleTalk addresses of all the nodes of the hypercube, and the address of the CP, cannot be gathered effectively at run time.

For this reason, a "boot-up" program is used to gather the node computers that will be used coherently and cooperatively as a hypercube. The boot-up program stores its data in the system heap as a system resource so that the hypercube will remain intact between program runs. This program is also used to release nodes from a Mac-Cube and to verify that all the nodes are still in place after a program has been run. The boot-up program enables multiple hypercubes per AppleTalk network. This program uses the higher-level ATP routines as well as the

Parallel-Processing Resources

In this article, we have described the Mac-Cube, an excellent low-cost system that emulates more sophisticated parallel computers. *Solving Problems on Concurrent Processors* (see reference 3) and its software supplement (see reference 5) provide an introduction to parallel processing and a large selection of tutorial software. Much of this is in the public domain and can be obtained from Caltech using c3plib, an electronic distribution system for software and documentation from C³P (Caltech Concurrent Computation Program), described below.

Mac-Cube-related software is available from c3plib and on BIX (see page 5 for further details). Another small tutorial system is based on the IBM PC-Cube (see reference 6), for which software can be obtained from c3plib. The PC-Cube is also commercially supported by Parasoft of Mission Viejo, California. Other elegant tutorial systems are built around add-on boards for Macs, Suns, and PCs. The most modern of these use transputers, each of which has a 10-MIPS performance. CrOS software for these add-on boards is discussed in reference 5 and can be obtained commercially from Parasoft at 27415 Trabuco Cir., Mission Viejo, CA 92692, (714) 380-8375.

Software Distribution: c3plib

The c3plib system is a file server at Caltech for the distribution of concurrent computation software, documentation, and reports from C³P. It's essentially a program that answers E-mail requests by responding with the appropriate material by E-mail. Requests should be addressed to "c3plib@caltech.edu" (for INTERNET users) or "c3plib@caltech.bitnet" (for BITNET users).

The file server understands several commands, and each command must be the first word on a line. The principal command is `send`. For example, the server will respond to a one-line `send help` message by sending a help file with detailed instructions about using the file server. A `send index` message will get the requester an index file that gives an overview of directory and file structure. If you don't have access to the network, requests for information should be sent to C³P Requests, Caltech Concurrent Computation Program, 206-49, Pasadena, CA 91125.

Name Binding Protocol to enable the nodes to find the CP.

Code Compatibility and Cube Efficiency Mac-CrOS has been tested on the Mac SE and the Mac II. Two CrOS III applications were taken from the Caltech/JPL Mark Series hypercube and ported to Mac-Cube. The algorithms used are described in detail in the book *Solving Problems on Concurrent Processors* (see reference 3). The two applications solve the Mandelbrot set in the complex plane, and a two-dimensional Laplace equation using finite-difference methods. Except for the graphical enhancements possible only on the Mac-Cube, the CrOS-based parts of the programs did not require any modifications to run in the Macintosh environment.

Although Mac-Cube is not designed for high performance, it does provide a speedup relative to the number of node computers. Figure 4 shows that the efficiency for solving the Mandelbrot set on a 1-cube (i.e., two Macs) is approximately 97 percent (speedup about 1.94 times) over that of a single Mac. This efficiency drops to 90 percent (speedup roughly 3.6 times) on a 2-cube (four-Mac) system.

Evaluating Value

Mac-Cube is valuable for learning hypercube programming and concurrent computation in general. It's inexpensive to set up and easy to install. The graphics and I/O capabilities of the nodes are particularly important for gaining insights into application development and problem solving, as well as for enabling users to actually look at each node of the hypercube in action.

The ability to watch the operation of each node also provides a good way to study parallel algorithm operation and makes debugging a simpler task. Applications implemented on the ark II/III series hypercube at Caltech/JPL have been ported to Mac-Cube with no relevant modification, demonstrating the compatibility of Mac-Cube's software environment with other hypercubes that use the Crystalline Operating System. ■

ACKNOWLEDGMENT

The system described here was developed by Caltech students funded by the Caltech Summer Undergraduate Research Fellowship (SURF) program. The students were Matt Breaden, Stanley Chen, Allen Knutson, and Sho Kuwamoto. This work is based on research supported by the Department of Energy grant DE-FG03-85ER25009 and by the Program Manager of Joint Tactical Fusion Office.

REFERENCES

1. Ho, A. W., G. C. Fox, D. Walker, T. Cole, M. Breaden, S. Chen, A. Knutson, and S. Kuwamoto. "Mac-Cube: A Macintosh-based Hypercube." *Proceedings of the Third Conference on Hypercube Concurrent Computers and Applications*. Edited by G. C. Fox. New York: ACM, 1988 (Caltech report C³P 573).

2. Kolawa, A., and B. Zimmerman. *CrOS III Manual*. Caltech Report C³P 253B, 1986.

3. Fox, G. C., M. A. Johnson, G. A. Lyzenga, S. W. Otto, J. K. Salmon, and D. W. Walker. *Solving Problems on Concurrent Processors*, vol. 1. Englewood Cliffs, NJ: Prentice Hall, 1988.

4. Fox, G. C., ed. *Proceedings of the Third Conference on Hypercube Concurrent Computers and Applications*. New York: ACM, 1988.

5. Angus, I., G. C. Fox, J. S. Kim, and D. Walker. *Software Supplement: Solving Problems on Concurrent Processors*, vol. 2. Englewood Cliffs, NJ: Prentice-Hall, 1989.

6. Ho, A. W., G. C. Fox, D. Walker, T. Cole, S. Snyder, D. Chang, S. Chen, and M. Breaden. "PC-Cube: An IBM PC-Based Hypercube." *Proceedings of the Third Conference on Hypercube Concurrent Computers and Applications*, 1988 (Caltech report C³P 587).

7. Fox, G. C., and P. Messina. "Advanced Computer Architectures." *Scientific American*, October 1987.

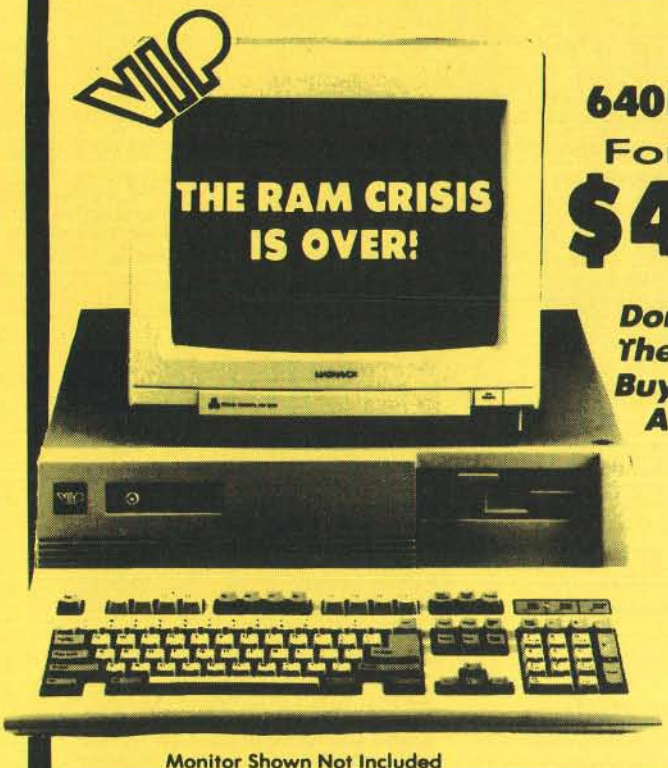
Geoffrey C. Fox is a professor of theoretical physics at Caltech and editor of the Journal of Concurrency: Practice and Experience. *Alex W. Ho is a member of the research staff at Caltech in the Concurrent Computation Program. Paul Messina is director of Caltech Concurrent Supercomputing Facilities. Terry Cole is chief technologist at the Jet Propulsion Laboratory. They can be reached on BIX c/o "editors."*

SINCE 1979 — 10th Anniversary

COMPUTER DIRECT

WE WON'T BE UNDERSOLD!*

Expires 10/31/8



Monitor Shown Not Included

Now, A Complete XT® Compatible Computer For Under $500!!

640K 10MHZ TURBO XT COMPUTE

For Only **$499.95** List $899.95

Don't Pass Up The Wise Buy, Buy Wise Now And SAVE!

We Won't Be Undersold!

FREE! DOS A $69.95 Value

LOOK AT ALL YOU GET!!!

- ☆ High Tech IBM® XT® Compatible With Front Panel LCD Display, Switchable Turbo Mode, And Security Keylock
- ☆ Full 640K RAM, Installed And Tested
- ☆ Parallel, Serial, And Game Ports Standard
- ☆ CGA, RGB, MGA Card Included
- ☆ Clock/Calendar
- ☆ 150 Watt Power Supply
- ☆ 101 Key AT®Style Keyboard
- ☆ 360K Floppy Drive And Controller
- ☆ 32K ROM
- ☆ Completely Assembled, Tested, And Burned I
- ☆ PLUS—Free Quality Word Processor "Ability"

TRIPLE THE VALUE!!!

1. We want you to be the first to take advantag of this opportunity. VIP Computer Inc. has mad Computer Direct your source for the best deal in the country!
2. If this computer fails due to workmanship or quality during the first year, we will replace it.
3. *NO RISK! 30 Day Home Trial!!!*

Throw Away Those Keys!!!

1 MB 16 Mhz* 0 Wait Computer

Here's What You Get...

QUICK 12

$999.95 LIST $1299.95

- 8 Or 12 Mhz Switchable Turbo
- 80286 Microprocessor
- 1 MEG Standard, Expandable To 4 MB
- Compatible With All Video Cards
- Dual Floppy/Hard Drive Controllers
- 1 Parallel, 2 Serial, 1 Game Port
- 101 Key AT®Style Keyboard
- 1.2 MEG Floppy Drive
- Built-in Math Co-processor Slot
- 200 Watt Power Supply
- Operation Speed Indicator
- IBM®, OS/2, Novell, Unix Compatible
- 110/220 VAC Switch
- Suntac Chip-set Technology
- EMS 4.0 Software Included

NEW! State Of The Art Soft Touch Security Keypad.

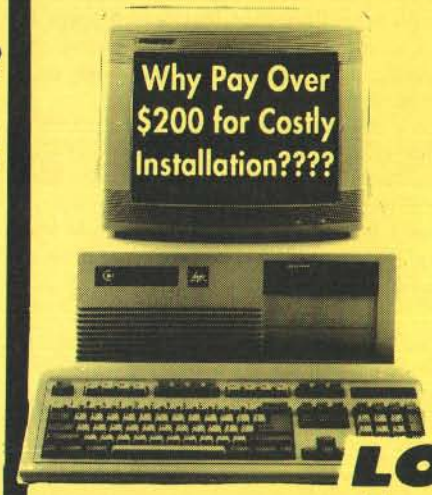
*16 Mhz Throughput On Norton Performance Rating

Monitor Shown Not Included

® IBM, AT, and XT are Registered Trademarks of International Business Machines, Inc.

The 12.5 Mhz* 286 Computer

With EGA, CGA, MGA Video Outputs Built Right In!



Look At All These Features...

- 8, 10, 12 Switchable Turbo
- 80286/12.5 Intel Microprocesso
- 512K Standard, Expandable To 4MB
- EGA, MGA, CGA, Hercules, ar Plantronics Compatible
- 101 Key AT®Style Keyboard
- 1.2 Meg Floppy Drive
- Phoenix BIOS
- Dual Floppy/Hard Drive Controllers
- PS/2 Compatible Mouse Port
- 1 Parallel and 2 Serial Ports
- Built- in Math Co-processor Slo
- DOS Included
- 32K Buffer Hard Disk Cache
- Small Footprint Case
- Western Digital Motherboard

LOOP 28

1 Year Immediate Replacement Warranty

$899.9 LIST $1299

Monitor Shown Not Include

For Standard Size Case - Add $40

*12.5 Mhz Throughput On Norton Performance Rating

IMMEDIATE ANSWER

800-BUY-WISE EXT. 38

800-289-9473 EXT. 38

Outside Service Area call 312-382-5058

We Love Our Customers

COMPUTER DIRECT
22292 N. Pepper Rd.
Barrington, IL 60010

BEST SERVICE IN THE USA

PRICE IS NOT ENOUGH!

- 90 Day Immediate Replacement
- Experts In Customer Satisfaction
- Free Technical Assistance
- Bulletin Board Service
- Fast, Low Cost Delivery
- No Credit Card Fees
- 15 Day Home Trial
- Free Catalogs

LOWEST PRICES EVER!

SEAGATE Hard Drives & Hard Cards

20 MEG Half-Height Drive Kit
$229.95 List $499 Model ST-225

40 MEG Half-Height Drive
$324.95 List $699 Model ST-251

40 MEG Super Fast Drive
$378.95 List $799 Model ST-251-1

80 MEG Hard Drive
$599.95 List $799 Model ST-4096

20 MEG Hard Card
$294.95 List $399 Model ST-125

30 MEG Hard Card
$334.95 List $499 Model ST-138RLL

180 CPS With NLQ Printer

NLQ 180-II

$149.95 List $399.95

No one can sell this printer for less!

SAVE 1%

with

The Computer Direct Credit Card

Special Introductory Offer

No Annual Fee
For the First Year

CALL TODAY!

1200 Baud Internal Modem

100% Hayes Compatible
Modem Software Included
- - - a $29.95 Value!

$44.95 List $129.95

Everyday low price!

720 CPS 6 Head Printer

15" Carriage

$699.95 List $1995

The fastest printer you'll ever need.

FREE CATALOG!!!

1000's of Items In Stock

1200 Baud External Modem

100% Hayes Compatible

$59.95 List $238.90

Fits in the palm of your hand!

Magnavox 8762 Color RGB Monitor

$234.95 List $399

5¼" DSDD Disks

As Low As...

Qty of 25 ....19¢ each
Qty of 25 w/sleeves....21¢ each
Qty of 100 w/sleeves & labels .....24¢ each

19¢ ea

Lowest Price in the Country!

5¼" High Density Disks

As Low As...

Qty of 25 .....45¢ each
Qty of 25 w/sleeves .....47¢ each
Qty of 100 w/sleeves & labels .....48¢ each

45¢ ea

☆ Made In the USA! ☆

Bondwell Laptop Computer

100% IBM® Compatible

The B-300 is a 286 based unit that gives you the power of an AT® at only 15lbs. With its built-in20 MB hard drive and 1200 Baud Hayes compatible modem, this is the one you've been waiting for!

$2195.95 List $2495

High Speed Ultra-Compact PC with Supertwisted Display

2400 Baud Internal Modem

Made in the USA!

100% Hayes Compatible
Modem Software Included
- - - a $29.95 Value!

$89.95 List $129.95

More Baud - Less Bucks!

Magnavox EGA Monitor

$299.95 List $599

3½" DSDD Disks

As Low As...

Lots of 10 59¢ ea

59¢ ea

No Limits - Lifetime Warranty!

2400 Baud External Modem

100% Hayes Compatible

$99.95 List $349

Made in the USA!

VISA
MASTERCARD
COD

COMPUTER DIRECT will match any current (within 30 days), valid nationally advertised delivered price on specially marked items of the exact same product with a comparable payment method, excluding any applicable sales taxes. Verification Required

Prices do not include shipping charges. Call to get your lowest delivered cost. We insure all shipments at no extra cost to you! All packages are normally shipped UPS Ground. 2nd Day or Overnight Delivery available. Minimum shipping charge per order is $3.75. Illinois residents add 6.5% sales tax. We ship to all points in the U.S., Canada, Puerto Rico, Alaska, Hawaii, Guam, and APO & FPO. (Color Monitors shipped in Continental USA only.) PRICES AND AVAILABILITY SUBJECT TO CHANGE WITHOUT NOTICE.

Circle 305 on Reader Service Card

We'll give you 30 days to plug our product.

Try our multi-user/multi-channel communication boards (and our promises) for 30 days with no risk.

You're looking at multi-user systems. You want high performance. High reliability. Great service and technical support. And real value. Trouble is, that's what every board company promises.

But whose promises can you afford to stake your reputation on? Ours. Because only DigiBoard dares to let you try us in the real world. With no risk.

With DigiBoard you can order any DigiCHANNEL multi-channel communications board and evaluate its performance for a full 30 days. Choose basic boards or the industry's fastest intelligent boards. PC-Standard or Micro Channel. Four, eight or 16 ports. Even a Synchronous option on some models.

While you're evaluating the performance of our boards, we hope you'll benchmark our technical support too. Customers tell us it's as great as our engineering. But enough talk. The only way to see how good we are is to try us. And now, you can plug us in without risking a penny. Just plug into your nearest DigiBoard distributor.

DigiBoard
Plugging you into tomorrow.

Ask your DigiBoard distributor for our FREE booklet, *How to Do Multi-User Right.*

NATIONAL DISTRIBUTORS

SOFTSEL COMPUTER PRODUCTS, East 800-645-7779, Central 800-645-7775, West 800-645-7778;
ARROW ELECTRONICS INC., COMMERCIAL SYSTEMS DIVISION, 800-323-4373 U.S., 516-391-1762 N.Y.;
INGRAM-MICRO D, 800-642-7631; ROBEC DISTRIBUTORS, 800-223-7081 Request Ann Brady

CANADIAN DISTRIBUTORS

CDI COMPUTER DISTRIBUTION, 604-984-0641; EMJ DATA SYSTEMS LIMITED, 519-837-2444;
SOFTSEL COMPUTER PRODUCTS, 800-268-1220; INGRAM-MICRO D, 416-738-1700

REGIONAL DISTRIBUTORS

MULTI COMPUTER PRODUCTS, South East Region, 800-456-8584
ICOM SYSTEMS INC., Central Region, 312-506-1444;
MP SYSTEMS, Central & Western Regions, 800-624-1688 U.S., 800-322-6411 CA
AIS INC., Central Region, 800-950-2471;
COMPUTER SOURCE INTERNATIONAL, North East Region, 800-222-5022;
TRICOM, North East Region, 800-TRICOM-1; REDLAW, South East Region, 305-791-5459

DigiBoard Inc., U.S. 800-344-4273, MN 612-922-8055

Circle 306 on Reader Service Card

DISK CACHING

Here's how to evaluate different disk-caching schemes

Personal computers have at last evolved to the point where computational speed is not the major source of delays. In most applications, the CPU spends the majority of its time waiting for one of two things: user input or peripherals (particularly disk transactions). It's unlikely that computer designers will be able to do anything to speed up the former, but they have done something about the latter. Taking advantage of increasingly inexpensive and quick DRAM, engineers are speeding up disk access by implementing hard disk caching.

RAM Caching vs. Disk Caching

A cache is a small amount of fast memory that holds the same information as some part of a slower storage medium, so that the information can be obtained quickly when it's needed. Most of the same terminology applies to RAM and disk caches: *hits*, *misses*, *lines*, and *associativity*. But because the physical and electrical characteristics of a hard disk are very different from those of a RAM chip, the optimal caching strategies are different as well.

The most important difference between disk and RAM caches, other than raw speed, is that not every byte of disk data is as easy to get to as every other byte. In most RAM systems, access times are the same for every byte. On a disk, the time it takes to retrieve an arbitrary byte can vary by two orders of magnitude (see the text box "What Affects Access Time?" on page 298).

Another important difference between disk caching and RAM caching is the size of the transfers involved. A RAM access on a typical microcomputer can retrieve as little as 1 byte; disk data must be accessed as whole sectors (typically 512 bytes, although some disks have 256-byte or 1K-byte sectors). This means that the minimum practical *line size* of a disk cache (i.e., the smallest chunk of data it can save for future access) is an order of magnitude larger than for a RAM cache.

Finally, there is the problem of maintaining *coherence*: keeping the contents of the slower storage medium the same as (or, in Unix parlance, in sync with) the cache. RAM is generally expected to be volatile. If you turn off the power switch on a machine with a RAM cache, you don't expect the contents to be preserved when you turn the machine back on. Thus, if a RAM cache doesn't get a chance to update main memory before the machine shuts down, it's not a problem. But it *is* a problem if your disk cache doesn't update the disk before you switch off. Whole files—and, worse yet, the directory structure of the disk itself—can be damaged or utterly lost.

Write-Through vs. Write-Back

Most cache programs used in microcomputers are *write-through* caches, maintaining coherence by sending write requests to the disk controller immediately. This is the most fail-safe method. But the cache can often save time and head motion if it delays writes. This is the idea of a *write-back* cache, which consolidates writes destined for the same track and does several at one time. If two write requests come in for the same sector, the cache can detect the situation and do only one write.

Delayed writes can cause problems, however. Early versions of Unix had a built-in disk cache that could delay writes for long periods. In fact, a sector that was written to frequently might not be updated for hours. If such a machine was shut down without a special command (called sync) or if it crashed suddenly, the file system could require major repairs. Fortunately, newer versions of Unix automatically do a sync at frequent intervals to avoid this problem.

Many cache programs that do delayed writes on other machines use a similar approach. The cache program I use on my IBM PC AT clone always flushes its cache after 2 seconds. It also intercepts the Ctrl-Alt-Del soft reset sequence and the INT 19 (Reset) vectors, and it makes sure that the disk gets updated before the machine is reset. It's not possible to trap a hard reset, however. Thus, if the machine crashes so badly that you need to reach for the big red switch or if you turn it off too quickly, you may lose data.

Read-Ahead

Just as it may be able to consolidate write operations by introducing a delay, a disk cache may be able to save time by implementing *read-ahead*—that is, reading into the cache for future use the sectors immediately after those requested by the operating system. Since disk access is often sequential, there's a good chance that this strategy will pay off.

The most simpleminded read-ahead algorithms do nothing more than increase the line size of the cache (i.e., always reading some additional number of sectors after the one requested). But smarter caches have more clever strategies. There's always a chance that an anticipatory read won't have any benefit, so it doesn't make sense to keep "extra" sectors in the cache until a least recently used (LRU) algorithm kicks them out. Instead, many caches reserve a separate portion of RAM exclusively as a read-ahead buffer and transfer only sectors that are really used to the main cache area.

Concurrent Operation

One thing that a cache can do—whether it's implemented as a caching controller or as software—is let disk operations

continued

What Affects Access Time?

Many factors influence the amount of time it takes a disk drive to retrieve data. They include *seek time*—the amount of time it takes the head to move to the right track, *settling time*—the time it takes for the head to stop vibrating after it gets to that track, *latency*—the amount of time it takes for the desired sector to come around to the disk head, and *transfer time*—the amount of time it takes to get the data off the disk, through the controller, and into the appropriate RAM buffer.

The most common number that you will be quoted when you ask the speed of a hard disk drive is the average track-to-track access time. This is the average time it takes the disk head to move one track during a relatively long seek (typically across a third of the total number of tracks). But latency is also an important factor; an incorrect interleave can cause the controller to wait many revolutions of the disk to get the data that it wants. And the *skew*, which is the angle between the first sectors on adjacent tracks, can also make a difference.

To understand why skew is important, imagine that the controller wants to read the data from several adjacent tracks in succession (i.e., it reads the first track, steps the head, reads the second track, and so on). Unless the system is smart enough to read sectors out of order, it must wait after each step until the first sector of the new track passes under the head.

How long does the controller wait? If the skew is set so that the head will arrive at the new track just before the needed sector passes under it, there will be a minimum amount of latency. Unfortunately, most controllers format with no skew at all. In this case, you will get optimal performance when the seek time is slightly shorter than the time it takes the disk to spin once (16 milliseconds on a hard disk that spins at 3600 revolutions per minute).

A smart cache program can sometimes reduce the effect of a nonoptimal skew angle by reading and caching every sector that passes under the head, even if it hasn't been requested yet. Since many accesses are sequential, there's a good chance that the sector data will be useful shortly.

proceed concurrently with other tasks. For instance, when the operating system instructs the disk to move the head to a particular track, there is generally no need to wait until the head has finished moving before returning control to the system. However, the IBM PC ROM BIOS, among others, does wait, thus causing unnecessary delays.

Many disk caches take care of performing seeks in the background so that the system can run faster—or they simply

The most powerful expanded memory software available.

TURBO EMS Version 4.3

With Added 386 Support

Turbo EMS 4.3 now includes 386 support, "Automatic Spillover" and special support for Windows, Excel, DESQview, and Ventura.

- 386 features include "VCPI" support, relocating TSR and device drivers, increasing DOS memory, shadowing ROM, large page mode, discontiguous extended memory support, and supports Lotus 3.0
- Provides "Automatic Spillover" between any combination of expanded memory, extended memory and disk file space
- Simulates LIM 4.0 expanded memory with LIM 3.2 hardware
- Allows customized individual configuration files for multiple software applications
- Supports the LIM XMS 2.0 specification for extended memory
- Provides up to 32 megabytes of LIM 4.0 expanded memory

Turbo EMS 4.3 $99.95 Sugg. retail

LANTANA TECHNOLOGY, INC.™

4393 Viewridge Avenue, Suite A • San Diego, CA 92123 • 619/565-6400 • FAX 619/565-0798

Circle 152 on Reader Service Card (DEALERS: 153)

don't do them if the destination track is in the cache. (If you use a disk benchmark program on a system that is running this kind of cache, the figure that you will be given for track-to-track access time will not be a meaningful one.)

Caches in multitasking systems and single-tasking systems with write-back often use *elevator seek* algorithms. The head is moved between tracks the same way an elevator moves between floors in a building, continuing in a given direction until there are no more outstanding requests for access to tracks in that direction. It then turns around and makes a pass back across the disk. The resulting access pattern is orderly and usually close to optimal.

In a disk cache, speed may be less critical than RAM space.

Finally, as I mentioned earlier, a system with a write-back cache must update the disk every so often in the event that the machine crashes or is turned off. This process should be handled as a background task.

Associativity in Disk Caches

Most RAM caches are direct-mapped or two-way associative. It usually isn't practical to provide a higher degree of associativity because the hardware required becomes too complex; it's less expensive to reduce cache misses by adding more cache memory.

In a disk cache, however, speed may be less critical than RAM space. A software disk cache usually uses storage taken from the pool of RAM normally available to other parts of the system; a caching disk controller can use only the amount of RAM that's available on the board. (Remember that sectors must always be cached as a whole; a single-byte read requires 512 bytes of cache.)

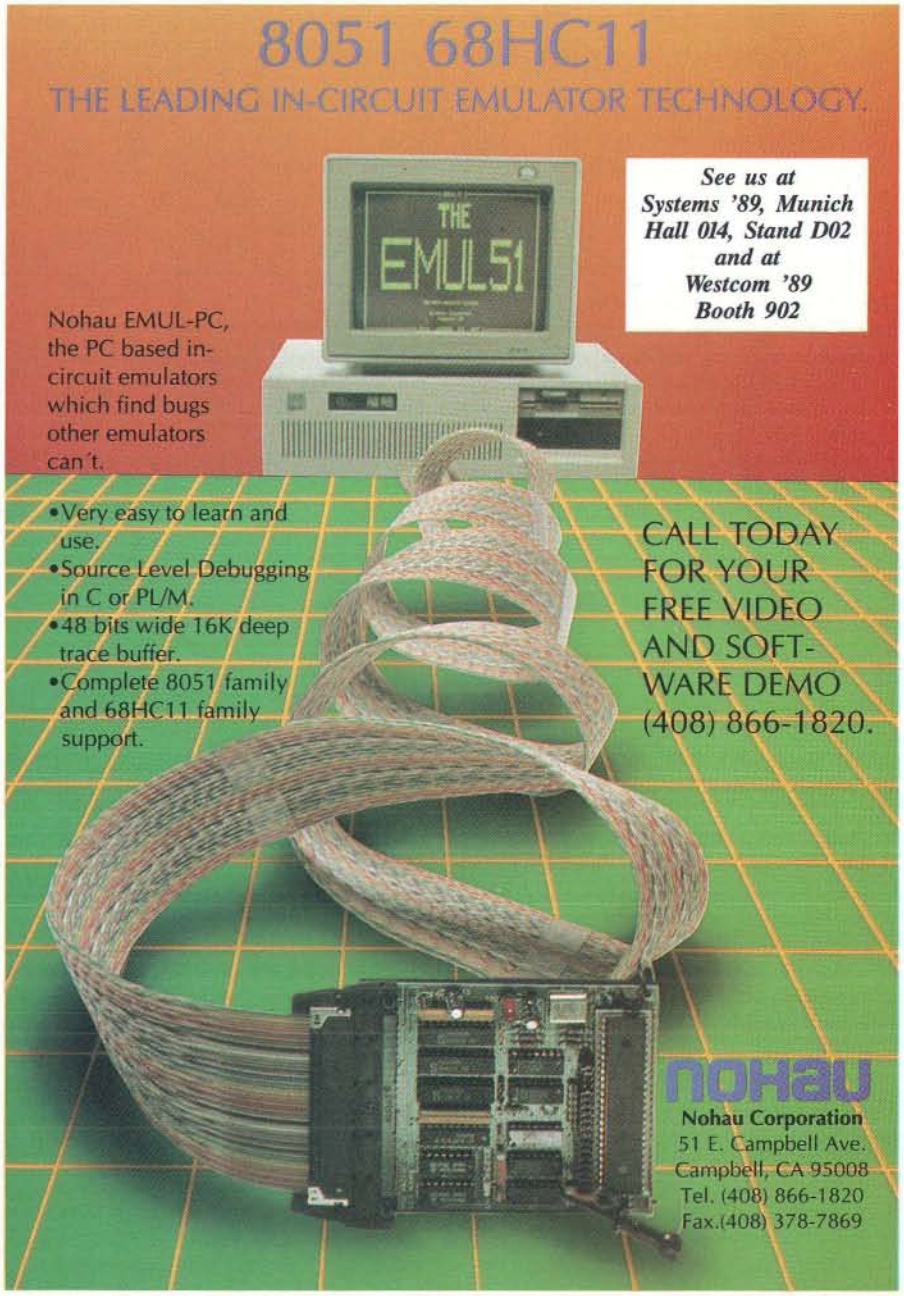
Also, since RAM and the CPU are faster than the disk mechanism, it pays to take more time to manage the cache well. The penalty for doing a binary search through a list of available sector numbers is small compared to the penalty incurred when an important sector—say, part of the file allocation table (FAT)—is thrown out of a direct-mapped cache.

For all these reasons, it pays to use a fully associative caching algorithm for a hard disk cache.

Replacement Strategies

Many disk caches use a strict LRU algorithm to choose a slot for new data. Other techniques are biased for amount as well as time of use—a sector that was once used a lot will "age" more slowly than one that wasn't used much. Some more-complex algorithms, especially in multitasking systems, factor in the difficulty of getting the data back. If the disk head is far from the data, it may be best to keep the data in the cache. Still other algorithms take into account special knowledge of the file system. For instance, it's a good idea for a DOS cache to keep the FAT—and possibly the root directory—in the cache at all times.

continued



Australia (02) 654 1873, Austria (0222) 38 76 38, Benelux +31 1858-16133, Denmark (02) 65 81 11, Finland 90-452 1255, France (01)-69 412 801, Great Britain 0962-73 31 40, Israel (03) 48 48 32, Italy (011) 771 00 10, Korea (02) 784 784 1, New Zealand (09) 392-464, Portugal (01) 83 56 70, Sweden, Norway (040) 92 24 25, Singapore 065 743-2086, Spain (93) 217 2340, Switzerland (01) 740 41 05, Taiwan (02) 7640215, West Germany 01831-1687, USA FAX (408) 378-7869.

Circle 192 on Reader Service Card

Know Thy System

A good cache will take advantage of special knowledge of the operating system under which it runs. A DOS cache, for instance, may recognize that sectors are allocated in groups called *clusters* and try to cache whole clusters (since that's the way DOS allocates and uses them). It should also know about and be able to use the different methods of allocating memory outside the limited 640K-byte DOS area, including LIM/EMS memory and the extended memory specification.

A disk cache is more essential in some operating environments than in others.

Familiarity with the file system is also useful. For instance, if a file is fragmented, read-ahead operations may be of no help; the next sector of the disk won't be the next sector of the file. But if the cache understands the file system well enough to find and read the sector that really *does* come next, it can do the right thing.

A disk cache is more essential in some operating environments than in others. The Amiga file system, for instance, is organized in such a way that reads and writes are relatively quick, but building a directory or locating a file can be very slow, even with the new, fast file system. A disk cache is important for good performance in this system.

As the user of a disk cache, you will need to know about the operating system as well, so that you can tune the machine for optimal performance. For instance, if you're running MultiFinder on the Macintosh, you may find it necessary to reduce the size of the cache to run many programs at once. Otherwise, the Resource Manager may continually purge resources from memory and then reread them from the cache, bogging down the system in the process.

Caching and Networks

If you're running a LAN, you will almost certainly want to use a hard disk cache on the server. Novell's NetWare has caching built in, and some NetBIOS-based networks (e.g., the Network-OS) come with a disk-cache program that's relatively easy to install. Novell also has drivers for caching controllers.

Caches on network workstations are another matter. There is a great danger of losing coherency if two workstations have access to a file at the same time. To prevent this problem, most software hard disk caches will refuse to cache a network disk, leaving this task to the network software. The network software, which understands the protocols and file sharing conventions, generally takes a conservative approach as well—usually, it won't let a file be cached locally unless it's marked read-only or opened for the exclusive use of one workstation.

Hardware or Software?

If you're buying a new computer system, you may be faced with the dilemma of whether to buy a caching disk controller (like recent offerings from Distributed Processing Technology or Mylex) or simply use a software caching program.

Caching controllers certainly have some advantages: They add dedicated processing power to the system and usually don't take much (if any) RAM away from the host system. Unfortunately, they don't always deliver performance

Listing 1: *The 8086 assembly language source code for capturing a record of all the disk reads and writes.*

```
; ****************************************************************
; SNOOP.ASM                    Created 6/24/1989 by L. Brett Glass
; ****************************************************************
; This TSR logs all hard disk reads and writes that pass through
; the IBM PC BIOS to a RAM buffer. The sector, cylinder, head, drive,
; operation, and number of sectors are recorded.
;
; Usenet: apple!well!rogue
; ARPANET: well!rogue@APPLE.COM
; BIX: glass
; CompuServe: [72267,3673] (Also reachable from MCI Mail)
;
; This program may be freely redistributed for noncommercial purposes
; only. It may not be made part of any hardware or software product
; without the express written consent of the copyright owner. This
; program is supplied on an "as is" basis. The author assumes no
; responsibility for its correctness or its fitness for a given
; purpose, nor for consequential damages that may arise from its use.
;
; ****************************************************************
;
DISKINT   equ 13h ; Disk I/O interrupt number
DOS       equ 21h ; Interrupt number for: DOS function
TSR       equ 27h ;                       Terminate/stay resident
GETVEC    equ 35h ; DOS function numbers: Get interrupt vector
SETVEC    equ 25h ;                       Set interrupt vector
PRINTMSG  equ 9   ;                       Print message
HARD      equ 80h ; Mask to test for hard disk number
DISKREAD  equ 2   ; BIOS functions: Read
DISKWRITE equ 3   ;                 Write
GETBUFADDR equ 99AAh ; Special Int 13h request for snoop buffer address
BADCMD    equ 1   ; Bad command result code for BIOS call
SENTINEL  equ 4321h ; Sentinel value to signal that SNOOP is present

MAXTRANSACTIONS equ 8 * 1024  ; Log 8K disk transactions
BUFFERSIZE equ 6 * (8 * 1024) ; Each transaction is 6 bytes

Code      segment
          assume cs:Code,ds:Nothing
          org 100h
Entry:    jmp near ptr Init ; Jump to transient portion of program
;
; Store the original vector here
;
DiskIO    label   dword   ; Make a label for the whole vector
DiskIOOfs dw 0 ; Now make labels for segment and offset
DiskIOSeg dw 0
;
; Define constants that indicate where buffer starts and ends
;
BufferStart equ (offset NextLoc) + 2
BufferEnd equ   (offset NextLoc) + 2 + BUFFERSIZE
;
Snoop     proc far
          test dl,80h ; Is it a call to the hard disk?
          jz Chain    ; Nope, let it through
          cmp ah,DISKREAD ; Is it a read request?
          je Log      ; If so, log it
          cmp ah,DISKWRITE ; Is it a write request?
```

```
            je Log
            cmp ax,GETBUFADDR ; Is it a buffer address request?
            jne Chain   ; If not read or write or addr request, pass on
GetAddr:    mov  ax,cs  ; Get address
            mov  es,ax
            mov  bx,offset WrapFlag
            mov  dx,SENTINEL ; Tell program SNOOP is present on the sly
            mov  ah,BADCMD ; Look like bad command
            stc         ; Generate apparent error
            ret 2       ; Do not restore original flags when returning
Log:        push di     ; Use di as a pointer into the buffer
            mov  di,cs:NextLoc ; Get the next position to be written
            mov  cs:[di],dx ; Store DX there
            add  di,2
            mov  cs:[di],cx ; Then CX
            add  di,2
            mov  cs:[di],ax ; Then AX
            add  di,2
            cmp  di,BufferEnd ; End of buffer?
            jb   @F
            mov  di,BufferStart ; If so, wrap to beginning
            mov  cs:WrapFlag,1 ; And set a flag so we know we've wrapped
@@:         mov  cs:NextLoc,di
            pop  di
Chain:      jmp cs:[DiskIO]  ; Jump to disk BIOS
Snoop       endp
;
; Labels used by TSR portion of program
;
WrapFlag    db   0 ; Flag to indicate buffer has wrapped at least once
NextLoc     label word ; Next location to store disk info
;
;           "Transient" area (also used for logging transactions) begins here
;
Message     db 'Hard Disk Log Utility'
            db 0Dh,0Ah,'Copyright (C) 1989 by L. Brett Glass'
            db 0Dh,0Ah,'Reboot to remove this TSR.'
            db 0Dh,0Ah,'$'
;
;           assume cs:Code,ds:Code
;
Init        proc near       ; This code executed on entry
            mov ax,(GETVEC shl 8) + DISKINT  ; Get interrupt vector from DOS
            int DOS         ; DOS call
            mov [DiskIOOfs],bx ; Save the old vector
            mov [DiskIOSeg],es
            mov dx,offset Snoop ; Get ready to add our own routine
            mov ah,SETVEC   ; Set interrupt vector through DOS
            int DOS         ; DOS call
            mov dx,offset Message ; Prepare to print message
            mov ah,PRINTMSG ; Print message through DOS
            int DOS         ; DOS call
            mov NextLoc,BufferStart ; Start from beginning of buffer
            mov dx,BufferEnd ; Reserve space for buffer
            int TSR         ; Terminate and stay resident
Init        endp
Code        ends
            end     Entry
```

commensurate with their price tags, especially under single-tasking operating systems like DOS, where a software cache may be as good or better.

Hardware caches usually have their own pool of RAM for the cache, and you may need to buy special boards or chips from the manufacturer to expand the cache. (Software caches, by contrast, use the same kind of memory the rest of your machine uses, and you can usually decide how much RAM goes to the cache and how much to the system.) A caching controller may also prevent you from using low-level disk maintenance packages like SpinRite and Disk Technician. Caching controllers may prevent you from running operating systems that don't use the BIOS (e.g., Unix and OS/2) unless they're register-compatible with the original AT controller or come with a special software driver.

When evaluating a caching controller, beware of manufacturers' claims of "0.5-millisecond access time" or less. These figures are usually produced by benchmark programs designed to measure the time it takes for a hard disk drive to physically move its heads—*not* controller performance or overall system throughput. Since most caching controllers don't actually move the head in response to a seek command or do seeks in the background after the call has returned, the figure you'll get from one of these programs has little bearing on the performance you'll get on a day-to-day basis. If you wish to do a benchmark, use a set of tests that corresponds to the kinds of disk transactions you're likely to use in your work.

A Hard Disk Snoop

How would different disk-caching strategies affect performance on your machine? To demonstrate how hard disk caching could speed up your system, I've included a program that will let you find out. It consists of two parts: a TSR *snoop* module, which invisibly logs the last 8192 requests your machine has made onto the IBM PC disk BIOS, and a *simulator*, which shows how much time could be saved by different caching strategies. Listing 1 shows the assembly language source code for the TSR module.

SNOOP.COM installs itself between the Int 13h interrupt vector and the disk BIOS, and it logs all hard disk read and write requests. (It detects and ignores requests that go to floppy disk drives.) It saves 6 bytes of information about each request—including the action, the head, the track, and the sector—in a circular buffer for use by the simulator.

EVAL.PAS, the simulator, is written in Turbo Pascal 5.5. It looks through RAM and extracts the relevant information from the buffer maintained by SNOOP.COM and then analyzes it to see how a cache could speed up the system. You can enter different drive characteristics (e.g., interleave factors and access times) to see how the system will perform under different conditions.

EVAL.PAS is designed to make it easy for you to try your own disk-caching algorithms to see how well they would work with your machine and access patterns. If you have a clever idea for a replacement strategy, head-motion strategy, or some other improvement to disk-caching technology, here's your chance to find out how well it will work. Add the algorithm to the simulator and watch the results! ■

Editor's note: *The source code listing for SNOOP.ASM and EVAL.PAS is available in several formats.* *See page 5 for details.*

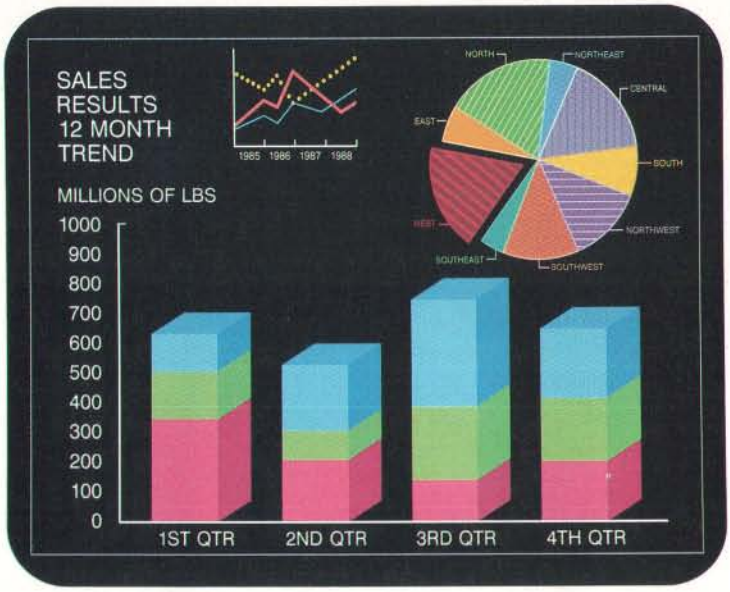
L. Brett Glass is a freelance programmer, author, and hardware designer residing in Palo Alto, California. He can be reached on BIX as "glass."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

BEST PICTURE OF THE YEAR.*

*Readers Poll, Data Based Advisor, February 1989

BUSINESS GRAPHICS FOR 'C' USERS



CATEGORY: BEST DATABASE MANAGEMENT GRAPHICS PACKAGE.

dGE the most powerful database graphics package on the market, has just been voted the **"best graphics tool for a database manager,"** according to the readers of Data Based Advisor.

If you think that's impressive, consider this: the vote was based on dGE 2.0.

Now dGE 3.0 is here.

dGE 3.0 is better than ever.

The Graphics Design Center, included in the new 3.0 version, supports the creation of graphic charts and pictures in a free-form menu driven environment.

So instead of requiring you to program in dBASE source code, the Graphics Design Center writes the code for you after you've designed the image using pull-down menus and WYSIWYG editing screens.

There's more good news. Version 3 also adds a font editor, expanded printer support, 3-D bar graphs and more.

Impress your boss, your clients, and yourself. Easily.

dGE does what you want. And it does it with the dialect of your choice. Consider the possibilities:

GRAPHS:

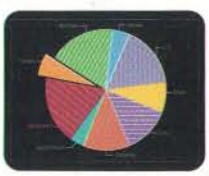
- Bar
- 3-D Bar
- High-low-close
- Pie
- Polar
- Polyline figure
- Polyvector
- Time series
- Cartesian

DIALECTS:

- dBASE III+
- dBASE IV
- Clipper
- FoxBASE+
- R:BASE Compiler
- Quicksilver
- dBFast
- Eagle
- Microsoft C
- Quick C
- Turbo C

dGE comes complete with interface to all dialects listed.

What's more, dGE 3.0 works with: CGA, EGA, VGA and Hercules monitors, IBM PC, XT, AT, PS/2 and compatibles. Supports the most popular printers and plotters including HP-G/L language plotters. PCX/PCC support now also included.



For more information and your **FREE DE DISK** just call 1-800-231-1293 or 1-206-941-2300 or write Pinnacle Publishing, P.O. Box 8099, Federal Way, WA 98003.

When you're ready for the best, you're ready for dGE.

Price: $195.00; contact Pinnacle Publishing or your local software dealer.

GUARANTEE

dGE is backed by a thirty-day money back guarantee.

Pinnacle Publishing Inc.

P.O. Box 8099
Federal Way, WA 9800
206/941-2300
800/231-1293
FAX 206/946-1491

© 1989 Pinnacle Publishing, Inc.

The Database Enhancement Expert™

dGE is a trademark of Bits Per Second. Other brand and produ names are trademarks of their respective holders.

Come Visit Us At Comdex Booth #C-740

Circle 315 on Reader Service Card

Part 1

TWO TIN CANS AND SOME STRING

A two-part series on AppleTalk and NetBIOS, and how each works with a file transfer program

Networks have snuck up on us. I can't remember how many times I've read or heard about "The Year of the LAN." I don't think there ever will be a Year of the LAN; the invasion moves like a sluggish tide: imperceptible but overwhelming. Here at BYTE, there are at least three LANs in operation (that I'm aware of), and they were all installed without fanfare or massive work interruptions: A phone man showed up one day to put a red sticker on my new outlet; a board and some cables showed up the next day. I was connected before I knew what was going on.

What has amazed me most about networks is how underutilized they often are. It wasn't until more than a year after installing AppleTalk that I finally shouldered my way into the *Inside AppleTalk* manual and realized that I already had services available for creating applications beyond simply sharing the laser printer. Later, after I'd installed one of the serial-card-based LANs (EasyLAN, to be exact) in two of my PC clones, I discovered that I could put together NetBIOS applications. It was like learning two languages that had sprung from a common ancestor but had developed in separate cultures (Apple and IBM).

I decided that the best way to present AppleTalk and NetBIOS was to concoct a real-world application as a common denominator and then build software to perform the task—one program using AppleTalk, the other using NetBIOS. The job—simple and useful—is transferring a file from one machine on a network to the other. Not a contest, more like a shared stage. And I'll start the performance with the AppleTalk program.

What's Your Address?

When you think about what a network is—a bunch of computers and printers sharing some form of common communications medium—you realize that one logistical problem that crops up is how to give users the ability to recognize one another. This boils down to providing each user with a unique address that other users can identify. On an AppleTalk network, each machine is assigned a unique, 8-bit *node* number. (I'll reveal which program does this assigning later.) Notice I said "each machine," not "each computer." A machine on a network can be an unmanned peripheral (e.g., a laser printer) as well as a manned Macintosh.

On a single Mac, I might run more than one application that's using the network. For example, I might run a DBMS program reading a shared database on some remote server to generate a sales report on the office laser printer. How does the network keep records arriving from the database server from getting mixed up with acknowledge packets from the printer, even though both are being sent to the same node (i.e., my machine)?

Sockets is the network term for the answer. A socket is a kind of logical node within a node, a post office box within an apartment number. Each application wishing to communicate across AppleTalk must first obtain an 8-bit socket number that is unique within the node. For this reason, a program that communicates across the network is often called a *socket client* (used interchangeably with the term *network-visible entity*). So, in the example above, my DBMS program might be communicating with the server via socket 64, while the print job is talking to the LaserWriter through socket 65. Messages coming back from the server say "Deliver me to socket 64," while acknowledge packets from the printer say "Deliver me to socket 65."

Finally, AppleTalk permits you to connect networks via bridges to form internets. AppleTalk allows up to 254 unique nodes on a single network. If bridging were not allowed, some large installations would quickly reach the limits of AppleTalk. To distinguish one network from another, AppleTalk defines a 16-bit network number associated with each network on an internet.

These three coordinates—network number, node number, and socket number—combine to form a socket client's *internet address*. This address is unique for each socket client on an internet.

Level Out

The components of AppleTalk are stratified in clearly defined layers (see the figure on page 149 of the July BYTE). Each layer is really nothing more than a set of functions. But it's convenient to speak of layers, because this helps you visualize the fact that functions of higher layers embody more complex activities. Also, functions in higher layers stand on the shoulders of those below: Functions of one layer can only call functions beneath them. It's important to point out, however, that layers are not opaque; those above do not hide those below. Programmers have full access to all layers, so if you don't like the way Apple has done things, you can literally write your own network operating system from the ground up.

• *ALAP.* The lowest of these layers is AppleTalk's Link Access Protocol. ALAP is the gateway through which everyone must pass to get to the actual network. It's also the AppleTalk traffic cop; since AppleTalk is physically a CSMA/CD network, it's ALAP's job to

continued

resolve collisions on the network. Basically, this means that everyone talks along the same wire, and if two users talk simultaneously, a collision occurs. ALAP, in the case of AppleTalk, detects the collision and handles retransmission.

Recall that machines on an AppleTalk network are recognized by unique node numbers; ALAP enforces that uniqueness. Packets traveling along the network are referred to as ALAP frames. These frames contain source and destination node numbers so that every machine can determine who's talking to whom.

ALAP is described as a "best effort" delivery system. This means that if you send a data packet from one node to another using ALAP calls, you're not guaranteed that the message will arrive safely at its destination. If some transmission error occurs along the way, the destination node will detect the error (since ALAP attaches a 16-bit frame check sequence). However, ALAP contains no accommodations for retransmitting the bungled packet—that's the job of higher-level protocols. ALAP makes certain only that it got sent—not that it arrived.

• *DDP.* Next up the ladder is the Datagram Delivery Protocol, which manages communications between sockets on an internet. DDP recognizes sockets within nodes, but, as with ALAP, it only provides a one-shot attempt; if the packet's contents are somehow fouled, DDP will make no attempt to resend. This is where ATP comes in.

• *ATP.* The AppleTalk Transaction Protocol, as its name implies, provides a controlled means of carrying out a complete transaction between two socket clients on the network. A *transaction* is AppleTalk for a dialog: the exchange of a request and a response between two application programs (see figure 1). A response can actually consist of up to eight transmissions. So, a single requesting transmission might be a message like "Send me the first eight 512-byte blocks from file BOB." The response would consist of eight actual packets that are consecutive 512-byte blocks from BOB.

ATP guarantees delivery. Application developers don't have to worry about calculating cyclic redundancy checks or what to do if one end drops a packet. This month's sample program uses ATP for that reason. The guarantee is possible because of the transaction ID that ATP attaches to outgoing request packets. When a respondent services the request, the response packets sent back to the requester carry that same transaction ID.

The ATP driver also holds a retry timer and maximum retry count. Once a request datagram is sent, ATP starts the retry timer. If the requester doesn't receive a response before the timer runs out, ATP retransmits the request. The retry count specifies how many times ATP should attempt retransmission. If you're bound and determined to get a request to its destination, you can specify a retry count of 255, which tells ATP to continue retransmission forever, until you explicitly tell it to stop (or until it succeeds).

ATP provides two classes of service: ALO (for "at least once") and XO (for "exactly once"). If you flag an ATP request as being ALO, then *any time* the request is received by the responder, the responding system's ATP driver will deliver that request to whatever application is calling ATP. So, even if the requester's ATP driver retransmits the same packet as part of a retry operation, that packet is delivered to the responder. This is useful for time-critical applications where one machine is monitoring a rapidly changing value (such as a timer) on another machine.

XO transactions allow only one copy of the request packet to make it to the responder's end, no matter how many times a request may have been retransmitted. (XO transactions are sufficient for most applications; this month's program uses them exclusively.) Each responder's ATP driver maintains a list of recently received XO transactions, so ATP can determine which transactions have already been sent to the calling application.

You Name It

Now that you've learned what facilities are available for setting up communications between two Macs, there's probably a question nagging at you: "How does a program on one Mac 'find' a program on some other Mac in order to set up communications?" Well, remember

continued

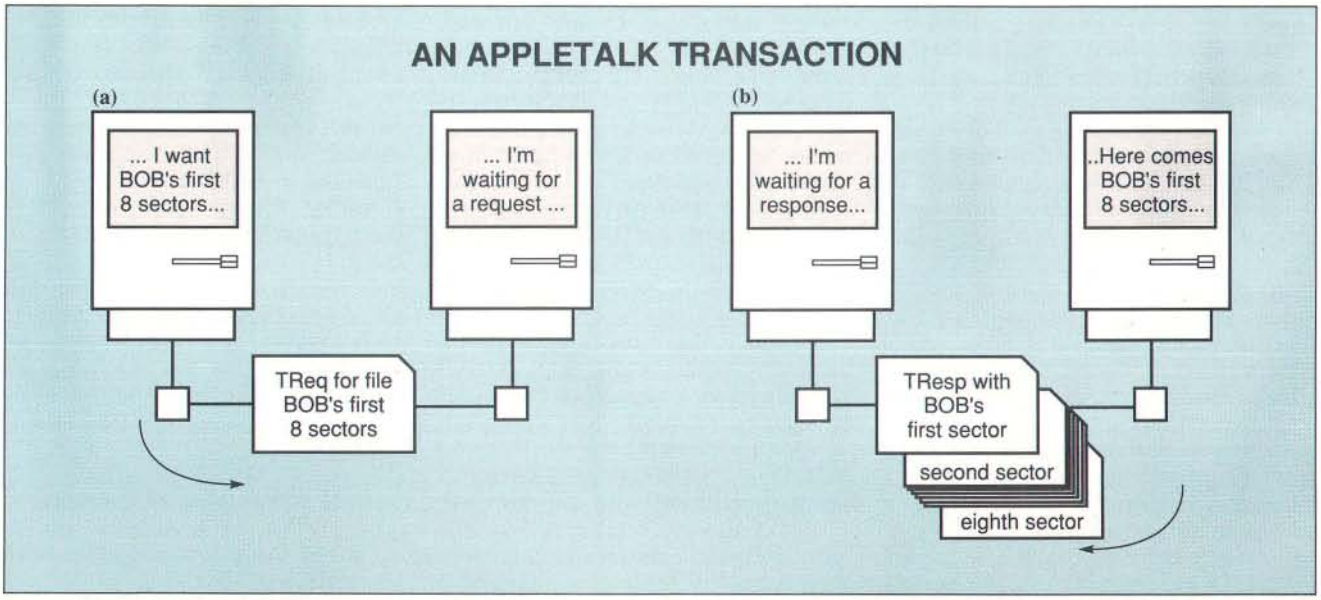
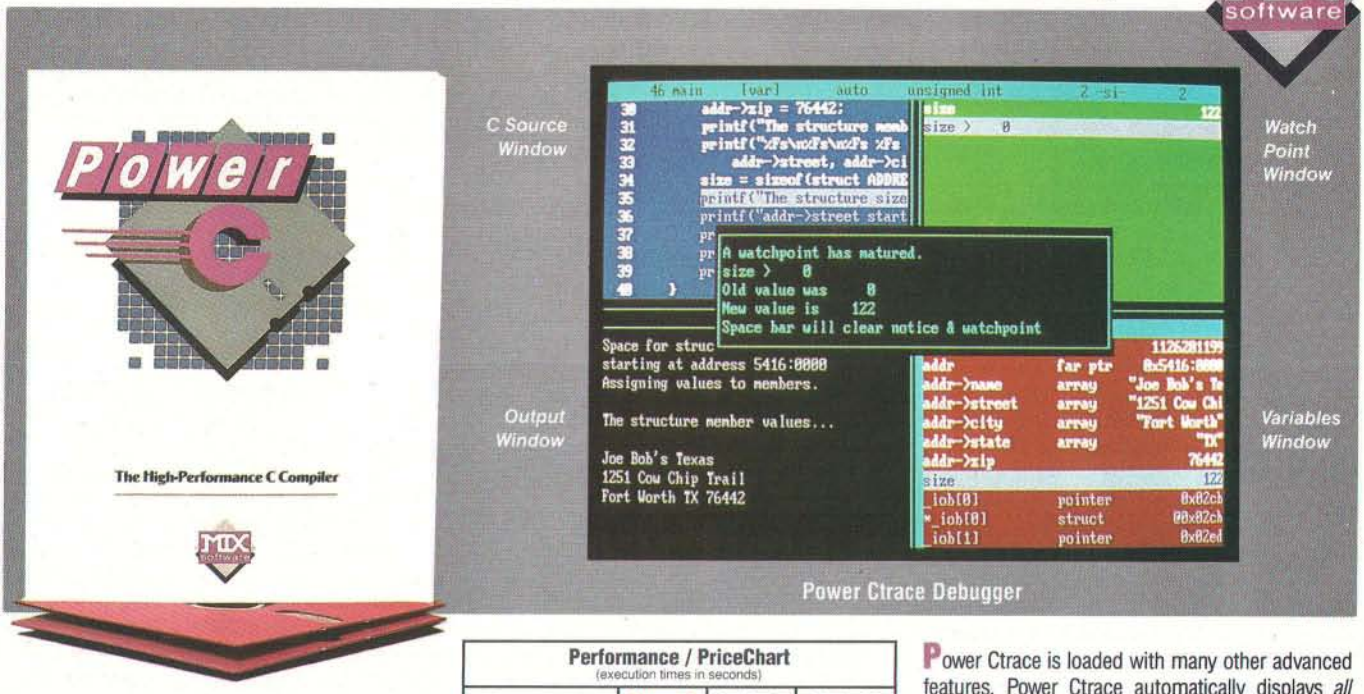


Figure 1: *The anatomy of a transaction.* **(a)** *The system on the left sends a request (TReq) to the system on the right. The request is for the first eight sectors of a file.* **(b)** *Since a single request can be answered with up to eight responses, the system on the right is able to satisfy the request with eight response (TResp) packets.*

How to create high-performance programs without wasting your time or money



Step 1: The $19.95 Power C compiler

Power C is the new ANSI compatible C compiler that runs faster than Microsoft C® and has more functions than Turbo C® . Power C combines high-performance software with superb documentation, all for less than the price of most C books alone. It's your fast route to fast programs without the fast bucks.

The quality of the Power C documentation makes it easier to learn C. The manuals that accompany our competitor's products are terse at best. They contain little or no information about C, and very few examples. In contrast, the Power C book includes a step-by-step tutorial and is chock-full of example programs. Most of our customers are saying that it's the best C book they've ever used.

The quantity of functions in the Power C library makes it easier to accomplish your programming tasks. The Power C library contains more than 420 functions, a superset of the functions in Microsoft C® 4.0 and Turbo C® 1.0. In addition, Power C includes a large number of video and graphics functions. You get super-fast functions for drawing lines, boxes, circles, ellipsis, pie charts, and more.

The speed of the Power C compiler makes programming fast. Power C's integrated *Make* utility saves you time and effort by automatically managing your large programming projects. If you modify your program, Power C makes a new version by recompiling only the files that have changed. The compiled programs are equally fast. Just check out the performance chart. See how much time and money you save with Power C.

Performance / PriceChart
(execution times in seconds)

	Power C	Quick C®	Turbo C®
1) fib	23.8	53.4	26.4
2) sieve	27.6	43.2	25.5
3) tdbl	3.5	9.0	9.6
4) diskio	13.5	14.4	14.3
5) report	11.0	71.7	60.7
6) drystone	36.6	41.6	31.8
Compile/Link	73.9	113.5	81.4
EXE File Size	25120	32092	27184
Compiler/Debugger	$39.90	$99.00*	$149.95*
Library Source	$10.00	$150.00	$150.00
Total Cost	$49.90	$249.00	$299.95

* Includes limited debugger only
Benchmark programs used by Dr. Dobb's Journal and Computer Language Magazine.

Step 2: The $19.95 Power Ctrace debugger

Power Ctrace is the new state-of-the-art C debugger that makes Microsoft's Codeview® look like old technology. Power Ctrace reduces the time you spend debugging your C programs by at least a factor of 10. With Power Ctrace, you work smarter instead of harder. Actually, using Power Ctrace is so much fun that debugging doesn't even feel like work anymore.

Power Ctrace shows you 7 windows of program information: 1) C source statements, 2) screen output, 3) variables, 4) watch points, 5) memory, 6) symbols, and 7) assembly instructions. You can view a single window or as many as 4 windows at the same time (as shown on the screen above). Eight predefined window arrangements are available at the press of a key, or you can design your own.

Power Ctrace is loaded with many other advanced features. Power Ctrace automatically displays *all* of your variables (including arrays and structures), saving you from having to remember and type their names. The virtual output window lets you see the screen output from your program while simultaneously viewing any of the other windows. Interruptible input allows you to get control even while your program is reading input from the keyboard. Backwards tracing gives you the ability to trace backwards through the execution path.

With all its advanced features, the single most important feature of Power Ctrace is simple operation. With Power Ctrace, you won't waste any time trying to understand or remember cryptic commands. A single keystroke is all it takes. Help screens show you which key to press and pop-up menus list your options. Invest just 10 minutes of your time with Power Ctrace now, and you'll save hours from now on.

Order Line: 1-800-333-0330
Technical: 1-214-783-6001
1132 Commerce Dr., Richardson, TX 75081

60 day money back guarantee

Name _____
Street _____
City _____
State _____ Zip _____
Telephone _____
Paying by: ☐ Money Order ☐ Check
☐ Visa ☐ MC ☐ AX ☐ Discover
Card # _____
Card Expiration Date _____
Computer Name _____ Disk Size ☐ 5 1/4" ☐ 3 1/2"

Product(s) (Not Copy Protected)
☐ Power C compiler ($19.95) $ _____
☐ Power Ctrace debugger ($19.95) $ _____
☐ Library Source Code ($10.00) $ _____
(includes assembler & library manager)
☐ BCD Business Math ($10.00) $ _____
Add Shipping ($5 USA - $20 Foreign) $ _____
Texas Residents add 8% Sales Tax $ _____
Total amount of your order $ _____
(Requires DOS 2.0 or later)

B

Power C & Power Ctrace are trademarks of Mix Software Inc. Turbo C is a registered trademark of Borland International. Quick C, Microsoft C, & Codeview are registered trademarks of Microsoft Corp.

that it's ALAP's job to assign unique node numbers to machines on the network. When you activate AppleTalk on your Mac, your local ALAP driver chooses the node number for your machine dynamically. It picks a random node number, say 88, and broadcasts onto the network a message like "I want to be node 88; are there any objections?" If a machine is already node 88, your ALAP driver keeps picking random numbers until there are no complaints.

Even though the node numbers are random, your machine locates your partner's machine thanks to the Name Binding Protocol. The NBP makes socket clients visible on the network. It provides a means by which a socket client's internet address can be tied (*bound*, in network terminology) to a name. Most important, once you've bound your internet address to a name, you can register that name in a kind of network-wide directory that all network users have access to. Then anyone who knows your internet name can find your internet address.

A name consists of three components: zone, type, and object. Each component can be up to 32 characters long. The zone portion lets you partition an AppleTalk internet into subnets—handy for setting up departments in a large, company-wide network. The type component lets you identify the kind of service an entity provides. Finally, the object portion lets you distinguish between members of the same type in the same zone.

Here's an example: This month's program runs on two machines—the one sending the file and the one receiving the file. Both machines call NBP and register their types as "BYTEFTRANS." However, the sender's object name is "ByteSend," and the receiver's object name is "ByteRecv."

Once a program registers its name on the network, applications on other machines can use NBP to locate the internet address of that program. Notice I said *program* and not *computer*. Remember that machines are associated with nodes, while programs are associated with sockets within nodes. So, a single machine may have several names registered on the network, each name attached to a particular application program running on that Macintosh.

Establishing a Dialogue

To make all this clear, I'll step through the AppleTalk calls that a program would use to send a file across the network. Imagine that you want to send a document from your Mac Plus to a colleague's Mac II across the office. In keeping with ATP terminology, assume your machine is the requesting end and your comrade's is the responding end, and assume both ends are running the same program. (This program is general enough to act as either sender or receiver.)

The program's first task is to make each end of the conversation visible to the other. This is a job for NBP, but before you can call it, you have to have an internet address with which to bind the name. On the responder's side, the program calls the `OpenATPSkt` function to open a socket for receiving requests. You must supply this function with two arguments: the internet address from which to expect requests, and the socket number on your node (the local socket) that will receive them. If you give the function a 0 for the local socket number, ATP will pick the socket number for you.

The internet address argument defines the requester's side of the transaction and acts as a filter for incoming requests. Remember that an internet address consists of network number, node, and socket. If you enter a nonzero number for any component of the internet address, your program receives only those transactions matching that value in that component. If you've constructed a networked database server, you might set its local socket to 89 and set the requester's socket to 89, and all network traffic pertaining to your database will occur only between applications talking through socket 89.

A zero in one of the requester's internet fields matches all requests in that field. Thus, if you pass `OpenATPSocket` all zeros for the requester's internet address, you've told ATP that the local socket will accept requests from anyone on the network. (Sockets 64 through 127 are available for applications to use. ATP uses socket numbers between 128 and 254 when it picks the number. Sockets 0 through 63 are reserved by Apple.)

Moving up to NBP

Now that the responder has opened a socket, the program can call the NBP

continued

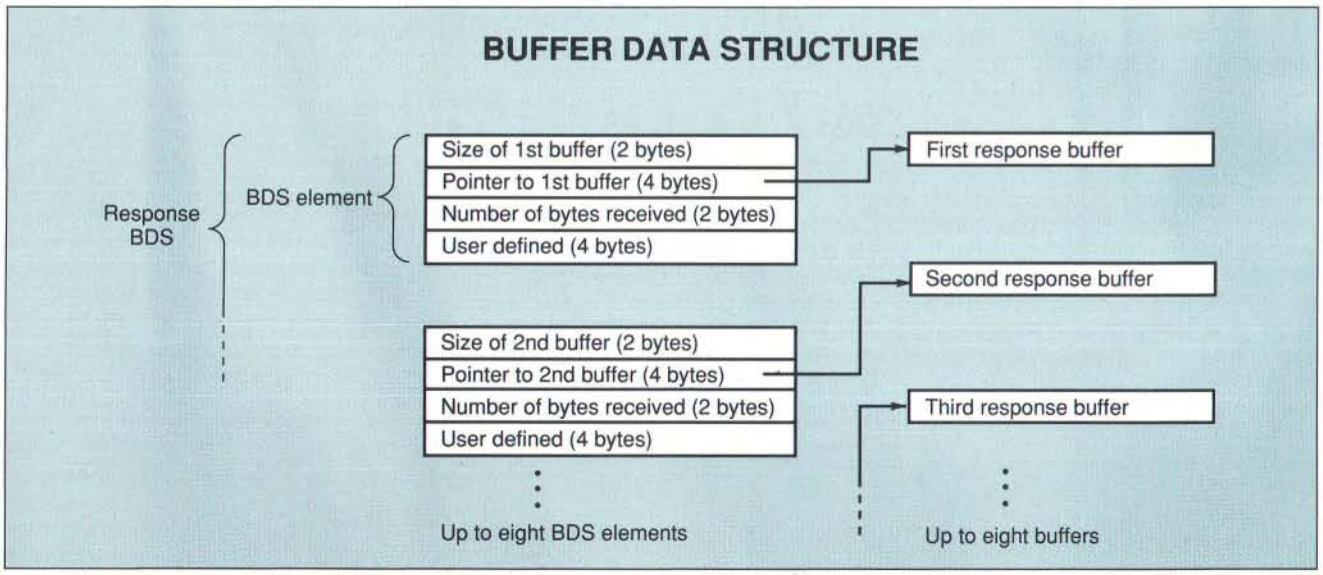


Figure 2: *The response buffer data structure (BDS) tells the AppleTalk Transaction Protocol where incoming responses can be placed. A single response BDS can consist of up to eight BDS elements of 12 bytes each. A BDS element governs a response buffer, where the actual response data goes.*

Listing 1: *Pseudocode for a program to send and receive a file on an AppleTalk network.*

```
IF receiving THEN direction:=1
      ELSE direction:=0;
{ Prompt user for filename.
IF direction=1 THEN
 BEGIN
  Display an SFPutFile Dialog Box;
  fname := entered filename;
 END
ELSE
 BEGIN
  Display an SFGetFile Dialog Box;
  fname := selected filename;
 END

{ Open an ATP socket.
{ Following lines tell OpenATPSocket that the local
{ socket (selected to be 89) will receive requests from
{ all network addresses, nodes, and sockets. Hence zeros
{ in each field.
IN Parameterblock DO
 BEGIN
  receive_network_address = 0;
  receive_node_number = 0;
  receive_socket_number = 0;
  mysocket = 89;
 END
CALL OpenATPSocket(Parameterblock);

{ Register your name on the network.
zone := "*";  { Local zone
type := "BYTEFTRANS";
IF direction=1 THEN object := "ByteRecv"
               ELSE object := "ByteSend"
mysocket := 89;
Build a Names Table Element;
IN Parameterblock DO
 BEGIN
  Set pointer to Names Table Element;
  retry_interval = 10; { Retry every 1.3 seconds
  retry_count = 50;
  verify_flag = TRUE;  { Check for duplicate names
 END
CALL NBPRegisterName(Parameterblock);

{ Look up the other station's name.
zone := "*";
type := "BYTEFTRANS";
IF direction = 1 THEN object := "ByteSend"
                 ELSE object := "ByteRecv";
Build an Entity Name;
IN Parameterblock DO
 BEGIN
  retry_interval = 10; { Retry every 1.3 seconds.
  retry_count = 50;
  Set pointer to Entity Name;
  { Set aside 40 bytes to receive response from
  { LookupName().
  ret_buffer = NewPtr(40);
  ret_buffer_size = 40;
  max_to_get = 1;   { Looking for 1 name.
 END
CALL LookupName(Parameterblock);
{ LookupName returns numGotten in Parameterblock.
IF numGotten = 0 THEN
 BEGIN
  Display(" **No answer")
  CALL REMOVE_MY_NAME;
  EXIT
END
{ If LookupName() was successful, the other
{ side's internet address is in ret_buffer.
EXTRACT his_address from ret_buffer;
Free(ret_buffer);  { Dispose of memory used by ret_buffer.

{ Both ends must build a response buffer data
{ structure-referred to as a BDS. See text for
{ details.
Build a response BDS;
IF direction = 0 THEN
BEGIN
 Open(fname);
 offset := 0;
 WHILE (fname NOT at end-of-file)
 BEGIN
  { Read 512 bytes from file fname into buffer, leave
  { the first 2 bytes of buffer empty.
  Read(fname,buffer[2],512);
  { Set the first 2 bytes of buffer to the number
  { of bytes actually read by Read().
  buffer[0..1]=number_actually_read;
  IN Parameterblock DO
   BEGIN
    Set exactly_once bit;
    addr_block := his_address;
    req_length := 514;
    req_pointer := buffer;
    Set bds_pointer to our response BDS;
    { We expect only 1 response.
    num_of_buffs := 1;
    timeout_val := 15; { Retry every 15 seconds.
    retry_count := 4;  { Retry 4 times.
   END
  CALL SendRequest(Parameterblock);
 END { End of WHILE loop }

ELSE  { direction = 1 }
 BEGIN
 Create(fname);  { Create the file.
 REPEAT
  { Get a request.
  IN Parameterblock DO
   BEGIN
    atp_socket := 89;  { Receive on socket 89.
    req_pointer := buffer;
    req_length := 514;
   END
  CALL GetRequest(Parameterblock);
  { GetRequest() returns a transaction ID in the
  { Parameterblock...I'll call it transaction_ID.

  { The number of bytes sent is in the first 2 bytes
  { of buffer.
  num_bytes := buffer[0..1]...;
  IF num_bytes<> 0 THEN
    Write(fname,num_bytes,buffer[2]);
  { Send a response.
  IN Parameterblock DO
   BEGIN
    atp_socket := 89;
    { Show that this is the last response
    { to the current request.
    atp_flags := atpEOMBit;
    addr_block := his_address;
    Set bds_pointer to our response BDS.
    { Only 1 response to send.
    num_of_buffs := 1;
    bds_Size := 1;
    trans_ID := transaction_ID.
   END
  CALL SendResponse();
 UNTIL (num_bytes <> 512); { End of REPEAT.
 END

{ Finish up.
 Close(fname);
 Display("Done");
 CALL REMOVE_MY_NAME;
 EXIT;

REMOVE_MY_NAME:
 zone := "*";  { Local zone
 type := "BYTEFTRANS";
 IF direction=1 THEN object := "ByteRecv"
                ELSE object := "ByteSend"
 { An entity_name is simply a concatenation
 { of zone, type, and object, with each string
 { preceded by a byte count.
 entity_name := zone + type + object;
 IN Parameterblock DO
   entity_pointer := address of entity_name;
 CALL RemoveName(Parameterblock);

 RETURN;
```

function RegisterName to attach a name to that socket and make the name visible on the network. You don't have to explicitly tell NBP your node or network number; it can find that out itself.

The requester doesn't need to make all the calls to ATP or NBP that I've mentioned. Strictly speaking, the requester can sit back and watch the network for the responder's name to appear and then begin transmitting requests at the responder's internet address.

However, in my file transfer program, I opted to have the requester call OpenATPSocket to capture a socket for the sole purpose of having one to give to RegisterName. In this way, both ends of the conversation can see that the other is on the network. So the requester's name serves merely as a semaphore to the responder's program, telling it that the requester is active and communication can commence.

The NBP routine LookupName allows a program to see visible entities on the network. You pass this routine a pointer to a data structure containing the three components (zone, type, and object) of a target name, and LookupName rummages around on the network and returns another data structure containing the internet address of all entities that match. Each component can contain wild-card characters: "*" in the zone field means the caller's local zone (similar to a default directory in a file open command); "=" in the type or object field tells LookupName to match all possible values for that field. This lets you locate all network entities in your zone of type "Database," for example.

In my file transfer program, the requester calls LookupName to search in zone "*" for type "BYTEFTRANS" and object "ByteRecv." The program then examines the data structure that LookupName returns to determine the responder's internet address. Once the requester knows the responder's address, the requester opens the file you've selected for transmission and calls SendRequest to begin passing data sectors over the network.

As I mentioned earlier, the responder calls LookupName merely to convince itself that the requester is on-line. Once that's done, the responder calls GetRequest to receive the data transmitted by the requester's SendRequest call. The rest is a dance choreographed by AppleTalk: The request packet passes from requester to responder, and the responder writes the data to the disk and issues a SendResponse call to inform the requester to send the next packet. This process—SendRequest, GetRequest, and SendResponse—continues until the entire file has been transmitted.

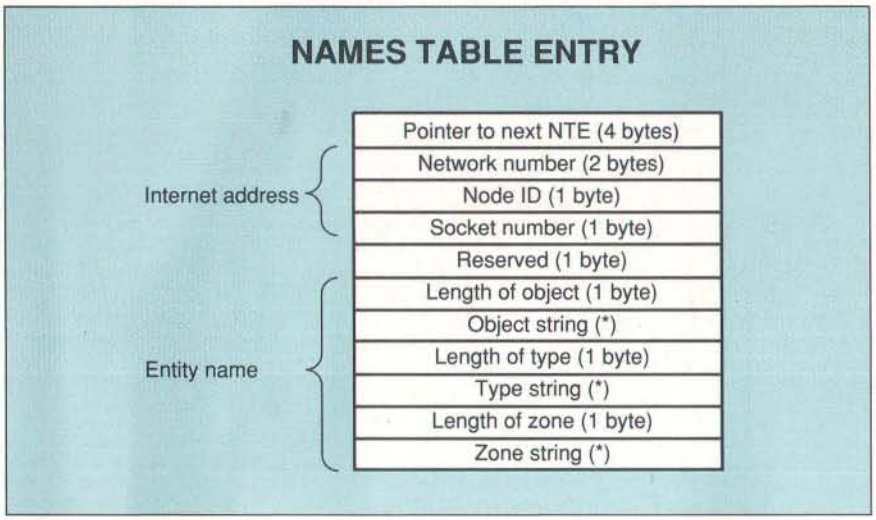


Figure 3: *The names table entry (NTE) list is the Name Binding Protocol's in-memory notebook of what names are currently active on the network. Each NTE is composed of two parts, the entity's internet address and name. (Fields with asterisks are variable-length, with size determined by a preceding count byte.)*

The Job Is Done

Once the job is done, both sides close things down in an orderly fashion: Both

continued on page 357

Circle 213 on Reader Service Card (DEALERS: 214)

PRODUCT SHOWCASE

- BUYER'S MART
- BYTE BITS
- PRODUCT SPOTS
- MICRO PRODUCT CENTER

ILLUSTRATION: JULIE E. MURPHREE © 1989

THE BUYER'S MART

A Directory of Products and Services

THE BUYER'S MART is a monthly advertising section which enables readers to easily locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes a Reader Service number to assist interested readers in requesting information from participating advertisers.

RATES: 1x—$525 3x—$500 6x—$475 12x—$425
Prepayment must accompany each insertion. VISA/MC Accepted.

AD FORMAT: Each ad will be designed and typeset by BYTE. Advertisers must furnish typewritten copy. Ads can include headline (23 characters maximum), descriptive text (250 characters is recommended, but up to 350 characters can be accommodated), plus company name, address and telephone number. Do not send logos or camera-ready artwork.

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to THE BUYER'S MART, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call Brian Higgins at 603-924-3754.

ACCESSORIES

CUT RIBBON COSTS!
Re-ink your printer ribbons quickly and easily. Do all cartridge ribbons with just one inker! For crisp, black professional print since 1982. You can choose from 3 models:
Manual E-Zee Inker — **$39.50**
Electric E-Zee Inker — **$94.50**
Ink Master (Electric) — **$189.00**
1000s of satisfied users. Money-back guarantee.
BORG INDUSTRIES
525 MAIN ST., JANESVILLE, IA 50647
1-800-553-2404 **Fax: 319-987-2251**

Inquiry 576.

COMPANION AND EXTENDER
Place a keyboard and monitor up to 600' from your CPU with EXTENDER and COMPANION products. Keep a second Keyboard/Monitor at the CPU with COMPANION. Supports MDA, CGA, EGA, VGA, PS2. Uses single ⅜" cable.
Prices start at $149.00 for EXTENDER and $219.00 for COMPANION 25 ft. unit complete.
CYBEX CORPORATION
2800-H Bob Wallace, Huntsville, AL 35805
205-534-0011 **International Fax #205-830-1947**

Inquiry 577.

FREE CATALOG
A complete source for computer supplies at low prices, Fast Service Call, write or circle inquiry card for a FREE CATALOG.
Use your VISA, MC or COD to order the following bulk diskettes
5.25" DS/DD (Min 50) **26¢**
5.25" DS/HD (Min 50) **62¢**
3.5" DS/DD (Min 30) **89¢**
GAAN COMPUTER SUPPLIES
186 B East Sunnyoaks Ave., Campbell, CA 95008
(800) 523-1238, In Calif. (408) 370-6747

Inquiry 578.

REFILL LASER PRINTER & COPIER CARTRIDGES
Don't throw away that used laser printer or copier cartridge. Refill it and save over 75%, it's easy. For use with Canon EP & EPS cartridges, HP LaserJet & LaserJet II, Apple Laserwriter & Laserwriter II, Canon LPB, FAX, and *many others*. Also kits for Canon Copiers. We have colors for laser printers. *Dealers Welcome.* VISA/MC
COMPLETE REFILL KIT $29.95
Includes toner, felt pad, and instructions.
VIDEO TAPE PROGRAM $45.00
Shows disassembly, cleaning, and remanufacture.
MORACK INC.
9132 Windsor Dr., Palos Hills, IL 60465
For order or information **(708) 598-0580 FAX: (708) 598-9203**

Inquiry 579.

PC UPS BREAKTHRU
Our patented technology provides *on-line (no-break) / sinewave* Uninterruptible Power Supplies at *standby / squarewave* unit prices!
15+ minutes of blackout operation time.
250W UPS.....$490 U.S.
500W UPS..... 790 U.S.
(International models also available)
SinePower Corporation
Box 820130 Houston, TX 77282-0130

Inquiry 580.

ACCESSORIES

HP LASERJET II
M-E-M-O-R-Y
1MB-2MB-4MB MEMORY EXPANSION BOARDS
Save 50%–60%
2-YEAR WARRANTY
STARION CORPORATION
(800) 782-8297 CA: (714) 750-2627

Inquiry 581.

ARTIFICIAL INTELLIGENCE

MANA
Intelligent Computing for 286/386
Transform your PC into an A1-based workstation. Expert systems, AI, knowledge base applications, rapid prototyping, object oriented, multi-tasking, virtual memory, LISP/PROLOG etc. modes in multi-language compiler, mouse driven, multi-windowed, fully integrated environment.
BMS, Inc.
700 E. Ogden Avenue, Westmont, IL 60559
Tel: (312) 789-9160 **Fax: (312) 789-0253**

Inquiry 582.

NATURAL LANGUAGE C LIBRARY
Increase your market share! Use JAKE to add a natural language front end to your application. JAKE translates English queries and commands into C function calls and data structures. JAKE offers context-sensitive semantic processing; interfaces easily; <64K mem.
JAKE $495. INTERACTIVE DEMO $10
ENGLISH KNOWLEDGE SYSTEMS, INC.
5525 Scotts Valley Dr. #22, Scotts Valley, CA 95066
(408) 438-6922

Inquiry 583.

NanoLISP $99.99
An MS-DOS Common LISP interpreter that supports most Common LISP operations and strictly adheres to the standard. Numerous advanced and extra features, excellent debugging facilities, sample AI programs, fully-indexed manual, free technical support.
Microcomputer Systems Consultants
P.O. Box 6646, Santa Barbara, CA 93160
(805) 967-2270

BAR CODE

PRINT BAR CODES/BIG TEXT FROM YOUR PROGRAM
Add bar codes and big graphics characters to your program. Print from ANY MS-DOS language. Bar codes: UPC, EAN, 2 of 5, MSI, Code 39. Epson, Oki, IBM dot matrix text up to ½". LaserJet up to 2". Font cartridges not required. $179–$239. 30-day $$ back.
Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 **In CA: (408) 458-9938**

BAR CODE

PORTABLE READER
Battery-operated, handheld reader with 64K static RAM, 2x16 LCD display, 32-key keyboard, Real-Time-Clock. Wand or laser scanner. Program prompts and data checking thru its own keyboard. Easy data transfer by RS-232 port or PC, PS/2 keyboard. Doubles as On-Line Reader. 30-day $$ back.
Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 **In CA: (408) 458-9938**

PRINT BAR CODES AND BIG TEXT
On EPSON, IBM, OKI dot matrix or LaserJet. Flexible design on one easy screen. Any format/size. Up to 120 fields/label. 13 text sizes to 1"-readable at 50'. AIAG, MIL-STD, 2 of 5, 128, UPC/EAN, Code 39. File Input & Scanned logos/symbols (PCX)—$279. Other programs from $49. 30-day $$ back.
Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 **In CA: (408) 458-9938**

BAR CODE READERS
For PC, XT, AT, & PS/2, all clones, and any RS-232 terminal. Acts like 2nd keyboard, bar codes read as keyed data. With steel wand—$399. Top rating in independent reviews. Works with DOS, Xenix, Novell, Alloy, -ALL software. Lasers, magstripe, & slot badge readers. 30-day $$ back.
Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 **In CA: (408) 458-9938**

BAR CODE SOLUTIONS
Bar coding is so easy with our complete line of readers. Our PC-Wand readers emulate your PC keyboard or ASCII terminal, and are carried around taking inventory, entering road sales and clocking time. Our bar code label printing software packages work with DOS and most matrix or laser printers. We also sell pre-printed labels. Our hardware can work with nearly every computer in the world.
International Technologies & Systems Corp.
635-C North Berry St., Brea, CA 92621
(714) 990-1880 FAX: (714) 990-2503 TLX 6502824734 MCI

Inquiry 584.

BAR CODE SOFTWARE SOLUTIONS
ISD has software solutions that allow you to use bar codes for most anything. Like identifying products. Labeling packages. Or even managing assets and paperwork. You'll be able to speed and simplify data collection. Track products dock-to-stock. Streamline inventory control. And more.
Integrated Software Design, Inc.
171 Forbes Blvd., Mansfield, MA 02048
TEL: (508) 339-4928 FAX: (508) 339-2257
©1989 Integrated Software Design, Inc.

Inquiry 585.

THE BUYER'S MART

BAR CODE

WHEN EASE-OF-USE COUNTS

Reading bar codes should be as easy as a "quick flick of the wrist." But many bar code readers require you to flick and flick and Flick and FLICK until the bar code label is finally read. PERCON designed bar code readers that *really are* as easy as a "quick flick of the wrist."

PERCON
2190 W. 11th Ave., Eugene, OR 97402
Phone: (800) 873-7266 FAX: (503) 344-1399

PERCON: THE BAR CODE SPECIALISTS

If you have questions about bar code technology, it's nice to know an experienced, friendly bar code specialist is only a phone call away. Want to know where to start or where to find hard-to-find bar code accessories? Call PERCON for answers.

PERCON
2190 W. 11th Ave., Eugene, OR 97402
Phone: (800) 873-7266 FAX: (503) 344-1399

5-YR. WARRANTY AT PERCON

PERCON decoders are now covered by a *five-year limited warranty.* That means you won't spend one cent replacing your PERCON bar code decoder for five full years. That's reliability you can count on!

PERCON
2190 W. 11th Ave., Eugene, OR 97402
Phone: (800) 873-7266 FAX: (503) 344-1399

PC BAR CODE SPECIALISTS

Bar code readers designed for fast, reliable, cost effective data entry. Looks just like keyboard data! Choose from stainless steel wand or laser interface. Also, powerful Bar Code and Text printing software. Great warranty. Dealer inquiries welcome.

Seagull Scientific Systems
15127 N.E. 24th, Suite 333, Redmond, WA 98052
206-451-8966

BAR CODE READERS

Among the best and most widely used bar code decoders. Reads all major codes (39, I 2/5, S 2/5, UPC/EAN/JAN, CODABAR, MSI). Connects between keyboard and system. IBM, PS/2, MAC, DEC-VT compatible. OS & software independent. Same day ship. 2 Year Warranty (pen incld).

Large Reseller Discounts.

Solutions Engineering
4705 Langdrum Lane, Bethesda, MD 20815
(800) 635-6533 (301) 652-2738

Inquiry 586.

DATA INPUT DEVICES

Bar Code, Magnetic Stripe Readers & SmartCard Encoder/Reader for microcomputers & terminals, including IBM PS/2 & others, DEC, Macintosh, AT&T, CT, Wyse, Wang. All readers connect on the keyboard cable & are transparent to all software. UPC & 39 print programs, magnetic encoders, & portable readers are also available.

TPS Electronics
4047 Transport, Palo Alto, CA 94303
415-856-6833 Telex 371-9097 TPS PLA
FAX: 415-856-3843

Inquiry 587.

BAR CODE

VARIANT MICROSYSTEMS
BAR CODE READERS DELIVER
WAND/LASER/MAGNETIC CARD CONNECTIVITY

- Keyboard wedges (Internal/External) for IBM PC/XT/AT, PS/2 and portables.
- RS232 wedges for WYSE, Link, Kimtron terminals
- Bar code and label printing software
- Full two-year warranty
- **30-Day Money-Back Guarantee**
- **Extensive VAR/Dealer Discounts**

3140 De La Cruz Blvd., Suite 200/Santa Clara, CA 95054/(408) 980-1880
FAX: (415) 623-1372

Inquiry 588.

BBS/PUBLIC DOMAIN

MedCom BBS
Use your modem to call
800/445-4BBS (800/445-4227)
81 lines, 3/12/24, 8N1
Group & private chat. Many games, including the new multi-player, fast-action full-color graphics & sound, "Flash Attack" from Galacticomm! Chess/Checkers/Othello. E-Mail, 1000s of d/l, message base, online news & entertainment. Free time & downloads.
6312 E. Santa Ana Cyn Rd #361, Anaheim, CA 92807
Voice (714) 996-9999

CASE

STATE OBJECT ORIENTED COMPILERS

The COMPEDITOR's use finite state and object oriented programming techniques to design, develop and document source programs in: Ada, Basic, C, Fortran and Pascal. IBM DOS 2. + 250K RAM.

Prices: $200–$300 (With Primer and Debugger)
Sampler $75 (With All manuals & Credit)

AYECO INCORPORATED 5025 Nassau Circle, Orlando FL 32808 **(407) 295-0930**

Inquiry 589.

CD-ROM

CD-ROM Drives & Titles
Largest selection for PC & Mac.
Microsoft Programmers Library & Drive $995
Computer Library $695 • Public Domain S/W $99.
Drives from $699. *Hundreds* of titles from $29.
MC/VISA/AMEX, Money-back Guarantee.
Call or write for free 100-page catalog.
Get it all from "The Bureau"
Bureau of Electronic Publishing
121 Norwood Ave., Upper Montclair, NJ 07043
(201) 746-3031

Inquiry 590.

Hitachi CD ROM 3500 PC/XT/AT internal kit	$639
Hitachi CD ROM 1503S PC/XT/AT external kit	$679
NEC CD ROM PS/2 Internal Kit	$799
NEC CD ROM Macintosh external kit	$799
Laser Drive 510 WORM kit (654MB)	$3,995
REO-650 Magneto-optical kit (650MB)	$5,795
County Statistics by State/Hall (IBM Title)	$1200
Grolier Encyclopedia (IBM or Mac Title)	$299
MicroSoft Bookshelf (IBM)	$249
Geophysics of North America by NASA (IBM Title)	$600

Free Brochures, Dozens and Dozens of DISKS

CD ROM, INC.
1120-B 10th St., Golden, CO 80401
303-278-8550

Inquiry 591.

CD-ROM/WE'LL BEAT ANY PRICE

All IBM/MAC drives/titles. Call for price list, monthly specials, POs, international orders welcome. Special library, school, government pricing. COD, Visa, MC, Amex

CD-ROM SHOPPER
(201) 290-8288
1168 Elm Street
Rahway, NJ 07065
24-HR AUTO ORDER LINE

Inquiry 592.

CD-ROM

CD-ROM Publishing Services

Complete CD-ROM publishing services including custom software interface. Reasonable rates, fast turnaround. Call for quote.

Titles published: Food/Analyst, Econ/Stats, Consu/Stats, Agri/Stats.

Hopkins Technology
CD-ROM Publisher
421 Hazel Lane
Hopkins, MN 55343-7117
(612) 931-9376 CIS 74017,614

Inquiry 593.

COMPUTER INSURANCE

INSURES YOUR COMPUTER

SAFEWARE provides full replacement of hardware, media and purchased software. As little as $39 a year provides comprehensive coverage. Blanket coverage; no list of equipment needed. One call does it all. Call 8 am–10 pm ET. (Sat. 9 to 5)

TOLL FREE 1-800-848-3469
(Local 614-262-0559)
SAFEWARE, The Insurance Agency Inc.

Inquiry 594.

COMP. MAINT. CHEMICALS

Buy Direct

A full line of Computer Maintenance chemicals: Pressurized Duster, CRT Screen Cleaner, Hood & Housing, Anti-Static, Head & disc, Freon T.F. Solvent, Cleaning Disketes, Wipes, Swabs. **All at wholesale prices. Call Data-Chem at:**

1-800-FON-6698

Inquiry 595.

COMPUTER PRINTERS

LAPTOPS * APPLE * IBM

COMPAQ SLT	IBM PS2
ZENITH	MACINTOSH
SHARP	LASERWRITER
TOSHIBA	IMAGEWRITER
NEC	HP LASERJET
PLOTTERS	EPSON
HARD DRIVES	FAX MACHINES

Call UCC 213-921-8900 For Prices
13738 E. Artesia Blvd. 150, Cerritos, CA 90701
Fax 213-802-0831 International Orders Welcome

Inquiry 596.

COMPUTER SUPPLIES

COLOR RIBBONS
COLORS: Black, Red, Blue, Green, Brown

	BLACK	COLOR
NEC P2200	$7.75	$12.00
Okidata 390/391	7.00	9.00
Panasonic KXP-1124	6.75	7.75
Toshiba P351	5.00	6.00

PRICE & SPEC. SUBJECT TO CHANGE W/O NOTICE.
FOR OTHER RIBBONS CALL FOR CATALOG

RAMCO COMPUTER SUPPLIES
P.O. Box 475, Manteno, IL 60950
(USA) 800-522-6922 * (CANADA) 800-621-5444 * 815-468-8081

Inquiry 597.

CROSS ASSEMBLERS

CROSS ASSEMBLERS
Universal Linker, Librarian
Targets for 36 Microprocessors
Hosts: PC/MS-DOS, micro VAX, VAX 8000
ENERTEC, INC.
BOX 1312, 811 W. Fifth St.
Lansdale, PA 19446
Tel: 215-362-0966 Fax: 215-362-2404

Inquiry 598.

THE BUYER'S MART

CROSS ASSEMBLERS

68000 CROSS ASSEMBLER
Assembles 68000/68010 code on a PC Compatible
• Very High Speed—2MB source code assembled per minute • Macros • S-Records
Knowledge Based Systems, Inc.
2746 Longmire • College Station • Texas • 77840
Phone: (409) 696-7979 • Fax: (409) 696-7277
BBS: (409) 696-7055

Inquiry 599.

Professional Series
PseudoCode releases its PseudoSam professional Series of cross assemblers. Most popular processors. Macros, Conditional Assembly, and Include Files. Virtually unlimited size. For IBM PCs, MS-DOS 2.0 or greater. With manual for $50.00. (MI res. 4% tax). Simulators and disassemblers also available. Shipping $5, Canada $10, Foreign $15. Visa/MC.
KORE Inc.
3510 Plainfield NE, Grand Rapids, MI 49505 **616-361-3666**
30-Day satisfaction guaranteed or purchase price refunded.

Inquiry 600.

CROSS ASSEMBLERS/SIMULATORS
Brand new full-function simulator for the 8096 controller, supporting ALL MODES of interrupts plus the HSI, HSO, A/D, and Serial features, with full disassembler; just $300.00! Our superb simulators for the 8048, 8051, and 8085 sell for $200.00, and those for the 8052 and Z80 for $250.00 each. Our line of cross assemblers for all above target CPUs are also full PC compatible and sell for $100.00 each. We offer discounts for simulator plus assembler packages.
Lear Com Company
2440 Kipling St./Ste. 206, Lakewood, CO 80215
303-232-2226

Inquiry 601.

MACINTOSH CROSS ASSEMBLERS
μASM™—available for most 8-bit MPUs. Fast. Full Mac interface. S or Hex output downloads to most EPROM programmers. Features macros, conditional ass'y, local and auto labels, symbol table cross-reference, module sectioning. Editor included. $129.95 each plus S/H. MC/V/AE. Technical bulletin available.
MICRO DIALECTS, INC., Dept B
P.O. Box 30014, Cincinnati, OH 45230
(513) 271-9100

Inquiry 602.

CROSS ASSEMBLERS
Macros, PC Compatible, Relocatable, Conditionals, Fast, Reliable . . . . . from **$150**
also: Disassemblers
EPROM Programmer Board
MICROCOMPUTER TOOLS CO.
Phone (800) 443-0779
In CA (415) 825-4200
912 Hastings Dr., Concord, CA 94518

Inquiry 603.

6800-Family Development Software
Our C Compilers for the 6800, 6801, 6809, & 68HC11 feature a complete implementation (excluding bit fields) of C as described by K&R and yield 30–70% less code than other compilers. Our Assemblers feature macros and conditional assembly. Linker & Terminal Emulator included.
Wintek Corporation
1801 South St., Lafayette, IN 47904
(800) 742-6809 or (317) 742-8428

Inquiry 604.

DATA CONVERSION

MEDIA CONVERSION/DATA TRANSLATION
More than just a straight dump or ASCII transfer!
Word Processing, DBMS, and Spreadsheet data on **Disks** or **Tapes** transferred directly into applications running on **Mainframes, Minis, Micros, Dedicated Word Processors, Typesetters,** and **Electronic Publishing** systems.
IBM PS/2 & Macintosh supported
#1 in the translation industry!
CompuData Translators, Inc.
3325 Wilshire Blvd., Suite 1202, Los Angeles, CA 90010
(213) 387-4477 **1-800-825-8251**

Inquiry 605.

DATA/DISK CONVERSION

RESULTS
You Can Depend On!
• Data Conversion
• Disk Duplication
• Optical Scanning
Computer Conversions
9580 Black Mountain Rd., Suite J, San Diego, CA 92126
619-693-1697

Inquiry 606.

DISK CONVERSIONS
Media transfer to or from: IBM, Xerox, DEC, Wang, Lanier, CPT, Micom, NBI, CT, Exxon, WRDPLEX also WP, WS, MS/WRD, DW4, MM, Samna, DEC DX, MAS 11, Xerox-Writer, ASCII.
FREE TEST CONVERSION
CONVERSION SPECIALISTS
531 Main St., Ste. 835, El Segundo, CA 90245
(213) 545-6551 **(213) 322-6319**

Inquiry 607.

FROM MACs TO MAINFRAMES . . .
Our 12 conversion systems support over 1000 formats
DISK INTERCHANGE SERVICE COMPANY
2 Park Drive • Westford, MA 01886
(508) 692-0050

Inquiry 608.

BUY YOUR OWN CONVERSION SYSTEM!
With nearly a decade of experience in data conversion, you can work with the industry leader in 9-track tape, cartridge tape and diskette conversion systems. Enjoy the convenience of your own conversion system. Call today to discuss your application!
Flagstaff Engineering
1120 Kaibab Lane, Flagstaff, AZ 86001
(602) 779-3341
MasterCard—Visa— American Express Accepted

Inquiry 609.

THE #1 CHOICE
in disk & tape conversion
for many leading corporations, government agencies, law firms, and companies in every industry—world-wide.
Free test • Satisfaction guaranteed
Call the helpful conversion experts . . .
Graphics Unlimited Inc.
3000 Second St. North, Minneapolis, MN 55411
(612) 588-7571

Inquiry 610.

DATA/DISK CONVERSION

10x FASTER EASIER TO USE
IBM PC ⬅ TO ➡ HP FILE COPY
Update version uses windows: Call for free demo! IBM PC to HP File Copy allows IBM PCs, PS/2, compatibles to interchange files with Hewlett-Packard Series 70, 80, 200, 300, 1000, 9000s.
Oswego Software **312/554-3567**
Box 310 **FAX 312/554-3573**
Oswego, IL 60543 **Telex 858-757**

Inquiry 611.

CONVERSION SERVICES
Convert any 9-track magnetic tape to or from over 2000 formats including 3½", 5¼", 8" disk formats & word processors. Disk-to-disk conversions also available. Call for more info. Introducing OCR Scanning Services.
Pivar Computing Services, Inc.
165 Arlington Hgts. Rd., Dept. #B
Buffalo Grove, IL 60089 **(800) Hi-Pivar**

DATABASE MGMT. SYSTEMS

dBASE file access from C
Code Base 4 is a library of C routines which gives complete dBASE or Clipper functionality and file compatibility. Use DOS, Unix, OS/2 or MS Windows.
$295 with Source! **FREE DEMO**
Sequiter Software Inc.
Call (403) 439-8171 Fax (403) 433-7460

Inquiry 612.

DEMOS/TUTORIALS

INSTANT REPLAY III
Build Demos, Tutorials, Prototypes, Presentations, Music, Timed Keyboard Macros, and Menu Systems. Includes Screen Maker, Keystroke/Time Editor, Program Memorizer, and Animator. Recid *Great* Reviews! Simply the BEST. Not copy protected. No royalties. 60-day satisfaction money-back guar. IBM and Compatb. $149.95 U.S.Chk/Cr. Crd. Demo Diskette $5.00.
NOSTRADAMUS, INC.
P.O. Box 9252
Salt Lake City, Utah 84109 **(801) 272-0671**

Inquiry 613.

DISASSEMBLERS

80x86 .EXE/.COM to .ASM
- Accurately reconstruct, study & modify [64K+] programs with a *minimum* of input *or* editing of output.
- Assembly language output is MASM 5.x-compatible.
- Exhaustive flow-trace distinguishes code from data.
- Best formats for each. Commented BIOS calls/DOS functions. SEGMENT/PROC/other vital pseudo-ops.

PC-DISnDATa (5¼" disk & manual) $165
PRO/AM SOFTWARE
220 Cardigan Road, Centerville, OH 45459
(513) 435-4480 (9 A.M.–5 P.M. EST M–F)

Inquiry 614.

SOFT-X-PLORE
See "BYTE's May '88 issue pg. 78." Disassemble 500 kb (*) program at 10,000/min. (*) in any file, ROM/RAM memory up to 80386 instruction set (*). **SOFT-X-plore:**
* is for MS/DOS 2.0+ systems
* uses 20 algorithms and seven passes (*)
* only *$99.95* plus S&H w/30-day guarantee.
To order call **(800) 446-4656** or info **(203) 953-0236**
Or write: **RJSWANTEK INC.**
178 Brookside Rd., Newington, CT 06111
* best on the market MC/VISA accepted

Inquiry 615.

THE BUYER'S MART

DISK DRIVES

PS/2 DRIVES FOR PCs ATs
CompatiKit/PC $279
CompatiKit/AT $219
Built-in floppy controllers—no problem. Supports multiple drives and formats. Lets your computer use IBM PS/2 1.4M diskettes *plus more!* Call for further information or to place an order.
VISA/MC/COD/CHECK.
Micro Solutions Computer Products
132 W. Lincoln Hwy., DeKalb, IL 60115 **815/756-3411**
See our ad on page 74.

Inquiry 616.

DISK DUPLICATION

SOFTWARE PRODUCTION
- Disk duplication
- All formats
- EVERLOCK copy protection
- Label/sleeve printing
- Full packaging services
- Warehousing
- Drop shipping
- Fulfillment
- 48-hour delivery
- Consultation & guidance

Star-Byte, Inc.
2880 Bergey Rd., Hatfield, PA 19440
215-997-2470 **800-243-1515**

Inquiry 617.

DUPLICATION SERVICES

SOFTWARE DUPLICATION
- One-Stop Shopping
- Custom Packaging
- Copy Protection
- Technical Support
- Drop Shipping
- Fast Turnaround
- Competitive Pricing

SATISFACTION GUARANTEED
800-222-0490 NJ 201-462-7628
MEGA*Soft*
P.O. Box 710, Freehold, NJ 07728

Inquiry 618.

EDUCATION

B.Sc. & M.S. In COMPUTER SCIENCE
The American Institute for Computer Sciences offers an in-depth correspondence program to earn your Bachelor of Science and Master of Science degrees in Computer Science at home. BBc. subjects covered are: MS/DOS, BASIC, PASCAL, C, Data File Processing, Data Structures & Operating systems. MS program includes subjects in Software Engineering and Artificial Intelligence.
AMERICAN INST. for COMPUTER SCIENCES
1704-BY 11th Ave. So., Birmingham, AL 35205
TOLL FREE 1-800-872-AICS

Inquiry 619.

Gradebook emulation
for
micro-computers
Da Poma GB
First dedicated gradebook
on the Macintosh
available since 1984
Da Poma, Inc.
P.O. Drawer H, Hondo, Texas 78861 (512) 426-5932

Inquiry 620.

ENTERTAINMENT

NEMESIS™ Go Master®
Go, a game of strategic elegance, has been a way of life in the Orient for over four thousand years. Many consider Go to be the secret of the Japanese businessman's success. *"While chess is a game of war, Go is a game of market share"*[President of Nikko Hotels].
"If you are interested in Go, buy this program."
Game of the Month J. Pournelle BYTE 7/87
Toyogo, Inc. *The Leader in Computer Go.*
76 Bedford St. #34-Y, Lexington, MA 02173, (617) 861-0488

Inquiry 621.

FLOW CHARTS

Flow Charting II+
For IBM and compatibles. It will amaze you with its speed, power and simplicity. 26 standard shapes with over 120 sizes — 10 text fonts — 4 line styles. Place text, lines and shapes anywhere on your chart. For only $229 you'll never draw another chart by hand.
Patton & Patton
81 Great Oaks Blvd., San Jose, CA 95119
1-800-525-0082 Ext. 42 (Outside CA)
408-629-5376 Ext. 42 (CA/Int'l)
See our ad on page 118.

Inquiry 622.

WINDOWS FLOWCHARTER $79
RFFlow is a professional drawing tool for flowcharts & org charts (requires Microsoft® Windows). 75 shapes automatically adjust in size. Move, copy, delete groups of objects. 7 levels of zoom. Move flowcharts to other applications via the Clipboard. Supports Windows printers, plotters, and cartridge or soft fonts. Call for free trial disk.
RFF ELECTRONICS
1053 Banyan Court, Loveland, CO 80538
(303) 663-5767

Inquiry 623.

STRUCTURED FLOW CHART
NSChart creates Nassi-Shneiderman (structured) flowcharts from a simple PDL. Key words define structures & text strings appear in the chart. Easy to create, even easier to revise! Automatic chart sizing, text centering. Translators from many languages available. For Mac and IBM PC.
SILTRONIX, INC.
P.O. Box 82544, San Diego, CA 92138
1-800-637-4888

Inquiry 624.

FOREIGN LANGUAGES

LEARN SPANISH! LEARN JAPANESE!
A new, easy way to learn a foreign language. Complete interactive learning environment with pop-up dictionary, hypertext language reference, and full mouse support. Conversational emphasis. IBM compatible. Each course includes disks, manual, and pronunciation tape. Call for Demo disk or free brochure!
Traveler's Guild
315 W. Washington St. Dept BY9, Marquette, MI 49855
24-hour order desk: **(906) 228-5030**

Inquiry 625.

FORTRAN TOOLS

TAME YOUR FORTRAN CODE!
Programming tools for MS-DOS
FORWARN—an invaluable aid to Fortran program development! Finds common programming errors such as mismatched parameter lists and common blocks, and uninitialized variables. Prints detailed cross-references and call-tree diagrams. **$329**
FORTRAN DEVELOPMENT TOOLS—includes Pretty (indents, renumbers, changes GOTOs to IF-THEN-ELSES, etc.) and 6 more tools. **$129.**
Quibus Enterprises, Inc.
106 N. Draper Avenue, Champaign, IL 61821
(217) 356-8876

Inquiry 626.

GRAPHICS

35mm SLIDES—In 24 Hours
We transform your PC-Graphics files into full-color high-resolution, 35mm slides and ship within 24 hours. Harvard, Pixie, Lotus, Freelance, and others supported. Files accepted by modem. Free Federal Express on all orders of 20+ slides. Only $8 per slide. Call for literature or circle reader service number shown below.
***Accent* Presentations, Inc.**
990 Highland Drive, Ste. 202, P.O. Box 1303, Solana Beach, CA 92075
1-800-222-2592

Inquiry 627.

GRAPHICS

RAINDROP™
FAST, compact PrtScrn Utility for end users AND developers. Hardcopy as fast as 10 secs. Average binary size - 6 kbyte. 12 video graphic standards. Scale, rotate, colorize and more. 'CALL' from user-written programs. Complete 9- & 24-pin dot-matrix, inkjet, and laserjet library $39.95+$3 s/h.
RAINBOW TECHNOLOGIES
8106 St. David Ct., Springfield, VA 22153
(703) 440-0064

Inquiry 628.

HARD DRIVE REPAIR

DISK DRIVE REPAIR
DATA RECOVERY
SALES of new, remanufactured and removable disk drives
FULL TECHNICAL SUPPORT
ROTATING MEMORY SERVICE
1506 Dell Avenue, Campbell, CA 95008
(408) 370-3113
We buy used drives good or bad

Inquiry 629.

HARDWARE

CHIP CHECKER
- 74/54 TTL + CMOS
- 14/4000 CMOS
- 14-24 Pin Chips
- 8000 Nat. + Signetics
- 9000 TTL
- .3" + .6" IC widths

Tests/Identifies over 650 digital chips with ANY type of output in seconds. Also tests popular RAM chips. IBM-compatible version $259. C128 + C64 version $159.
DUNE SYSTEMS
2603 Willa Dr., St. Joseph, MI 49085
(616) 983-2352

Inquiry 630.

LATEST AWARD BIOS!
PC/XT ☆ 286 ☆ 386
Support for:
- Enhanced Keyboards
- EGA & VGA Graphics
- 3.5 inch Floppies
- Custom Drive Tables

Authorized AWARD Distributor
1-800-423-3400 or (412) 782-0384
KOMPUTERWERK, INC.
851 Parkview Blvd., Pittsburgh, PA 15215

Inquiry 631.

Macintosh® Parts & Repairs
Programs for the corporate, government, dealer and educational buyer. Call for kit.
Save up to 55% on Mac II CPU
800-274-5343 / 617-891-6851
Pre-Owned Electronics, Inc.
30 Clematis Ave • Waltham, MA 02154
Macintosh is a registered trademark of Apple Computer, Inc.

Inquiry 632.

NEED AN EXTRA SLOT FOR YOUR 8-BIT PC?
Add: LAN MODEM, Accelerator Card or Fixed Disk and/or 3½" Diskette
RMT's 2001-F2H2 Single Card Controller:
- Uses only one expansion unit
- Supports two 3½" and/or 5¼" diskette drives
- Supports two fixed disk drives (up to 140 MB each)
- On-board BIOS, automatically handles any comb. of drives

RMT 2001-F2H2 . . . . . THE SPACE ODYSSEY
RMT SYSTEMS, INC. (714) 863-1092

Inquiry 633.

THE BUYER'S MART

HARDWARE/ADD-ONS

The World's First Highest Density Module!
- 18 Meg on the smallest surface
- Organization: 2x1024Kx9 bit
- Package: DIL 64 pin Jedec-Standard
- Technology: CMOS, hybrid, 18xHMS1100JP-10
- Compatibility: With two Hitachi HB56A 19-10
- Suitable for extension of basic memory
- Engineers take notice. This product can be manufactured on large scale.

For more information please write or call:

TermoTrol Corp.
1888 Century Park East, Suite 1900, L.A., CA 90067
Tel: 213-284-3242

Inquiry 634.

HARDWARE/COPROCESSOR

DIGITAL SIGNAL PROCESSOR
DSP products for the IBM PC/XT/AT based on the TI TMS32010 and TMS320C25 up to 12 MIPS operation. Designed for applications in communications, instrumentation, speech, and numeric processing. Offered with 12 bit 110 KHz A/D and D/A and continuous-to-disk data acquisition & playback option. From $650.

DALANCO SPRY
89 Westland Ave., Rochester, NY 14618
(716) 473-3610

Inquiry 635.

SC/FOX™ PARALLEL COPROCESSOR
PC/XT/AT/386 plug-in board with Forth software. 10 MIPS operation, up to 50 MIPS burst. 64K to 1M byte memory. Uses Harris RTX 2000™ RISC real-time CPU with 1-cycle multiply, 1-cycle 14-priority interrupts, two 256-word stacks, three 16-bit timer/counters, 16-bit i/o bus. Ideal for real-time control, signal and image processing, and multiple board operation. From $2,295.

Optional SC/FOX Single Board Computer version for stand-alone operation. Eurocard size with software, starting at $1,495.

SILICON COMPOSERS, INC. (415) 322-8763
210 California Ave., Suite K, Palo Alto, CA 94306

Inquiry 636.

IMAGE PROCESSING

ZIP Image Processing
ZIP brings affordable, sophisticated image processing to the PC. Capture video from camera/VCR. Versions for ImageWise, Willow Pubs VGA, HRT 512x512, serial ImageWise (for PC/ laptop/PS2) frame grabbers.

Call **(314) 962-7833** to order (VISA/MC). ZIP starts at $79, frame grabbers, $398. 30-day money-back guarantee.

Hogware Company
470 Belleview, St. Louis, MO 63119
(314) 962-7833

Inquiry 637.

INVENTORY MANAGEMENT

STOCK-MASTER 4.0
Commercial grade inventory management software at micro prices.
- Supports all 12 transaction types
- Trend Analysis
- Quality Control
- Multiple Locations
- Purchase Order Tracking
- Open Order Reporting
- Serial/Lot # Tracking
- Stock Status Reporting
- Activity History Analysis
- Bill of Materials
- Purchase Order Writing
- Order Entry
- Material Requirements
- On Line Inquiry

Applied Micro Business Systems, Inc.
177-F Riverside Ave., Newport Beach, CA 92663 714-759-0582

Inquiry 638.

dFELLER Inventory
Business inventory programs written in modifiable dBASE source code.
dFELLER Inventory **$150.00**
Requires dBASE II or III, PC-DOS/CPM
dFELLER Plus **$200.00**
with History and Purchase Orders
Requires dBASE III or dBASE III Plus (For Stockrooms)

Feller Associates
550 CR PPA, Route 3, Ishpeming, MI 49849
(906) 486-6024

Inquiry 639.

LANS

The $25 Network
Try the 1st truly low-cost LAN
- Connect 2 or 3 PCs, XTs, ATs
- Uses serial ports and 5-wire cable
- Runs at 115K baud
- Runs in background, totally transparent
- Share any device, any file, any time
- Needs only 14K of ram

Skeptical? We make believers!

Information Modes
P.O. Drawer F, Denton, TX 76202
817-387-3339

Inquiry 640.

LAPTOP COMPUTERS

Laptop Savings
Laptops: Toshiba • Zenith • Nec • Sharp • Epson • Mitsubishi • Compaq
Also Laptop Accessories: Modems, Fax Modems, External Drives, Portable Printers, Memory, Key Pads, Hard Drives, Batteries, and Auto Adapters.

Computer Options Unlimited
12 Maiden Lane, Bound Brook, NJ 08805
Phone: 201-469-7678 (Fax: 201-469-7544)
Hours: 9am/10pm **7 days** **Worldwide sales**

Inquiry 641.

Laptop Connection
2PC — THE File Transfer Utility
- Lap to Lap, Lap to Desk
- Super Easy to Use
- Breaks the "Bridge-Link" Price Barrier
- Desk to Desk, PC to PC
- No Installation Required
- 115 K Baud

$55 w/universal cable, $45 w/o cable
See Jan. 89 Issue—"What's New" Column—p.94
PLUS . . . .Quality Cables at FAIR Prices:

Null Modem (6')	$12	Centronics (6')	$12
Kbd Ext (6')	$12	Mon Ext (6')	$12
Par Print (6')	$10	Serial (6')	$10

MANY MORE CABLES AVAILABLE. Mac & PC **(VISA MC)**

Thompson Computing—587 F N. Ventu Park Rd., Ste. 306, Newbury Park, CA 91320, **(805) 498-7653 FAX (805) 499-8104**

Inquiry 642.

LAPTOP PERIPHERALS

LAPTOP BACKLIGHTS
Factory Installed • 90-Day Warranty
Toshiba, Amstrad, Sanyo, DG, Kaypro, IBM, HP, etc. **$295**
The Portable Peripherals People

Axonix Corporation
(801) 466-9797

Inquiry 643.

TOSHIBA PERIPHERALS	T1000	T1200 T1600	T3100 10/20	T3100e T5100
Battery AdaptaPAK (12V)	PX25T	PX3T	P80	P80+
Vehicle Battery Adapter	X2.5		A80	A80+
Built-in 2400bps Modem		M24BI		
Internal 2400bps Modem	M24IC	—— M24EC & M24ES ——		
Single COMMS Port Card	S232T	———— S232E ————		
Dual COMMS Port Card		———— D232E ————		
SCSI Interface Card		———— SCSIE ————		

PRODUCT R&D Corporation
1194 Pacific St., Suite 201, San Luis Obispo, CA 93401
(805) 546-9713 or (800) 234-5584

Inquiry 644.

MAC PROGRAMMING TOOLS

MAC DEVELOPMENT TOOLS
Professional Programmers Extender: Standard Mac interface, lists, printing, graphics, tiling. Extender GraphPac: Quality color graphs. Line, bar, semi-log, customizable symbols.

INVENTION Software
(313) 996-8108

Inquiry 645.

MEMORY BOARDS

MEMORY EXPANSION
Intel Above Boards w/LIM 4.0
8 MHz PC/ATs
IBM, Compaq, Zenith etc.
1MB $299.00
2MB $399.00
10 + MHz ATs
1MB $499.00
Prices subject to change

COUNTERTRADE **(303) 530-5433**

Inquiry 646.

MEMORY CHIPS

MEMORY CHIPS

41256-15-12-10	Call	51000 (1 Meg)	Call
4164-15	Call	51258 for Compaq 386	Call
4164-12	Call	8087-3-2	Call
41128 Piggy Back for AT	Call	80287-8-8-10	Call
41464-12 (64Kx4)	Call	80387	Call
414256 (256Kx4)	Call	NEC-V-20-8	Call
2764,27128,27256,27512	Call	Mouse	Call

Prices subject to change

ESSKAY ***718-353-3353***

Inquiry 647.

FREE
INFORMATION
DRAM•SIMMS•MATH CO-PROCESSORS

TOLL FREE 24 HRS. 7 DAYS A WEEK
1-800-338-1531

DEDICATED TOLL FREE FACSIMILE LINE 24 HRS.—7 DAYS A WEEK
1-800-242-5751

DIRECT LINE MON-FRI 9-6 C.S.T.
1-402-691-8248
Best Prices in U.S.A.

McDonald and Associates
WHOLESALE DISTRIBUTOR *THE CHOICE OF* INDUSTRY PROFESSIONALS

Inquiry 648.

MEMORY PRODUCTS

LOW LOW PRICES

256K	**DRAM**	256×8	**SIM/SIP**
1 Meg	**DRAM**	1 Meg×9	**SIM/SIP**
256×9	**SIM/SIP**	1 Meg×8	**SIM/SIP**

All Speeds
INTEL
8087 - 80287 - 80387
All MHz

R & R Electronics
1-800-736-3644

Inquiry 649.

MONITOR INTERFACE

COMPUTER VIDEO GENERATOR
Test EGA, VGA, Multisync & Data Projectors with handheld monitor tester. From 15.7 KHz to 64.0 KHz, battery powered, 4 patterns, all plug-in with no adapter cables.

NETWORK TECHNOLOGIES INC.
800-RGB-TECH **In OH: 216-543-1646**
UK: 0244-880478 Paris: 01331-476-32789
See our Ad on page 342.

Inquiry 650.

YOUR SALES MESSAGE
about the special computer product or service that you provide belongs in print.

THE BUYER'S MART
can help you reach computer professionals and produce valuable inquiries for your company!

Call Brian Higgins for more information

603-924-3754

Inquiry 651.

THE BUYER'S MART

NETWORKING

NETWORK BUSINESS SYSTEMS

Keycard Eliminator.....$99.
D C B Eliminator.....$99.
ELS Utilities.....$59.
Netcrack (lose password?).....$99.
Getdisk (get BIOS drives).....$59.
BIOS Tools (patch drive tbls).....$99.

NETWORK BUSINESS SYSTEMS
1215 Woodhollow Drive, Suite 1104, Houston, TX 77057
(713) 783-4457

Inquiry 652.

So Far Your Computers Have Been Talking to Each Other NOW Your Staff Can as Well

CHAT — ACCESS

A Complete Chatting and Messaging Solution for 3Com, Novell, and Other Netbios Networks.
CHAT-ACCESS is the ultimate in user friendly software, enabling you to send messages, receive them and engage other logged-in users in full scale conversation. Using only 1 Kbyte of your workstation RAM (for TSR program), CHAT-ACCESS provides a list of logged in users and sends one or all of them a brief message. It also enables you to "CHAT" with another workstation through interactive windows that simultaneously display both sides of the conversation. CHATACCESS operates on 3Com's 3PLUS, 3+OPEN (MS-DOS workstation), Novell NetWare and all other PC LANs that support NetBIOS.

Shany Computers Ltd.
Rechter Building, 4 Smilansky St., Natanya, Israel 42304
Tel: (972) (53) 333931 Fax: (972) (53) 342418

Inquiry 653.

SHANY COMPUTERS, SOFTWARE THAT MAKES YOUR NET...WORK

CO/FILE+

An essential expansion to your MS-DOS and Network operating system so that you can run your existing single user applications with no modifications as multi-user applications running on your network. Using only 1-2 Kbytes of your workstation RAM, CO/FILE+ enables your single user applications to share common files on any MS-DOS 3.10 and higher LANs. Data is protected by automatic file or record level locking and unlocking. **FEATURES/BENEFITS** +Supports all the MS-DOS 3.10 and higher Local Area Networks. +Consumes only 2Kbytes of RAM at each workstation for the TSR program. +Supports 3 levels of file sharing • Read Only Sharing. • Write Sharing. • Create Sharing. +Supports automatic record or file level locking and unlocking for Write and Create Sharing.

Shany Computers Ltd.
Rechter Building, 4 Smilansky St., Natanya, Israel 42304
Tel: (972) (53) 333931 Fax: (972) (53) 342418

Inquiry 654.

OBJECT ORIENTED TOOLS

OBJECT-ORIENTED TOOLKIT

TRIPLE your productivity with Complete C™

The only object-oriented development utility for C with precompiler, foundation classes (source code included), integrated make, real-time debugger, Documentation Generator, Application Streamliner. Versions for DOS ($449), SCO-XENIX ($495), QNX ($449) with full technical support. Other ports available upon request.

Complete Computer Corporation
111 West 57th St., Suite 1400, NY, NY 10019
212-582-2635

Inquiry 655.

OS/2 UTILITIES

INTEGRATED OS/2 PACKAGE

- Protected mode • Hot-key activated
- Background/foreground • Multi-sessioned shell
- Lightning fast text/binary forward/backward file lister
- Search directory trees for multiple strings
- Where file finder • Disk usage reports
- EGA/VGA mode support • Configurable colors
- Pop-up clock, calendar • On-line help

$29.95 Check/MC/VISA

SASNAK SOFTWARE
P.O. Box 56, Dept. B; Lansing, KS 66043
(913) 651-1728

Inquiry 656.

PROGRAMMERS TOOLS

LAN Application Development

NPPC: High performance library routines callable from C and Assembler. High level interface permits rapid development of peer-to-peer, client/server, or multi-server NetBIOS applications under DOS. Synchronous or Asynchronous message control. Compact Code. Source Avail. No Royalty. **NPPC** $495

Applied Software Technology
PO Box 397, Dpt. N, Los Gatos, CA 95031
(800) 678-1111 ext. N1

Inquiry 657.

PROGRAMMERS TOOLS

Screen Master

Screen designer & program generator for C, dBASE & Clipper. Full color control, eight box types + shadowing, line drawing, supports .DBF files directly, alignment, many editing features, writes code for any menu type, mouse support, demo available. $69.95 (+ S&H)

(508) 435-0585
Athena Technologies, Inc.
P.O. Box 1261, Westboro, MA 01581

Inquiry 658.

HYPERINTERFACE™

Menu Creator™ — A program generator for menu-driven user interface. Excellent for complex menu systems. $99.95. **Advanced Library** — Extended capability for data entry and advanced text-display control from your programs. $99.95, FORTRAN, Pascal, C, BASIC supported. **HYPERMATH™** — An application of Menu Creator™ and the Advanced Library. FREE

Avanpro Corp.
P.O. Box 969, Pacific Palisades, CA 90272
(213) 454-3866

Inquiry 659.

TLIB™ 4.12 Version Control

"TLIB™ is a great system" — ***PC Tech Journal* 3/88.** Full-featured configuration mgmt for software professionals. All versions of your code instantly available. Very compact, only changes are stored. Check-in/out locks, revision merge, branching, more. Mainframe deltas for **Pansophic, ADR, IBM, Unisys. Only $99.95** + S&H, or 5-station LAN **$299.95** + S&H. MS-DOS VISA/MC

BURTON SYSTEMS SOFTWARE
P.O. Box 4156, Cary, NC 27519 **(919) 856-0475**

Inquiry 660.

Have Same 'C' Source for UNIX and DOS

D-ISAM—Unix standard indexed file management library for UNIX DOS and NETWORKS. Manages all locking. UNIX/DOS source $595 (for both), DOS libs* $145.

'W'—Character windowing with COLORS, Line Graphics, Bells and more. You need not modify DOS code to work WELL on any UNIX terminal. UNIX/DOS source $295 (for both), DOS libs* $95.

BYTE DESIGNS
P.O. Box F195-76, Blaine, WA 98230
1-800-663-8547 or (604) 278-5200
**(DOS libs available for Microsoft or Borland 'C' compilers)*

Inquiry 661.

Async Executive™ & Tutorial

Interrupt driven transmit & receive. Supports up to eight ports. Buffered I/O to 64K. 50 to 19200BPS. XON/XOFF. DTE/DCE. Modem controls. Transfer characters or blocks. Millisecond timing. Universal language interface. BIOS/DOS extension capabilities. XMODEM w/CRC. 300+ page comprehensive manual. Sample programs include a spooler written in C. For IBM PC/XT/AT & all compatibles.
Software Developer's Kit: **$195.** NO ROYALTIES
Shipping $5, Canada $10, International $15
CA residents must add sales tax. Checks/MO only.

CIRRUS SOFTWARE, INC.
P.O. Box 51924, Dept. B., Palo Alto, CA 94303
(415) 949-1470

Inquiry 662.

ProPak 2.0

The Programmer's Productivity Pack

The most useful programmer's tools and utilities, smoothly integrated into a single package. Ideal for professional programmers, software developers, and students, too! Versions for MS-DOS, DESQview and OmniView included. Powerful, flexible, and easy to use. Fully customizable! Full 30-day money-back guarantee! Only **$79.95 plus S&H**

Falk Data Systems
5322 Rockwood Ct., El Paso, TX 79932
(800) 326-5615

Inquiry 663.

PROGRAMMERS TOOLS

TURBO PLUS $149.95

Programming tools for use with Turbo Pascal 5.0 & 5.5. Screen Painter, Code Generator, I/O Fields, Dynamic Menus, Programming Unit Libraries, OOP Support, and Sample Programs included. All routines work in both text and graphics modes! 60-day money-back guarantee! Demo Disk avail. For IBM and compatibles.

Nostradamus Inc.
P.O. Box 9252, Salt Lake City, UT 84109-0252
(801) 272-0671

Inquiry 664.

Get INSIDE!

The best PC software performance tool is now better than ever with source line timing, caller timing and arbitrary event timing—all with microsecond accuracy and without source modification. The expanded DOS analysis mode identifies I/O bottlenecks. **$125**

Call today for a free brochure and the latest list of supported compilers. 30-day guarantee. VISA/MC/COD

Paradigm Systems
P.O. Box 152, Milford, MA 01757
(800) 537-5043 In MA: **(508) 478-0499**

Inquiry 665.

FREE BUYER'S GUIDE

Programmer's Connection is an independent dealer representing more than 450 manufacturers with over 1000 software products for IBM personal computers and compatibles. We have serviced the professional programmer since 1984 by offering sound advice and low prices. Call or write today to receive your **FREE** comprehensive Buyer's Guide.

Programmer's Connection **US 800-336-1166**
7249 Whipple Ave. NW Canada 800-225-1166
North Canton, OH 44720 International 216-494-3781

Inquiry 666.

OBJECTIVE-C 4.0 MS-DOS

Object-Oriented Language used by over 800 companies. Now on affordable hardware! For PC-AT, PS/2 w/2MB, 20MB HD & MS C 5.1.

Includes — Objective-C Compiler, Runtime Library, ICpak101 Library with 16MB extended memory suport.

$249 - 30-Day Money-Back VISA/MC/AMEX/Check

THE STEPSTONE CORPORATION
75 Glen Road, Sandy Hook, CT 06482
(800) 289-6253 **(203) 426-1875**

Inquiry 667.

OBJECTIVE-C 4.0 OS/2

Workstation-Class Object-Oriented Technology on OS/2! For PS/2 M50 and up, w/2MB RAM, 20MB HD, OS/2 1.1 & MS C 5.1.

Includes — Objective-C Compiler, Runtime Library and ICpak101

$495 — 30-Day Money-Back
VISA/MC/AMEX/Check

THE STEPSTONE CORPORATION
75 Glen Road, Sandy Hook, CT 06482
(800) 289-6253 **(203) 426-1875**

Inquiry 668.

OBJECT-ORIENTED TRAINING

Industry's Object-Oriented Technology trainer since 1986. Over 120 seminars & workshops conducted. Public courses nationwide & corporate on-site courses available. Offerings include:

- **Essentials of Object-Technology:** *$625*
- **Object-Oriented Design:** *$1,000*
- **Programming in Objective-C:** *$1,000*

THE STEPSTONE CORPORATION
75 Glen Road, Sandy Hook, CT 06482
(800) 289-6253 **(203) 426-1875**

Inquiry 669.

THE BUYER'S MART

PUBLIC DOMAIN

$3.00 SOFTWARE FOR IBM PC
Hundreds to choose from, word processors, databases, spreadsheets, games, lotto, communications, business, music, bible, art, education, language and useful utilities for making your computer easier to learn. Most programs have documentation on the disk.
Free 125-page catalog.
BEST BITS & BYTES
P.O. Box 8245, Dept-B, Van Nuys, CA 91409
In CA: (818) 764-9503 **800-245-BYTE**

Inquiry 669.

$1 per DISK Sale
20 TOP IBM PC PD/SW DISKS (360K) ONLY $20 + $3 S&H
QubeCalc, EDRAW, AutoMenu, Math Tutor, PC-DOS Help, Baker's Dozen, Languages, EZ-Form, PC-Style, PackDisk, PC-Stock, KidGames, Best Games, Home Inventory, PC-Outline, Form Letters, ImagePrint, SideWriter, PC-Prompt, Best Utilities.
BRIGHT FUTURES INCORPORATED
P.O. Box 1030, East Windsor, CT 06088
FREE CATALOG ($1.50 per disk)

Inquiry 670.

FREE CATALOG
PUBLIC DOMAIN/SHAREWARE
• 400 IBM PC & compatibles disks •
200 Amiga disks • 125 Atari ST disks
PC disks as low as $1.25 each, Amiga & ST as low as $1.60 each! Rent or buy. *Free shipping!* Call toll free, write or circle reader service for FREE BIG CATALOG with full descriptions. Please specify computer—48-hr. turnaround!
Computer Solutions
P.O. Box 354—Dept. B, Mason, Michigan 48854
1-800-874-9375 (M–F 10–6 EST) 1-517-628-2943

Inquiry 671.

FREE IBM SOFTWARE
FREE CATALOG also contains SHAREWARE. 5¼ and 3½-inch. All categories. ENGINEERING, CAD, DESKTOP PUBLISHING, LANGUAGES, UTILITIES, BUSINESS, GRAPHICS, SPREADSHEETS, WORD PROCESSORS, CHURCH, MEDICAL, HEALTH, EDUCATION, HOME.
SECTOR SYSTEMS COMPANY, INC.
Dept. B10, 416 Ocean Avenue, Marblehead, MA 01945
(617) 639-2625

Inquiry 672.

FREE CATALOG
$1 IBM SOFTWARE
For your free 32-page Master Edition catalog featuring the best of IBM Shareware from just $1 each, call or write today!
1-800-338-2118
SOFSOURCE
Box 828, East Lansing, MI 48826

Inquiry 673.

FREE SOFTWARE CATALOG
Low as $1.20/disk
Over 1000 quality IBM software
On 5.25" and 3.5" format
From outside U.S.A., except Canada, please send US $2.00 refundable with order.
For fast service, write to
SOFTSHOPPE
P.O. BOX 3678, Ann Arbor, MI 48106-3678
313-761-7638

Inquiry 674.

PUBLIC DOMAIN

TOP 10 IBM SOFTWARE - FREE
10 disk set — PC Write, PC Calc+ TreeView, DanCad, FileExpress, Moraff's Revenge, HGCIBM, Novatron, Home Base, Spacewars plus our 1600+ disk catalog
We accept Visa/MC/Amex
PAY ONLY $5.00 shipping/handling
limited introductory offer
INTERNATIONAL SOFTWARE LIBRARY
511 Encinitas Blvd. • Ste. 104 • Encinitas, CA 92024
order today toll free 800 669-2669

Inquiry 675.

16 and 32 BIT MICROS
EDUCATIONAL TRAINING SYSTEMS in a notebook with power supply — for the Motorola 68000/68020/68881, TMS32010 DSP, Intel 8086/8087. A/D-D/A Convertors, cross assemblers, serial interfaces with software, complete systems, documentation, schematic, operating system, cables, Starting Prices — $230.00
Phone URDA, Inc.
1-800-338-0517

Inquiry 676.

SECURITY

EVERLOCK COPY PROTECTION
★ Thwarts ALL Bit-copy Software
★ Protect any COM/EXE w/o Source changes
★ Shut down Debug Tracing & Disassemblers
★ Install to Floppy, Hard Disk, or LAN
★ Remotely reset Program Install-Count, Expire-Date or #Executes
★ No damaged media or I/O plugs
For IBM and clones. $195 & up. Free Info.
Az-Tech Software, Inc.
305 East Franklin, Richmond, MO 64085
(800) 227-0644 (816) 776-2700 FAX: (816) 776-8398

Inquiry 677.

THE ULTIMATE COPY PROTECTION
• Completely Menu Driven
• Defeats all Hardware/Software Copiers
• No Source Code Changes
• Multiple Layering
• No Damaged Media
• Full Hard Disk Support
• Unlimited Metering
• *FREE* Demo Disk
Quite Simply The Best Way To Protect Your Valuable Software Investment
STOPCOPY™ $325[00] **STOPCOPY PLUS™ $450[00]**
BBI COMPUTER SYSTEMS® (301) 871-1094
14105 Heritage La., Silver Spring, MD 20906 FAX: (301) 460-7545

Inquiry 678.

COP's Copylock II
• Protect on standard diskettes
• Cannot be copied by any device incl. Option Board
• Fully hard disk installable
• Normal back-up of protected programs
• LAN-support
• Creates safe demo version of your software
Start Pak $450
Standard Version $975, Automatic Version $1950
DANCOTEC Computer
In US: 2835 Sierra Rd., San Jose, CA 95132 408-729-8162 or 1-800-344-2545
Int'l: 2880 Bagsvard, Denmark Phone +45-44440322 Fax: +44440722

Inquiry 679.

ALL-IN-ONE PROTECTION!
TOTALSAFE gives you total security: access control, virus protection, data encryption, secure directories, and lots more! Req. PC, HD, 1 slot (or socket). Completely transparent. Introductory price: $120.00 + $8.00 S/H (U.S.). 30-day guarantee. Also available a complete line of PC access and data security products. Call/write for info. MC/VISA/AMEX. **Gamma Security Products,** 710 Wilshire Blvd., Ste. 609, Santa Monica, CA 90401 TEL: 213-394-8622 FAX: 213-395-4214
Eliashim Inc.
520W Hwy 436, Suite 1180-30, Altamonte Spgs., FL 32714
TEL: 407/682-1587 FAX: 407/774-8103

Inquiry 680.

SECURITY

BIT-LOCK® SECURITY
Piracy SURVIVAL 5 YEARS proves effectiveness of powerful multilayered security. Rapid decryption algorithms. Reliable/small port-transparent security device. PARALLEL or SERIAL port. Complemented by economical KEY-LOK™ and multifeatured COMPU-LOCK™ including countdown, timeout, data encryption, and multiproduct protection. (Dos/Unix/Mac)
MICROCOMPUTER APPLICATIONS
3167 E. Otero Circle, Littleton, CO 80122
(303) 922-6410/770-1863

Inquiry 681.

PC Security "Password"
With All the Computer Security Talk, PASSWORD is the Perfect Security Lock.
Password is a software program providing security for your PC. Password is Easy to understand and Simple to install, requires no reformatting. The boot limit option secures your hard disk. Password provides for up to 100 users with the supervisor controlling access to protected directories. Password is menu-driven with pop-up windows and help screens. The program provides an audit trail of users, and a screen blanking feature.
PASSWORD $99.00 US Visa, M/C, Amex
Nasdec International Inc.
2704-85 Garry Street, Winnipeg MB Canada R3C 4J5
PH: (204) 956-2798 FAX (204) 943-3702

Inquiry 682.

COPY PROTECTION
The world's leading software manufacturers depend on Softguard copy protection systems. Your FREE DISKETTE introduces you to SuperLock™—invisible copy protection for IBM-PC (and compatibles) and Macintosh.
• Hard disk support • No source code changes
• Customized versions • LAN support
• New upgrades available
(408) 773-9680
SOFTGUARD SYSTEMS, INC.
710 Lakeway, Suite 200, Sunnyvale, CA 94086
FAX (408) 773-1405

Inquiry 683.

HANDS OFF THE BOARD™
1/2 SIZE SECURITY BOARD
Stop floppy boot — Require password to boot PC
Real-time disk encrypt — prevent boot sector virus
Prevent DOS FORMAT/FDISK and low-level formats
Set hard disk READ ONLY or turn ON/OFF
Turn floppies, printers and COM ports ON/OFF
IBM XT, AT Bus — DOS V3.0+ — $149.95 + $5.00 S/H
SYSTEMS CONSULTING INC.
PO BOX 111209, Pittsburgh, PA 15238
(412) 963-1624

Inquiry 684.

SOFTWARE ENTERTAINMENT

BE MORE ENTERTAINING!
With the new, improved **Humor Processor Version 2** you can add humor to your speeches, newsletters, or everyday conversation. Create original jokes or select from the indexed, expandable 500-joke database. *Only* $49.95 + $5 S&H. IBM PC or Compatible. 30-day money-back guarantee. Call today for *special offer!*
Responsive Software
1901 Tunnel Rd., Berkeley, CA 94705
800-669-4611 ***VISA/MC***

Inquiry 685.

SOFTWARE FORTRAN

EXPAND & EXTEND LIBS
122 FORTRAN callable routines. **EXPAND** allows DOS compilers access to LIM/EMS 3.2 or 4.0 expanded memory. **EXTEND** provides CGA, EGA, VGA, Hercules, HP, Tektronix, AutoCAD DXF graphics, access to BIOS/DOS functions plus additional utilities. **EXPAND** $119, **EXTEND** $149, both $218.
DESIGN DECISIONS, INC.
P.O. Box 12884, Pittsburgh, PA 15241
(412) 941-4525

Inquiry 686.

THE BUYER'S MART

SOFTWARE/ACCOUNTING

PC TIME CLOCK

AutoTime is an Employee Management System that allows you to turn any PC into an Electronic Time Clock. AutoTime provides Time & Attendance, Job Costing, Payroll Interface, and Labor Distribution reporting. Network compatible. Prices start at $495. Other Business Products: Network FAX, Absence Call-In, db-EDI.

Chase Technologies
1617 Kingman Ave., San Jose, CA 95128
(408) 998-2917

Inquiry 687.

dBASE BUSINESS TOOLS

- GENERAL LEDGER
- ORDER ENTRY
- JOB COSTING
- BILL OF MATLS
- PAYROLL
- PURCH ORD/INVNTORY
- ACCOUNTS RECVABLE
- JOB ESTIMATING
- SALES ANALYSIS
- ACCOUNTS PAYABLE

$99 ea. + S&H

dATAMAR SYSTEMS Cred. Card-Check-COD
4876-B Santa Monica Ave.
San Diego, CA 92107 **(619) 223-3344**

Inquiry 688.

SOFTWARE/BUSINESS

DATA ENTRY POWERFULLY SIMPLE

Full featured, heads-down data entry with two-pass verification. Designed for the PS/2®, PC, XT, AT or compatibles.
Standalone $395 LAN version available.
FREE trial.

Computer Keyes Tel: 206/776-6443
21929 Makah Rd. Fax: 206/776-7210
Woodway, WA 98020 USA: 800/356-0203

TSA88—TRANSPORTATION PROGRAMMING

A general-purpose system for solving transportation, assignment and transshipment problems (capacitated or uncapacitated) with up to 1300 origins and destinations. Build TSA88 into your own programs with compiled Turbo Pascal units. TSA88 reads/writes LOTUS worksheets. Use 1-2-3/Symphony as a matrix generator or post processor. Many other features including interactive and batch operation, spreadsheet display and editing, problem/basis storage, file I/O, Simplex restart, report generator, sensitivity analysis. $149 with manual and 8087 support. $299 with Turbo Pascal units.

Eastern Software Products, Inc.
P.O. Box 15328, Alexandria, VA 22309
(703) 360-7600

Inquiry 690.

LOW COST/HIGH QUALITY

Established, Powerful, Complete, Business Management Software Systems. Point-of-Sale/Inventory Control "SALES-PRO", Service and Repair, Video/Rental Store Management, Church Management, Accounting and Many more starting at $39. For IBM PC Compatibles and the Atari ST.

HI-TECH ADVISERS
P.O. Box 7524, Winter Haven, FL 33883-7524
1-800-882-4310 FOR TECHNICAL INFO (813) 293-3986
Florida (813) 294-1885 24 HOUR FAX (813) 325-0375

Inquiry 691.

LOCATE HARD-TO-FIND BUSINESS AND STATISTICAL SOFTWARE

Econometrics • Biometrics • Cluster Analysis • Multivariate Analysis • Marketing Statistics • Experimental Statistics • ANOVA • Regression • Linear Programming • Project Planner • Forecasting & Time-Series • Sales & Market Forcasting • Quality Control and Industrial Experiments • Parameter and Tolerance Design • And Many More!
SEND FOR FREE PRODUCT GUIDE!

Lionheart Press, Inc.
P.O. Box 379, Alburg, VT 05440
(514) 933-4918 FAX: (514) 939-3087

Inquiry 692.

SOFTWARE/BUSINESS

DATA ENTRY

KeyEntry III®, a **complete** Data Entry System that provides all the capabilities for designing data entry applications, controlling data flow, & monitoring/reporting operator activity & performance. Supports LAN and stand-alone environments. Evaluation copy (all programs & documentation) available. Call today for information!

Southern Computer Systems, Inc.
2732 Seventh Avenue South
Birmingham, AL 35233
(800) 533-6879/(205) 251-2985

Inquiry 693.

SOFTWARE/DEVELOPMENT

Moby Words™

On 5¼" floppies

Moby Words
530,000 unique words & phrases
The largest word list in the world **$78**

Moby Hyphenator
150,000 syllabified words
Never give the user a bad break again **$128**

Moby Part-of-Speech
150,000 words with parts of speech
For razor-sharp language parsing **$148**

Moby Pronunciator
150,000 words with standard IPA marks
For perfect text-to-speech **$198**

All Royalty free. Send check or MO (CA add 6%) to:

Illumind Unabridged
571 Belden St., Ste. A, Monterey, CA 93940-1307
COD/Info: 1-408-373-1491

Inquiry 694.

SOFTWARE/ENGINEERING

Affordable Engineering Software

FREE APPLICATION GUIDE & CATALOG

Circuit Analysis • Root Locus • Thermal Analysis • Plotter Drivers • Engineering Graphics • Signal Processing • Active/Passive Filter Design • Transfer Function/FFT Analysis • Logic Simulation • Microstrip Design • PC/MS-DOS • Macintosh • VISA/MC

BV Engineering Professional Software
2023 Chicago Ave., Suite B-13, Riverside, CA 92507
(714) 781-0252

Inquiry 695.

Analog Circuit Simulation

- Schematic Entry
- SPICE Simulator
- Model Libraries
- Monte Carlo Analysis
- Parameter Sweeps
- Plotting/Graphics Output

Intusoft has a complete PC based system including everything from schematic entry through SPICE simulation using extended memory to comprehensive interactive post processing. Starting at $95 for IsSpice, the complete system sells for just $790.

Intusoft
The leader in low cost, full featured CAE software
P.O. Box 6607, San Pedro, CA 90734
(213) 833-0710 FAX (213)831-3956

Inquiry 696.

SIMULATION WITH GPSS/PC™

GPSS/PC™ is an MS-DOS compatible version of the popular mainframe simulation language GPSS. Graphics, animation and an extremely interactive environment allow a totally new view of your models. If you are comtemplating the creation or modification of a complex system you need GPSS/PC to help you predict its behavior. Call now.

MINUTEMAN Software
P.O. Box 171/Y, Stow, Massachusetts, U.S.A.
(508) 897-5662 ext. 540 (800) 223-1430 ext. 540

Inquiry 697.

Circuit Analysis — SPICE

Non-linear DC & Transient; Linear AC.
* Version 3B1 with BSIM, GaAs, JFET, MOSFET, BJT, diode, etc. models, screen graphics, improved speed and convergence.
* PC Version 2G6 available at $95.
Call, write, or check inquiry # for more info.

Northern Valley Software
28327 Rothrock Dr., Rancho Palos Verdes, CA 90274
(213) 541-3677

Inquiry 698.

SOFTWARE/ENGINEERING

FREE ENGINEERING MAGAZINE

Personal Engineering is a monthly magazine sent free of charge (USA only) to scientists/engineers who use PCs for technical applications. Topics each month include **Instrumentation • Data Acq/Control • Design Automation.** To receive a free sample issue and qualification form either circle below or send request on letterhead to:

Personal Engineering Communications
Box 300, Brookline, MA 02146

Inquiry 699.

ECA-2 Analog Circuit Simulation

ECA-2 Electronic Circuit Analysis is a high performance, interactive, analog circuit simulator. Available for a wide range of computers and operating systems.

ECA-2 Offers
- AC, DC, Transient, Fourier, Temperature.
- Worst-case, Monte-Carlo.
- Over 500 nodes
- Full nonlinear simulator
- Built-in real time graphics

• 2 to 50 times faster than SPICE— Now with multiple plots!

ECA-2 2.40 IBM PC **$775** FREE DEMO.
Turn-key Systems Available

Tatum Labs, Inc.
3917 Research Park Dr. B-1, Ann Arbor, MI 48108
313-663-8810

Inquiry 700.

SOFTWARE/GEOLOGICAL

GEOLOGICAL CATALOG

Geological software for log plotting, gridding/contouring, hydrology, digitizing, 3-D solid modelling, synthetic seismogram, fracture analysis, image processing, scout ticket manager, over 50 programs in catalog. Macintosh too! Please call, or write, for Free Catalog!

RockWare, Inc.
4251 Kipling St., Suite 595, Wheat Ridge, CO 80033 USA
(303) 423-5645 Fax (303) 423-6171

SOFTWARE/GRAPHICS

QuickGeometry Library

Many powerful math subroutines for CAD/CAM and graphics: LINES, ARCS, CIRCLES, ELLIPSES, NON-UNIFORM RATIONAL B-SPLINES W/OFFSET (NURBs); INTERSECTION (even splines!), ROTATE, SCALE, TRANSLATE, MIRROR, OFFSET, BREAK, TRIM; ENDPOINTS, TANGENTs, CURVATURE; DXF i/o; lists. IBM PC comp MS-DOS 2+. $199.00 + no S&H; incl C source, manual, support, 30-day guarantee.

Building Block Software
P.O. Box 1373, Somerville, MA 02144
(617) 628-5217

Inquiry 701.

PROFESSIONAL GRAPHICS FOR SCIENTISTS AND ENGINEERS
PC/MS-DOS • Macintosh
FREE 48-page Catalog

Linear/Log Scaling • Graphs with error bars • AUTO PLOT • BATCH Mode • Multiple Y-axes • Multiple data files • Auto/Forced Scaling • Full labeling • Built-in editor • 1-2-3 Interface • Curve fitting • Statistics • CGA, EGA & Hercules Compatible. 40 pen plotters supported.

BV Engineering Professional Software
2023 Chicago Ave., Suite B13, Riverside, CA 92507
VISA/MC **(714) 781-0252**

Inquiry 702.

TurboGeometry Library 3.0

New 3.0 upgrade! Now over 300 2D & 3D routines. Surfacing, Solids, HiddenLine, Volumes, Areas, Transforms, Perspectives, Tangents, Clipping, Decomp, & more. IBM PC/Comp. MS-DOS 2.0+. Turbo Pascal, Turbo C, MSC. Manual. 30-Day guar. $199.95 w/source. Foreign S&H extra. VISA, MC, PO. USA funds only.

Disk Software, Inc.
2116 E. Arapaho Rd., #487, Richardson, TX 75081
214-423-7288/FAX 214-423-4465/800-636-7760

Inquiry 703.

THE BUYER'S MART

SOFTWARE/GRAPHICS

TECHNICAL GRAPHICS FROM ANY LANGUAGE

- Logarithmic, Time/Date & Linear Axes.
- Easy Curve Fitting and Data Smoothing.
- Supports all Video & Device Standards.
- 10 Curves with up to 8000 points each.
- Plus much much more. . .

Only $95 Call Today 800-284-3381

Edmond Software, Inc.
5900 Mosteller Dr. #1125, Oklahoma City, OK 73112

Inquiry 704.

PEN PLOTTER EMULATOR

FPLOT turns your dot matrix or laser printer into an HP pen plotter. Fast hi-res output. No jagged lines. Vary line width, color. Works with Autocad, Drafix, etc. Supports NEC P5/P6, IBM Proprinter, Epson LQ/FX, Toshiba, HP Laserjet, Okidata 29x/39x, Hercules/CGA/EGA/VGA. $64 check/m.o.

Fplot Corporation
24-16 Steinway St., Suite 605, Astoria, NY 11103
718-545-3505

Inquiry 705.

POPULAR HGRAPH

SCIENTIFIC 2D & 3D graphic routines for IBM PC, VAX, SUN and Macintosh. Powerful, easy to use. Multiple fonts, device and machine independent. Uses max resolution. Links with FORTRAN, Pascal, C, Modula-2 and QuickBasic. **$119.00**

Custom software development.
UGraph—the graphics editor available now!

HeartLand Software, Inc.
234 S. Franklin, Ames, IA 50010
(515) 292-8216

Inquiry 706.

GRAPHICS PRINTER SUPPORT

AT LAST! Use the PrtSc key to make quality scaled B&W or color reproductions of your display on any dot matrix, inkjet, or laser printer (incl. PostScript). GRAFPLUS supports all versions of DOS with IBM (incl. EGA, VGA, Super VGA), Hercules, or compatible graphics boards. Linkable/OEM versions available. $99.95.

Jewell Technologies, Inc.
4740-44th Ave. SW, Seattle, WA 98116
800-628-2828 x527 (206) 937-1081

Inquiry 707.

FORTRAN PROGRAMMER?

Now you can call 2-D and 3-D graphics routines within your FORTRAN program.

GRAFMATIC: screen routines	$135.
PLOTMATIC: plotter driver	135.
PRINTMATIC: printer driver	135.

For the IBM PC, XT, AT & compatibles. *We support a variety of compilers, graphics bds., plotters and printers.*

MICROCOMPATIBLES
301 Prelude Dr., Dept. B, Silver Spring, MD 20901 USA
(301) 593-0683

Inquiry 708.

GRAPHIC TOOLS LIBRARY

NOVA XGLIB: High speed. Window/viewport, arcs, splines, figure fill, borders, text scale, rotate, align, bitmaps, bitblt, pens, keyboard, mouse, image capture and processing. Animation. Over 150 functions. **$75.**
PC_VDI: High speed text at any angle, size and position, outline fillable font factory, plots, charts and curve fit. **Free Demo Disk. $395. Both products** ANSI compatible. Free drivers for printers, plotters, lasers. Hercules, CGA/EGA/VGA/VGA256, most boards. For all "C" compilers, **FORTRAN,** MS **QuickBASIC.** Manual.

NOVA INC.
P.O. BOX 68976, Schaumburg, IL 60168
312-882-4111

Inquiry 709.

SOFTWARE/INVESTMENT

MIDNIGHT ENGINEERING™

A new publication for entrepreneurial hardware and software engineers that will encourage and challenge you to personally develop and market your own products.

- PRACTICAL ARTICLES
- INSIGHTFUL INTERVIEWS
- DETAILED PRODUCT REVIEWS

call or write for a **FREE** copy of the premiere issue of *Midnight Engineering.*

DATArx
111 E. Drake Rd., Suite 7041, Fort Collins, CO 80525
303-223-2120

Inquiry 710.

SOFTWARE/LANGUAGES

FORTH with DRUMA FORTH-83
Break the 64K barrier without speed/space penalty. Well designed, attractively priced. '83 Standard.

- 1Mb+ automated memory management
- On-line documentation, ASCII/block files
- Many powerful and useful features
- Other products: windows, modules, profiler
- IBM PC/XT/AT & all compatibles

Write or call for FREE example diskette.

DRUMA INC.
6448 Hwy. 290 East E103, Austin, TX 78723
Orders: 512-323-0403 BBoard: 512-323-2402

Inquiry 711.

SOFTWARE/MATHEMATICS

MATH EDITING FOR THE PC

$$x_i^2 = \sum_{k=0}^{\infty} \left[x_k^{2\pi\theta} (\binom{n}{k}) \right] + \left(\frac{\int F\, ds}{\sqrt[n]{\alpha \pm \beta x}} \right)$$

- *MathEdit constructs math equations to be inserted into WordPerfect TeX and Manuscript documents.*
- *User-friendly interface—no new word processor needs to be learned.*
- *MathEdit—**$149***

K-TALK COMMUNICATIONS
50 McMillen Ave., Suite 100
Columbus, Ohio 43201
(614) 294-3535

Inquiry 712.

Derive™
A Mathematical Assistant

Makes math more inspiration and less perspiration! Combines the power of computer algebra with 2D & 3D plotting and a friendly menu-driven user interface. Does equation solving, calculus, trigonometry, vector & matrix algebra, and more. **Derive** requires a PC compatible computer & 512K memory.

Soft Warehouse, Inc.
3615 Harding Ave., Suite 505, Honolulu, HI 96816
(808) 734-5801

Inquiry 713.

SOFTWARE/MEDICAL

Medical Systems with ECS

PPM offers a complete line of medical software ranging from simple insurance claims processing to comprehensive A/R management.
PC CLAIM PLUS–claims processing with ECS to over 100 major insurance carriers–30-day money-back guarantee
THRESHOLD–complete A/R, patient billing, comprehensive practice management statistics
CLAIM NET–Nationwide electronic claims clearinghouse transmits claims to over 100 insurance carriers
Software prices start at $459.00. Dealer inquiries welcome.

Physicians Practice Management
350 E. New York, Indianapolis, IN 46204
800-428-3515 317-634-8080

Inquiry 714.

SOFTWARE/PACKAGING

HARD TO FIND COMPUTER SUPPLIES FOR SOFTWARE DEVELOPERS & POWER USERS

Cloth binders & slipcases like IBM's. Vinyl binders, boxes, and folders in many sizes. Disk pages, envelopes, & labels. Low quantity imprinting. Bulk disks. Everything you need to bring your software to market. Disk and binder mailers. Much more! Low Prices! Fast service. Call or write for a **FREE CATALOG.**

Anthropomorphic Systems, Limited
376-B E. Saint Charles Rd., Lombard, IL 60148
1-800-DEAL-NOW 312-629-5160

Inquiry 715.

SOFTWARE/PACKAGING

SAVE SAVE SAVE SAVE
LET'S TALK PACKAGING

From Disk Labels to Manuals to Shipping Boxes—We are a complete packaging service. Everything you need to market your software. Call for our free catalog.

SOFCOM Printing and Packaging
10305 Reading Rd., Cincinnati, OH 45241
513-563-7136

Inquiry 716.

SOFTWARE/PRINTING

PRINTER GENIUS

Powerful memory-resident printer management • Control printer features from menus or within documents • Print spool-to-disk files or memory • Background print • File & directory browse • Edit small text • and more. . . • User friendly pop-up screens • 92-page manual • Preset for all printers • Completely flexible • PC MS-DOS • $89 + $4 S/H • VISA/MC

Nor Software Inc.
527 3rd Ave., Suite 150, New York, NY 10016
(212) 213-9118

Inquiry 717.

SOFTWARE/SCANNERS

Optical Character Recognition

Stop retyping: PC-OCR™ software will convert typed or printed pages into editable text files for your word processor. Works with HP ScanJet, Panasonic and most other scanners. Supplied with 18 popular fonts. User trainable: you can teach PC-OCR™ to read virtually any typestyle, incl. foreign fonts. Proportional text, matrix printer output, Xerox copies OK. $385. Check/VISA/MC/AmExp/COD

Essex Publishing Co.
P.O. Box 391, Cedar Grove, NJ 07009
(201) 783-6940

Inquiry 718.

SOFTWARE/SCIENTIFIC

TableCurve—TableCode
Curve-Fit 211 Equations in a Single Step

TableCurve™ generates printed reports and Lotus, dBase, Quattro, Harvard Graphics, and Pagemaker/Ventura output. **TableCode™** generates functions and calling code for C, Pascal, BASIC, FORTRAN, Modula-2 and dBASE languages.

Demo $5, TableCurve $159, TableCode $149 MC/Visa

AISN Software
P.O. Box 32277, Phoenix, AZ 85064
602-266-1925

Inquiry 719.

Chaos/Nonlinear Dynamics

* Ordinary and Delay Differential Equation Solvers * Bifurcation Diagrams * 2- and 3-D Plotting, Sequential Magnification, Poincaré Sections * Next Maximum, 1-D & Circle Maps * Phase Portraits with Multiple Initial Conditions * Spectral Analysis, Fractal Dimensions, Lyapunov Exponents

DS:I $250.00 DS:II $350.00

CHAOS IN THE CLASSROOM $49.95

DYNAMICAL SYSTEMS, INC.
P.O. Box 35241, Tucson, AZ 85740, 602-825-1331

Inquiry 720.

C SCIENTIFIC LIBRARY

Extensive library of matrix, mathematical, and statistical routines. Developed and documented for use by technical specialists and C programmers in research, education, engineering, and scientific applications. Over 550 functions, superior documentation—four manuals, including Tutorial, Function Pages, and Example Programs. Includes Real and Complex Linear Algebra, Eigensystems, Differential Equations, Quadrature, Smoothing, Filtering and Prediction, Multivariate Statistics, Multi-Dimensional Optimization, Linear Programming, Curve Fitting and Interpolations, etc. $295 object only and $395 with C source code.

EIGENWARE TECHNOLOGIES
13090 La Vista Dr., Saratoga, CA 95070 **(408) 867-1184**

Inquiry 721.

THE BUYER'S MART

SOFTWARE/SCIENTIFIC

LARGE MATRICES

Invert a 235 × 235 REAL*8 non-sparse matrix in 35 min on your 640K DOS based 16 MHz 386/387 (13 min on 12 MHz 286/287) using LU decomp with back subst. Also large matrix capability for matrix multiply, transpose, scale, add, simul eq, etc. 80 bit precision. No added memory boards required. Use with Microsoft or IBM Pro FORTRAN unformatted matrix files. Full featured demo disk can generate and run large random matrices $20.

JOYCE NUMERICS INC.
500 Chesterbrook Blvd., Suite 15 C-6, Wayne, PA 19087
(215) 993-9013

Inquiry 722.

Free catalog includes technical application notes

1-800-942-MATH

MicroMath Scientific Software
Salt Lake City, Utah 84121-3144

Inquiry 723.

SOFTWARE/SECURITY

HANDS OFF THE PROGRAM®
OPERATING SYSTEM SECURITY

Secures subdirectories, files, printers and floppies
Keyboard lock — automatic or manual
Log PC boot, program exec, file opens, login/logouts
Prevents DOS FORMAT and most viruses
Drive A: Boot Protection / Hard Disk Lock
IBM PC or 100% comp. — DOS V3.0+ — $89.95 + $3.75 S/H

SYSTEMS CONSULTING INC.
PO BOX 111209, Pittsburgh, PA 15238
(412) 963-1624

Inquiry 724.

SOFTWARE/SORT

OPT-TECH SORT/MERGE

Extremely fast Sort/Merge/Select utility. Run as an MS-DOS command or CALL as a subroutine. Supports most languages and file types including Btrieve and dBASE. Unlimited file sizes, multiple keys and much more! MS-DOS **$149.** OS/2, XENIX, UNIX **$249.**

(702) 588-3737
Opt-Tech Data Processing
P.O. Box 678 — Zephyr Cove, NV 89448

Inquiry 725.

STATISTICS

SX STATISTIX

PC Magazine Editors Choice!
• Easy to learn and use • Fast *Free* Support
• Money-Back Guarantee
At $179 SX outperforms higher priced programs!
If you value your time and money, call today for FREE SX demo disk

612-631-2852

Analytical Software Box 13204, Roseville, MN 55113

Inquiry 726.

The BASS System™

Why use up 8 meg and 640K just to run a data step on your PC? Now you can run your data step code and statistical procs with a system that takes only 1 meg and 400K (and costs only $399)! Free information:

BASS Institute, Inc.
P.O. Box 349, Chapel Hill, NC 27514
(919) 933-7096 or BB: (919) 968-6755 (N,8,1)

Inquiry 727.

STATISTICS

SOLO 3.0 from BMDP

Popular statistics and excellent graphics for the PC. Quick and easy to use. For business professionals, researchers, or students. From the leader in statistical software for over 25 years. Top-notch support. Satisfaction guaranteed! $199 complete with graphics. Call today, VISA or MC.

BMDP Statistical Software, Inc.
1440 Sepulveda Blvd., Suite 316, Los Angeles, CA 90025
(213) 479-7799

Inquiry 728.

STATA

Stata 2.05 Now Available. More statistics, graphics and an all-new manual. Still only $590. Quantity Discounts Available. New, lower academic price. $20 Demo. Call toll-free for more information.

1-800-STATAPC

Computing Resource Center
10801 National Boulevard, Los Angeles, CA 90064
(213) 470-4341

Inquiry 729.

DBMS/COPY

CONVERTS YOUR DATA INTO INFORMATION

Now your favorite stat package can access any database. DBMS/COPY can directly convert any database or spreadsheet file (ORACLE, PARADOX, dBASE, LOTUS etc.) into any stat package file (SAS, SPSS, SYSTAT, etc.) and vice versa. The PLUS version allows sorts, selections, and recalculations. $195. 30-day guarantee. VISA/MC/AMEX/PO/COD.

CONCEPTUAL SOFTWARE INC.
P.O. Box 56627, Houston, TX 77256
(713) 667-4222 **FAX: (713) 667-3FAX**
1-800-STATWOW

Inquiry 730.

THE SURVEY SYSTEM

An easy-to-use package designed specifically for **questionnaire data.** Produces banner format, cross tabs & related tables, statistics (incl. regression) & bar charts. Codes and reports answers to open-end questions. All reports are camera-ready for professional presentations. CRT interviewing option.

CREATIVE RESEARCH SYSTEMS
15 Lone Oak Ctr., Dept. B, Petaluma, CA 94952
707-765-1001

Inquiry 731.

MINITAB's a PC of cake!

MINITAB's intuitive commands are easy to use and remember. Features descriptive statistics, regression, time series, chi-square, hi-res graphics, much more. PC version incl. LOTUS interface, data editor, network pricing. Call for FREE brochure.

Minitab, Inc.
3081 Enterprise Dr., State College, PA 16801
(814) 238-3280

Inquiry 732.

NCSS

Professional, easy to use, menu-driven statistical system. Used by over 5,000 researchers.

- 5.0 Statistical System —$99
- 5.1 Graphics (2D & 3D)—$59
- 5.3 Power Pac Supplement—$49
- 5.4 Exp. Design/QC—$49
- 5.5 Survival Analysis—$59
- 5.6 Forecasting—$69

We accept checks, POs, Visa, MC. Add $3 s/h.

NCSS-B **801-546-0445**
865 East 400 North, Kaysville, UT 84037

Inquiry 733.

STATISTICS

SCA STATISTICAL SYSTEM

The *only* statistical software encompassing
Forecasting & Time Series Analysis
Quality and Productivity Improvement
General Statistical Analysis

Available on both DOS and OS/2 operating systems.
Call today for more information

Scientific Computing Associates
4513 Lincoln Ave., Suite 106, Lisle, IL 60532, USA
Phone: (312) 960-1698 **FAX: (312) 960-1815**

StatPac Gold™

StatPac Gold is the award-winning statistics and forecasting package that delivers. It's fast, flexible, easy to use and dependable. Time-tested and loaded with features. You be the judge. Get the facts! Call for your FREE brochure.

1-800-328-4907
Walonick Associates, Inc.
6500 Nicollet Ave. S., Minneapolis, MN 55423
(612) 866-9022

Inquiry 734.

UNINTERRUPTABLE POWER

HOW TO PROTECT YOUR COMPUTER

And Make It Last Longer

FREE money-saving literature. What you need to know about UPS—uninterruptible power supply. How to get complete protection from power line problems. 350VA through 15KVA models from the world's largest manufacturer of single-phase UPS.

Best Power Technology, Inc.
P.O. Box 280, Necedah, WI 54646
(608) 565-7200 ext. 3737
TOLL FREE (800) 356-5794 ext. 3737

Inquiry 735.

UTILITIES

COPY AT TO PC—BRIDGE-IT 3.5

"CPYAT2PC" RELIABLY writes 360KB floppies on 1.2 MB drives, saving a slot for a second hard disk or tape back-up. Only $79.00 + S/H
"BRIDGE-IT 3.5" is a DEVICE DRIVER supporting 3½" 720KB/1.44MB drives for PC/XT/AT without upgrading DOS/BIOS. Only $39.00 + S/H
BRIDGE-IT 3.5 BUNDLED WITH INTERNAL 1.44MB DRIVE AT $129.00 + S/H
VISA/MC/COD UPS B/R

MICROBRIDGE COMPUTERS
655 Sky Way Suite 113, San Carlos, CA 94070
1-415-593-8777(CA) **1-415-593-7675 (FAX)**
1-514-845-0818 (CANADA) **1-800-523-8777**

Inquiry 736.

DELTA, the better text file comparison tool. Scrollable windowed presentations of file or directory comparisons, with a built-in editor window. Ideal for programmers! Requires DOS 2.0 or higher with at least 384K RAM. A hard disk is recommended. **Order now. $79.**
DEMO available on our BBS

OPENetwork
POWER TOOLS FOR POWER USERS
215 Berkely Pl. (B-1), Brooklyn, NY 11217
718-638-2240 **BBS: 718-638-2239**

Inquiry 737.

Recover deleted files fast!

Disk Explorer now includes automatic file recovery. You type in the deleted file's name, Disk Explorer finds and restores it. Disk Explorer also shows what's really on disk; view, change or create formats, change a file's status, change data in any sector. MS-DOS **$75** U.S. Check/Credit card welcome.

QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

THE BUYER'S MART

UTILITIES

DATABASE UTILITIES

NORTAK Software Ltd. now offers a menu-driven ASSIST-like file utility for dBASE, Clipper, and FoxBASE. Self-contained (.EXE file), fast and simple to use.

SINGLE VERSION—$35; 3-VERSION PACKAGE—$60.
To order call:

SHOSHIN Systems Inc.
USA 1-800-267-0755 Canada 1-800-267-8856
Info Only 613-235-2310
VISA and MC accepted

Inquiry 738.

AppleWorks ↔ IBM

CROSS-WORKS transfers both ways between Apple IIe/IIc/IIgs and IBM PC/XT/AT/PS-2 & compatibles. Exchange AppleWorks with WordPerfect (keeps formatting), Lotus 1-2-3 (keeps formulas), and dBase II/IV! Included cable plugs in serial ports for 19,200 baud transfers. Easy menu operation.

Phone (919) 878-7725 for free info packet.
*Soft*Spoken Co., PO Box 97623, Raleigh, NC 27624

Inquiry 739.

SAVE TIME and MONEY

with the RED Utilities. Programs include: Batch file compiler speeds batch files. Disk cache speeds hard and floppy disks. Printer spooler. Path command for data files. Wild card exceptions. Sort directories. Over 10 more programs. Only $79.95. Order today! 30-day money-back guarantee. IBM PC. Visa/MC.

The Wenham Software Company
5 Burley St., Wenham, MA 01984 **(508) 774-7036**

Inquiry 740.

WORD PROCESSING

We can read 130 languages from Armenian to Zulu

Use SPOT OCR Software with an image scanner and your PC to read 130 foreign languages, typed pages, typeset material, magazines and books into standard text files. Flagstaff Engineering can provide any OCR solution. Call today to discuss your application!

Flagstaff Engineering
1120 Kaibab Lane, Flagstaff, AZ 86001
(602) 779-3341
MasterCard—Visa—American Express Accepted

Inquiry 741.

FARSI / GREEK / ARABIC / RUSSIAN

Hebrew, all European, Scandinavian, plus either Hindi, Punjabi, Bengali, Gujarati, Tamil, Thai, Korean, Viet, or IPA. Full-featured multi-language word processor supports on-screen foreign characters and NLQ printing with no hardware modifications. Includes Font Editor. $355 dot matrix; $150 add'l for laser; $19 demo. S/H in U.S. incl'd. Req. PC, 640K, graphics. 30-day Guarantee. MC/VISA/AMEX

GAMMA PRODUCTIONS, INC.
710 Wilshire Blvd., Suite 609, Santa Monica, CA 90401
213/394-8622 Tlx: 5106006273 Gamma Pro SNM

Inquiry 742.

YOUR SALES MESSAGE
about the special computer product or service
that you provide belongs in print.

THE BUYER'S MART
can help you reach computer professionals and produce valuable inquiries for your company!
Call Brian Higgins for more information
603-924-3754

WORD PROCESSING

DuangJan

Bilingual word processor for English and: Armenian, Bengali, Burmese, Euro/Latin/African, Greek, Gujarati, Hindi, Khmer, Lao, Punjabi, Russian, Sinhalese, Tamil, Telugu, Thai, Ukranian, Viet, . . . Only $109+$5 s/h (foreign + $12 s/h). Font editor included. For any IBM compatibles with dot-matrix & LaserJet printer. Demo $9+$1 s/h. Visa/MC

MegaChomp Company
3438 Cottman Ave., Philadelphia, PA 19149-1606
(215) 331-2748 FAX: (215) 331-4188

Inquiry 743.

PC-Write 3.0 — Shareware

Fast, full featured word processor for IBM PC. Now edits large files & multiple columns. Also spell check, mailmerge, networking, ASCII, and macros. Easy-to-use, optional menus. Supports 500 printers incl. lasers. Software, guide and tutorial on disk: $19. Registration with manual, support newsletter and 2 free updates: $99.

90-day money-back guarantee. VISA/MC.

Quicksoft **1-800-888-8088**
219 First Ave. N., #224-BYTC, Seattle, WA 98109

Inquiry 744.

Subscription Problems?

We want to help!

If you have a problem with your BYTE subscription, write us with the details. We'll do our best to set it right. But we ***must*** *have the name, address, and* ***zip*** *of the subscription (new and old address, if it's a change of address). If the problem involves a payment, be sure to include copies of the credit card statement, or front and back of cancelled checks. Include a "business hours" phone number if possible.*

BYTE

Subscriber Service, P.O. Box 555, Hightstown, NJ 08520

Circle 91 on Reader Service Card

Pay Less $$ for more Memory

■ SIMM MODULES
AST • APPLE • DELL• EVEREX • PS2 • COMPAQ

1 Meg x 8 – 10 (Macintosh)	$108.00
1 Meg x 9 – 10	$119.00
1 Meg x 9 – 80	$129.00
PS II 2 meg Simm Module	$495.00

■ EXPANSION BOARDS
COMPAQ • PS2 • HP LASERJET

■ MEMORY CHIPS
64K • 256K • 1MG

■ INTEL MATH COPROCESSORS – FULL LINE

VISA call: 714-855-0411 master charge
(FAX) 714-855-8504

23552 Commerce Center Drive, Suite L, Laguna Hills, CA 92653

ESTABLISHED 1985 • LOW, LOW PRICES • VISA MASTERCARD • SAME DAY SHIPPING • CORPORATE & SCHOOL P.O.'S WELCOME

Dynamic Electronics
STOCKING DISTRIBUTOR OF SEMICONDUCTORS

Circle 25 on Reader Service Card

DOS IN EPROM

Or any other code, for that matter! **PromKit** allows you to create Eproms that look like read-only disk drives in your PC-compatible systems. Use PromKit **even if you're not a programmer.** Just use PromKit to convert any disk into EPROM images for your Prom blaster! Copy system files, batch files, data files, or anything else you want. Use Proms for read-only, SRAMS for read-write! **Includes source code in C.** Over 180 pages, including disk, only $179.

FREE We'll include a free copy of the pocket-sized **XT-AT Handbook by Choisser and Foster** with each PromKit if you mention this ad when you order. Of course, this $9.95 value is also available by itself. Or buy five or more for only $5.00 each.

MasterCard (619) 271-9526 VISA

Annabooks
12145 Alta Carmel Ct Suite 250-262
San Diego, California 92128 Money-back guarantee

REEL 9-TRACK GENIUS

OVERLAND DATA will bring out the **GENIUS IN YOU** when it comes to connecting your PC to the mini/mainframe world. **OUR ENGINEERS DESIGNED** the most successful tape drives, controllers and software in use today. Call the experts . . .**ODI!**

- PC/XT/AT/386/PS2 & Compat.
- DOS, XENIX, UNIX, NOVELL
- 800, 1600, 3200, & 6250 BPI
- Outstanding Customer Support
- 24-hour delivery available on Cipher, Qualstar, Anritsu & M4

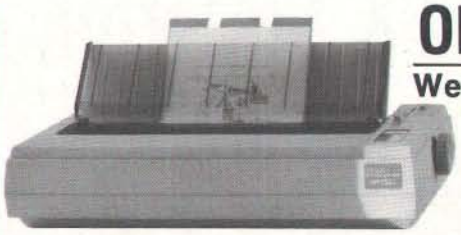
"See us at Comdex #W604"

Overland Data
"Experience Makes The Difference"

CALL TODAY AT 1-800-PC-9TRAK!

5600 Kearny Mesa Road • San Diego, CA 92111
TEL: 619/571-5555 • FAX: 619/571-0982

OLIVETTI
We Print Better



PRINT SAMPLES

ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789
abcdefghijklmnopqrstuvwxyz 0123456789
ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789
ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789
abcdefghijklmnopqrstuvwxyz 0123456789

PRINT SPEED
- 240 cps in high speed draft mode
- 180 cps in draft mode
- 60 cps in letter quality mode

LINE LENGTH
- DM 250: 80 columns at 10 cpi
- DM 250L: 136 columns at 10 cpi

EMULATIONS
- IBM Graphics Printer
- IBM Proprinter XL
- Epson FX 80/100 (Subset)
- Epson JX 80 (Subset)

BIT IMAGE MODE
- Horizontal resolution: 60, 72, 80,
- 90, 120, 240 dpi
- Vertical resolution: 180 dpi

COLOR

PRINTERS As Low As $289

FUJACORP INC.
473 SAPENA COURT #2
SANTA CLARA, CA 95054
FAX: 408-496-5877
To order, please call:
800-345-4408 or
408-980-8181
We accept Visa and Master Card

Circle 197 on Reader Service Card

Circle 106 on Reader Service Card

Connectivity Solutions

DCB

Universal converter; high capacity 64KB to 1 MB printer buffer with parallel / serial input and output ports.

Frees computer while doing printing. Converts data if required. Connects more than 1 computer to more than 1 printer.

DCI

Internal converter printer buffer for IBM or compatibles computers.

Built in microprocessor frees computer while printing. Serial and parallel outputs. Features include using any type of printer or using 2 printers software selectable.

MOP

Parallel interface card for PC, XT or AT with up to 4 output ports Connect up to four different printers or plotters. Software selectable.

DCU

Universal data converter serial/parallel, parallel/serial. Completely programable with software protocol.

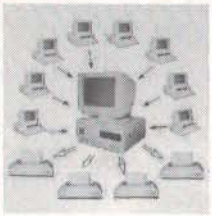
MOS

Multi-serial interface for IBM or compatibles. Up to 8 serial ports. Interconnects computers, modems, printers, plotters, etc.

MIP

Multi-parallel input ports for PC, XT or AT with 8 ports. Allows up to 64 external data lines, 24 input/output control lines.

MAX-E-CON



Ultra high storage capacity suitable for LANs and multiple stand alone computers. Share or switch computers, printers, plotters, modems,etc

Up to 24 serial / parallel input/output ports. System capacity : 512 KB RAM with 20 or 40 MB fast access hard disk. Basic model comes with 512 KB, 8 input ports (serial or parallel) and 4 output ports (parallel). Each port is completely independent and can use different speeds, protocols, etc. System status display (optional).

MAXCIMA Corporation

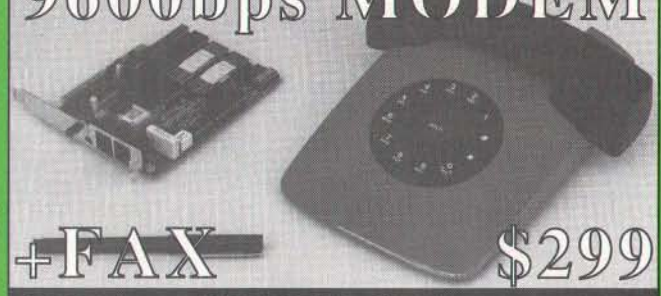
Call today for details
Phone (415) 968-8404
FAX # (415) 968-8390

VISA

Dealer's inquires welcome

Maxcima Corporation
970 Terra Bella Ave. Bldg. 3
Mountain View, CA 94043

9600bps MODEM



2400 bps MODEM $95 30 DAY FREE TRIAL

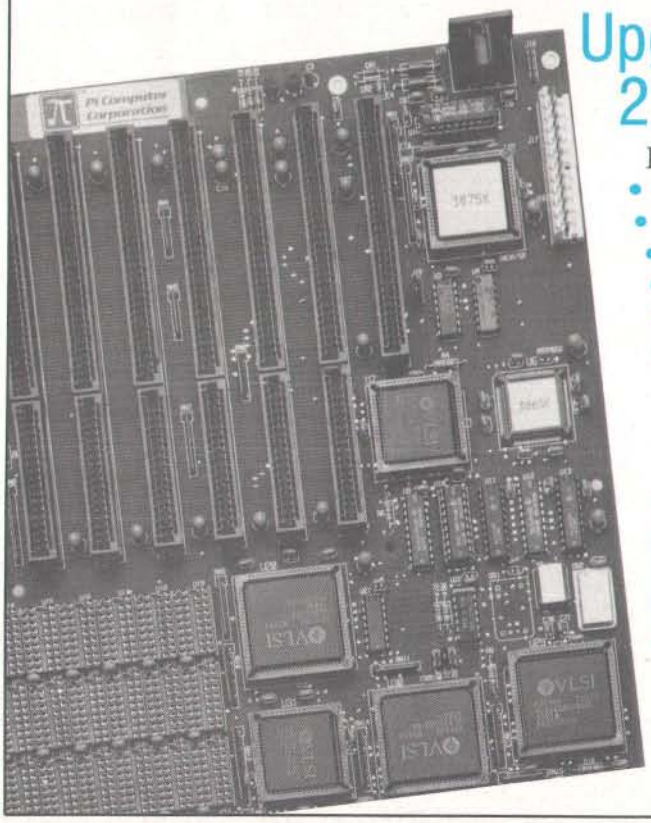
***ECONO*FAX™ OR MNP-5. . .CALL**

Many low cost modems are faulty or very error prone....**Not ours!!!** **PERFORMANCE** *"I have recently had a lot of trouble getting 2400 BAUD MODEMS to work...this one is working perfectly."* R.T.,Moreno Valley CA. **SUPPORT** *"I get the impression that your company, indeed, bends over backwards to provide service to its customer."* M.F., Selma CA. **SUPERIOR TECHNOLOGY...**The phone connection is the main source of data errors. **DYNAMIC IMPEDANCE STABILIZATION™, DIS™** (invented by CompuCom) improves signal quality and reduces these errors by up to 95% compared to a standard modem. Model 2400 (without DIS) at $95 outperforms the low cost alternatives, the 24DIS at $119 outperforms the challengers, regardless of cost. IBM internal, Hayes compatible, made in USA, 6 COM ports, internal speaker, five year warranty, EasyCom software, dealers inquire. *If you aren't totally satisfied, return within thirty days for a full refund !*

March '89 p102 **BYTE MAGAZINE**
"Real deal...worked fine...quite a bargain."

CompuCom Corporation
CALL (408) 732-4500 (800) 228-6648

386SX Performance is as easy as π



Upgrade to 386SX Power with 2 MB Ram for only $795.00!

Featuring:

- Fits XT, Baby or Full AT's and Towers
- 387SX and Shadow BIOS Support
- Your choice of Award™ or Phoenix™ BIOS
- SXD (2 MB DIP) or SXS (8 MB SIMM) versions
- Three year parts & labor warranty
- 45 day trial offer period
- 20, 25 and 33 Mhz 386DX motherboards, RAM, Drives, Cases, P/Ss, and Add-in Cards
- Professional Workstations available

To Order, Call 800-666-9248

Pi Computer Corporation
Beyond the Standards

1030 Earlysville Forest Drive, Earlysville, VA 22936
Fax: 804-978-3906 Information: 804-978-3917
Visa, MC and AMEX Accepted
*Since 1983

© 1989 Pi Computer Corp.

COMPARE OUR NEW LOWER PRICES AND SUPERIOR QUALITY

PCI-286-12

- 80286-12
- 1.2 MB Floppy Drive
- 640K RAM
- Serial / Parallel / Game
- 101-Key Enhanced Key Board
- SI = 13.3 (1 Wait)
  SI = 15.2 (0 Wait $100 Option)
- 6/12 MHz Key Bcard Switchable
- WA2 HD & FD Controller
- 80287 SOCKET
- 200W POWER SUPPLY

MONO SYSTEM
- W/Mono Monitor
- 20 MB Hard Disk

$1095

VGA COLOR SYSTEM
- W/VGA Card & Monitor
- 20 MB Hard Disk

$1580

EGA COLOR SYSTEM
- W/EGA Card + Monitor
- 20 MB Hard Disk

$1480

PCI-386-20

- 80386-20
- W/40 MB HD

Mono System **$1795**
VGA **$2295**

GAS PLASMA 286-12 ___ $1895

- 80286-12 CPU
- SI = 13.3
- 3½" FD 1.44 MB
- 20 MB HD ST-138
- LCD Screen (640 X 400)
- I/O Card Parallel/Serial/Game
- 640K RAM

GAS PLASMA 286-20 $1995

- CPU 80286-20
- SI = 23

LCD-286-10 PORTABLE ___ $1349

- 10 MHZ 80286 SI =10.3
- 12 MHZ SI = 13.3 (Option $50.00)
- 16 MHZ SI = 18 (Option $250.00)
- 640K RAM
- LCD Screen 640 X 200
  (Option 640 X 400 $180.00)
- Super Twist & Back Lighting
- 86 Key Board
- External / Parallel / Game
- 1.2 MB Floppy drive
- 20 MB Hard Disk
- 80287 Socket
- 200 W Power Supply
- Side 15 ¾" X 9 ½" X 8"
- 23 LBS

LCD-386-16 ___ $2095

- 80386-16 MHZ
- 40 MB Hard Disk
- 80387 Socket

LCD-386-20 ___ $2195

- 80386-20 MHZ
- 40 MB Hard Disk
- 80387 Socket

CRT-PORTABLE-286 ___ $1249

- Compaq Type
- 80286 (10 MHz or 12 MHz)
- 12 MHz SI = 13.3 (Option $50.)
- 16 MHz SI = 18 (Option $250)
- One 1.2 MB Floppy Drive
- 200 W Power Supply
- TTL Disply 9" Amber
- AT Key Board
- Serial / Parallel / Game
- WA2 HD & FD Controller
- 20 MB Hard Disk

CRT-386-16 $1795 — 80386-16
CRT-386-20 $1895

PCI PACIFIC COMPUTER
702 S. Del Mar Ave., #B,
San Gabriel, California 91776
(FAX) 818-286-8662

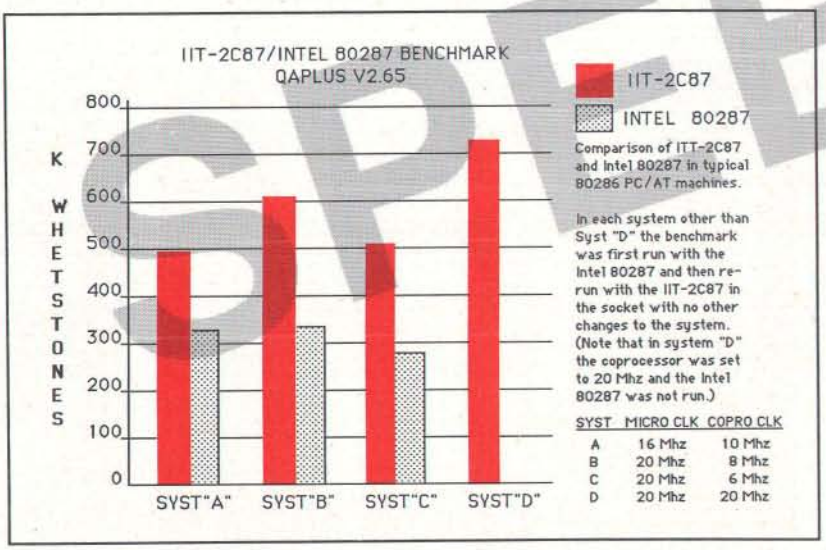
(818) 571-5548 (Technical support)
(800) 421-1102 (IN CA) ORDER ONLY
(800) 346-7207 (OUT CA)
Mon - Sat
9:00 AM - 6:00 PM

MasterCard VISA

*ALL SYSTEMS COME WITH ONE YEAR PARTS & LABOR WARRANTY

IIT's 287 Coprocessor

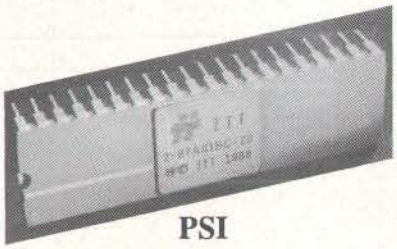
- Twice the speed of Intel's 80287 - 10 Mhz
- 100% Intel Compatible
- CMOS/NMOS Compatible
- Lower power for your laptop



Comparison of IIT-2C87 and Intel 80287 in typical 80286 PC/AT machines.

In each system other than Syst "D" the benchmark was first run with the Intel 80287 and then re-run with the IIT-2C87 in the socket with no other changes to the system. (Note that in system "D" the coprocessor was set to 20 Mhz and the Intel 80287 was not run.)

SYST	MICRO CLK	COPRO CLK
A	16 Mhz	10 Mhz
B	20 Mhz	8 Mhz
C	20 Mhz	6 Mhz
D	20 Mhz	20 Mhz



PSI
2005 Hamilton Ave. #220
San Jose, CA 95125
800-622-1722
408-559-8544

Mail Order Electronics · Worldwide

Jameco ELECTRONICS

Mail-Order Electronics

24 HOUR ORDER HOTLINE

415-592-8097

IC Clearance Sale!

NEC V20 & V30 CHIPS

Replace the 8086 or 8088 in Your IBM PC and increase its Speed by up to 30%

Part No.		Price
UPD70108-5	(5MHz) V20 Chip..... ~~$6.49~~	$5.95
UPD70108-8	(8MHz) V20 Chip..... ~~$9.49~~	$7.95
UPD70108-10	(10MHz) V20 Chip .. ~~$12.25~~	$10.95
UPD70116-8	(8MHz) V30 Chip..... ~~$9.95~~	$7.95
UPD70116-10	(10MHz) V30 Chip .. ~~$16.95~~	$15.49

7400

Part No.	1-9	10+	Part No.	1-9	10+
7400	SALE	.15	7474	SALE	.25
7402	.29	.19	7475	.49	.39
7404	SALE	.15	7476	.45	.35
7405	.35	.25	7483	.69	.59
7406	.39	.29	7485	SALE	.45
7407	SALE	.25	7486	SALE	.29
7408	.35	.25	7489	1.95	1.85
7410	SALE	.15	7490	.49	.39
7411	SALE	.19	7493	.45	.35
7414	SALE	.25	7495	SALE	.29
7416	SALE	.19	74107	SALE	.13
7417	SALE	.19	74121	SALE	.25
7420	.29	.19	74123	SALE	.35
7427	SALE	.13	74125	SALE	.35
7430	SALE	.15	74147	SALE	1.49
7432	.39	.29	74150	SALE	1.10
7438	SALE	.25	74151	SALE	.13
7442	SALE	.29	74154	1.35	1.25
7445	SALE	.59	74161	.69	.59
7446	.89	.79	74173	SALE	.59
7447	.89	.79	74174	SALE	.35
7448	1.95	1.85	74175	SALE	.35
7473	.39	.29	74193	.79	.69

74LS

74LS00	SALE	.15	74LS139	SALE	.29
74LS02	SALE	.15	74LS151	SALE	.29
74LS03	SALE	.15	74LS153	SALE	.25
74LS04	SALE	.19	74LS154	1.19	1.09
74LS05	SALE	.19	74LS157	.45	.35
74LS06	.59	.49	74LS161	SALE	.29
74LS07	.59	.49	74LS163	SALE	.35
74LS08	.28	.18	74LS164	SALE	.35
74LS09	SALE	.15	74LS165	.75	.65
74LS10	SALE	.15	74LS166	SALE	.69
74LS11	.29	.19	74LS173	SALE	.35
74LS14	SALE	.29	74LS174	SALE	.29
74LS20	SALE	.15	74LS175	SALE	.29
74LS21	SALE	.19	74LS191	SALE	.39
74LS27	SALE	.19	74LS192	.69	.59
74LS30	SALE	.15	74LS193	.69	.59
74LS32	SALE	.19	74LS194	SALE	.45
74LS38	SALE	.25	74LS221	SALE	.49
74LS42	.49	.39	74LS240	SALE	.45
74LS47	.89	.79	74LS241	SALE	.49
74LS73	SALE	.25	74LS244	SALE	.49
74LS74	SALE	.19	74LS245	SALE	.59
74LS75	SALE	.25	74LS257	SALE	.29
74LS76	.39	.29	74LS259	.99	.89
74LS83	.59	.49	74LS273	.89	.79
74LS85	.59	.49	74LS279	.49	.39
74LS86	.29	.19	74LS367	SALE	.29
74LS90	SALE	.29	74LS373	SALE	.59
74LS93	SALE	.29	74LS374	SALE	.49
74LS123	SALE	.35	74LS393	SALE	.69
74LS125	.49	.39	74LS541	SALE	.99
74LS132	SALE	.29	74LS590	5.95	5.85
74LS138	.49	.39	74LS688	2.39	2.29

74S/PROMS*

74S00	SALE	.19	74S188*		1.49
74S04	SALE	.19	74S189		1.49
74S32	SALE	.19	74S240		1.35
74S74	SALE	.19	74S244	SALE	.75
74S112	SALE	.25	74S287*		1.49
74S124	SALE	1.25	74S288*		1.49
74S138	SALE	.49	74S373	SALE	.99
74S153	SALE	.25	74S374	SALE	.99
74S163	SALE	.75	74S387*		1.29
74S174	SALE	.25	74S472*	SALE	2.49
74S175	SALE	.25	74S571*		2.49

CD-CMOS

CD4001		.19	CD4051		.59
CD4002		.19	CD4052		.59
CD4007		.25	CD4053		.59
CD4011		.19	CD4060		.65
CD4012		.25	CD4066		.29
CD4013		.29	CD4069		.19
CD4015		.49	CD4070		.29
CD4016		.29	CD4071		.22
CD4017		.49	CD4072		.22
CD4018		.59	CD4073		.22
CD4020		.59	CD4081		.22
CD4021		.59	CD4093		.35
CD4024		.45	CD4094		.89
CD4027		.35	CD4503		.39
CD4028		.49	CD4511		.69
CD4029		.69	CD4518		.75
CD4030		.35	CD4520		.75
CD4040		.65	CD4522		.79
CD4042		.59	CD4528		.69
CD4043		.59	CD4538		.79
CD4046		.65	CD4543		.79
CD4047		.65	CD4584		.49
CD4049		.29	CD4585		.69
CD4050		.29			

EEPROMS

2816A	2048x8 350ns (9V-15V) 5V **Read/Write**	5.25
2816A-25	2048x8 250ns (9V-15V) 5V **Read/Write**	5.49
2817A	2048x8 350ns 5V **Read/Write**	7.95
2864A	8192x8 250ns 5V **Read/Write** (Pin 1: No R Bi	13.95
2864A-30	8192x8 300ns 5V **Read/Write** (Pin 1: No R Bi	12.95
2865A	8192x8 250ns 5V **Read/Write**	12.95
52B13	2048x8 350ns (21V) 5V Read Only	1.49

MICROPROCESSOR COMPONENTS

Z80, Z80A, Z80B, SERIES

Part No.	Price
Z80	1.19
Z80A	1.29
Z80A-CTC	1.65
Z80A-DART	~~4.95~~ 3.95
Z80A-PIO	~~1.89~~ 1.49
Z80A-SIO/O	~~9.95~~ 2.95
Z80B	2.75
Z80B-CTC	~~3.95~~ 3.25
Z80B-PIO	3.95
Z8681B1	~~8.95~~ 6.95

8000 SERIES

8031	~~3.95~~ 3.49
80C31	~~9.95~~ 8.95
8035	~~1.95~~ 1.25
8039	~~1.95~~ 1.59
8052AHBASIC	24.95
8080A	~~2.25~~ 1.49
8085A	~~2.49~~ 1.95
8085A-2	3.59
8087 (5MHz)	~~99.95~~ 94.95
8087-1 (10MHz)	184.95
8087-2 (8MHz)	134.95
8088 (5MHz)	~~4.95~~ 3.49
8088-2 (8MHz)	~~6.95~~ 5.95
8116	~~4.95~~ 3.95
8155	2.49

8000 SERIES Continued

Part No.	Price
8155-2	3.49
81C55	3.95
8156	2.95
8205	~~9.49~~ 8.99
82C11	6.95
8212	~~2.29~~ 1.99
8216	1.39
8224	~~1.75~~ 1.49
8228	~~1.95~~ 1.49
8237-5	~~4.25~~ 3.95
8243	1.75
8250A	~~4.95~~ 3.95
8250B (For IBM)	~~5.95~~ 4.95
8251A	1.69
8253	1.89
8253-5	1.95
82C53-5	3.95
8254	3.95
8255A-5	2.95
82C55A-5	3.49
8259-5	2.25
8272	~~3.95~~ 2.95
8274	~~5.95~~ 4.95
8279-5	~~2.95~~ 2.75
8282	3.49
8284	1.75

8000 SERIES Continued

Part No.	Price
8286	2.29
8741	~~9.95~~ 9.49
8742	~~17.95~~ 14.95
8748 (25V)	7.95
8748H (HMOS)(21V)	9.95
8749	9.95
8751H (3.5-12MHz)	36.95
8755	13.95
80286-10 (10MHz)LCC	49.95
80287-3 (5MHz)	109.95
80287-8 (8MHz)	209.95
80287-10 (10MHz)	259.95
80386-16 PGA	279.95
80387-16 (16MHz)	395.95
80387-20 (20MHz)	459.95
80387-25 (25MHz)	569.95
82284 (8MHz)	~~9.49~~ 7.95
82288 (8MHz)	~~9.95~~ 7.95

DATA ACQUISITION

ADC0804LCN	3.25
ADC0808CCN	~~5.95~~ 5.49
ADC0809CCN	3.69
ADC1205CCJ-1	18.49
DAC0808LCN	~~1.75~~ 1.49
AY-3-1015D	4.95
AY-5-1013A	1.95

STATIC RAMS

Part No.	Function		Price
2016-12	2048x8	120ns	~~3.75~~ 2.95
2102	1024x1	350ns	.89
2112	256x4	450ns MOS	~~2.49~~ 1.95
2114N	1024x4	450ns	~~.99~~ .79
2114N-2L	1024x4	200ns Low Power	1.49
21C14	1024x4	200ns (CMOS)	.49
5101	256x4	450ns (CMOS)	~~2.49~~ 1.95
6116P-1	2048x8	100ns (16K) CMOS	~~3.95~~ 3.19
6116P-3	2048x8	150ns (16K) CMOS	~~3.49~~ 2.79
6116LP-1	2048x8	100ns (16K) LP CMOS	~~4.39~~ 3.59
6116LP-3	2048x8	150ns (16K) LP CMOS	~~3.95~~ 3.09
6264P-10	8192x8	100ns (64K) CMOS	~~9.95~~ 9.49
6264P-15	8192x8	150ns (64K) CMOS	~~9.25~~ 7.49
6264LP-10	8192x8	100ns (64K) LP CMOS	~~10.95~~ 10.25
6264LP-12	8192x8	120ns (64K) LP CMOS	~~10.49~~ 8.95
6264LP-15	8192x8	150ns (64K) LP CMOS	~~10.25~~ 7.95
6514	1024x4	350ns CMOS	3.75
43256-10L	32,768x8	100ns (256K) Low Power	~~26.95~~ 23.95
43256-15L	32,768x8	150ns (256K) Low Power	~~25.25~~ 22.95
62256LP-10	32,768x8	100ns (256K) LP CMOS	~~27.95~~ 24.95
62256LP-12	32,768x8	120ns (256K) LP CMOS	~~27.25~~ 24.25
62256LP-15	32,768x8	150ns (256K) LP CMOS	~~26.25~~ 23.95

DYNAMIC RAMS

421000A9A-10	1,048,576x9	100ns 1MEGx9 SIP	~~399.95~~ 229.95
421000A9B-10	1,048,576x9	100ns 1MEGx9 SIM	~~399.95~~ 195.95
421000A9A-80	1,048,576x9	80ns 1MEGx9 SIP	~~419.95~~ 229.95
421000A9B-80	1,048,576x9	80ns 1MEGx9 SIM	~~239.95~~ 225.95
TMS4416-12	16,384x4	120ns	~~6.75~~ 5.95
TMS4416-15	16,384x4	150ns	~~6.25~~ 5.49
4116-15	16,384x1	150ns (MM5290N-2)	~~1.39~~ 1.25
4128-15	131,072x1	150ns (Piggyback)	4.49
4164-100	65,536x1	100ns	~~3.49~~ 3.29
4164-120	65,536x1	120ns	~~2.95~~ 2.85
4164-150	65,536x1	150ns	~~2.59~~ 2.49
41256-60	262,144x1	60ns	~~9.25~~ 8.49
41256-80	262,144x1	80ns	~~7.95~~ 6.95
41256-100	262,144x1	100ns	~~7.25~~ 6.49
41256-120	262,144x1	120ns	~~6.95~~ 6.19
41256-150	262,144x1	150ns	~~6.49~~ 5.89
41264-12	64Kx4	120ns Video RAM	12.95
41464-10	65,536x4	100ns	~~14.49~~ 8.95
41464-12	65,536x4	120ns	~~11.95~~ 8.25
41464-15	65,536x4	150ns	~~10.95~~ 7.95
51258-10	262,144x1	100ns Static Column	~~13.95~~ 8.95
41256A9A-10	262,144x9	100ns 256x9 SIP	~~149.95~~ 69.95
41256A9B-10	262,144x9	100ns 256x9 SIM	~~74.95~~ 64.95
511000P-10	1,048,576x1	100ns (1 Meg)	~~19.95~~ 19.49
511000P-80	1,048,576x1	80ns (1 Meg)	~~22.95~~ 21.75
514256P-10	262,144x4	100ns (1 Meg)	~~24.95~~ 22.95
514258-10	262,144x4	100ns Static Column	31.95

EPROMS

TMS2516	2048x8	450ns (25V)	~~5.95~~ 4.95
TMS2532	4096x8	450ns (25V)	5.95
TMS2532A	4096x8	450ns (12.5V)	~~4.49~~ 3.25
TMS2564	8192x8	450ns (25V)	6.95
TMS2716	2048x8	450ns (-5V, +5V, +12V)	~~6.95~~ 6.49
1702A	256x8	2K (1µs)	~~4.95~~ 4.25
2708	1024x8	450ns	~~6.95~~ 5.95
2716	2048x8	450ns (25V)	~~3.75~~ 3.25
2716-1	2048x8	350ns (25V)	~~3.95~~ 3.49
27C16	2048x8	450ns (25V) CMOS	~~4.25~~ 3.75
2732	4096x8	450ns (25V)	3.95
2732A-20	4096x8	200ns (21V)	~~4.25~~ 3.95
2732A-25	4096x8	250ns (21V)	~~3.95~~ 3.75
27C32	4096x8	450ns (25V) CMOS	~~4.95~~ 4.25
2764-20	8192x8	200ns (21V)	4.25
2764-25	8192x8	250ns (21V)	3.59
2764A-25	8192x8	250ns (12.5V)	~~3.69~~ 3.39
27C64-15	8192x8	150ns (12.5V) CMOS	5.95
27128-20	16,384x8	200ns (21V)	~~6.49~~ 5.95
27128-25	16,384x8	250ns (21V)	~~5.95~~ 4.95
27128A-15	16,384x8	150ns (12.5V)	7.75
27128A-20	16,384x8	200ns (12.5V)	~~5.25~~ 4.75
27C128-25	16,384x8	250ns (21V) CMOS	~~5.95~~ 5.49
27256-15	32,768x8	150ns (12.5V)	8.95
27256-20	32,768x8	200ns (12.5V)	~~6.25~~ 5.49
27256-25	32,768x8	250ns (12.5V)	~~5.49~~ 4.95
27C256-15	32,768x8	150ns (12.5V) CMOS	~~7.95~~ 7.25
27C256-25	32,768x8	250ns (12.5V) CMOS	~~5.49~~ 4.95
27512-20	65,536x8	200ns (12.5V)	10.95
27512-25	65,536x8	250ns (12.5V)	9.95
27C512-25	65,536x8	250ns (12.5V) CMOS	~~9.49~~ 8.49
27C1024	131,072x8	200ns (12.5V) CMOS (1 Meg)	~~24.95~~ 19.95
68764	8192x8	64K 450ns (25V) (Chip Enable)	19.95
68766-35	8192x8	64K 350ns (25V) (Output Enable)	16.95

6500/6800 68000 Series

Part No.	Price
6402	~~3.95~~ 3.49
6502	~~2.65~~ 2.25
6502A	~~2.75~~ 2.59
65C02 (CMOS)	7.75
6520	1.95
6522	2.95
65C22	4.25
6532	~~5.49~~ 4.95
6551	~~2.95~~ 2.69
65C802 (CMOS)	~~15.95~~ 14.75
6800	~~1.95~~ 1.49
6802	2.95
6808	1.95
6810	~~1.25~~ .99
6820	2.75
6821	~~1.75~~ 1.49
68B21	~~1.95~~ 1.75
6840	~~3.49~~ 2.95
6845	~~2.75~~ 2.49
6850	~~1.95~~ 1.49
6852	~~.75~~ .59
MC68000L8	~~9.95~~ 8.49
MC68000L10	~~11.95~~ 8.95
MC68010L10	~~39.95~~ 29.95
MC68020RC12B	89.95
MC68701	17.95
MC68705P3S	9.95
MC68705U3L	~~10.95~~ 9.49
MC68705U3S	~~10.95~~ 9.49
MC68450L10	~~49.95~~ 29.95
MC68881RC16A	129.95
MC68881RC20A	169.95

Commodore

WD1770	~~8.95~~	7.49
SI3052P	~~1.25~~	.99
6504A		1.19
6510		14.95
6526		14.95
6526A		15.95
6545-1	~~3.95~~	2.95
6560	~~10.95~~	8.95
6567		24.95
6572	~~10.95~~	7.95
6581 (12V)		12.95
6582 (9V)	~~12.95~~	9.95
8502		7.95
8564	~~4.95~~	2.95
8566	~~9.95~~	7.95
8701		9.95
8722	~~10.95~~	8.95
*82S100PLA**		15.95
325572-01		17.95
901225-01		15.95
901226-01		15.95
901227-02		4.95
901227-03		15.95
901229-05		15.95
901460-03		1.95
901486-06		2.95

*No specs available
**Note: 82S100PLA = U17 (C-64)

74C/CMOS

74C00	Sale	.19	74C174 Sale .39
74C02	Sale	.19	74C175 Sale .59
74C04	Sale	.19	74C192 Sale .99
74C08	Sale	.19	74C194 Sale .49
74C10	Sale	.15	74C221 1.79
74C14		.49	74C240 Sale .75
74C32	Sale	.19	74C244 1.79
74C74		.49	74C373 Sale 1.49
74C85		1.49	74C374 Sale 1.49
74C86	Sale	.19	74C911 6.95
74C89	Sale	2.95	74C912 7.95
74C90		.99	74C915 Sale 1.19
74C151	Sale	1.49	74C917 Sale 3.95
74C154	Sale	2.75	74C920 Sale 3.95
74C157	Sale	1.25	74C921 Sale 2.95
74C160	Sale	.49	74C922 3.95
74C161	Sale	.49	74C923 3.95
74C162	Sale	.49	74C925 5.49
74C173		.59	74C926 5.95

MISC. COMPONENTS

TANTALUM CAPACITORS

TM.1/35 .1µf @ 35V	.19	TM4.7/35 4.7µf @ 35V	.45
TM1/35 1µf @ 35V	.19	TM6.8/35 6.8µf @ 35V	.49
TM2.2/35 2.2µf @ 35V	.25	TM10/35 10µf @ 35V	.59

POTENTIOMETERS

Values available (insert ohms into space marked "XX"): 500Ω, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 1MEG

43PXX 3/4 Watt,15Turn .99 | **63PXX** 1/2 Watt, 1Turn .89

TRANSISTORS AND DIODES

PN2222	.13	PN2907	.13	1N4004	.12
2N2222A	.29	2N4401	.12	1N4148	.07
2N3055	.65	1N270	.25	1N4735	.29
2N3904	.12	1N751	.15	C106B1	.49

SWITCHES

JMT123 SPDT, On-On	1.19	206-8 SPST, 16-pin DIP	1.25
MPC121 SPDT, On-Off-On	1.19	MS102 SPST, Momentary	.39

D-SUB CONNECTORS

DB25P Male, 25-pin	.69	DB25S Female, 25-pin	.75

LEDS

XC556R T1¾, Red	.13	XC556Y T1¾, Yellow	.17
XC556G T1¾, Green	.17	XC556C T1¾, Clear/Red	.17

IC SOCKETS

Low Profile		Wire Wrap (Gold) Level #2	
8LP	.11	8WW	.59
14LP	.12	14WW	.65
16LP	.13	16WW	.69
24LP	.25	24WW	1.19
28LP	.27	28WW	1.39
40LP	.29	40WW	1.89

Soldertail Standard (Gold & Tin) & Header Plug Sockets Also Available

74HC HI-SPEED CMOS

Part No.		Price	Part No.		Price
74HC00	SALE	.17	74HC175		.59
74HC02	SALE	.17	74HC221	SALE	.69
74HC04	SALE	.17	74HC240	SALE	.59
74HC08	SALE	.17	74HC244		.79
74HC10	SALE	.19	74HC245	SALE	.69
74HC14		.29	74HC253	SALE	.39
74HC30	SALE	.19	74HC259		.49
74HC32	SALE	.25	74HC273	SALE	.49
74HC74	SALE	.29	74HC373		.69
74HC75	SALE	.29	74HC374	SALE	.59
74HC76	SALE	.29	74HC595		1.29
74HC85		.55	74HC688	SALE	1.25
74HC86	SALE	.25	74HC943	SALE	7.95
74HC123	SALE	.49	74HC4040	SALE	.79
74HC125		.49	74HC4049	SALE	.25
74HC132	SALE	.39	74HC4050	SALE	.25
74HC138		.45	74HC4060	SALE	.69
74HC139	SALE	.35	74HC4511	SALE	.99
74HC154		1.49	74HC4514		1.79
74HC163	SALE	.39	74HC4538	SALE	.99
74HC174		.59	74HC4543	SALE	.99

74HCT-CMOS TTL

74HCT00	SALE	.15	74HCT139	SALE	.29
74HCT02	SALE	.15	74HCT157	SALE	.19
74HCT04	SALE	.17	74HCT174	SALE	.25
74HCT08	SALE	.15	74HCT175	SALE	.25
74HCT14		.29	74HCT240	SALE	.59
74HCT32	SALE	.17	74HCT244	SALE	.49
74HCT74	SALE	.25	74HCT245	SALE	.49
74HCT86	SALE	.15	74HCT373	SALE	.45
74HCT138		.39	74HCT374	SALE	.45

LINEAR

TL071CP	.59	LM1489N	.45
TL072CP	.79	DS14C89N (CMOS)	1.19
TL074CN	.99	LM1496N	.69
TL081CP	.49	LM1871N	1.95
TL082CP	.49	LM1872N	1.95
TL084CN	.89	ULN2003A	.75
LM301N	.35	XR2206	3.95
LM307N	.39	XR2211	2.95
LM308N	.59	XR2240	1.49
LM309K	1.25	26LS29	2.25
LM310N	1.29	26LS31	.99
LM311N	.39	26LS32	.99
LM317T	.65	26LS33	1.49
LM318N	.99	ULN2803A	1.19
LM319N	1.99	LM2901N	.25
LM323K	3.49	LM2907N	1.29
LM324N	.35	LM2917N (8 pin)	1.79
LM335Z	1.39	MC3470P	1.19
LM336Z	.99	MC3479P	3.95
LM337T	1.09	MC3486P	1.19
LM338K	4.49	MC3487P	.99
LM339N	.39	UDN3613M	.39
LF347N	1.49	LM3900N	.49
LM348N	.69	LM3905N	1.19
LF351N	.39	LM3909N	.89
LF353N	.49	LM3914N	1.79
LF356N	.79	NE5532	.69
LF357N	.89	NE5534	.69
LM358N	.49	7805K (LM340K-5)	1.29
LM380N	.89	7812K (LM340K-12)	1.29
LM386N-3	.89	7815K (LM340K-15)	1.29
LM393N	.39	7805T (LM340T-5)	.45
LF398N	1.95	7812T (LM340T-12)	.45
LF411CN	.79	7815T (LM340T-15)	.45
LF412CN	1.29	7905K (LM320K-5)	1.35
NE555V	.29	7905T (LM320T-5)	.49
XRL555	.59	75113	1.19
LM556N	.45	75150	1.19
LM565N	.89	75154	1.19
LM566CN	1.19	75174	2.95
LM567V	.75	75176	2.95
LM723CN	.39	75451	.39
LM741CN	.29	75452	.39
LM747CN	.49	75492	.79
LM1458N	.35	MC145406P	2.95
LM1488N	.45		
DS14C88N (CMOS)	1.19		

PARTIAL LISTING • OVER 4000 COMPONENTS AND ACCESSORIES IN STOCK! • CALL FOR QUANTITY DISCOUNTS

RAM'S SUBJECT TO FREQUENT PRICE CHANGES

Circle 137 on Reader Service Card

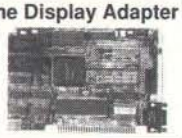
Worldwide • Since 1974
• QUALITY COMPONENTS • COMPETITIVE PRICING • PROMPT DELIVERY

15th ANNIVERSARY YEAR 1974 - 1989

SPECIAL! Monochrome Text Card

Sperry Monochrome Display Adapter

- IBM PC/XT Compatible
- Use for Text only
- Great for Network Servers and Dedicated Work Stations



TEXT.....$12.95

COMPUTER ACCESSORIES

DFI Handy Scanner and 3 Button Mice for IBM PC/XT/AT

FREE DPE Software with HS3000!

The HS3000 offers a full 4 inch window at 400dpi resolution. Scan photos, logos, drawings, etc. Can be used with today's most popular applications.

HS3000 Pictured

HS3000	Handy Scanner	**$179.95**
DMS200	200DPI 3-Button Ser. Mouse	**$39.95**
DMS200S	200DPI 3-Button Ser. Mouse with Dr. Halo Software	**$59.95**

IBM Compatible Cases and Power Supplies

JE2010 Pictured

JE1030 Pictured

JE1010	Flip-Top Standard PC/XT Case	**$39.95**
JE1018	Slide Baby AT Case ~~$69.95~~	**$59.95**
JE1030	150 watt PC/XT Power Supply	**$59.95**
JE1032	200 watt Baby AT Power Supply	**$89.95**
JE2010	Tower Case w/250 watt Pwr. Supply	**$279.95**
JE2014	Flip-Top Baby XT Turbo Case	**$69.95**
JE2019	Flip-Top Baby AT Case	**$69.95**

Datatronics 2400/1200/300 Baud Pocket Size Modems

2400 Baud Pocket-Size Modem...Only $149.95!

2400P Pictured

1200P	1200/300 Baud Pocket Size Modem With ProComm Software	**$89.95**
2400P	2400/1200/300 Baud Pocket Size Modem With ProComm Software	**$149.95**

TEST EQUIPMENT

Metex Digital Multimeters

Metex General Specs:
- Handheld, high accuracy
- AC/DC Voltage, AC/DC Current, Resistance, Diodes, Continuity, Transistor hFE • Manual ranging w/overload protection

M3650/B & M4650 only:
- Also measures frequency and capacitance

M4650 only:
- Data Hold Switch
- 4.5 Digit

M4650 Pictured

M3610	3.5 Digit Multimeter	**$49.95**
M3650	3.5 Digit w/Freq. & Capacitance	**$69.95**
M3650B	Same as M3650 w/Bargraph	**$79.95**
M4650	4.5 Dig. w/Freq., Capacitance and Data Hold Switch	**$99.95**

Jameco 16MHz 80286 NEAT Computer Kit With 2 Megabyte RAM

- *Fully IBM AT Compatible*
- *Free! QAPLUS Diagnostic Software Included!*
- *Free! PC Write Word Processing Software Included!*
- *2Mb RAM Included, Expandable to 8Mb*
- *8 or 16MHz Operation*
- *AMI BIOS ROMs Included*
- *Flip-Top Case w/200 Watt Power Supply*
- *1.2Mb Disk Drive*
- *18.0 Norton SI Rating*
- *101-Key (Enhanced) Keyboard*

SALE

SAVE $190.55

Shown with VGA Option (not included)

JE2055 Monitor and Adapter Card....$599.95 (See Below)

JE3013	16MHz IBM AT Comp. Kit... ~~$1199.95~~	**$949.95**
EZDOS	EZ-DOS: MS/PC-DOS Comp. Operating System	**$49.95**
EZDOSP	Same as above with TrueBASIC	**$69.95**

IBM COMPATIBLE DISPLAY MONITORS

AMBER	12" Amber Monochrome		**$99.95**
HD55H	14" RGB 640x240	~~$249.95~~	**$239.95**
TM5154	EGA 14" 720x350	~~$399.95~~	**$369.95**
JE1059	EGA Monitor & Card ..	~~$519.95~~	**$479.95**
TM5155	14" Multiscan 800x560	~~$549.95~~	**$479.95**
QC1478	14" VGA 720x480	~~$449.95~~	**$399.95**
JE2055	VGA Monitor & Card ..	~~$649.95~~	**$599.95**

SALE!

QC1478 Pictured

JAMECO IBM PC/XT/AT COMPATIBLE CARDS

JE1043	360K/720K/1.2Mb/1.44Mb Floppy Disk Controller Card (PC/XT/AT)	**$49.95**
JE1050	Monochrome Graphics Card w/Parallel Printer Port (PC/XT/AT)	**$59.95**
JE1052	Color Graphics Card w/ Parallel Printer Port (PC/XT/AT)	**$49.95**
JE1055	EGA Card w/ 256K Video RAM (PC/XT/AT) ~~$159.95~~	**$149.95**
GC1500	Orchid 8-Bit VGA Card w/256K Video RAM (PC/XT/AT) ~~$269.95~~	**$249.95**
GC1501	Orchid 8/16-Bit VGA Card w/256K Video RAM (PC/XT/AT) ~~$349.95~~	**$329.95**
JE1060	I/O Card w/ Serial, Game, Printer Port & Real Time Clock (PC/XT)	**$59.95**
JE1061	RS232 Serial Half Card (PC/XT)	**$29.95**
JE1062	RS232 Serial Half Card (AT)	**$34.95**
JE1065	I/O Card w/ Serial, Game and Parallel Printer Port (AT)	**$59.95**
JE1071	Multi I/O Card w/ Controller & Monochrome Graphics (PC/XT)	**$119.95**
JE1077	Multi I/O Card w/ 360K/720K/1.2Mb/1.44Mb Floppy Controller (AT)	**$79.95**
JE1081	2Mb Expanded or Extended Memory Card (zero-K on-board) (AT)	**$99.95**

SEAGATE HALF-HEIGHT HARD DISK DRIVES

ST225	20Mb Drive only (PC/XT/AT)	**$224.95**
ST225XT	20Mb w/Controller (PC/XT)	**$269.95**
ST225AT	20Mb w/Controller (AT)	**$339.95**
ST238	30Mb Drive only (PC/XT/AT)	**$249.95**
ST238XT	30Mb w/Controller (PC/XT)	**$299.95**
ST238AT	30Mb w/Controller (AT)	**$389.95**
ST251	40Mb Drive only (PC/XT/AT)	**$379.95**
ST251XT	40Mb w/Controller (PC/XT)	**$419.95**
ST251AT	40Mb w/Controller (AT)	**$489.95**
ST251-1	40Mb Fast 28ms (Drive only)	**$469.95**

Your One-Stop Center for Hard Disk Drive Needs!

ST225XT Pictured

Seagate 60Mb, 80Mb &120Mb Hard Disk Drives Also Available!

HARD & HARD/FLOPPY DISK CONTROLLERS

Computer Type	MFM Hard Part No./ Price	RLL Hard Part No./ Price	MFM Hard/Floppy Part No./ Price	RLL Hard/Floppy Part No./ Price
8088 (PC/XT) 3:1 Interleave	XTGEN $79.95	ACB2072 $89.95	JE1044 $129.95	-------- --------
80286 (AT)/386 2:1 Interleave	1003VMM1 $129.95	1003VSR1 $189.95	1003VMM2 $149.95	1003VSR2 $199.95
80286 (AT)/386 1:1 Interleave	1006VMM1 $149.95	1006VSR1 $199.95	1006VMM2 $179.95	1006VSR2 $219.95

IBM PC/XT/AT COMPATIBLE 3.5"/5.25" DISK DRIVES

352KU	3.5" 720Kb (PC/XT/AT)	**$109.95**
356KU	3.5" 1.44Mb (PC/XT/AT)	**$129.95**
JE1020	5.25" 360Kb (PC/XT/AT) Black	**$89.95**
JE1021	5.25" 360Kb (PC/XT/AT) Beige	**$89.95**
JE1022	5.25" 1.2Mb (PC/XT/AT) Beige	**$99.95**

JE1022 Pictured

MOTHERBOARDS

20MHz 386 Only $749.95!

• All w/ ØK RAM (except JE3027)

JE3520 Pictured

JE1001	Jameco 4.77/8MHz 8088 (PC/XT)	**$89.95**
JE1002	Jameco 4.77/10MHz 8088 (PC/XT)	**$99.95**
JE3005	Jameco Baby 8/12MHz 80286 (AT)	**$279.95**
JE3010	Jameco Baby 8/16MHz 80286 (AT)	**$379.95**
JE3020	AMI Baby 16MHz 80386 (AT)	**$999.95**
JE3025	AMI Baby 20MHz 80386 (AT)	**$1199.95**
JE3026	AMI Full-Size 25MHz 80386 (AT)	**$1999.95**
JE3027	AMI Full-Size 33MHz 386 w/4Mb (AT)	**$4299.95**
JE3520	Jameco Baby 20MHz 80386 (AT)	**$749.95**
JE3525	Jameco Baby 25MHz 80386 (AT)	**$1499.95**

SUPER SONY SALE

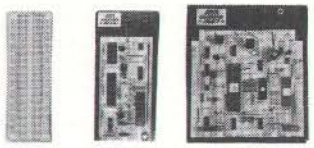
720Kb 3.5" Floppy Drive

- For use with IBM PC/XT/AT and compatible computers • Double-sided, double density • 135TPI • 160 tracks • Rotation speed: 300rpm • Size: 4"W x 6"D x 1"H

MPF11	720Kb Drive	**$59.95**
SMK	5.25" Mounting Kit	**$14.95**

PROTOTYPING PRODUCTS

Jameco Solderless Breadboards



JE23 JE24 JE27

Part No.	Dim. L" x W"	Contact Points	Binding Posts	Price
JE21	3.25 x 2.125	400	0	**$4.95**
JE23	6.5 x 2.125	830	0	**$7.95**
JE24	6.5 x 3.125	1,360	2	**$12.95**
JE25	6.5 x 4.25	1,660	3	**$19.95**
JE26	6.875 x 5.75	2,390	4	**$24.95**
JE27	7.25 x 7.5	3,220	4	**$34.95**

COMPUTER ACCESSORIES

Jameco IBM PC/XT/AT Compatible Keyboards

JE2017 Pictured

JE1015	84-Key Standard AT Layout	**$59.95**
JE1016	101-Key Enhanced Layout	**$69.95**
JE2016	111-Key Enhanced w/Solar Calculator	**$79.95**
JE2017	104-Key Enhanced w/Trackball	**$99.95**

Colorado Memory 40Mb Tape Back-Up for IBM PC/XT/AT

DJ10	40Mb Tape Back-Up and Tape	**$299.95**
TB40	40Mb Tape Cartridge	**$24.95**

ENGINEERING/DATA BOOKS

21035	Sams TTL Cookbook (88)	**$14.95**
21398	Sams CMOS Cookbook (88)	**$19.95**
22453	Sams Op-Amp Cookbook (88)	**$21.95**
270645	Intel 8-bit Controller Hndbk. (89)	**$19.95**
270646	Intel 16-bit Controller Hndbk. (89)	**$19.95**
270647	Intel 32-bit Controller Hndbk(89)	**$19.95**
400041	NSC Linear Data Book Vol 1 (88)	**$14.95**
400042	NSC Linear Data Book Vol 2 (88)	**$9.95**
400043	NSC Linear Data Book Vol 3 (88)	**$9.95**
ICM89	1989 IC Master (3 Volume Set)	**$119.95**

1355 Shoreway Road
Belmont, CA 94002
24 Hour Order Hotline (415) 592-8097
FAX's (415) 592-2503 or (415) 595-2664
Telex 176043 - Ans. Back: Jameco Blmt
IC Data Sheets - 50¢ each

Send $2.00 Postage for a FREE 1989 Catalog

© 1989 Jameco Electronics **10/89**
IBM is a registered trademark of International Business Machines

MasterCard VISA

Mail Order Electronics · Worldwide

Jameco ELECTRONICS

MEMBER DIRECT MARKETING ASSOCIATION

MMC MICROCOMPUTER MARKETING COUNCIL

$20.00 Minimum Order - U.S. Funds Only

CA Residents Add 6%, 6.5% or 7% Sales Tax

Shipping - Add 5% plus $1.50 Insurance (May vary according to weight)

Terms: Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to substitute manufacturers. Items subject to availability and prior sale. Products pictured may only be representative. Complete list of terms/warranties is available upon request.

24-Hour Order Hotline (415) 592-8097 • **The Following Phone Lines Are Available From 7AM - 5PM P.S.T.:**

• Customer Service (415) 592-8121 • Technical Assistance (415) 592-9990 • Credit Department (415) 592-9983 • All Other Inquiries (415) 592-7108

LAPTOPS $385 FAX

TOSHIBA T1000 . . . $635	NecUltralite 2meg . $2289	CANON Fax 20 . . . $949	AVATEX 110/220V . . $625
" T1200F $1299	Prospeed 286/20 . $3049	" Fax 225 . . . . . $1545	NISSIE 320 . . . . . $495
" T1200FB $1385	" 286/40 . . . . . $3399	" Fax 270 . . . . . $1795	" 303 . . . . . $495
" T1200H $1795	" 386/40 . . . . . $4395	" Fax 350 . . . . . $1995	MURATA 1200 . . . . $569
" T1200HB $1895	Mitsubishi 286-219 $1995	" Fax 450 . . . . . $2349	" 1600 . . . . . $669
" T1600 . . . . . $3045	" 386-290 . . . . . $2299	" Fax 630 . . . . . $2699	" F30 . . . . . $1399
" T3100E $2565	" 386-240 . . . . . $2795	" Fax 705 . . . . . $2999	RICOH RF800 . . . . $649
" T3200/40 . . . . . $3299	SHARP 7241/40mb $1999	" Fax 730 . . . . . $3499	" Fax 15 . . . . . $1155
" T5100 . . . . . $4099	" 4602 . . . . . $1445	PANASONIC	" Fax 25 . . . . . $1295
" T5200 40 . . . . . $4795	" 4641 . . . . . $2295	KXF 100 . . . . . $825	" Fax 35 . . . . . $1545
" T5200 100 . . . . . $5299	" 5541 . . . . . $3599	KXF 120 . . . . . $975	" Fax 65 . . . . . $1595
ZENITH Z-184-10 . . $1495	PANASONIC PRINTERS	PANAFAX UF 135 . . $799	SHARP FO 220 . . . $699
" Z-184-20 . . . . . $2129	KXP1180 . . . . . $179	" UF 145 . . . . . $895	" FO 300 . . . . . $849
" Z-286-20 . . . . . $2949	KXP1191 . . . . . $229	" UF 250 . . . . . $1299	" FO 330 . . . . . $999
" Z-286-40 . . . . . $3388	KXP1124 . . . . . $325	" UF 260 . . . . . $1549	" FO 550 . . . . . $Call
" Z-384-40 . . . . . $4799	KXP1592 . . . . . $395	SANYO SF 100 . . . . $765	" UX 350 . . . . . $1099
COMPAQ 286-20mb $call	LASER KXP 4450 $1369	" SF 200 . . . . . $929	TOSHIBA 30100 . . . $745
" 286 40 MB . . . . . $call	KXP1595 . . . . . $425	" SF 515 . . . . . $1145	T3300 . . . . . $799
NEC MLTSPD HD . $1949	KXP1524 . . . . . $509	SHARP UX 50 . . . . $535	T3600 . . . . . $965
" MLTSPD EL $1499	CANON Fax 8 . . . . . $619	Remfg. UX 30 . . . . $385	T3700 . . . . . $1099

PREPAY PRICES: VISA/MC/COD + 2.9% Restock 20% Handling Chg. 5.95 No Exchange/Returns.

T.P.C. 12603 Hoover St.
Garden Grove, CA 92641

714/898-8262
FAX 714/891-1202

1-800-383-3199

BYTE BACK ISSUES FOR SALE

	1987	1988	1989
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			
Inside the IBM PCs			
Applications Software Today			

☐ Issues Available

Rates (postage and handling included):

1987-'89 BYTE Issues	**$6.00***	BYTE 1988 Index	**$4.00**
BYTE '83-'84 Index	**$4.00**	1985 Inside The IBM PCs	**$4.00**
BYTE 1985 Index	**$4.00**	1986 Inside The IBM PCs	**$5.00**
BYTE 1986 Index	**$4.00**	1988 Inside The IBM PCs	**$6.00**
BYTE 1987 Index	**$4.00**	Applications Software Today Special	**$4.00**

*June 1988 (Benchmarks) **$3.00**

The above prices include postage in the US. Please add $.50 per copy for Canada and Mexico; and $2.00 per copy to foreign countries (surface delivery). European customers please refer to Back Issue order form in International Advertising section of book.

Please indicate which issues you would like by checking (✓) the boxes. Send requests with payment to:

BYTE Back Issues, One Phoenix Mill Lane, Peterborough, NH 03458
(603) 924-9281

☐ Check enclosed **Charge:** ☐ VISA ☐ MasterCard

Card # _____

Exp. Date _____

Signature _____

Name _____

Address _____

City _____

State _____ Zip _____

All orders must be prepaid. Please allow four weeks for domestic delivery and twelve weeks for foreign delivery by surface mail.

★High Quality ★No-Risk Guarantee ★Low Price ★Expert Service ★Fast Delivery

We've Built Our Reputation on These Factors for 10 Very Successful Years.

CLONE 386

$1999

True 386. Not an SX!

20MHz, 32MB HARD DRIVE, 1 MB 0 WAIT RAM, AND 14" MONOCHROME MONITOR.

0MHz, 1MB RAM, base system $1499
0MHz, 1MB RAM, 32K cache, base system .. 1786
5MHz, 1MB RAM, 32K cache, base system .. 2094
3MHz, 1MB RAM, 32K cache, base system .. 2729

With MS-DOS® 3.3 or 4.01 and GWBASIC $79 or $99 Extra.

CLONE 386 STANDARD FEATURES:
- Genuine 80386 - 20/25/33 CPU's.
- 1MB Fast 0 Wait State RAM (32K Cache on some models, see chart).
- High Performance 1:1 Interleave, 800 Kb/sec 2 Floppy/2 HD Controller.
- 1.2M 5.25" or 1.44M 3.5" Floppy Drive (your choice).
- 101 Key "Click-Tactile" Keyboard.
- 1 Parallel, 1 Serial, 1 Joystick Port.
- 200/220 Watt Power Supply.
- 80387/Weitek Coprocessor (Except Base 20MHz).
- On-board Clock/Cal w/Battery Backup.
- 8 Expansion Slots.
- Setup Utility in ROM.
- System Reset Switch on Front Panel.
- LIM EMS 4.0 Driver.
- CPU Speed Switchable.
- Fully Expandable to 16MB RAM.
- FCC Certified.
- Novell and OS/2 Compatible.
- One Year Parts & Labor Warranty.
- Complete Software Pack Including: PC-Write - QModem - ExpressCalc AutoMenu - HomeBase - MoneyMaster Findex - Hard Disk Cache - Clone Utilities.

Clone 386 20MHz monochrome system pictured.

CLONE 286

$1279

Complete System!

12MHz, 32MB HARD DRIVE, 1 MB 0 WAIT RAM, AND 12" MONOCHROME MONITOR.

12MHz, 1MB RAM, base system $784
16MHz, 1MB RAM, base system 983

With MS-DOS® 3.3 or 4.01 and GWBASIC $79 or $99 Extra.

CLONE 286 STANDARD FEATURES:
- 1MB Fast 0 Wait State RAM.
- High Performance 1:1 Interleave, 800 Kb/sec 2 Floppy/2 Hard Disk Controller.
- 1.2M 5.25" or 1.44M 3.5" Floppy Drive (Your Choice).
- 101 Key Enhanced Keyboard.
- 1 Parallel, 1 Serial, 1 Joystick Port.
- 200 Watt Power Supply.
- 80287 Math Coprocessor Socket.
- On-board Clock/Cal. w/Battery Backup.
- 8 Expansion Slots.
- Setup Utility in ROM.
- System Reset Switch on Front Panel.
- CPU Speed Switchable.
- Fully Expandable to 4/8MB.
- FCC Certified.
- Novell Compatible.
- One Year Parts & Labor Warranty.
- Complete Software Package including: PC-Write - QModem - ExpressCalc AutoMenu - HomeBase - MoneyMaster Findex - Hard Disk Cache - Clone Utilities.

CLONE VALUE CHART

CLONE 286	12" MONOCHROME	14" EGA COLOR	14" VGA COLOR
12MHz CPU, 32MB 40MS SEAGATE HD	$1279	$1690	$1813
16MHz CPU, 32MB 40MS SEAGATE HD	1479	1890	2013

Add $20 for "Click/Tactile" 101-key Keyboard.
Add $20 for 14" Monochrome Monitor.

CLONE 386	14" MONOCHROME	14" EGA COLOR	14" VGA COLOR
20MHz CPU, 32MB 40MS SEAGATE HD	$1999	$2393	$2516
20MHz CPU, 32K CACHE, 32MB, 40MS SEAGATE HD	2299	2693	2816
25MHz CPU, 32K CACHE, 32MB 40MS SEAGATE HD	2604	2998	3121
33MHz CPU, 32K CACHE, 32MB 40MS SEAGATE HD	3240	3634	3757

OPTIONS FOR CLONE 286/386 COMPUTERS:

Add $27 for 32MB, 28MS Seagate HD.
Add $42 for 48MB, 40MS Seagate HD.
Add $69 for 48MB, 28MS Seagate HD.
Add $146 for 65MB, 40MS Seagate HD.
Add $173 for 65MB, 28MS Seagate HD.
Add $203 for 85MB, 28MS Seagate HD.
Add $495 for 122MB, 28MS Seagate HD.
Add $30 to VGA price for 16 bit VGA card.
Add $49 to VGA price for 14" Multi-frequency Monitor.
Add $125 for 6 drive tower case.

OPTIONAL EQUIPMENT FOR CLONE COMPUTERS

Star NX-1000 Printer, 144/36cps, NLQ $179
Star NX-1000 Rainbow Printer, same as above w/color 239
Star NX-2400 Printer, 170/57 cps, LQ, 24 pin 339
Star XR-1000 Printer, 300/76 cps, NLQ, 8 fonts 359
192/63 cps, LQ, 24 pin $349
Panasonic KX-P1191 Printer, 240/48 cps, NLQ 259
Star XB-2410 Printer 240/80 cps, super LQ, 24 pin, 16 fonts 469
Star XB-2415 Printer (same as above with wide carriage) 599
1200/300 baud int. modem 59

SATISFACTION GUARANTEED!

You get a rock-solid one year guarantee on parts and labor, plus a 30 day money-back Satisfaction Assurance guarantee (except on software and shipping).

SERVICE AFTER THE SALE!

Your Clone equipment will be promptly and expertly serviced by our specially trained, knowledgeable technicians who know what they are doing.

FAST DELIVERY!

Clone Computers are custom-manufactured to their buyers' specifications, burned-in and shipped within one week of their order, in most instances.

NO ORPHANED CUSTOMERS

We have been supplying our customers with high quality hardware and software since 1980. We enjoy an excellent industry-wide reputation built on providing top quality merchandise, a no-risk guarantee, low price, expert service and fast delivery. Our customers expect and receive no less.

Buy with Confidence! Our Guarantee Removes All the Risk from Your Buying Decision!

The Clone guarantee is simple and straightforward. You have 30 days after receipt of your Clone to see if you and it are going to be compatible. If you are not satisfied with your Clone for any reason within that time, you may return it for a full refund, less shipping charges.

TURBO CLONE

AT Style Keyboard **$699** Save Now!

Standard Features:
- 8088 @ 4.77— 10MHz Turbo-speed Mainboard.
- 640K RAM standard.
- 8087 Socket.
- 150-watt power sup.
- 360K Floppy Drive with Disk Controller.
- Hercules® Compatible Video Card.
- HiRes TTL monitor (green or amber).
- 2-Parallel prnt prts.
- 1-Serial port (2nd optional at $29).
- Game-Joystick port.
- Clock/Calendar.
- Fully Expandable.
- PC-Write - QModem ExpressCalc - Home Base - MoneyMaster - Findex - Clone Utilities - AutoMenu.
- FCC Class B Certif.
- Keyboard Lock.
- LED's for Power, Turbo and Hard Disk Access.
- 1 yr parts, lab. war.

SOFTWARE SALE!

LOWEST PRICES — FAST DELIVERY

This list is only a small portion of our inventory! Call us for all of your software needs!

MS-DOS®BUSINESS SOFTWARE

Aldus Pagemaker 3.0	$549
Allways	87
Borland Quattro (1-2-3 Clone)	169
Borland Reflex 2.0	179
Borland Sprint: Word Processor	138
DAC Easy Accntg. (all version 3)	61
DAC Easy Payroll	61
DAC Easy Bonus Pack (includes accounting, payroll, both tutors)	120
DAC Easy Light	42
dBase IV	479
Design CAD	162
Design CAD 3D	214
Desqview	79
Desqview with QEMM 386	114
Formtool	55
Framework III	399
Generic CADD, Level 3 (includes DotPlot and DeskConvert)	172
Lotus 1-2-3 version 3.0	369
Lotus Agenda	285
Lotus Symphony	459
Microsoft Multiplan	126
Microsoft Word 5.0	235
Paradox 3.0	446
Peachtree Complete System II	174
Peachtree Double Bonus Bundle	239
pfs: First Choice	91
pfs: First Publisher	83
pfs: Professional Write	144
Printshop Bundle	36
Publish It!	120
Q & A	215
Quicken 3.0	39
Rightwriter	51
Wordperfect 5.0	242
Wordstar Professional Release 5.5	216

MS-DOS LANGUAGES/UTILITIES

Autosketch Enhanced	$ 99
Borland Turbo Basic	69
Borland Turbo C	96
Borland Turbo Pascal	103
Bor. Turbo Assembler/Debugger	99
Carbon Copy + (need two copies)	$114
Copy II PC	25
Copy II PC Option Board Deluxe	118
Fastback Plus	113
Grammatik III	53
Microsoft C Compiler 5.1	289
Microsoft Macro Assembler 5.1	99
Microsoft Quick Basic Compiler	67
Microsoft Quick C Compiler	67
Microsoft Windows 286	67
Microsoft Windows 386	127
Norton Commander	53
Norton Utilities 4.5 Advanced Edit	88
PC Tools Deluxe 5.5	79
Procomm Plus	46
Sidekeys	42
X Tree Professional	78

OTHER MS-DOS

Alge Blaster	$ 28
Chess Master 2100	32
F-19 Stealth Fighter	44
Falcon AT	32
Kings Quest (I, II, III or IV)	31
Leisure Suit Larry II	30
Math Blaster Plus	28
Mavis Beacon Teaches Typing	32
Reader Rabbit	24
Where in U.S.A. is C. San Diego?	27

BOOKS

Take advantage of our volume discounts and save a bundle! Buy any 3 books and earn an additional $3 discount. Buy 4 and deduct $4. Buy 5 and deduct $5, etc.

Using 1-2-3, Special Edition	$18
dBase III Plus Handbook	17
Managing Your Hard Disk	16
MS-DOS Users Guide	17
Running MS-DOS	19
Using Autocad	21
Using Managing Your Money	15
Using Q & A	16
Using Symphony	19
Using Wordperfect 5.0	18

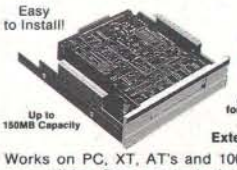
VISA MasterCard AMERICAN EXPRESS TeleCheck

ORDER TOLL FREE!

Mon.-Fri. 9-7; Sat. 10-3
Call from anywhere in the lower 48 states and Hawaii.

1-800-527-0347 AD T9

Save Your Data and Money, Too! Peripherals Sale!



Easy to Install!

Up to 150MB Capacity

This is the fastest floppy interface tape drive around!

60MB TAPE DRIVES

Add $10 for Shipping **$279** 40MB Tape $18 60MB Tape $30

External model now available for only $99 extra!

Works on PC, XT, AT's and 100% compatibles. Connects to the internal floppy (B:) connector or the optional adapter card ($77). Comes complete with installation instructions and the data compression software that allows up to 100MB data storage on a 40MB tape—150MB on a 60MB tape. Easy to install. Order now at this low price and save.

Brand New Genuine Seagate Drives.

Add $10 for Shipping

Limited Time Only! Fantastic Prices Now On

LOW COST HARD DRIVES

For IBM and Tandy

5.2MB 95ms ST-506 MFM XT Kit **$149**
21.4MB 65ms ST-225 MFM XT Kit **$239**
32.7MB 65ms ST-238 12LL XT Kit **$259**
42.8MB 40ms ST-251 MFM XT Kit 28ms Optional **$369**

$319 49.1MB 40ms ST-157R RLL Bare 28ms Optional
$419 65.5MB 40ms ST-277R RLL XT Kit 28ms Optional
$579 80.2MB 28ms ST-4096 MFM Bare
$539 84.9MB 28ms ST-296N SCSI Kit
$639 122.7MB 28ms ST-4144R RLL Bare

We provide the best low cost, high quality, fast access hard drives for your IBM, 100% compatible or Tandy computer. Our XT and SCSI kits are complete with drive, controller, cables and installation instructions. We use only brand new genuine Seagate drives so you can be assured of long trouble-free drive life. Data transfer rates as fast as 500KB per second MFM, 800KB RLL and 1MB using SCSI. We provide software to park the heads (some drives self-park). Tandy 1000 requires DMA and ROM 1.01+. Not for EX/HX. Please specify the computer brand and model when ordering. ST 506, 4096 and 4144R are full size 5¼", and ST 157R is 3½". All others are half height 5¼". Sizes listed are after formatting. One year parts and labor warranty. Satisfaction guaranteed or your money back, less shipping.

Completely Assembled, Ready to Install.

Save on 32MB & 49MB Hard Cards

32.7MB 40ms RLL **$329** 49.1MB 40ms RLL **$429**

These units are completely assembled with brand new drives and come ready to install. For IBM XT's, 100% compatibles and Tandy 1000/1000A, SL, SX, TL, TX. Please specify the exact make and model of your computer. One year parts and labor warranty.

Circle 52 on Reader Service Card

Total Power Protection!

UNINTERRUPTABLE POWER SUPPLY

As Low As **$279** 250 Watt Model

Add $23 shipping in the lower 48 states.

250 Watt	120 Volt	$ 279
300 Watt	120 Volt	399
500 Watt	120 Volt	499
600 Watt	120 Volt	639
1200 Watt	120 Volt	1099
1600 Watt	120 Volt	1444*

230 volt units also available. Specify exact input voltage. Shipped motor freight collect.

Protects Against
- Brownouts.
- Blackouts.
- Overvoltage.
- Overload.
- Spills/Surges.
- EMI

Features
- Two Audible Alarms.
- LED Displays.
- Optional Network Port.
- Transfer Times As Fast As 1 Millisecond (Depends on Model).

Save on Low Cost Floppys!

Select the drive or drives you want, pick the enclosure and appropriate cable and we will assemble and test at no additional cost to you. All drives are brand new, not factory seconds, and carry a full one year part and labor warranty. Add $5 shipping and handling per drive.

360K 5.25" TEAC 55B bare	$69
720K 5.25" TEAC 55F bare	85
1.2M 5.25" TEAC 55FGH bare	79
360K 3.5" TEAC 35B bare	59
720K 3.5" TEAC 35F bare	85
1.44M 3.5" TEAC 35FGH bare	79
5.25" mounting bracket for 3.5" drives (Includes rails, signal and power adapter. Specify beige or black faceplate).	10
Dual 3.5" external case/power supply. Use with one or two 3.5" drives (horizontal)	$49
Dual 5.25" same as above except vertical	59
IBM external floppy cable for C/D. DB37 required (Add $10 for brushed Stainless Steel cover)	39

Clone Clone® Reg. U.S. Pat. Off.

SERVING YOU SINCE 1980

CLONE COMPUTERS • 2544 W. Commerce St. • Box 223957
Div. of Analogy Corp.
Dallas, Texas 75222-3957 • Telex: 882761 • Fax: 214-634-8303

For professional technical assistance on Clone products, call 214-638-8826.

MEMBER DIRECT MARKETING ASSOCIATION

MMC MICROCOMPUTER MARKETING COUNCIL

©1989 by Clone Computers. All rights reserved. Prices and specifications subject to change without notice. All prices are in U.S. Dollars. Payments must be in U.S. funds drawn on a U.S. bank.

VIDEO FRAME GRABBERS

MODEL	RESOLUTION	
HRT 256-4	256 x 256 x 4	495
HRT 256-8	256 x 256 x 8	795
HRT 512-8	512 x 512 x 8	995
HRT 512-24	512 x 512 x 24	1995

- IBM PC/XT/AT COMPATIBLE
- DIGITALIZE IN REAL TIME
- COMPOSITE VIDEO IN
- 24 BIT RGB OUT except model HRT 256-4 16 level gray scale out
- SOFTWARE LIBRARY OF IMAGE ANALYSIS ROUTINES
- FREE SOFTWARE UPGRADES TO REGISTERED OWNERS
- FULL CREDIT ON UPGRADE PURCHASE IN FIRST YEAR RETURN OLD BOARD AND JUST PAY DIFFERENCE

HRT
HIGH RES TECHNOLOGIES
P.O. BOX 76
LEWISTON, N.Y. 14092
PHONE 416-497-6493 FAX 416-497-1988

Circle 119 on Reader Service Card

DS/HD **1.2 MB** **49¢** IN LOTS OF 100

5.25" DS/HD 1.2 MB .... DK. BLUE – 69¢
PACKED IN LOTS OF 100 WITH TYVEC SLEEVES & TABS

5.25" DS/HD 1.2 MB, Sleeves & tabs – BLACK
Lots of 100 — 49¢ ..... Lots of 50 — 59¢

5.25" DS/DD 360K, Sleeves & Tabs
Lots of 1,000 — 21¢ ..... Lots of 200 — 25¢

3.5" DS/DD 720K (1MB) 55% Clip. Level
Lots of 100 — 79¢ ..... Lots of 50 — 85¢

3.5" DS/DD 720K (1MB) 70% Clip. Level
Lots of 500 — 89¢ ..... Lots of 25 — 99¢

3.5" DS/High Density 1.44MB (2MB)
Lots of 100 — $2.50 ..... Lots of 25 — $3.00

AMERICAL GROUP
800-288-8025
12132 Sherman Way
N. Hollywood CA 91605 • VISA-MC

Circle 21 on Reader Service Card

PAL/EPROM PROGRAMMER for PC

VERSION 2 of Software and Hardware $475

- Programs 20 and 24 pin MMI, NS, TI, Altera, Cypress, Ricoh/ Panatec PALs. EPLD (UV erasable), polarity, and RA types.
- Functions Include: read, write, verify, protect, edit, print, and file load and save of program.
- JEDEC files supported.
- 2716-27512 EPROMs.
- Functions Include: read, write, verify, blank check, HI/LO split, edit in ASCII, HEX, or Decimal.
- INTEL Hex and Motorola 'S' Record file support.

200/100 MHz LOGIC ANALYZER for PC

LA27100 $1299
LA27200 $1899

- 24 Channel mode with 4K/channel • 6 Channel mode with 16K/channel
- Internal Rates from 200MHz(LA27200) or 100MHz(LA27100) to 250 Hz
- External Clock from DC to 50 MHz • 16 Level Triggering Sequence
- Threshold Voltage Level at TTL, ECL, or -8V to +14V variable • Data Display as Timing Diagram or State List • Save/Load Data and Setup Info.

(201) 994 - 6669
Link Computer Graphics, Inc.
4 Sparrow Dr., Livingston, NJ 07039

Circle 155 on Reader Service Card

5218 Printer Interface for PS/2 and AT

Qua Tech interface cards connect IBM 5218 DisplayWriter printer to PS/2 and AT.* Available now. Hundreds installed.

For order info, call:
1-800-553-1170

QUA TECH

QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

IBM, DisplayWriter, PS/2, and AT are trademarks of IBM Corp.

Circle 226 on Reader Service Card

2 parallel, 2 serial, 1 board

Qua Tech DSDP-402 for PC-AT has two parallel ports, and two serial ports for any combination of RS-232, 422, and 485 communication. All ports address selectable. Interrupts sharable and selectable.

For order info, call:
1-800-553-1170

QUA TECH

QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

Circle 227 on Reader Service Card

Turn your old XT/AT into a WARPSPEED/386

386SX MotherBoard
$ 395.00

- Intel 16 MHz 80386 SX CPU
- Socket for Intel 80387 SX Coprocessor
- Shadow RAM Support
- 8 Expansion Slots 6-16 bits, 2-8 bits
- I/O Speed at 8 MHz to use existing cards
- Interleave w/1Mb RAM
- Fully AT Compatible

386/20 w/0K..$ 595.00
386/25 w/0K..$ 975.00
386/25Cache..$1495.00

HomeSmart Computing
1(800) 627-6998

Circle 121 on Reader Service Card

THE GENERAL STORE RETAIL OPERATIONS SYSTEM

The premier system for retail store management. Supports cash drawers, barcode readers, receipt printers, customer displays, digital scales and complete online credit card authorization. Controls all types of retail stores both hardgoods and apparel with complete size/color matrix management and reporting. Easy to install and use. Field proven for speed and reliability. Provides all the features needed for today's retail merchant at a price far below comparable systems. Demo system available.

Accounts Receivable
Point of Sale
Inventory Control
Accounts Payable
General Ledger
Mailing List
...Multiuser/Network Ready...

$995 Complete system
Dealer inquires invited.

Crichlow Data Sciences, Inc.
(804) 471-0500
P.O. Box 6420 – Virginia Beach, VA 23456

Circle 74 on Reader Service Card

CACHE CONTROLLER

WORLDS FASTEST ACCESS TIME 0.3 MB
And you already have the drive!

Perfect for CAD CAM and Desktop Publishing
hyperSTORE 816 SPU
REVIEW IN THIS ISSUE

SIMMS
BEST PRICES • 2 YEAR WARRANTY
CALL FOR PRICES

8087	64K	256x9
80287	256K	256x8
80C287A-12	4464	1 MEG x 9
80387DX	VIDEO	1 MEG x 8
80387SX	1 MEG	LOW PROFILE

Dealer and OEM Inquiries Welcome
Tel: (213) 383-9701
FAX: (213) 383-3423
G. Reed, Inc.
258 South Western Avenue, L.A., CA 90004
Shipping and handling charges may apply.

Circle 26 on Reader Service Card

ICs PROMPT DELIVERY!!!

SAME DAY SHIPPING (USUALLY)
QUANTITY ONE PRICES SHOWN for AUG. 27, 1989
OUTSIDE OKLAHOMA: NO SALES TAX

DYNAMIC RAM				
SIMM (1)	256Kx36	80 ns	$400.00	(3) 2-PORT VIDEO RAM
SIMM	1Mx9	70 ns	185.00	
SIMM (2)	1Mx9	80 ns	145.00	
SIMM	256Kx9	100 ns	50.00	
1Mbit	1Mx1	100 ns	12.75	
41256	256Kx1	60 ns	7.25	
41256	256Kx1	80 ns	6.25	
41256	256Kx1	100 ns	3.95	
41256	256Kx1	120 ns	3.50	
4464	64Kx4	120 ns	4.50	
41264 (3)	64Kx4	120 ns	9.75	
EPROM				
27C1000	128Kx8	200 ns	$22.00	80387-16 80387-20 80387-25 80387-33
27512	64Kx8	200 ns	9.50	
27256	32Kx8	150 ns	7.25	
27128	16Kx8	250 ns	4.50	
STATIC RAM				
62256P-10	32Kx8	100 ns	$19.95	80287-8 $215.00
6264P-12	8Kx8	120 ns	5.95	8087-2 $125.00
6116AP-12	2Kx8	120 ns	4.50	

(1) FOR: PS2/70 OR PS2/80 14MBYTE
(2) FOR: AST AT&T COMPAQ DELL MAC'S MYLEX PS/2 Tandy WYSE WD

OPEN 6½ DAYS, 7:30 AM-10 PM. SHIP VIA FED-EX ON SAT.

SAT DELIVERY INCLUDED ON FED-EX ORDERS RECEIVED BY:
Th Std Air $6/3 lb
Fr: P-1 $12.25/1 lb

MasterCard/VISA or UPS CASH COD
MICROPROCESSORS UNLIMITED, INC.
24,000 S. Peoria Ave., (918) 267-4961
BEGGS, OK. 74421
No minimum order. Please note: prices subject to change! Shipping, insurance extra, up to $1 for packing materials.

Circle 176 on Reader Service Card

Up to date.
Down to earth.

Changing the world. UNIX is changing the world of computers, the world of business – quite simply, changing the world. It's revolutionizing office automation. It's required for U.S. government computer contracts. It's the backbone of information strategies worldwide.

The information you need. That's why you need *UNIXWORLD* – the magazine that keeps you up to date on the rapidly changing world of open systems computing. Each issue brings you the latest product trends and technical advances that can affect your business. The inside story on some of the world's biggest high-tech companies. Easy-to-understand programming tips and tutorials that can help you and your company use UNIX to its fullest. And unbiased hardware and software reviews to help you invest wisely when you buy.

The whole UNIX-verse. *UNIXWORLD'S* in-depth features go beyond dry technical facts, to show how the pieces fit together – to tell you what's important about the advances and the strategies that are changing your world. And *UNIXWORLD* consistently offers the freshest, most down-to-earth writing you'll find in any computer publication.

Subscribe and Save. Subscribe today, and receive the next 12 issues of *UNIXWORLD* for just half the regular newsstand price. Save even more by ordering for two or three years. You can't lose – every subscription to *UNIXWORLD* comes with a no-risk guarantee.*

1 year $18.00 (save 50%)
2 years $32.00 (save 55%)
3 years $42.00 (save 60%)

Subscribe now! Call toll-free:

1-800-341-1522

UNIXWORLD

If you're into UNIX, you need *UNIXWORLD MAGAZINE.*

UNIX® is a registered trademark of AT&T. UNIX WORLD is not affiliated with AT&T.
*UnixWorld's no-risk guarantee: If not satisfied, cancel and receive a full refund for the balance of your subscription.
A McGraw-Hill publication

LOW PRICE LEADER

SINCE 1983

IBM

PS/2 model 30/286	1895
PS/2 model 50/30 meg	2395
PS/2 model 70/60 meg	3695
PS/2 model 80/40 meg	4395
PS/2 model 70/120 meg	5595
PS/2 model 80/115 meg	Call

Call for other models

COMPAQ

386 S 40 meg	Call Call
386 20E - 40 meg	4295
286E 40 meg	Call
386 110 meg/25 MHz	7295
386 60 meg/25 MHz	5895
Portable III 40 meg/12 MHz	3995

CARD & MONITOR EXTRA

Call for other models

Macintosh

Mac IICX/80 Meg, 40 Meg RAM	5095
Mac-II/40 Meg	4095
Mac-SE 30/40 Meg	3695
Call for 60 and 100 Meg	
Lazer NT	3595
Lazer NTX	4895

Compaq SLT 286-20/40		3795/Call
Toshiba T1000		Call
T1200F	Toshiba	Call
T1200HB	Sale!	Call
T1600-20/40 Meg	Call for	Call
T3100E	all!	Call
T3200-40 Meg		Call
T5100-40/100		Call
T5200-40/100		Call
Zenith 286-20 Meg		3195/Call
Zenith 8088-20 Meg		Call
Mitsubishi 286-20/40		2449/Call

Pacific Data (For HP)

25-N-1 Cartridge	265	Pacific Page	459
1 Meg. Memory Board	295	Plotter Cartridge	239

EVEREX

Everex

Step 286 - 12 & 16 MHz & 20 MHz
1 Meg RAM
Set up utility in ROM
S/P, C/C
Enhanced keyboard
1.2 MB floppy
DOS/BASIC

Call! for your configuration

Everex

Step 386-20 MHz & 16 MHz & 25 MHz & 33 MHz
Up to 256K cache of very high speed RAM
2 Meg RAM, expandable to 16 Meg
S/P, C/C
Enhanced keyboard
1.2 MB floppy
DOS/BASIC

Call!

AST

AST 286 model 140X	Call
AST 286 model 80	1495
AST 386 model 300c	Call
AST 386 40 Meg	3195

CARD & MONITOR EXTRA
CALL FOR OTHER MODELS

WE STOCK

CITIZEN, OKIDATA, EVEREX, GOLD STAR, TOSHIBA, NEC, WYSE, HITACHI, PRINCETON GRAPHICS, SONY, ACER, HOUSTON INSTRUMENTS, AMDEK, HAYES, SAMSUNG, CALCOMP, PC MOUSE, MICROSOFT MICE, LOGITECH, MITSUBISHI, IRWIN & ARCHIVE TAPE BACK, TAXAN, MAGNOVOX

BOARDS

Paradise VGA+	239
Vega VRAM	449
ATI VGA Wonder	285
Everex EGA	159
Tatung 16 bit	249

SOFTWARE SPECIALS

dBase IV	455
Wordperfect	229
Aldus Pagemaker	495
Ventura Publisher	495
Clipper	435
WordStar 5.5	219

MONITORS

Nec Multisync IIA	525
Nec Multisync 3D	649
Magnavox EGA	339
Nec Multisync XL-19"	1995
Samsung EGA	359
Goldstar VGA	375

FAX MACHINES

Sharp FO 220	795
Sharp UX 350	1249
Canon	Call
Brother	Call
Richo	Call
Murata	Call

NOVELL Authorized Dealer

Intel Coprocessors

8087-3	105
8087-2	145
80287-8	225
80287-10	249
80387-16	395
80387-20	425
80387-25	495
80387-33	599

PRINTERS

EPSON

LX-810/LQ-510	199/339
LQ-850/1050	545/749
FX-850/1050	359/479

OKIDATA

320/321	359/490
390/391	490/649

TOSHIBA

321-SL/341-SL	439/595
351-SX 350 CPS	929

BROTHER

1709-9 PIN	425
1724-24 PIN	595

LASER PRINTERS

HP Laser II	1695
HP Desk Jet ±	695
Panasonic 4450	1395
Brother HL-8-E	1895
Nec LC 890	3195
PageLaser 12	$$$$$
Canon Laser	Call

MODEMS

Everex 1200 Int	89
Everex 2400 Int	159
Hayes 1200 B	299
More in Stock	**Call**

WE ACCEPT CASHIER CHECKS, MONEY ORDERS, VISA, MC, AmEx
3% charge on VISA, MC & 5% on American Express

EXPORTS Available

COMPUTERLANE

HOURS:
M-S 9-6

1-800-526-3482 (Outside CA)
(818) 884-8644 (In CA)
(818) 884-8253 (FAX)

22107 ROSCOE BLVD.
CANOGA PARK
½ BLOCK W. OF TOPANGA
CA 91304

CORPORATE ACCOUNTS WELCOME
CALL FOR VOLUME DISCOUNTS
CONSULTANTS CALL FOR PRICING

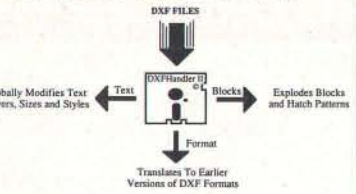
Prices subject to change without notice

Compaq is a Registered Trademark of Compaq
IBM is a Registered Trademark of International Business Machines

Circle 66 on Reader Service Card

THE DXFHandler II

The **global editor for all DXF files!**



ELIMINATE THE HOURS OF PAINSTAKING LABOR INVOLVED IN EDITING AND IMPORTING DXF FILES INTO YOUR PRESENT CAD SOFTWARE!

With the "DXFHandler II", you can globally modify text layers, sizes and styles; explode blocks and hatch patterns globally, no matter how deeply they are nested; and you can also translate/convert later versions of DXF files, (e.g., AutoCAD Version 10) into earlier DXF versions (e.g., AutoCAD Version 9) so they can be read into any CAD system. "DXFHandler II" can process DXF FIles on any DOS-based PC with or without AutoCAD or any other CAD software.

$149.95

IMAGENET SYSTEMS, INC.

200 Brevard Avenue Cocoa, Florida 32922
(407) 632-4333 Fax (407) 632-7632

Note: AutoCAD is a registered trademark of Autodesk, Inc.

Circle 127 on Reader Service Card (DEALERS: 128)

EPROM PROGRAMMER CROSS ASSEMBLERS

MODEL SX151

RS232C OR STAND ALONE (all models), Communication protocol; XMODEM, HEX, and BIN. Programs: EEPROMS, 2716 - 27512 and CMOS. Programs (w/adapter); 25XX, 27101 (and above), 68701, 68705, 68764/6, 8741/2, 8744, 8748/9, 8751/2, 8755, 87252, 870751, 870752 and CMOS. More available soon. **Model SX151 $214** (assembled with case). Other models are available from $49 (kit).

Cross assemblers by **Pseudocorp** for IBM-PCs, $50. Z80, 1802, 6502, 6800/1/2/3/5/8/9/11, 68000/8/10, 8048/9, 8051/2, 8080/5, 8096, and more soon. Simulators and disassemblers also available.

KORE, Inc.
3150 Plainfield N.E.
Grand Rapids, MI 49505
(616) 361-3666

$5 for shipping (USA), plus $3.00 COD.

Circle 148 on Reader Service Card

80386-20 COMPUTER $1989

- Intel 80386-20 CPU, 16/20/24 MHz clock rates, 0 wait states.
- 1 MB SIMM RAM, expandable to 8 MB on board, total 16 MB system.
- 40 MB hard disk and 1.2 MB floppy drive with controller.
- SuperEGA Card, AMI Bios.
- Two serial port and one parallel printer port.
- 6 expansion slots.
- Socket for 80287/80387/Weltek 1167.
- 200 Watts power supply, case, and enhanced 101-key keyboard.
- OS/2, WINDOW/386 UNIX compatible.

386-25 COMPUTER CALL FOR PRICE

- Intel 80386-25 CPU with 32 KB CACHE memory.
- 20/25 MHz clock rates.
- 1MB/16MB DRAM module on board.
- 8 expansion slots.
- VGA Legal BIOS, OS/2, WINDOW/386 UNIX compatible.
- 80 MB hard disk, 1.2 MB floppy/controller.
- EGA/VGA card, 200 watts power supply, case, enhanced 101-keyboard.
- Socket for 80287/80387/Weltek 1167.

OTHER PRODUCTS

KD5208 SINGLE-BOARD CONTROLLER **$275.00**

Intel 8052 based single-board controller with 10 bit 8 channel A/D converter, 40 KB memory, 24 PIO

KUSTEM DATA SERVICES, INC.
4 HUDSON COURT, CRANBURY, NJ 08512
TEL: (609) 799-2963 FAX: (609) 799-5416

Circle 149 on Reader Service Card

Complete PC Systems

For Complex Stand-Alone Applications

- Now Available! Systems that are functionally equivalent to large PC's, in compact packages. Our systems are based on single board CPU's and include all hardware, software, and support needed to run your special applications.
- Run DOS applications without a disk using our BIOS. Store DOS and user programs in EPROM's.
- Debug Monitor, BIOS for disk capability, utilities, and source code are available.
- Compatible with PC systems. Run 8088 code and DOS applications. Use standard PC/AT cards in passive backplanes for expansion.
- Our CPU cards use V40/V50 micros and drive PC/AT bus. Options: 1meg RAM, 256K ROM, 5 serial ports, SCSI, CMOS, floppy, printer, graphics.

CPU Cards $249 (q25)
Systems $499 (q1)
Customization available
(303)444-7737

Kila SYSTEMS
655 Hawthorne Ave. Boulder, CO 80304 FAX (303) 786-9983

Circle 144 on Reader Service Card

Advertise your computer products through BYTE BITS (2″ x 3″ ads)

For more information call Mark Stone at 603-924-6830

BYTE

One Phoenix Mill Lane
Peterborough, NH 03458

Circle 46 on Reader Service Card

IEEE 488 Solutions

- Hardware & software interfaces for PC, AT, 386, PS/2, Macintosh, SUN, HP & DEC
- IEEE converters to SCSI, RS-232, RS-422, modem, Centronics, digital I/O & analog I/O
- IEEE extenders, expanders & buffers
- IEEE drivers for DOS, UNIX®, Lotus 1-2-3, Symphony & Quattro.

Call or send for your FREE Technical Guide

Demo disks and application notes available

Please see our ad on page 204.

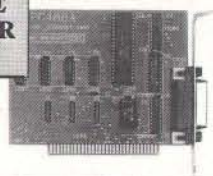
IOtech

(216) 439-4091
Telex 6502820864 • Fax (216) 439-4093
IOtech, Inc. • 25971 Cannon Road
Cleveland, Ohio 44146

Circle 135 on Reader Service Card

Circle 48 on Reader Service Card

LOW COST INTERFACE CARDS FOR PC/XT/AT



RS-485/422 Card [PC485] $95/125

- **Serial Async. Communication up to 4,000ft;** 2 or 4 wires; NS16450 UART;
- Can be configured as **COM1-COM4;** Maximum Baud Rate **56KB.**
- Flexible configuration options. **RTS** or **DTR** control of transmission direction.
- **Full/Half duplex operation.** Supports hardware handshaking (RTS,CTS).
- Dual drivers/receivers;**Handles 64 devices;**Compatible with most comm. sftwr.
- **High speed version** available (supports baud rates up to **256KB**) - **$165**

Dual-Port RS-485/422[PCL743] $175

- Two independent channels / UARTs; 2 or 4 wire operation. Max. Baud 56KB.
- Dipswitch configurable as COM1-4 (IRQ2-7). On board terminator resistor.

IEEE-488 Card [PC488A] $145

- Includes **INSTALLABLE DOS DEVICE DRIVERS** and support for **BASIC.**
- Additional Support for **ASSEMBLY, C, Pascal** and **FORTRAN - $ 50.**
- **IRQ (1-6).** DMA channel 1 or 2. Up to **4 boards** per computer.
- Compatible with most **IEEE-488 Software packages** for IBM-PC (e.g. **ASYSTANT-GPIB, Lotus Measure**). Compatible with NI's **GPIB-PCIIA.**

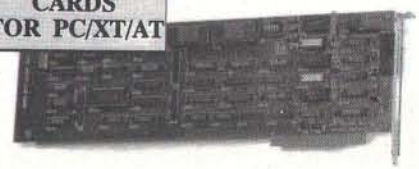
IEEE- 488 Card [PC488B] With Built-In Bus Analyzer $345

- Software Support for BASICA, QuickBASIC and GWBASIC.
- Additional libraries for **C, Pascal, FORTRAN, Assembly** available - **$50 (all)** Full range of Talker, Listener, Controller, Serial/Parallel Poll, SRQ, etc...
- Powerful menu-driven **BUS ANALYZER** can be run in the background while 488 programs or commands are executed; Features **Program Stepping, Break points,** Real Time **Bus Data Capture** (4K buffer), **Instant Screen Toggling.**
- **Complete Controller / Talker / Listener** capability. Based on TI's **TMS-9914.**
- Memory-resident **Printer Port Emulation Utility** included. (LPT1-3).
- **NEC-7210 based** card (compatible with NI's **GPIB-PCII**) - **$445.**

DIGITAL I/O Card [PCL720] $175

- **Input:** 32 TTL compatible channels; Input load is 0.2 mA at 0.4V.
- **Output:** 32 TTL compatible channels;Sinks 24mA(0.5V); Sources 15mA(2.0V)
- **Counter/Timer:** DC to 2.6MHz; 3 channels; 16 bit counters; 6 counting modes.
- **Breadboard area** for prototyping. **Dipswitch I/O port selection (200-3F8 hex).**

LOW COST DATA AQUISITION & CONTROL CARDS FOR PC/XT/AT



12 BIT A/D & D/A [PCL711s] $295

- **A/D converter:** 8 single-ended channels; Device: AD574; Conversion time less than 25μsec; Input range: ±5V; Software Trigger Mode only.
- **D/A converter:** 1 channel; 12 bit resolution; 0 to +5V/10V Output Range.
- **Digital I/O:** 16 Input / 16 Output channels; All I/Os TTL compatible.
- **External Wiring Terminal Board** with mounting accessories included.
- Utility Routines and Demo/Sample Programs for **BASIC** and **Quick-BASIC.**

12 BIT A/D & D/A [PCL812] $375

- **A/D converter:** 16 single ended inputs; Device : AD574; Conversion time less than 25 μsec; Built-in programmable pacer; **Input ranges:** ± 10V, ±5V, ±1V.
- **D/A converter:** 2 channels ; 12 bit resolution.; Output Range 0-5V .
- **Digital I/O:** 16 Input / 16 Output channels; All I/Os TTL compatible.
- **Counter:** 1 channel programmable interval counter/timer; Uses Intel 8254.
- DMA and interrupt capability. Utility software for Basic included.

FAST 12BIT A/D/A [PCL718] $895

- **A/D converter:** 16 single ended or 8 differential channels; **12 bit resolution;** Programmable scan rate; Built-in Interrupt and DMA control circuitry. Conversion speed **60,000 smpls/sec** (standard), **100,000 smpls/sec** (optional).
- **Input ranges:** Bipolar ±10V, ±5V, ±2.5V, ±1V, ±0.5V; Unipolar 10,5,2,1V.
- **D/A converter:** 2 channels; Resolution: 12 bits res; Settling time: 5μsec; ±5V
- **Digital I/O:** 16 OUT, 16 IN; TTL compatible; All I/Os TTL compatible.
- **Counter:**16 bit progr. interval counter/timer; Uses Intel 8254; Pacer clock;
- **Software:** Utility software for BASIC and QuickBASIC included. Supported by LabDAS ($195/495), ASYST, LABTECH, UnkelScope

6 Channel 12 bit D/A [PCL726] $495

- Output Ranges: 0 to +5V, 0 to +10V, ±5V, ±10V or sink 4-20mA.
- Settling time: 70μS. Linearity: ±1/2bit.Voltage output driving capacity: ±5mA
- **Digital I/O:** 16 digital inputs and 16 digital outputs; TTL compatible.

STEPPER MOTOR CARD $395

- Capable of independent and simultaneous control of up to 3 stepper motors.
- **Speed:** Programmable from 3.3 PPS to 3410 PPS; Built-in acceleration control.
- **Output Mode:** One clock (Pulse, Direction) or two clock (CW, CCW pulses)
- Step position Read-back; Opto-isolated outputs; Crystal based timing.
- Includes 8 bit digital input/output port. **Order P/N [PCL-738B]**

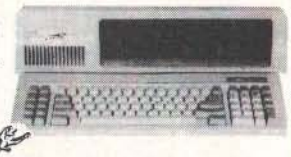
MC / VISA / AMEX **Call today for datasheets!**

B&C MICROSYSTEMS INC.
355 WEST OLIVE AVE., SUNNYVALE, CA 94086
TEL: (408) 730-5511 FAX: (408) 730-5521

Circle 49 on Reader Service Card

Every Order Over $500 Receives a FREE Gift Certificate*

CAT™ 10MHZ
BASE SYSTEM
- 256K (Opt. 640K) • 150 Watt Power Supply • AT Style Keyboard & Case
- 4.77 or 10 MHZ Keyboard Selectable
- Floppy Disc Controller
- 8087 Socket • 360K Floppy Drive
- 1 Year Warranty



$399.00

CAT 386 SYSTEM
- 12" Amber Monitor with Graphics Interface Card
- 1.2 Meg Floppy Drive (expandable to 8 Meg)
- 1 Meg of Memory
- Parallel, Serial & Clock

Xenix, Unix, Novell Compatible

20MHz **$1695.00**

CAT™ 286-10MHZ
BASE SYSTEM
- 512K Exp. to 1 MEG • 200 Watt Power Supply • AT Style Keyboard
- Western Digital Controller • 1.2 Meg Floppy • Legal Bios w/manuals • Systems Documentation • 1 yr war. • Clock/Calc
- 10MHz DTK Motherboard

$799.00

11.3 NORTONS SL

SYSTEM OPTIONS

8088 XT Compatible

640 K Upgrade	129.00	Clock Calendar	24.00
12" Amber Monitor w/Interface	139.00	Parallel & Serial Ports	39.00
DOS 4.01 w/GW BASIC	89.00	Additional Drives	See Below

286, 386 AT Compatible

640 K Upgrade	49.00	14" EGA Monitor w/Interface	549.00
512K Upgrade	108.00	Novell Network...Call 12 Mhz add	100.00
12" Amber Monitor w/Interface	139.00	14" Color Monitor w/Interface	289.00

COPROCESSORS

8087	5MHz or less		88.50
8087-2	8MHz		129.00
8087-1	10MHz or less		179.00
80287	6-8MHz		139.00
80287-8	8-10MHz		209.00
80287-10	10MHz		239.00
80C287-12	12MHz	I	299.00
80387-16	16MHz	N	369.00
80387-20	20MHz	T	439.00
80387-25	25MHz	E	549.00
90387-33	33MHz	L	649.00
80387SX	16MHz		399.00

MORE UPGRADES

Description	150NS	120NS	100NS	80NS
64 x 1	2.75	2.95	3.25	4.95
64 x 4	4.75	5.25	5.75	6.75
256 x 1	3.95	4.25	4.95	5.95
1 Meg x 1	12.00	13.75	14.25	15.25
256 x 4	12.00	14.00	15.00	17.00
64x4 Video	6.00	7.00	8.00	11.00
1 Meg Video	—	24.00	—	—
8K x 8 Static	7.00	8.00	9.00	11.00

The above Memory Upgrades come in DIP Form. Please specify if you need ZIP - Soj - PLCC - Flat Pack or if you need Nibble Mode

RAM UPGRADES FROM THE RAM SPECIALISTS

WE BUY EXCESS RAMS PLEASE CALL OR FAX LIST

IBM PS2

Description	Equiv. IBMPS2 Part #	For Model #	Meads Low Price
128K Upgrade	78 x 8955	25	59.00
512K Upgrade	30F 5348	30/286	189.00
2MB Upgrade	30F 5360	30/286	599.00
1MB Module	6450603	70-E61 &121	239.00
2MB Module	6450604	70-E61 & 121	579.00
2MB Mem. Board	6450608	70-A21	899.00
1MB Mem. Board	6450375	80-041	419.00
2MB Mem. Board	6450379	80-111 & 311	899.00
8MB Mem.Bd.w/0K	1497259	50Z & 60	429.00
8MB Mem.Bd.w0K	6450605	70 & 80	1289.00

COMPAQ

Description	Equiv. Compaq Part #	For Model #	Meads Low Price
1MB Add-on Module	113131-001	Deskpro 386/20/25/ 20e/286E	359.00
1MB Add-on Module	113646-001	Deskpro 386S	369.00
4MB Add-on Module	113132-001	Deskpro 386/20/25/ 20E/286E	899.00
4MB Add-on Module	112534-001	Deskpro 386S	999.00
1MB Memory Exp. Bd.	113644-001	Deskpro 386/20e	499.00
1MB Memory Exp. Bd.	113633-001	Deskpro 386S	499.00
4MB Memory Exp. Bd.	113645-001	Deskpro 386/20e	1399.00
4MB Memory Exp. Bd.	113634-001	Deskpro 386S	13990
1MB Mem.Upgrade Kit	107651-001	Portable 386	499.00
1MB Memory Exp. Bd.	117428-001	286E	499.00
4MB Memory Exp. Bd.	117429-001	286E	1399.00
1MB Upgrade Bd.	110235-001	SLT/286	599.00
4MB Upgrade Bd.	108070-001	386/16	1399.00

IBM & Compaq boards & Modules come with 1 year warranty and are manufactured on a 2nd party board.

SIMM MODULES (add $20 for SIPP Version)

Description	150NS	120NS	100NS	80NS
64 x 9 IBM & Compatibles	19.00	29.00	34.00	39.00
256 x 8 For Apple Products	39.00	44.00	49.00	59.00
256 x 9 IBM & Compatibles	42.00	48.00	64.00	74.00
1Meg x 8 For Apple Products	139.00	148.00	164.00	189.00
1Meg x 9 For IBM & Compatibles	149.00	159.00	169.00	189.00

HARD DRIVES

Seagate

ST125 20Meg 40 Mil ½ Ht 3½" Drive only	259.00
ST138 30Meg 40 Mil ½ Ht 3½" Drive only	299.00
ST225 20Meg w/cont. & Cables	259.00
ST238 30Meg w/cont. & Cables	289.00
ST251 40Meg ½ HT 40 Mil w/software, Drive only	349.00
ST251-1 40Meg, 28 Mil Sec, Drive only	379.00
ST277R 60MB 40 Mil ½ Ht	469.00
ST4026 20Meg Full Ht 40 Mil	299.00
ST4038 30Meg 40 Mil Full Ht	399.00
ST4053 40MB 28 Mil Full Ht	519.00
ST4096 80Meg Full HT w/software	639.00

WESTERN DIGITAL CONTROLLERS

WX-1 8 Bit ½ Sized for XT	79.00
MM2 16 Bit Full Sized Hard/Floppy	119.00
WD-27X 8 Bit RLL ½ Size	89.00
WAH 16 Bit Hard Drive Controller	129.00
RA2 16 Bit RLL Hard/Floppy for AT	159.00
MEAD Floppy Disk Controller for XT	19.00
MEAD 1.2 Meg & 360K Controller for XT, 720K-1.44	69.00
Cable Set for Hard Drive Only	5.00

MODEMS BY EVEREX

MNP ADD $20

EV-923 EverCom 12 300/1200 bps Bitcom Software.... 69.00
EV-941 EverCom 24 2400 Baud Int. Bitcom Software...139.00
EV-945 External 2400 Baud 199.00
EV-942 2400 PS2 .....229.00 **EX-955** FAX Card 349.00

MORE MODEMS...

1200 Baud Internal w/Software CPI 54.00
1200 Baud External fully Hayes Compatible, Everex 99.00
2400 Baud Internal ½ card w/software CPI 99.00
2400 Baud External Fully Hayes Compatible, Zoom 129.00

Imtec/SAMSUNG MONITORS

1256A 12" Amber w/Tilt & Swivel Base 89.00
1257 12" Amber Flat Screen 720 x 350 ..... 109.00
1464 14" Color 640 x 200, 16 colors 239.00
1453 14" EGA 640 x 350. 64 colors/.31 ..... 369.00
1455N EGA 720x480 *Multisync Compatible* 449.00

VIDEO CARDS BY EVEREX

EGA EV659, 640 x 350 ..... 119.00
VGA Viewpoint 16 Bit 256 ..... 269.00

MORE VIDEO CARDS...

MonoGraphics or Color Graphics (Hercules Compatible)...44.00

Mitsumi FLOPPY DRIVES

1 YR. WAR.

360K ½ Ht. PC Compatible — Mitsumi	69.00
1.2 Meg Black Face — Mitsumi	89.00
720K 3½" Drive w/5¼" mounting — Mitsumi	89.00
1.44 Meg 3½" Drive w/5¼" mounting — Mitsumi	109.00
360K Tandon TM100-2 Full Ht (The Original IBM)	89.00
160K Tandon TM100-1 Full Ht	59.00
External Case w/Power Supply 2, ½ HTs or 1 Full	149.00

EVEREX TAPE BACKUPS

40MB	Mini Cartridge, 1.8MB/min, XT (DC 2000)	339.00
40MB	Mini Cartridge, 3.6MB/min, AT (DC 2000)	339.00
60MB	Streaming Cassette, 5MB/min w/cont (CT600)	649.00
60MB	Streaming 600A, 5MB/min w/Full cont (DC600)	849.00
125MB	Streaming Cartridge, 5MB/min w/Full cont	1119.00

DC2000 24.00 **External Add 195.00** **DC600 24.00**

Liquidation Below Dealer Cost — New With Warranties

LETTER QUALITY PRINTER

DAISYWHEEL PRINTER MANUFACTURED BY C.ITOH

Why pay $1149 for a C.Itoh

STARWRITER™ F-10

When our 40 cps letter quality daisywheel printer from the same manufacturer is only

$399.00 ea.

OPTIONS

- 6 ft. Serial Cable ..... $ 19.00
- Bidirectional Tractor 149.00
- Cut Sheet Feeder 199.00
- Serial to Parallel Converter 99.00

STANDARD FEATURES

- 40 CPS • Accepts Paper to 15 inches • Form Length and Pitch Set from Conrol Panel
- Industry compatible ribbon, printwheels and control commands • RS232 Serial Interface

MICROSOFT MOUSE

- In Port with Bus Interface
- Fully IBM Compatible (of course)
- Includes Showpartners and Paint Brush

List $199 Mead **$79.00** 10 for $740

KRAFT MONITOR

FREE TILT SWIVEL BASE

- 14" Flat Screen • Paper White Phosphorus
- TTL Monochrome & Composite Interface

List $199 Mead **$99.00** 10 for $950

MEAD HOTLIST

PRINTER	KXP 1124 Panasonic	329.00
MONITOR	NEC Multisync 2A	498.00
MODEM	Hayes Smartmodem 2400 Int	388.00
SYSTEM	AST Premium 286 Model 70	1398.00
BOARDS	Paradise VGA Plus	248.00
SOFTWARE	Fastrax The Disk Organizer	29.00

AT STYLE / XT CASE

- 2 Bay Standard AT Style Case
- Keylock Power and Hard Drive LED's

List 99.00 Mead 29.00 10 for $240

WESTERN DIGITAL

WD1003/RAH — RLL HDC For AT 16 Bit, List 199.00 Mead 99.00

WD1005-WAH — 16 Bit Esdi Controller for AT 2 to 1 Interleave List 269.00 Mead 99.00

PARADISE MONO EGA

Auto Switch Monochrome EGA Card, 640x350 EGA, MDA, CCA, Herc. List 319.00 Mead 99.00

CLOSEOUTS/OVERSTOCK

Wordstar Professional 5.0	149.00
Epson Universal Printer Stand	9.00
DC300A Used	5.00
SideKick Plus 1.0 by Borland	69.00
10Meg w/controller & cables	159.00
WD Controller 27X or WX1	49.00

800-654-7762
SALES: 7 a.m.-6 p.m. PST
702-294-0204
TECHNICAL / CUSTOMER SERVICE / ORDER STATUS: 9 a.m.-4 p.m. PST
FAX 702-294-1168

WE ALSO PURCHASE EXCESS INVENTORY— FAX LIST

MEAD COMPUTER

- Quantity Pricing Available — CALL
- We Accept International Orders
- Purchase Orders from Universities, Government Institutions, Fortune 1000 and Qualified Firms.

*October Orders Only — $50.00 Value

NO SURCHARGE FOR MC/VISA
TERMS:
MC • VISA • COD • CASH
Purchase Orders from Qualified Firms
Personal Checks • AE add 4% • COD add $5.00
20% Restocking Fee on Non-Defective Returns within 15 days

SHIPPING: (min. 6.25) UPS

1000 Nevada Hwy. • Unit 101 • Boulder City, NV 89005

Trademarks are Registered with their respective Co.'s. Prices Subject to Change
All Products 90 Day Warranty unless stated otherwise.

Circle 169 on Reader Service Card

ALLCON
Alarm/Control System
Less than one $ per channel for PC—AT

176 ch. TTL/sig. 1 board	$199
320 ch. TTL/sig. 1 board	$399
656 ch. TTL/sig. 2 boards	$599

3 ch. TTL/sig. composit alarm output.
Standard connector board can be used.
Prog. time 600 signals about 15 hours.
Signal name 24 characters.
Ten operators, 7 key level authority.

ALLregulator AB
Dagjgat: 9, S-415 09 Gothenburg, Sweden
Fax +46 31 43 47 30 Tel +46 31 48 01 80
US office Mesa AZ Tel (602) 649 1202
Estab. 1967 VISA/MC CHECK

Circle 18 on Reader Service Card (DEALERS: 19)

SAME-DAY SHIPMENT!
MONEY-BACK GUARANTEE!

"RS-232C TO CURRENT LOOP BI-DIRECTIONAL CONVERTER" Model 232CL2 only **$89.95**

Interface your RS-232 port to existing current loop system. Model 232CL2 couples and isolates Transmit and Receive Data through high speed optical isolators. Powered from pins 4, 5, 6, 8 and 20 on the RS-232 side; one pin must be high, one must be low.

No power required if current loop port is active. Model 232PS-12V DC Power Supply required if current loop port is passive; only $14.95.

Order direct from manufacturer *TODAY* and *SAVE!*

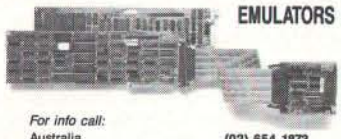
Request your FREE copy of B & B ELECTRONICS' Catalog which lists a host of interface and monitoring equipment for RS-232 ports.

*Terms: Visa, MC, cash orders postpaid; P.O.'s from qualified rated firms accepted. IL residents add 6¼% sales tax.

B&B electronics MANUFACTURING COMPANY
4002K Baker Road, P.O. Box 1040 • Ottawa, IL 61350
Phone: 815-434-0846

Circle 31 on Reader Service Card

8051 68HC11
EMULATORS



For info call:

Australia	(02) 654 1873
Austria	(0222) 38 76 38
Benelux	+31 1858-16133
Denmark	(02) 65 81 11
Finland	90-452 1255
France	(01) 69 412 801
Great Britain	0962-73 3140
Israel	(03) 484832
Italy	(011) 7710010
Korea	(02) 784 7841
New Zealand	(09) 392464
Portugal	(01) 83 56 70
Scandinavia	+46 40922425
Singapore	065 743-2086
Spain	(93) 217 2340
Switzerland	(01) 740 41 05
Taiwan	(02) 7640215
West Germany	08131-1687
U.S.A. FAX	(408) 378-7869

See us at Wescon '89, booth 902

nohau CORPORATION
51 E. Campbell Ave., Campbell, CA 95008
(408) 866-1820
See our ad on page 299

Circle 193 on Reader Service Card

EVEREX
COMPUTER SYSTEMS DIVISION

Step 386/25/20/16MHz • Step 286/20/16/12MHz
IN STOCK
Call for best price

INTEC 386/25MHz Motherboard $1495.00

• Intel 386-25MHz CPU • 64K cache upgradeable to 256K • Up to 8MEG on board with SIMM • AMI High speed BIOS • LANDMARK 43.5MHz, P.M.=6.2MIPS • 80387 and Weitek support • As Fast as Northgate 386/25 • Call for quantity discount

AGI System from Everex

386	3000D 20MHz/0w/1M	$1895
	3000A 16MHz/0w/1M	$1695
	3000G SX/16MHz/0w	$1470
286	1800R 8MHz/512K	$780
	1700A 10MHz/512K Baby	$800
	1800A 10MHz/512K	$850
	1800B 10MHz/512K	$1090
	1700C 12MHz/1M Baby	$1125
	1800C 12MHz/1M	$1195

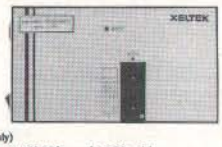
We carry full line of Everex products, Hard disk and monitors, CALL

Schwab Computer
"Authorized Dealer of Everex System Division"
730C E. El Camino Real, Sunnyvale, CA 94087
408-245-6666 FAX 408-241-1279

Circle 249 on Reader Service Card

UNIVERSAL PROGRAMMER

@programs
E(E)PROM,
PAL,EPLD,
GAL,PEEL,FPL,
BIPOLAR,
8748/51 SERIES.
@tests TTL/CMOS
and D/S RAM.



$ 545 Complete. (u.s.only)

- programs E(E)PROMs upto 2MBits and 16 Bit wide.
- 16Bit- and 32Bit- WORD SPLIT & 4-GANG adaptor.
- programs PALs (22V10) from AMD,MMI,TI,NS,SAMSUNG.
- supports PALASM2/CUPL/ABEL/ORCAD JEDEC files.
- supports VERIFICATION using TEST VECTORs.
- programs GALs & FPLs from LATTICE,SGS,NS,SIGNETICS.
- supports RALs in GAL (16V8,20V8) devices.
- programs EPLDs from INTEL,ALTERA,ATMEL,CYPRESS.
- programs PEELs from ICT,HYUNDAI,GOULD(253,273).
- programs BIPOLAR PROMs.
- programs SINGLECHIPs 8748,8751,87C51 SERIES including 87C451,87C751,63701X/Y/V,63705V with adaptors.
- tests ICs (TTL,CMOS) & MEMORYs (upto 1MB) with USER-DEFINABLE TEST PATTERN GENERATION. High-Speed,Parallel Interface & S/W Upgradable for New Parts.

XELTEK
473 SAPENA CT. #26
SANTA CLARA,
CA 95054
1-800-541-1975 (Toll Free Order)
TEL: (408) 727-6995
FAX: (408) 727-6996
COD,VISA,MC,AMEX

Circle 292 on Reader Service Card

Computers for the Blind

Talking computers give blind and visually impaired people access to electronic information. The question is how and how much?

The answers can be found in *The Second Beginner's Guide to Personal Computers for the Blind and Visually Impaired* published by the National Braille Press. This comprehensive book contains reviews, written by blind users, of software that works with speech.

Send orders to:
National Braille Press Inc.
88 St. Stephen Street Boston, MA 02115
(617) 266-6160

$12.95 for braille or cassette
$14.95 for print

NBP is a nonprofit braille printing and publishing house

PC BASED UNIVERSAL DEVICE PROGRAMMER $595-845

- Programs **EE/EPROMs, PALs, GALs, IFLs, EPLDs, MICROs, BIPOLARs.**
- **Software driven pin drivers. D/A generated** programming voltages.
- **Upgradeable for virtually any future programmable devices up to 40 pins.**
- Self-subsistent operation. No additional modules or plug-in adapters required.
- Includes user friendly **MEMORY BUFFER FULL SCREEN EDITOR.**
- Friendly **Menu-Driven** interface. Device selection by **P/N** and **manufacturer.**
- Supports **8/16/32 bit word,** Intelligent I & II, Quick Pulse programming.
- **Functional testing,** Register-Preload, **FUSEMAP EDITOR** for logic devices.
- File formats accepted: **Intel Hex 86/88, Tektronix Hex, Motorola S , JEDEC.**
- Customer support via voice line, **dedicated BBS** or fax. **Full 1 year warranty.**
- Base price includes Interface card, cable, **Memory** device library and 1 year free updates. Additional **Device Libraries (Logic, Micros, Bipolars) $95 ea.**
- Libraries updates available every 6 mo. and can be received via floppy or BBS.

PC BASED 8-SOCKET GANG PROGRAMMER $595

- Handles **all memory devices to 32 pins.** (Upgradeable up to **8 megabit** parts).
- **FULL SCREEN BUFFER EDITOR** plus all applicable features from above.
- Customer support via voice line, dedicated BBS or fax. **Full 1 year warranty.**
- Includes PC Interface card, Memory device library and **1 year free updates.**

UNIVERSAL RS-232 PROGRAMMER $345-595

- Programs **EE/EProms, FlashEproms, ZPRams, Intel Micros, Memory Cards.**
- **Stand-Alone** Mode for EE/EProm and Memory Card Duplication / Verify.
- All 24/28/32 pin **EE/EProms** to 4 MBits (upgradeable to 32 **megabits**).
- **Micros:**8741/A,-2/A,-4,-8,-9,-51,-C51,-C51FA/B,-52,-53,-55,-CS21,-C541,9761.
- **Memory Cards:**Seiko/Epson,Fujitsu **(Integrated Adapter included)**
- Modular design;Firmware easily upgradeable; 4 socket Gang module available
- **On-Board Programming capability;** Custom interface modules available.
- User friendly **Menu-Driven** Interface Program for **IBM-PC and Macintosh.**
- Can be operated with any computer containing an **RS-232 serial port.**
- Optional built-in **Eraser/Timer** module ($50);Top cover **conductive foam pad.**
- OEM open board programmer configurations available (from $245).
- Customer support via voice line, **dedicated BBS** or fax; **Full 1 year warranty.**

INTELLIGENT PC ROM EMULATOR $395

- Emulates **2716** through **27512** EProms (2k to 64k bytes) with a single unit.
- Connects to the standard parallel printer port. Uses standard printer cable.
- Intelligent features include: **Reset Output, Address Compare, Address Snapshot, Trigger Input. Memory buffer editing capability.** Selectable wordsizes.
- User friendly software. Command set includes: **Load, Write, Display, Run, Type, Edit, Fill, Run-Command-File, Monitor, Port, Reset, Help, Calculator.**
- **FAST** data loading via parallel printer port (65k bytes in less than 10 seconds).
- **Cascadable up to 8 units.**Includes interface cable with Trigger and Reset clips.
- **CMOS model with NiCad rechargeable 9V battery backup - $495.** Built-in battery recharging circuitry. After code downloading from the host computer, this model can be disconnected and used in **stand-alone mode.**
- File formats accepted: **Binary, Intel Hex, Motorola S.**

MC / VISA / AMEX Call today for datasheets!

B&C MICROSYSTEMS INC.
355 WEST OLIVE AVE., SUNNYVALE, CA 94086
TEL: (408) 730-5511 FAX: (408) 730-5521

VOICE MASTER KEY® VOICE RECOGNITION SYSTEM

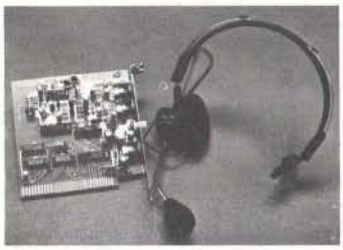
FOR PC/COMPATIBLES & TANDY 1000 SERIES

A FULL FEATURED VOICE I/O SYSTEM

GIVE A NEW DIMENSION TO PERSONAL COMPUTING. . .The amazing **Voice Master Key System** adds voice recognition to just about any program or application. Voice command up to 256 keyboard macros from within CAD, desktop publishing, word processing, spread sheet, or game programs. Fully TSR and occupies less than 64K. Instant response time and high recognition accuracy. Voice recognition tool-box utilities are included. **A genuine productivity enhancer!**

SPEECH RECORDING SOFTWARE. . .Digitally record your own speech, sound, or music to put into your own software programs. Software provides sampling rate variations, graphics-based editing, and data compression utilities. Create software sound files you can add to macros for voice recognition verification response. **A complete, superior speech and sound development tool.**

SOFTWARE CONVERSION CODES. . .The **Voice Master Key System** operates a growing list of third party talking software titles using synthesized phonetics (text-to-speech) or digitized PCM, ADPCM, and CVSDM encoded sound files. **Voice Master Key System does it all!**



EVERYTHING INCLUDED. . .**Voice Master Key System** consists of a plug-in card, durable lightweight microphone headset, software, and manual. Card fits any available slot. External ports consist of mic inputs and volume controlled output sockets. **High quality throughout, easy and fun to use.**

ONLY $149.95 COMPLETE

ONLY $89.95 FOR TANDY 1000 SL/TL MODELS—SOFTWARE PACKAGE ONLY.
Requires Tandy Brand Electret microphone.

ORDER HOTLINE: (503) 342-1271
Monday-Friday, 8AM to 5PM Pacific Time

Visa/MasterCard, company checks, money orders, CODs (with prior approval) accepted. Personal checks subject to 3 week shipping delay. Specify computer type and disk format (3½" or 5¼") when ordering. Add $5 shipping charge for delivery in USA and Canada. Foreign inquiries contact Covox for C & F quotes. 30 DAY MONEY BACK GUARANTEE IF NOT COMPLETELY SATISFIED. ONE YEAR WARRANTY ON HARDWARE.

CALL OR WRITE FOR **FREE** PRODUCT CATALOG

COVOX INC. 675-D Conger St.
Eugene, Oregon 97402 U.S.A.
TEL: 503-342-1271 • FAX: 503-342-1283

Circle 269 on Reader Service Card

PC MAGAZINE EDITOR'S CHOICE

MULTI-LINE POWER LINE VOICE MAIL

- Voice Mail System
- Call Processing
- Telemarketing
- Order Processing
- Call Distribution
- Programmers Tool Kit

Complete Systems
BIGMOUTH $295
Starting at . . . . . PLUS 6 S/H
(415) 652-9600

TALKING TECHNOLOGY, INC. TTi
4383 PIEDMONT AVE., OAKLAND, CA 94611

Circle 32 on Reader Service Card

E/EPROM & MICRO PROGRAMMER

Special offer
~~$495~~ $395
VISA ACCEPTED

MICRO-BURNER System 512

The MICRO-BURNER sets a new price performance standard in programmers adaptable to all single-chip micros with on-chip EPROM. Features include reverse EPROM detection/protection and 12 volts dc operation for portable applications. 30-day money-back offer.

Dealers Welcome
(604) 988-9853
24 hours/7 days.

BARADINE Products Ltd.
P.O. Box 86757
North Vancouver, B.C.
CANADA V7L 4L3

Circle 294 on Reader Service Card

Z-WORLD
Z80 Specialists Embedded Systems

C Compiler
Assembler/Linker
Remote Debug
Realtime Kernel
Emulator
PC Coprocessors
Proto Board

Integrated Software/Hardware Targeted for Z80/64180 Development on PC/XT/AT

2 NEW PRODUCTS
* **C Compiler-Version 2**
(ask for free tech brief)
* **ICEPROM-In Circuit Debugger**
(Cost effective alternative to ICE)

Assembler/linker (only)	$195.00
In-circuit Emulator	$995.00
Source/symbolic debugger	$195.00
Standalone Proto Board (64180μP)	$295.00

Z-World Engineering
1340 Covell Blvd. Suite 101
Davis, CA 95616
(916) 753-3722
fax: 753-5141

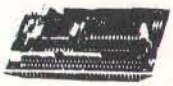
FLASH C™ - Interactive C program environment. Test Drive it WESCON 89 (#1251)

Circle 309 on Reader Service Card

INSTANT PRODUCT!

*** just add software ***

Forth control computer
TDS 9090



Powerful 4" x 3" s.b. computer based on the **CMOS HD6303Y**. High-level **Forth** language. **30 K RAM, 16 K RAM/PROM 2K EEPROM**. Attach **keyboard, lcd, I2C** peripherals. Built-in **interrupts, multitasking, watchdog timer**, editor and assembler. **32 I/O lines, two RS-232** ports. 6 - 16 volts operating at 3 ma . Optional 10 channel, 10 bit A/D, 128K RAM, D/A, date/time clock. Program with PC-compatible. Includes lots of ready-made software solutions. Made in England. Over 3000 in use in Europe for machine control, data-logging, robotics, factory automation, inspection, remote monitoring,etc. **ONLY $219** (25qty)

The SAELIG Company 1193 Moseley Rd Victor NY 14564 (716) 425-4367 or fax (716) 425-7381

Circle 164 on Reader Service Card

MARYMAC®

13TH year of Discounting Computers, FAX & Cellular Phones

Radio Shack® Tandy® SCO

We will meet or beat. . .
GUARANTEED LOWEST PRICES

MARYMAC INDUSTRIES INC.
22511 Katy Fwy.
Katy (Houston), TX 77450
1-713-392-0747 FAX (713) 574-4567
Toll Free 800-231-3680

Circle 150 on Reader Service Card

4-MEGABIT PROGRAMMER
for IBM XT/AT.....$245

30-day money back guarantee
2716 to 274001 incl. EEPROM/CMOS
High speed programming algorithm
Intel/Motorola/Binary files utilities
87C51/51 & 41/42/48/49 adaptors (Optional)
Eprom emulator adaptor 2716 - 27256
Industrial Model $398

4 Meg eproms available
(Concom Restriction)
One per customer

879 E. Hastings, Vancouver B.C. CANADA V6A 1R8
2370 Midland Ave. Unit A-28, Scarborough Ont. CANADA M1S 1P8

K.E.M.
Tel (604) 251-1514
Tel (416) 754-7565
Fax (416) 754-7431

LANtastic!

Cost Effective—Power Based LAN/RAN Solutions

CERTIFIED COMPATIBLE
NOVELL

DISPLAY

VIDEO SEVEN
FastWrite VGA™

- *Maximum Resolution 1024x 768*
- *256 Color Palette*
- *VGA/EGA/CGA/MDA/Hercules*
- *Supports 1 or 2 Monitors*
- *Drivers for Most Popular Software*
- *Works in AT/XT/386*

$199*

Including VGA Color Monitor.....*Now* **$499***

FAX SYSTEMS

FAX+ MODEM

4800 Baud Internal Includes Group III Broadcast FAX PLUS Hayes Compatible 2400 Baud Modem. Xlnt Software, *Was* $395.

Now Only **$99***

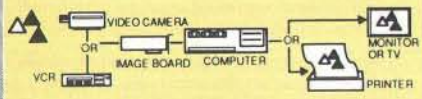
JT/FAX by Quadram

4800 Baud JT/FAX Int.....$199*
4800 Baud JT/FAX Ext.....339*
9600 Baud JT/FAX w/Modem.....499*

PC Magazine Editor's Choice

IMAGING

INTEGRATED IMAGE BOARD



Tap the rich graphics sources of your TV, VCR or video camera with the push of a button. In less than 10 seconds you can make high resolution video snapshots and turn them into sharp halftone graphics. The program's quick editing utilities let you retouch, crop, and rotate images for use in virtually any graphics or desktop publishing application.

- *NTSC/PAL Input and Output*
- *High Resolution 512 x 480*

$199*

WORLD'S LARGEST MODEM DEALER...

...AND WITH PRICES LIKE THESE ON HIGHEST QUALITY HAYES COMPATIBLE MODEMS YOU'LL SEE WHY.

			Internal Version	*External Version*
Fast	**2400 BAUD**	FULLY HAYES COMPATIBLE	**$69***	**$99***
Faster	**4800 BPS**	HAYES COMPAT. W/ LEV. 5 SFT	**$99***	**$129***
Fastest	**9600 V.32**	TRUE INDUSTRY STANDARD	**$399***	**$499***

All modems are top quality, famous brand OEM models offering savings of up to 80%. Each features auto fallback to slower speeds. Two year warranty.

AWARD WINNING SYSTEMS

386 MICRO TOWER

IBM/OS2 COMPATIBLE

$995 *Full Cash Price*

While Special Supply Lasts!

386/25 Mhz 65MB

HARD DISK

$1995 *Full Cash Price*

Also: 33 Mhz Now Available!

PORTABLES TO GO

PORTABLE 286/386

- *6 Expansion Slots*
- *640 x 400 Backlit LCD*
- *Handsome Carry Case*
- *High Speed Processor*
- *2400 Baud Modem*

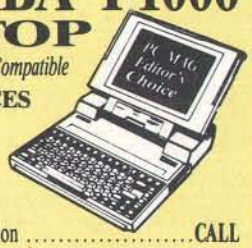
286 Processor, 40 MB Hard Disk, 640K.....$1495*
386 Processor, 65 MB Hard Disk, 1 MB 1895*

TOSHIBA T-1000 LAPTOP

- *Battery/AC*
- *IBM Compatible*

LOWEST PRICES ANYWHERE!

$639*



20 MB Hard Drive Option .....CALL
T-3100 20 MB HD, Gas Plasma.....$2495*
T-1200FB Dual FD, Batt/AC..... 1495*

BEST MULTI-USER

386 POWER BASED MULTI-USER SYSTEM

4 WORKSTATIONS

For the cost of most stand alone 386 computers, you can have the processing speed and power of a 130MB, 386 network file server with four workstations, modem, plus BBS software for password protected remote access.

Complete System Now Only **$3995** *Full Cash Price*

On-Site Installation & Support Now Available in Most Areas!

ALL *PRICES SHOWN ARE WHOLESALE AND REFLECT AN ADDITIONAL 3% CASH DISCOUNT. THE ON-LINE STORE'S WHOLESALE + 7% PURCHASERS PAY JUST 7% ABOVE THE WHOLESALE PRICE, PLUS SHIPPING AND HANDLING. Minimum shipping: $5 per order. International orders: call for rates. Prices subject to change. Products subject to availability and may be private label versions. WE ALSO SERVE LARGE CORPORATE ORDERS: call for information. This ad supersedes all previous.

CALL NOW! 24 HOUR ORDER LINE:
805/650-0188

MasterCard VISA ON CHARGE

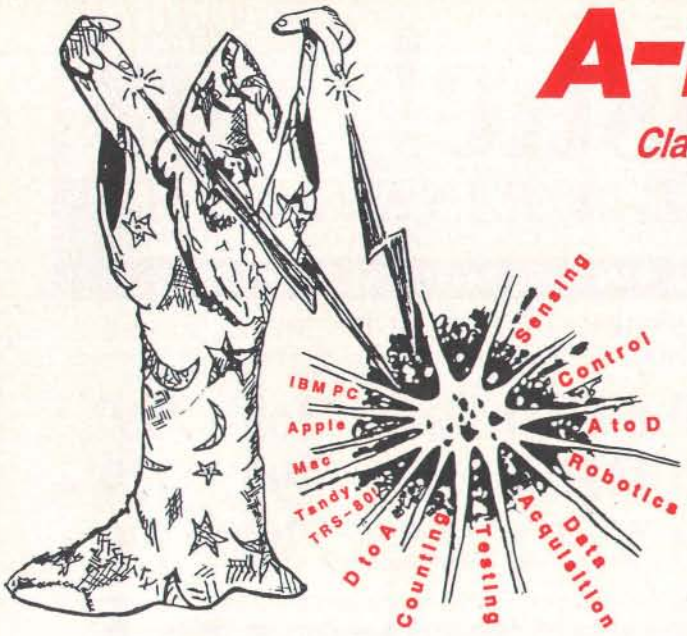
BBS 805/650-0193
FAX 805/650-0195
CUSTOMER SERVICE **805/650-0188**
3037 Golf Course Dr., Ventura, CA 93003

ON-LINE STORE
Your International Headquarters for BBS

Circle 196 on Reader Service Card

A-BUS™ MAGIC

Classroom to advanced industrial applications.



Be a Wizard in your Lab, Factory, College, Home...

It used to be difficult and costly to do process control, robotics, data acquisition, monitoring and sensing with your computer. Now the low-cost A-BUS system makes it easy to do almost any project you can imagine.

Versatility. A-BUS cards handle most interfacing, from on/off switching, to reading temperatures, to moving robot arms, to counting events, to sensing switches...

Adaptability. The A-BUS is modular, allowing expansion well beyond your needs. It works with almost any computer, or even as a remote data station with the **new** serial adapters.

Simplicity. You can start using the A-BUS in minutes. It's easy to connect, and software is a breeze to write in any language.

Reliability. Careful design and rugged construction make the A-BUS the first choice in specialized I/O.

An A-BUS system consists of: ▪ An A-BUS adapter plugged into your computer ▪ A cable to connect the adapter to 1 or 2 A-BUS function cards. ▪ The same cable will also fit an A-BUS Motherboard for expansion to up to 25 cards in any combination.

NEW: REMOTE A-BUS! Use the new Serial (RS-232) Adapter or Processor to control any A-BUS system. Cards can be up to 500 ft away using phone type cable, or off premises using a modem. Call or send for the new A-BUS Catalog which covers all the products.

Important

All A-BUS Systems: ♦ Come assembled and tested ♦ Include detailed manuals with schematics and programming examples ♦ Can be used with almost any language (BASIC, Pascal, C, assembler, etc.) using simple "IN" and "OUT" commands (PEEK and POKE on some computers) ♦ Can grow to 25 cards (in any combination) per adapter ♦ Provide jumper selectable addressing on each card ♦ Require a single low cost unregulated 12V power supply ♦ Are usually shipped from stock. (Overnight service is available.)

About Alpha Products

Founded in 1976 for the purpose of developing low cost I/O devices for personal computers, Alpha has grown to serve over 70000 customers in over 60 countries. A-BUS users include many of the Fortune 500 (IBM, Hewlett-Packard, Tandy, Bell Labs, GM...) as well as most major universities. A-BUS products are U.S. designed, U.S. built, and serviced worldwide.
Overseas distributors: England: Caldy Science Assoc. Ltd., Merseyside, 051 342 7033.
Australia: Brumby Technologies Pty. Ltd., NSW, 759 1638. **France:** Coserm, Rungis, 46 86 64 75

Inputs, Outputs, etc.

Analog Input: 8 analog inputs. 0-5.1V in 20mV steps (8 bits). 0-100V range possible. 7500 conversions/second. **AD-142: $142**

12 Bit A to D: Analog to digital converter. Input range -4V to +4V, expandable to 100V. On-board amplifier. Resolution 1mV. Conversion time 130ms. 1 channel. (Expand to 8 channels with the RE-156 card.) **AN-146: $153**

Relay Card: 8 individually controlled industrial relays each with status LED's (3A at 120VAC contacts, SPST). **RE-140: $142**

Reed Relay Card: 8 reed relays (20mA at 60VDC, SPST). Individually controlled and latched, with status LEDs. **RE-156: $109**

D/A converter: 4 Channel 8 Bit D/A converter with output amplifiers and separate adjustable references. **DA-147: $149**

24 line TTL I/O: Connect 24 input or output signals (TTL 0/5V levels or switches). Variety of modes. (Uses 8255A) **DG-148: $72**

Digital Input: 8 optically isolated inputs. Input can be 5 to 100V voltage levels or switch closures. **IN-141: $65**

Digital Output Driver: 8 outputs: 250mA at 12V. Drive relays, solenoids, stepper motors, lamps, etc. **ST-143: $78**

Clock with Alarm: Powerful clock/calendar. Battery backup. Timing to 1/100 sec. Alarm relay, LED and buzzer. **CL-144: $98**

Touch Tone Decoder: Each tone is converted into a number which is stored on the board. **PH-145: $87**

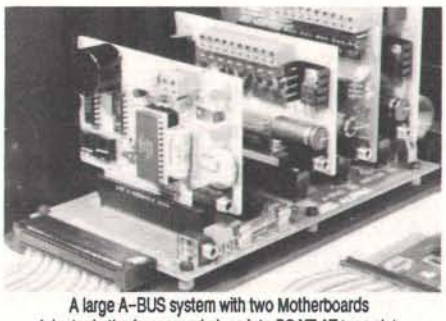
A-BUS Prototyping card: 4x4.5" card. Will accept up to 10 I.C.s. With power & ground bus. **PR-152: $16**

Counter Timer: Three 16 bit counters/timers. Use seperately or cascade for long (48 bit) counts. **CT-150: $132**

Call our application engineers to discuss your project.

Motion Control

Smart Quad Stepper Controller: The world's finest. On board microprocessor controls four motors simultaneously. Uses simple English commands like "MOVE ARM 10.2 (INCHES) LEFT". For each axis, you control coordinates (absolute or relative), ramping, speed, units, scale factors, etc. Many inputs for limit switches, etc. On the fly reporting of speed, position... Built in drivers for small motors (such as MO-103 or 105). **SC-149: $299**
Options: ► 5 amp/phase power booster for 1 motor: **PD-123: $49**
► Remote "teach" keypad for direct motor control: **RC-121: $54**



A large A-BUS system with two Motherboards
Adapter in the foreground plugs into PC,XT,AT type slot.

Stepper Driver Kit: For experimenting with stepper motors. Includes 2 MO-103 motors and a ST-143 dual driver **PA-181: $99**

Stepper Motors: (4 phase, unipolar)
MO-103: 2¼" dia, ¼" shaft, 7.5°/step, 12V, 5 oz-in torque. **$15**
MO-104: 2" dia, ¼" shaft, 1.8°/step, 5V, 60 oz-in torque. **$45**
MO-105: 1.7" square. .2" shaft, 3.75°/step, 12V. 6 oz-in. **$15**

A-BUS Adapters

► Can address 64 ports and control up to 25 A-BUS cards.
► Require one cable. Motherboard required for more than 2 cards.

A-BUS Parallel Adapters for:

IBM PC/XT/AT & compatibles. Uses one short or long slot.	**AR-133: $69**
Apple II,II+,IIe Plugs into any slot inside.	**AR-134: $52**
Commodore 64,128 Plugs into Expansion Port on back.	**AR-139: $48**
TRS-80 Model 102,200 Uses 40 pin "System bus".	**AR-136: $76**
Model 100 (Tandy portable) Plugs into socket on bottom.	**AR-135: $75**
TRS-80 Model 3,4,4D Y-Cable available if 50 pin bus is used.	**AR-132: $54**
TRS-80 Model I Plugs into 40 pin expansion bus.	**AR-131: $39**
Tandy Color Computers Fits ROM slot, Multipak or Y-Cable	**AR-138: $49**

A-BUS Cable: Necessary to connect any parallel adapter to one A-BUS card or to first motherboard. 50 pin, 3 ft. **CA-163: $24**
Special Cable for two A-BUS cards **CA-162: $34**

Serial Adapter: Connect A-BUS systems to any RS-232 port. Allows up to 500 ft from computer to A-BUS. **SA-129: $149**

Serial Node: To connect additional SA-129/A-BUS systems to a single RS232 serial port (max 16 nodes). **SN-128: $49**

Serial Processor: same as above plus built in BASIC for off-line monitoring, logging, decision making, etc. **SP-127: $189**
Use SA-129 or SP-127 with modems for remote data acquisition.

Motherboard: Holds up to 5 A-BUS cards in sturdy aluminum frame with card guides. A sixth connector allows (using cables CA-161: $12) additional Motherboards to be added. **MB-120: $108**

Power Supply: Power pack for up to 4 cards. **PS-126: $12**

Complete Catalog Available
For Orders and Info call (203) 656-1806
Weekdays from 9 to 5 EST or **FAX** 203 656-0756

Ordering Information: We accept Visa, Mastercard, Checks, and M.O. C.O.D. is $4 extra. Purchase orders are subject to credit approval. CT residents add 7.5% sales tax.
Shipping: $4 per order (usually UPS ground). UPS 2nd Day Air: $4 extra. Next Day service available. *Canada:* $6 per order (Airmail). *Outside US and Canada:* Add 10% of order total.

a Sigma Industries Company

ALPHA Products
242-B West Avenue, Darien, CT 06820

Circle 20 on Reader Service Card

EZ-WRITER

(E)EPROM Multiprogrammer™

DATA I/O 212* Performance For Only $995.

100% USA Made

- Supports (E)EPROMs up to 40-pins.
- Stand-alone or Remote.
- 40-pin Micros Opt.
- SET/GANG 4 (E)EPROMs Opt.
- Parallel port for Fast Up/Down Load.
- 256K bytes, expandable to 16 megabits.

BYTEK **1-800-523-1565**
In Florida (407) 994-3520
Fax: (407) 994-3615

* DATA I/O is a registered trademark of DATA I/O Corporation

Circle 47 on Reader Service Card

Terminal Emulation

TEK 4105/4010

- *Tektronix 4105*
- *Tektronix 4010/4014*
- *VT220, VT102*
- *Picture files*
- *VGA and EGA support*
- *High resolution hardcopy*

VT220

- *VT220, VT102 emulation*
- *File transfer*
- *132 column modes*
- *Color support*
- *Hot key*

Diversified Computer Systems, Inc.
3775 Iris Avenue, Suite 1B
Boulder, CO 80301 (303) 447-9251
FAX 303-447-1406

Trademarks: VT102, VT220 — DEC; Tektronix — Tektronics Inc.

Circle 90 on Reader Service Card

Circle 89 on Reader Service Card

3M

Authorized Distributor Magnetic Media Division

5¼" DD	5¼" HD
6.25 PER BOX	11.30 PER BOX
3½" DS	**3½" HD**
11.95 PER BOX	25.95 PER BOX

Dysan®

5¼" DS	
6.40 PER BOX	
3.5 DS	3.5 HD
9.95 PER BOX	22.95 PER BOX
5¼" HD	
10.95 PER BOX	

a complete 80386 system for only $1995

- 1meg ram
- 40 meg. hard drive
- TTL mono. monitor
- Parallel & Serial Ports
- Expand to 16 meg.
- 1 year warranty
- 30 day moneyback

Call for other systems and configurations at similar savings.

Scioto Computers
1-800-283-8616

Circle 253 on Reader Service Card

DYNAMIC RAMS

SIMM	80/100	$CALL
1MBIT	100ns	$11.25
514256	100ns	$11.75
41464	150ns	$ 3.95
41256	120ns	$ 3.65
✓ 41256	150ns	$ 3.50
51258	100ns	$ 4.50
✓ 4164	150ns	$ 2.35

* For high-speed, Zip, Plcc, Simm ..... Please Call !

MATH COPROCESSORS

80387-33	33mHz	$560.00
80387-25	25mHz	$455.00
80387-20	20mHz	$360.00
80387-16	16mHz	$305.00
80387SX		$295.00
80C287A	12mHz	$275.00
80287-10	10mHz	$209.00
80287-8	8mHz	$186.00
8087-1	10mHz	$160.00
8087-2	8mHz	$125.00

E PROMS

27C101	250ns	$ 23.00
27C512	200ns	$ 13.00
27512	250ns	$ 8.00
27C256	250ns	$ 5.25
27256	250ns	$ 4.75
27128A	250ns	$ 4.50
27C64A	200ns	$ 4.25
2764	250ns	$ 3.50

CPU

V-30	8mHz	$ 12.75
V-20	8/10mHz	$ 8.5/15

I.C. EXPRESS

15358 Valley Blvd. City of Industry,CA 91746 Tel:818-369-2688
ORDER TOLL FREE (Mon-Fri 8-5 PST)
(800) 892-8889 • (800) 882-8181
outside california inside california
CALL FOR CURRENT PRICES & VOLUME DISCOUNTS.
Price Shown for cash. MasterCard/Visa add 3%. Prices are subject to change.
Minimum order $10.00. Shipping & Handling: UPS Ground $5.00, Air $7.00 (1 lb.)
ALL MERCHANDISE IS 100% GUARANTEED WITH PROMPT DELIVERY.

Circle 126 on Reader Service Card

LASER TONER

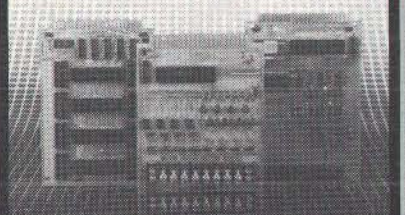
- *HP LaserJet 2 & 2D
- *CANON 2
- *HP LaserJet Plus & 500+
- *CANON LPB
- *APPLE LaserWriter

84.95 ea.

Ricoh Toner Kit 80	**"CALL"**
Ricoh OPC 80,81 or 150	**$139.95**
Qume Toner	**21.95**

KYOCERA F1000A, F1010
BROTHER LP 10
UNISYS 37

6800/6809 Micro Modules



OEM 6800/6809 MICROCOMPUTER MODULES for dedicated control and monitoring. Interfaces for sensors, transducers, analog signals, solenoids, relays, lamps, pumps, motors, keyboards, displays, IEEE-488, serial I/O, floppy disks.

WINTEK Wintek Corp.
1801 South Street
Lafayette, IN 47904
317-742-8428

Circle 324 on Reader Service Card

New, Gridless, 100% Autorouting

Create schematics and PCBs quickly and simply with **HiWIRE-Plus®** and your IBM PC. With the new, gridless, multilayer autorouter (AR) for HiWIRE-Plus, creating printed-circuit layouts is even faster. AR and HiWIRE-Plus are each $895 and come with 30-day money-back guarantees. Credit cards welcome.

WINTEK **Corporation**
1801 South St., Lafayette, IN 47904
(800) 742-6809 or (317) 742-8428

Circle 291 on Reader Service Card

the **Diskette Connection™**

Delaware 1·800·451·1849
P.O. BOX 10247, WILMINGTON, DE. 19850

Oklahoma 1·800·654·4058
P.O. BOX 1674, BETHANY, OK. 73008

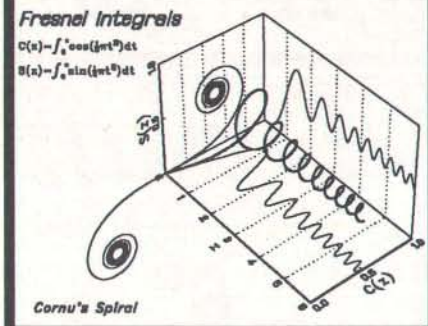
Nevada 1·800·621·6221
P.O. BOX 12396, LAS VEGAS, NV. 89112

Minimum order $20.00 "No Surcharge on Visa MasterCard." COD orders add $3.00. Surface Shipping UPS add $4.00 per 100 for 3½" or 5¼", add $4.00 per 100 for 8." U.S. Mail delivery add 9%."Prices subject to change without Notice."

VISA MasterCard FAX-405-495-4598

GraphiC™

"gives you all the C language routines you need to write an impressive scientific graphing program of your own. Highly recommended."*
PC Magazine



IBM® PC version (with source code) $395
Circle 250 on Reader Service Card
Macintosh® version (no source code) $295
Circle 251 on Reader Service Card
For personal use only.

VTEK 4.3™

DEC® VT100/102/52 & Tektronix® 4010/4014/4105 Terminal Emulator

"its ease of use, high resolution graphics, emulation, and price make it a more attractive purchase than the other products."*
MINI-MICRO Systems
Only $150
Circle 252 on Reader Service Card
* Full reprints on request

Scientific Endeavors
508 North Kentucky Street
Kingston, TN 37763
(615) 376-4146

New, Improved!

8051/8052 BASIC COMPILER!

Now with integer, byte and bit extensions.
Fully compatible with MCS BASIC 52
Runs on IBM-PC or compatible

$ 449.00

Call Now! ***603-469-3232***

Binary Technology, Inc.
Main Street • P.O. Box 67 • Meriden, NH 03770

Circle 37 on Reader Service Card

NEW

Add some FUN to your PC!

EYE-GARD is a great novelty for your home or office! The EYE-GARD vision sensor detects anyone *simply walking up to your PC.* Then it . . .
- . . . displays any PCX-format picture.
- . . . displays any message YOU choose.
- . . . plays music or sound effects.
- . . . requests a password before letting anyone use your PC.

EYE-GARD can even run other programs. It is *perfect* for sales or software demos!

EYE-GARD runs on all IBM-compatible computers. Comes with EYE-GARD sensor, software, sound and picture files.

EYE-GARD™

EYE-GARD is a great gift for you . . . or anyone! . . . who uses personal computers.

FOCUS RESEARCH
P.O. Box 140005
Dallas, TX 75214
(214) 826-3353

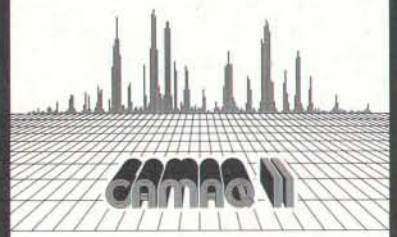
Order NOW for Christmas!
Only $19.95
(plus $3.50 p/h)
VISA/MasterCard Accepted

Circle 99 on Reader Service Card

Data acquisition · process control · mathematical and statistical analysis · data generating · libraries for GPIB, RS-232 and plug-in cards · high-performance graphics and presentation · PC/XT/AT compatible

Acquisition, Control, Analysis and Presentation

Take it easy with

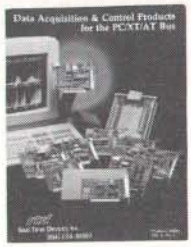


Dealer welcome!

IMES GmbH
Nebelhornstr. 38
D-8031 Eichenau

West-Germany
Phone 49-8141-80403
FAX 49-8141-80358

Circle 129 on Reader Service Card



PC/XT/AT BUS DATA ACQUISITION

Free Catalog!

AD1000 12-Bit A/D, DIO, Counters	$295
ADA300 8-Bit A/D, D/A, DIO	$239
DG24/96 8255-based DIO	$95/$239
TC24 Am9513 Counter, DIO	$189
DA600 2/4 Channel 12-Bit D/A	$179/$239

All cards made in USA!
We offer a wide range of A/D, D/A, DIO, counters, prototype, extender cards, interfacing books & accessories. 30 day NO RISK return and 1 year warranty on all cards.

Real Time Devices, Inc.
531 E. Marylyn Avenue
P. O. Box 906
State College, PA 16804 USA
rtd 814/234-8087

Circle 237 on Reader Service Card

ULTIBOARD COMPUTER AIDED PCB DESIGN

The ULTImate PCB layout package featuring:
- **Real-Time** Design Rule Check
- Trace Shove and Reroute-While-Move
- Autoroute by window, component or net
- 32 layer support; blind & buried vias
- Curved and angular traces
- Full SMT support
- Powerful placement tools
- Backannotation; pin/gate swap

Extended memory versions with unlimited design size and 32 bit performance are available

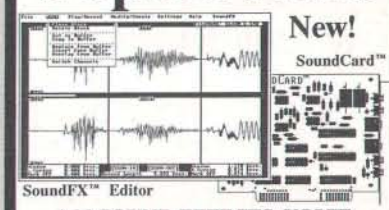
USA/Canada: ULTImate Technology Corp. • Tel. (408) 43 98 944 • Fax 439-8906
UK/Ireland: ULTImate Technology (UK) Ltd. • Tel. (0734) 812030 • Fax 815323
Int. Headquarters: ULTImate Technology B.V. • Tel. (+31)2159 - 44424 • Fax 43345

ULTIMATE TECHNOLOGY — ASK FOR YOUR FREE DEMO DISK

See us at Wescon, San Francisco, Booth 1546

Circle 281 on Reader Service Card

SuperSound



New!
SoundCard™
SoundFX™ Editor

Add SOUND EFFECTS, VOICE, MUSIC to IBM-PC/XT/ATs from $69.95!

***Best* Digital Audio Software/Hardware**
SuperSound - Stereo Version $339 - Mono $239
30 Day Money-Back Guarantee if not Satisfied
- **With SoundFX™ - Friendly GUI / Graphical Editor for Fast Easy Record, Play and Special Effects (Uses Mouse or Keyboard) and 1W/ch SoundCard™**
- **Full Fidelity - Adjustable Sampling Rate / Recording Time - VLSI A/D D/As**
- **82 Functions / Special Effects - 94 Page Manual w / Digital Audio Tutorial**
- **4 Diskette Starter Set of SoundBytes™ - 14 Sample Sounds**
- **For Business:** Training, Point-of-Sale Shows - Works with Grasp, QBasic, etc.
- **For Engineering:** Built-in Function Generators, Make Clear Voice Alarms, etc.
- **For Fun:** Create Your Own Mac-like Boot-up Sounds, Error Messages...

Silicon Shack
5120 Campbell Ave. #112, San Jose, CA 95130
PH:(408) 446 - 4521 VISA - MasterCard
™ SuperSound, SoundFX, SoundCard, and SoundBytes are trademarks of Silicon Shack, Ltd.

Circle 254 on Reader Service Card

BEST BUYS FOR 14 YEARS!

JADE COMPUTER

Turbo-88

Monitor Optional

$498

—A PROVEN BEST SELLER—

- 8088 microprocessor running at 10 MHz or 4.77 MHz
- 640KB
- 5.25" 360KB RAM Drive
- Dual diskette drive controller
- Parallel printer port
- Eight XT expansion slots
- 150 watt power supply
- 8087 socket
- Front panel display
- 101 Key enhanced keyboard
- Serial RS-232C port
- Game Port
- Clcok/Calendar

Monitor & Hard Drive Options

Floppy Only	20 Megabyte	30 Megabyte
Complete Monographics System		
$648	$798	$848
Complete Color System		
$748	$898	$948
Complete VGA System		
$998	$1148	$1198

JADE COMPUTER

PRO-286

12 MHz **$798**

20 MHz **$998**

Monitor Optional

—286 POWERHOUSE—

- 80286 processor running at 12 MHz or 20 MHz
- Zero wait state
- 512K RAM expands to 4 MB
- 1.2 MB or 1.44 MB drive
- Hard/Floppy controller
- Six 16-Bit & Two 8 Bit expansion slots
- 80287 socket
- Clock/Calendar
- 101-key enhanced keyboard
- 200 watt power supply
- Norton S.I. 13.7/20.3
- Landmark 16/25.9
- One Year Warranty

Monitor & Hard Drive Options (12 MHz)

Floppy Only	40 Megabyte	80 Megabyte
Complete Monographics System		
$928	$1278	$1498
Complete VGA System		
$1298	$1648	$1898

For 20 MHz System Add $198

JADE COMPUTER

Super-386

20 MHz **$1578**

25 MHz **$1878**

Monitor Optional

25 MHz Cache **$2498**

—FIRE BREATHING 386—

- 80386 processor running at 20 MHz or 25 MHz
- 1 MB RAM expands to 6 MB
- 384K Shadow RAM
- 1.2 MB or 1.44 MB drive
- 1:1 Interleave Hard Disk /Floppy Disk controller
- 80387 socket
- Full size case
- One 32-Bit, Five 16-Bit Two 8-Bit slots
- 101 key enhanced keyboard
- 200 watt power supply
- Clock/Calendar
- Norton S.I. 23/31.6/31.6
- Landmark 25.5/32.6/43.5

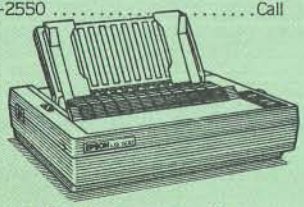
Monitor & Hard Drive Options (20 MHz)

Floppy Only	40 Megabyte	80 Megabyte
Complete Monographics System		
$1698	$2058	$2298
Complete VGA System		
$1998	$2398	$2678

For 25 MHz add $298 — 25 MHz Cache add $898

EPSON

LX-810	$188
FX-850	Call
FX-1050	Call
LQ-510	$328
LQ-850	Call
LQ-950	Call
LQ-1050	Call
LQ-2550	Call



Panasonic

KX-1180	$178
KX-1191	$238
KX-1124	$318

Daisywheel Printer 40 CPS **$199**

Plotter $688

List Price $1798

Roland DXY-980

8 PEN 230mm/SEC
.05mm Resolution
HPGL Compatible
Electrostatic Hold Down
Parallel and Serial Input
Digitizing Capacity

Surge Protector

S.L. Waber 6 outlet	$18
Isobar 4 outlet	$48
Isobar 8 outlet	$68
Isobar modem protector	$24

Tripplite Line Stabilizer

600 Watt Line Conditioner	$98
1200 Watt Line Conditioner	$158
1800 Watt Line Conditioner	$188

Tripplite Battery Back-up

450 Watt UPS	$398
750 Watt UPS	$498
1200 Watt UPS	$698

intel

8087	$88	80287-12	$278
8087-2	$118	80387-SX	$318
8087-1	$158	80387-16	$348
80287	$128	80387-20	$388
80287-8	$198	80387-25	$488
80287-10	$228	80387-33	$598

IIT Coprocessors In Stock——Call

Modems

1200 internal w/software	$48
2400 internal w/software	$88
1200 baud external	$88
2400 baud external	$148
2400 PS/2 internal	$198
Intel 2400B for PS/2	$278

Mouse Opto Mechanical With Software **$29**

Logitech

LogiMouse Serial	$68
LogiMouse Hi-Rez,Bus	$88
LogiMouse Hi-Rez Serial	$98

Full Page Scanner With OCR Software **$359**

Scanner

Complete Hand Scanner	$98
LogiTech Scan Man	$248
Diamond Flower HS-3000 Plus	$228

VISA · AMERICAN EXPRESS · MasterCard

California
Torrance, Costa Mesa, Woodland Hills
Kearny Mesa, Sunnyvale

Texas
Addison, Houston

Georgia Smyrna **Arizona** Phoenix

Not all items in stock at our nine retail locations.

JADE COMPUTER

4901 W. Rosecrans Ave. Box 5046 Hawthorne, California 90251-5046 213-973-7707

Continental U.S.A. **1-800-421-5500** Inside California **1-800-262-1710**

MEMBER MMC MICROCOMPUTER MARKETING COUNCIL

We accept checks, credit card or purchase orders from qualified firms and institutions. No surcharge on credit card orders. CA., TX. GA. & AZ. residents add sales tax. Prices and availability subject to change without notice. Shipping and handling charges via UPS ground 50¢/lb. UPS air $1.00/lb. Minimum charge $4.00. **Fax machine 1-213-675-2522**

Unitex IC DIVISION

Established 1976

Now Open in Las Vegas!

California Residents call:

1-800-843-8414

and save 6% SALES TAX

located at 4025 S. Industrial Blvd.
Las Vegas, NV
(702)732-8689

SIMM SIPP MODULES

1 MG X 9-for IBM TYPES
1 MG X 9-120NS ... $165
1 MG X 9-100NS ... $145
1 MG X 9- 80NS ... $160
1 MG X 9- 70NS ... $200

256 X 9- for IBM TYPES
256 X 9-120NS $49
256 X 9-100NS $60
256 X 9- 80NS $65
256 X 9- 60NS $75

APPLE SIMM MODULES
1 MG X 8-120NS ... $149
1 MG X 8-100NS ... $165
256 X 8-120NS $45
256 X 8-100NS $50

PS-2 SIMMS

256 X 9 (FOR PS2)
256 X 9-120NS $79
(30F5348)(KIT-2EA.)$158

MODEL 30-286
1 mg x 9-100 ..... $235
(30F5360)(KIT-2EA.)$470

PS-2 MODEL70&80 SIMM
1 MG X 9-100NS .. $249
1 MG X 9-80NS $299
2 MG X 9-80NS $685
(6450608) (For 70A21)
2 MG X 9-80NS $649
(6450604)
(For70E61/ 70-121/ all models)
1 MG X 9-80NS $299
(6450603)
(For 70E61 / 70-121)

DIP
ZIP
SIMM
SIPP
PS-2 SIMM
MATH-CO

ZENITH 386 MODULES
1 MG X 9-80 NS $299

AST 386 MODULES
1 MG X 9-80 NS .. $295
1 MG X 9-70 NS .. $329

D RAM

1 MG X 1
1 MG X 1-120NS $12.00
1 MG X 1-100NS $12.50
1 MG X 1- 80NS $12.95
1 MG X 1- 70NS $18.00

256 X 1
256 X 1-150NS $3.95
256 X 1-120NS $4.29
256 X 1-100NS $4.50
256 X 1- 80NS $8.00
256 X 1- 70NS $6.50
256 X 1- 60NS $7.20

256 X 4
256 X 4-120NS .. $13.50
256 X 4-100NS .. $14.00
256 X 4- 80NS .. $18.00

64 X 1
4164-150NS $1.40
4164-120NS $2.10
4164-100NS $2.40

64 X 4
4464-150NS $5.00
4464-120NS $4.50
4464-100NS $5.00
4464- 80NS $4.50

256 X 4 STATIC COL
514258-100NS $25

256 X 1 STATIC COL
51258-100NS $5.50
51258- 80NS $8.50
51258- 70NS $7.00

COMPAQ 386 MEMORY
1 mg-expansion $349
4 mg $999

Daughter BD Mods- 70,80
1 mg(6450375) ... $429
2 mg(6450379) ... $929

MATH CO-PRO

8087-3(5MHZ) $88
8087-2(8MHZ) $118
8087-1 ..... $165
80287-6 ..... $120
80287-8 ..... $195
80287-10 ..... $218
80C287-12 ..... $295
80387-16 ..... $310
80387-20 ..... $360
80387-25 ..... $460
80387-33 ..... $629

CPU CHIPS

8088 ..... $5.00
80286-8 ..... $49
80286-10 ..... $59
80286-12 ..... $69
80386-16 ..... $180
80386-20 ..... $240
80386-25 ..... $330
V-20 (8MHZ) $7.50
V-20 (10MHZ) $12.00

VIDEO RAM FOR VGA CARDS

64 x 4(150NS) $7
64 X 4(120NS) $10
64 X 4(100NS) $13

RAM TESTER

only **$139**

Tests the following memory chips:
64K X 1 256 X 1
64K X 4 256 X 4
4M X 1 1M X 1
The RTI can help anyone come through the frustrating process of identifing bad (or good) D-RAM chips.

MEMORY EXPANSION BOARDS

BOCA RESEARCH

BOCARAM 50Z- up to 3 MG $169
for model 50 - 50Z - 60 • 0 wait state.• Expanded, extended and base memory.• Uses 1MG D-RAM (DIP)

BOCARAM 50/60 - Up to 4 MG $169
for model 50-60 • 0 wait state expanded, extended and base memory.• Uses 1MG D-RAM (DIP)

BOCARAM AT PLUS - Up to 8 MG $159
for all AT (80286) Computers• Expanded, extended and base memory can be used w/ LIM, EMS 4.0, OS/2, UNIX ,16 BIT BD and operates up to 33 MHz. • Uses 1 MG D-RAM (DIP)

BOCA MCA Parallel Card (for PS/2) $90
BOCA MCA Serial Card (for PS/2) $160

IBM

1497256 - For PS-2 MOD 50/60 ..... $439
with 0K Expands to 8MB
Uses 256K SIMMS (IBM only)
6450605 - For PS-2MOD 70/80 ..... $1299
with 2 MG Expands to 8 MB
Uses 2MG SIMMS (IBM only)
6450203 - For AT - Has 512K RAM $129

UNITEX

3MG Multifunction - for AT $129
Expands to 3MG - has SER/PAR PORT
256K D-RAM
384 Multi-function Card for PC/XT $89
Expands to 384K
has SER/PAR/CLK/Game port
Uses 64K D-RAMS

COMPAQ MEMORY

ADD-ON MODULES

MODEL	1MG	4MG
386/20	$349	$999
386/25	$349	$999
386/20E	$349	$999
386/S	$399	$1349
286 E	$349	$999

MEMORY EXPANSION BOARDS

MODEL	1MG	4MG
386/20E	$549	$1349
386 S	$549	$1349
386/16	--	$1429
286 E	$549	$1329
SLT/286	$579	--

386/16(8MG EXPANDS TO 16MG) $2699
PORTABLE 386 (1MG MEMORY UPGRADE) $529

ZUCKER

PS2 - 2MG MB -Up to 2 MG for microchannel PS2 and Compatibles. Uses 256 X 9 SIMM $49

PS2 - 2 MG Multifunction BD- Up to 2 MB- Has serial and PAR Port-Software. Uses 256 X 9 SIMM $89

ORCHID

RAMQUEST IIZ -Up to 2MB of 0 wait state memory for the IBM PS/2 Models 50, 50Z & 60 • Guaranteed EMS 4.0 and OS/2 Compatible• Easy 4-keystroke installation.• Uses 1MG Dip's $199

RAMQUEST EXTRA -The only multifunction card that provides up to 8MB and two serial ports on one board for the IBM PS/2 Models 50, 60 and 80. • Guaranteed EMS 4.0 and OS/2 Compatible. • Easy to install with only 4 keystrokes. Uses 256 and/or 1MB SIMM'S. $319

RAMQUEST EXTRA 16/32 -The only 0-8MB, 0 wait state card for PS/2 Models 50, 50Z, 60, 70 and 80 which fully supports both 16-bit and 32-bit memory access. Includes one serial and one parallel port plus a free serial cable. Guaranteed EMS 4.0 and OS/2 compatible. Easy 4-keystroke installation. Uses 256 and/or 1MB SIMM'S $319

RAMQUEST XT/AT -A full size, 0-8 MB, zero wait state card for IBM PC, XT, AT, PS/2 25, 30 and compatables. Uses 256K and/or 1MB SIMM'S. Automatically supports either 8 or 16-bit bus. . $259

RAMQUEST XT/AT with I/O- Same as above plus 1-serial and 1-parallel port $319

ACCELERATORS

TINY TURBO 286 Low-cost High-speed Half-slot PC/XT -Accelerates your PC/XT with an 8 MHz 80286 Microprocessor. 80287 math chip socket $239

TINY TURBO XT Hi High-speed Half-slot accelerator for PC/XT- Accelerates your PC/XT up to 4.5X faster with a 12 MHz 80286 microprocessor. 80287 math chip socket. $299

JET 386-Hyperspeed Accelerator Card for ATs- Accelerates your AT up to 3X faster with a 16 MHz. 80386 Socket for math chip $895

EVEREX

RAM 3000 DELUXE-Up to 3 MB. Selectable memory addresses. Expanded Memory Specifications (EMS)4.0/OS/2. Can be used to backfill base memory up to 640K and the rest as either Expanded or Extended or both. Uses 256K D-RAM $99.00

RAM 8000-Up to 8MB capacity/supports base, extended or expanded memory in any combination. Fully compatable with Lotus/ Intel/ Microsoft EMS 4.0/ EEMS. Supports multitasking and DMA multitasking in hardware. Software configurable (no dip switches to set).Full 16MB window for future expansion of Lotus/ Intel/ Microsoft EMS 4.0. 0 wait states, uses 1MG D-RAM (DIP) $279

RAM 10000-Up to 10 MB capacity/supports base, extended or expanded memory in any comnbination. Compatable with Lotus/Intel/Microsoft EMS 4.0. Operates with no additional wait states. Uses 1MG D-RAM (DIP) $179

MINI-MAGIC - (EV138)-Up to 576K . For PC-AT. Uses 256K & 64K $50

MODEMS

Everex

EverCom 12 300/1200 bps Bitcom Software $74
EverCom 24 2400 Baud Internal Bitcom Software $139
External 2400 Baud $199

Hayes Compatatble

1200 Baud Internal w/Software $59
1200 Baud External Fully Hayes Compatable $99
2400 Baud Internal 1/2 card w/Software $109
2400 Baud External Fully Hayes Compatable $129

VIDEO ADAPTER

ATI

SUPER WONDER BASIC EGA $189
Supports MDA, CGA , EGA & Hercules
EGA WONDER $239
Supports MDA, CGA , EGA & Hercules
VIP VGA $275
Supports VGA, CGA, MDA, EGA & Hercules

ORCHID

Designer 800 VGA $229
800 X 600 - 16 Colors
Prodesigner VGA $319
Supports 1024 X 768 - 16 Colors
Pro Designer VGA Plus $399
Same as Prodesigner
Has downloadable fonts

UNITEX

MONOCHROME GRAPHICS CARD $41
With Par port • MGA/ Hercules
COLORGRAPHICS CARD $41
RGB Color with Par Port • EGA/ MGA/ CGA/ Hercules
EGA CARD $149
640 X 480, 16 Colors, EGA/ MGA/ CGA/ Hercules
VGA CARD $199
600 X 800, 16 Colors,VGA/ EGA/ MGA/ CGA

NO SLOT CLOCK

Clock for PC & XT Computers - Plugs into empty ROM Socket on Mother Board. Accurate 1/100 th of a second
Only **$34.95**

TERMS AND CONDITIONS

No Surcharge for MC / VISA Terms: MC • VISA • COD • CASH • AMEX add 4%
Purchase Orders from qualified firms • 20% restocking fee on non-defective returns
Prices Subject to Change

We Accept AMERICAN EXPRESS
4% Handling

VISA

MasterCard

Unitex, Inc
A Publicly Traded Company
Corporate Headquarters
2852 F Walnut - Tustin, CA 92680
Phone: 714/730-5232 • FAX#: 714/838-8593

Customer Service #: 714/730-9527

Mon-Fri 7am - 5pm
Sat 8am - 2pm

TOLL FREE OUTSIDE CA: 1/800/533-0055

Circle 282 on Reader Service Card

E/EPROM & MICRO PROGRAMMER

$895

- EP-II4O includes: software, cable, user's manual, 2 free software update coupons, toll-free technical support, one-year warranty & a unconditional 30-day money back guarantee
- Programs 24-, 28-, 32- & 40-pin E/EPROMs
- Supports 874X & 875X series microcontrollers
- Connects to a standard parallel port
- 32-pin model, EP-II32, available for $695

The Engineer's Programmer™

CALL TODAY 800-225-2102

BP MICROSYSTEMS
10681 Haddington, #190, Houston, TX 77043
713/461-9430 FAX 713/461-7413

Circle 44 on Reader Service Card (DEALERS: 45)

IMAGING CARD

- Dual camera inputs
- Composite video in/out
- 256 × 240 resolution
- Digitize/display at frame speed
- 16 Meg. color palette out (DV-02)
- External trigger input option
- PC/XT/AT compatible
- Complete with software & library

DV-02 8-bit 256 gray levels . $849
DV-03 6-bit 64 gray levels . . $549
VISA/MC Demo disk available

Control Vision
PO Box 596 Pittsburg KS 66762
800/292-1160 316/231-6647

Circle 69 on Reader Service Card

DATA ACQUISITION

MEASURMENT TO GO

ALL needs ! ANY computer !

- PC Software Included
- Serial, Modem, & Bus
- Stand Alone Ability
- Laptop & Handheld
- PC & MAC Cards
- Inexpensive
- OEM & VAR
- RTU's

Call for FREE DEMO DISK !

Specialists in portable and battery backed up as well as PC compatible modular systems.

Call for applications info: **(201) 299-1615**
P.O. Box 246; Morris Plains, NJ 07950

ELEXOR

Circle 93 on Reader Service Card

800 Pixel Windows with your EGA and the WinTerm™ EGA800

The WinTerm™ EGA800 daughterboard and driver will give your standard EGA 800 pixel resolution when running Microsoft® Windows 286.

Think of it — 56,000 more pixels with a standard EGA and enhanced color display.

Special Introductory Offer
$59.00

KEA Systems Ltd.

2150 West Broadway, Suite 412
Vancouver, B.C. CANADA V6K 4L9
Tel: 604-732-7411 Fax: 604-732-0715
Toll Free Order Desk: 800-663-8702
WinTerm is a trademark of KEA Systems Ltd.

Circle 143 on Reader Service Card

Sure it's insured?

SAFEWARE® Insurance provides full replacement of hardware, media and purchased software. As little as $39/yr. covers:
• Fire • Theft • Power Surges
• Earthquake • Water Damage • Auto Accident

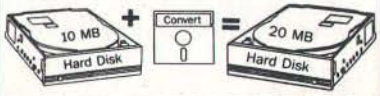
For information or immediate coverage call:
1-800-848-3469
In Ohio call 1-614-262-0559

SAFEWARE

SAFEWARE, *The Insurance Agency Inc.*

Circle 246 on Reader Service Card

A Real Breakthrough–No Bull!



20 MB HARD DRIVE $89

- Turn your 10 MB Hard Drive into a real 20 MB Hard Drive!
- Our easy to use software is not a file compression program and it's not memory resident!
- Use it once. It actually changes the physical characteristics of your 10 MB Hard Drive and makes it a permanent 20 MB Hard Drive.
- Your programs will work normally
- Works on any 10 MB hard Drive.
- It's true–Money Back Guarantee! Order CONVERT® today!

We pay S & H. Mail $89 to:

SWIRLSOFT®

3240 Dueber Ave. S.W. Canton, OH 44706
216-484-5320

Circle 266 on Reader Service Card

3M

DS-DD	Quantity Discounts Available	DS-HD
5.69*	5.25" 3M Diskettes 10/Box	10.99
10.99	3.50" 3M Diskettes 10/Box	25.49
17.99	8.00" 3M Diskettes 10/Box	19.99

DC-2000 . . . . . 14.49 DC-600A 20.49
DC-300XLP . . . 18.49 DC-6150XTD . . 21.49

3M Compac Tape™ 1/2" DEC TK-50 Tape-min 10 . . . **25.95**
IBM 3480 Tape Cartridge-min 30 . . . . . **5.85**
3M Mag. Tape with seal 2400'-min 10 . . . . . **12.70**

BASF

DS-DD	Quantity Discounts Available	DS-HD
4.79	5.25" BASF Diskettes 10/Box	7.79
9.29	3.50" BASF Diskettes 10/Box	22.99
.32	BASF 5.25" DS-DD No-Logo Bulk with Tyvek sleeves, labels & W/P	
.29	BASF Branded 5.25" 1S/2D/48TPI Diskettes	

BASF Mag Tape 2400' **10.50**

Verbatim DataLifePlus

Teflon/Preformatted

DS-DD		DS-HD
5.89	5.25" DataLifePlus 10/Box	11.29
10.95	3.50" DataLife Plus 10/Box	23.79
6.49	Verbatim DataLife Color Disks 5.25" 2S/2D 10/Box	

DYSAN PRECISION

6.29	5.25" DS/DD 10/Box	3.39
10.49	5.25" DS/HD 10/Box	6.39
10.95	3.50" DS/DD 10/Box	8.99
23.79	3.50" DS/HD 10/Box	20.99

MAXELL

*FREE Audio Cassette

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
5.79	11.39	11.59	26.99

3M HIGHLAND

5.25" DS/DD		5.25" DS/HD
3.69	3M Highland Diskettes 10/Box	6.79
3.50" DS/DD		3.50" DS/HD
8.99	Brand Name 10/Box	20.99

KAO Color Diskettes

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD 2MB Box/10
.32*	.72*	.79	21.99

*5.25" Color add 4¢ for Tyvek sleeves & labels

No-Logo Bulk Diskettes

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
.27*	.49*	.68	1.79*

*Bulk diskettes include sleeves, labels and w/p tabs

TERMS: No surcharge on VISA, Mastercard or AMEX. COD only add $3.00. PO's accepted from recognized institutions on Net 30 Bank draft, T/T or L/C acceptable. **Shipping:** $4/100 or fewer disks. Reduced shipping charges on large quantities. Price quoted for case (100 disks) quantities less than a case add 5%. (Min. order $25.00 Min. order on PO's $150.00.)

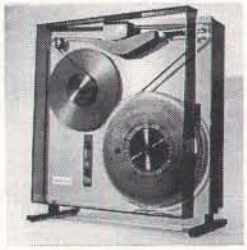
Toll Free Order Line: **1-800-523-9681**
TLX-9102404712

Information Line: **1-801-255-0080**
FAX-801-572-3327

DISKCOTECH

DISKCO TECHNOLOGIES, INC.
213 Cottage Avenue
P.O. Box 1339 Sandy, Utah 84091

ALL NEW !!!
9 TRACK TAPE SUBSYSTEM
for IBM PC/AT/386
complete for only
$2,595.00
1 YEAR WARRANTY



- **IBM/ANSI** compatible at 800*/1600/3200 bpi
- Controller, cables and software included
- Interfaces for PS/2*, Xenix* and DEC*
- SCSI*, AT or MCA* Bus I/O at 25/50/100 ips.

* optional

AKSystems Inc.
20741 Marilla St. Chatsworth CA 91311
TEL:818/709-8100 FAX: 818/407-5889

Circle 17 on Reader Service Card

SIMMS

1 MB X 9 - 80/100NS
256K X 9 - 80/100NS
1Mbit, 41256, 4164, 41464
Get The Memory You Need
At The Price You've Waited For.

FAST SERVICE
LOWEST PRICES IN USA
914-565-7080
VISA C.O.D. M/C
VOLUME DISCOUNTS AVAILABLE
CALL TODAY FOR LOW PRICE QUOTE

DELTA COMPUTING TECH. CORP.
292 North Plank Rd.
Newburgh NY 12550
PH# 914-565-7080
FAX 914-565-7082

Via L. Landucci No 26
50136 Florence Italy
PH# 39 55 676 045
FAX 39 55 666 942

UPGRADE YOUR 386 TODAY!!

Circle 82 on Reader Service Card

AMX 68000

KADAK's engineers bring years of practical real-time experience to over 600 installations world-wide.

This *real time*
MULTITASKING KERNEL
simplifies *real life*
product development

- No royalties
- Full source code included
- * C interface
- Preemptive scheduler
- Intertask messages
- Terminal Handler
- * Dynamic memory allocation
- * Event Manager
- * Semaphore Manager
- * Resource Manager
- * Buffer Manager

AMX 68000 operates on any 68000/10/20 system

Manual only $75 US
AMX 68000 $1600 US
* Options — ask for price list.
(Shipping/handling extra)

Also available for 8080, Z80, 8086/186/286

KADAK Products Ltd.
206 - 1847 W. Broadway
Vancouver, B.C. Canada V6J 1Y5
Telex: 04-55670
Fax: (604) 734-8114
Telephone: (604) 734-2796

Circle 142 on Reader Service Card

16-BIT RESOLUTION ANALOG-TO-DIGITAL CONVERTER
12,000 SAMPLES/SEC for IBM PC, XT & AT
SINGLE PIECE PRICE $475

We manufacture a broad line of data acquisition and control hardware and software for Apple and IBM computers.

Call for quotes on custom hardware or complete systems.

LAWSON LABS, INC.
5700 RAIBE ROAD
COLUMBIA FALLS, MT 59912
800-321-5355 or 406-387-5355

Circle 154 on Reader Service Card

9-Track Tape Subsystem for the IBM PC/XT/AT

Now you can exchange data files between your IBM PC and any mainframe or mini-computer using IBM compatible 1600 or 6250 BPI 9-Track tape. System can also be used for disk backup. Transfer rate is up to 4 megabytes per minute on PCs and compatibles. Subsystems include 7" or 10½" streaming tape drive, tape coupler card and DOS compatible software. For more information, call us today!

QUALSTAR®
9621 Irondale Ave., Chatsworth, CA 91311
Telephone: (818) 882-5822

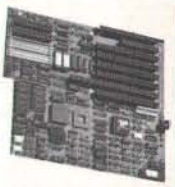
Circle 228 on Reader Service Card

25MHZ 80386 MOTHERBOARD

Faster Than The Everex Step ™ !
6.2 Mips! $1499 (0K) QTY 1

Features:

- *64K/256K Write Back Cache
- *Dual Read/Write Cache
- *Transparent Refresh
- *8MB maximum on motherboard
- *Supports 80387/Weitek
- *Compatible with UNIX, OS/2, and Novell
- *1 Year Full Warranty
- *72 HR In-Circuit Burn-In!



20 MHz also available @ 4.9 MIPS

SIMM Modules
256Kb x 9, 100ns-$48
1Mb x 9, 100ns-$150

Same Day Shipping!

Technology Power Enterprise, Inc.
46560 Fremont Blvd., Suite 118,
Fremont, CA 94538
TEL (415) 623-9162 FAX (415) 623-9462

Novell, OS/2, and UNIX are registered trademarks

Circle 270 on Reader Service Card

5.4 Gigabytes Unattended Backup

Store up to 5.4 Gigabytes of data on a single T-120 VHS video cartridge. Error rate is less than 1 in 10^{19} bits. High speed search gives average access time of three mintues.

Use GIGASTORE™ to backup your largest disk drive on off-hours without an operator.

GIGASTORE is a trademark of Digi-Data.

DIGI-DATA CORPORATION
8580 Dorsey Run Road
Jessup, MD 20794-9990
(301) 498-0200
Telex 87-580
... First In Value

Circle 86 on Reader Service Card

PC PRODUCTIVITY

NEW

EMU-TEK™

4200 Plus

Turn your PC into a Tektronix Graphics Terminal

FTG DATA SYSTEMS
(800) 962-3900
10801 Dale St., Stanton, CA 90680

Circle 105 on Reader Service Card

KEYBOARD & MONITOR 500 FEET AWAY - ALSO DRIVE MANY MONITORS AT ONCE — CALL FOR

FREE CATALOG

NTI NETWORK TECHNOLOGIES, INC.
19145 Elizabeth St., Aurora, OH 44202
US 216-543-1646 or 800-RGB-TECH
UK 0244-880478
PARIS 331-47632789
GENEVA 022-431124
CANADA 416-677-6500
MUNICH 0130811234

Circle 191 on Reader Service Card

Buy with

Confidence

In an effort to make your telephone purchasing a more successful and pleasurable activity, The Microcomputer Marketing Council of the Direct Marketing Association, Inc. offers this advice, "A knowledgeable buyer will be a successful buyer." These are specific facts you should know about the prospective seller before placing an order:

Ask These Important Questions

- *How long has the company been in business?*
- *Does the company offer technical assistance?*
- *Is there a service facility?*
- *Are manufacturer's warranties handled through the company?*
- *Does the seller have formal return and refund policies?*
- *Is there an additional charge for use of credit cards?*
- *Are credit card charges held until time of shipment?*
- *What are shipping costs for items ordered?*

Reputable computer dealers will answer all these questions to your satisfaction. Don't settle for less when buying your computer hardware, software, peripherals and supplies.

Purchasing Guidelines

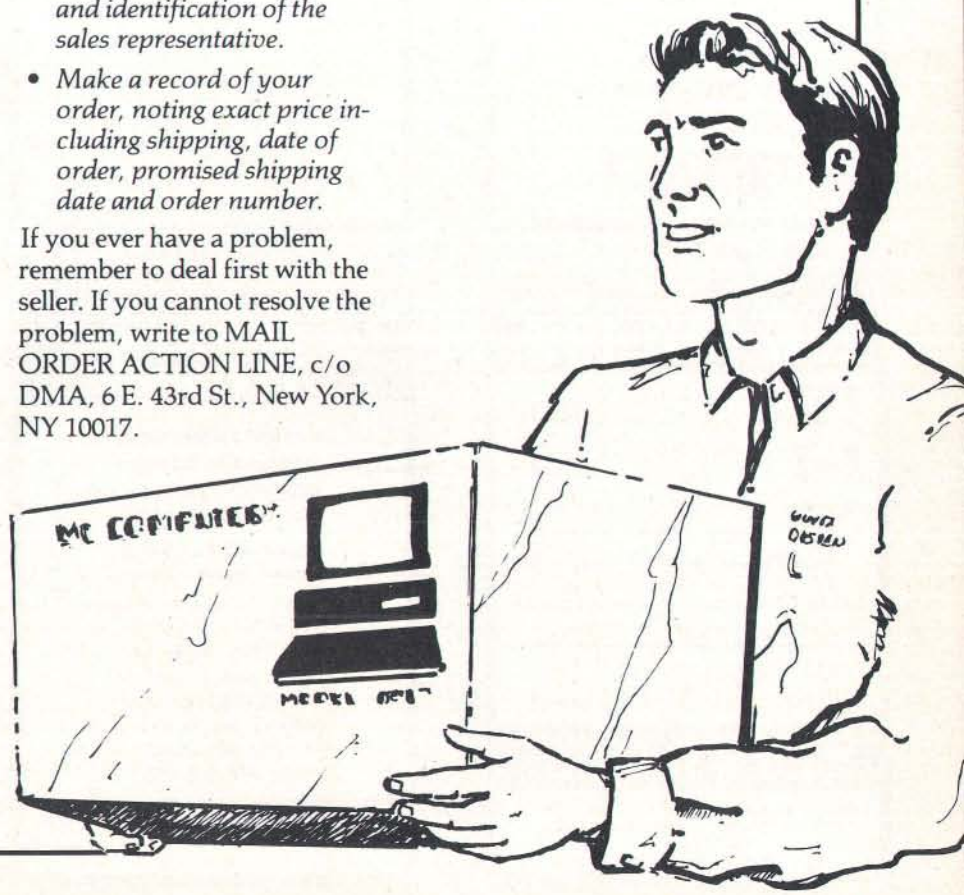
- *State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.*
- *Establish that the item is in stock and confirm shipping date.*
- *Confirm that the price is as advertised.*
- *Obtain an order number and identification of the sales representative.*
- *Make a record of your order, noting exact price including shipping, date of order, promised shipping date and order number.*

If you ever have a problem, remember to deal first with the seller. If you cannot resolve the problem, write to MAIL ORDER ACTION LINE, c/o DMA, 6 E. 43rd St., New York, NY 10017.

This message is brought to you by:

the MICROCOMPUTER MARKETING COUNCIL of the Direct Marketing Association, Inc.
6 E. 43rd St.,
New York, NY 10017

MMC
MICROCOMPUTER MARKETING COUNCIL
of the Direct Marketing Association, Inc.



© Direct Marketing Association, Inc. 1988

STAND-ALONE UNIVERSAL PLD PROGRAMMER

Costs Less, Performs More

Palpro-2x™ is an intelligent programmer supporting PLDs from a wide variety of sources. Works with any PC or computer using a serial port. FREE one year device update and warranty. Price $795.00.

LOGICAL DEVICES, INC.
1201 N.W. 65th Place
Ft. Lauderdale, FL 33309
(305) 491-7404
1-800-331-7766

Circle 157 on Reader Service Card (DEALERS: 158)

LOW COST, RELIABLE

EPROM PROGRAMMER

1 Year Warranty

Operates stand-alone or PC based. Shooter™, an intelligent EPROM programmer, uses serial port for communications. No modules to buy. Now includes 512K buffer; $395 price includes cable, software and manual.

LOGICAL DEVICES, INC.
1201 N.W. 65th Place
Ft. Lauderdale, FL 33309
305-974-0967
1-800-331-7766

Circle 159 on Reader Service Card (DEALERS: 160)

Complete Telephone Management System

TeleGenie™

Sophisticated Voice Mail and Call Processing with High Quality REAL VOICE Digital Recording for your PC, XT, AT or Compatible

CALL PROCESSING

- Unlimited Phonebook Database • Autodial/Redial Search/Sort • Caller Computer Touch-Tone Interaction • User-Definable Voice Prompted Menus
- Call Forward/Call Distribution • In/Out Call Logging • Outbound Timed Calls • Automatic Attendant

This Unique System Also Features ...

Includes circuit board, software, phone cable, and external speaker

VOICE MAIL

• Forwards to Extensions/ Beepers/Cellulars
• Individual Greetings and Passwords • Multi-User Box-Capacity • Remote Touch-Tone Access
• Replay/Delete/Record/Edit

Enjoy the same benefits and features of systems costing thousands for only...

$279.95

800-637-3861
In CA 408/438-2378

VISA MasterCard

Multiple Unit Discounts • Dealer Inquires
250 Technology Circle, Scotts Valley, CA 95066

Circle 11 on Reader Service Card

SAVE ON

9 TRACK TAPE SYSTEM

FOR IBM PC/XT/AT & PS-2

- Mainframe to PC Data Transfer
- High Speed Backup
- All Software, Complete System
- Service and Support, easy Installation

call **(818) 343-6505** or write to:

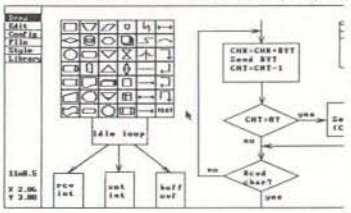
CONTECH Computer Corp.
P.O. Box 153 Tarzana, CA 91356

CONTECH

Circle 68 on Reader Service Card

TurboFlow $69

Flowchart drawing for IBM PC/XT/AT/PS2



$89 with Logitech mouse!

- Pop-up icon menus
- Variable size symbols
- Paper size to 34" x 44"
- Hercules mono, CGA, EGA
- HP-GL, DM/PL, SweetP Plotters
- Automatic PANning to scan drawing quickly
- IBM/EPSON, NEC, OKIDATA, HP LaserJet

Daytron Electronics Inc.
610 S. sherman #104, Richardson, Tx 75081
Add s&h ($4 USA, $15 foreign), Texas residents add 8% sales tax
for technical information call 214-669-2137

Order Today! 1-800-882-5822

Money-back guarantee

Circle 79 on Reader Service Card

nagan

SEAGATE		FAX	
ST-225 KIT	$220	Toshiba 3300	$798
ST-238 KIT	$255	Toshiba 30600	$1035
ST-251-0	$311	Panafax F100	$835
ST-251-1	$327	Sharp UX	$817

OTHERS

KEYBOARD 102 AT STYLE	$35
KEYBOARD 102 AT STYLE W/CLICK	$44
HAND SCANNER D.F.I. HS3000 PLUS	$171
HAND SCANNER LOGITECH	$169
SERIAL MOUSE LOGITECH	$67
BUS MOUSE LOGITECH	$72
MOUSE D.F.I.3. BUTTONS W/SOFTWARE	$37
MOUSE D.F.I.3. BUTTONS NO SOFTWARE	$31

10 pieces or more, except fax, all products are 100% IBM compatible. Check for more items.
1-800-683-2255

Nagan Corporation
8021 N.W. 14th St.
Miami, FL 33126
Tel: (305) 477-3929
Fax: (305) 477-4326
TLX: 159292NAGAN UT

Circle 186 on Reader Service Card

LOW·LOW·LOW

hp Laserjet *Printer* Series II $1650

hp Scanjet *Scanner* + interface kit $1355

IBM COMPAQ Apple ACER EVEREX AST & other

XT/AT Compatibles & 386 Computers
CALL for LOW PRICES

Gov't, Corporate, Schools, Dealers, & Export INQUIRIES WELCOME.

SURAH inc.

44862 Osgood Road, FREMONT, CA 94539
PH: (415) 651-5101 FAX: (415) 651-5241
1-800-543-1001
VISA, Master Card accepted. w/sc

Circle 265 on Reader Service Card

Statistical Navigator™

An expert system using AI strategies in helping to determine appropriate statistical analysis.

Version 1.1 - $99.95
(plus shipping and handling)

VISA, MC, AMEX, PO and Personal Checks accepted.

The Idea Works, Inc.
Call toll-free
1-800-537-4866
Missouri residents call
314-445-4554
FAX **314-445-4589**

IDEA·WORKS

Circle 271 on Reader Service Card

8051 SBC $99 oem qty 1

Single Board Computer

FEATURES: 8031, RAM and ROM Sockets, 8 bit I/O, RS 232 port, optional UART, and Expansion Bus. Size: 3.5" x 6.0", +5Vdc only. OPTIONS: 8032, CMOS, 18 MHz, NV Memory, Monitor Firmware and High Level Languages.
Development Board.....$199

8031 ICE $199

Our emulator provides most of the features of an 8031 In-Circuit-Emulator at a significantly lower price. It assists in integration, debug and test phases of development. Commands include: disassembly, trace, breakpoints, alter register/memory, and load Intel Hex file.

8051 Simulator Program..... $99
IBM PC/XT/AT Software simulation of 8051 µC.

HTE
HiTech Equipment Corporation
9400 Activity Road
San Diego, CA 92126
(619) 566-1892

Circle 120 on Reader Service Card

California Digital

17700 Figueroa Street ● Carson, California 90248

OPTICAL WORM $895

~~$2795~~

Write Once Read Many... California Digital has just purchased from **PRIAM CORPORATION**, 300 hundreds of Information Storage's ISI/525WC optical WORM drive. The WORM's were manufactured for Priam and bare the Priam logo. Chosen "Editors Choice" by PC Magazine, (March 29, 1988) the 525 provides 230 megabytes of random accessible data on each doubled sided flippy cartridge. (manually flipped).

Optical storage is the perfect medium for maintaining "on line" programs or other static data. Ideal for catalogs, part lists or any application where random accessibility is required.

The ISI/525 is available in IBM internal configuration but an external enclosure may be added. Supplied with one cartridge, ESDI/PC controller, cable and transparent optical software. For additional information, contact Steven in our technical support department (213) 217-1947. The ISI/525 is a current production drive.

$539 CD/ROM Complete Kit

Doctor, lawyer, indian chief . . . Virtually every industry and profession is disseminating information on CD/ROM. One compact disk, the same size as an audio disk, can store over 500 megabytes of data in High Sierra format.

Below is a listing of some of the CD/ROM drives currently available from California Digital. The best value is the Eclipse 430 external drive. The CDS/430 includes PC/XT interface, cables, sampler software and MS/DOS extension. It also offers an audio output feature for mulitmedia presentations. The system is Manufactured in Japan by one of the Worlds largest producers of magnetic storage equipment. A super value at only $539.

Eclipse 430 external system $539	NEC interface kit for above 159
Hitachi 1503S External system 695	Sony CD/510 internal drive only ..559
Hitachi 3500 Internal system 595	Sony 6101 external drive only 795
Hitachi internal drive only 519	Sony 230B interface kit 159
NEC CDR/77 External drive only .695	Panasonic LF5000 "write once" 1895
NEC CDR/80 Internal drive only ..639	Panasonic interface kit for above .359

40 Meg. Tape Back-up $179

~~$659~~

Head Crash, Power Spikes or just poor disk maintenance... Don't loose data because you didn't back up. The Alloy/40 is an inexpensive way to save and restore files in the event that your data has been destroyed. This 40 megabyte half height tape back is manufactured by North Americas largest producer of data retrieval equipment.

No need to purchase a separate tape controller... the Alloy/40 attaches directly to your existing floppy disk controller. Supplied software allows your computer to back up any time Day or Night. Come back in the morning and 40 megabytes of irreplacable data has been stored on one Scotch DC/2000 data cassette. Back up entire hard disk, modified files only, or by file name. Loss of data is inevitable but when you are backed up on an Alloy/40 its not a catastrophe. Model 250 for PC/XT $179; Model 500 for AT $239.

DISK DRIVES

5" DISK DRIVES

TEC501 ½ height sgl.side.....39	
TEC504 ½ ht. double sided 59	
TANDON 101/4 full ht. 96 TPI ..99	
TEAC FD55BR half height 89	
TEAC FD55FR 96 TPI, half ht..119	
TEAC FD55GFR for IBM AT..109	
PANASONIC 455 Half Height...89	
PANASONIC 475 1.2 Meg./AT..99	
Fujitsu 5¼" double sided 69	
Dual enclosure for 5¼" drives 69	

3½" DISK DRIVES

SONY MP-73W, 1.44 Meg 139	
TEAC 235HF 1.44 Meg.....99	
5¼" Form Factor Kit 20	

8" DISK DRIVES

QUME 842 double sided 189	
QUME 841 single sided.....99	
SHUGART 851R dbl.sided 319	
SHUGART 801R sgl.sided 259	
SIEMENS 100/8 sgl. sided.....119	
REMEX RFD4000 dbl. sided ..189	

Dest Scanner $559

~~$3995~~

Image scanning for OCR text, photographs, and line art. High resolution 300 DPI, the DEST PC Scan Plus/651 is capable of rendering photographs to 32 halftone shades. Also inputs text directly from printed pages to ASCII files or directly into most word processing programs. Electronic status display. Available for both the **Macintosh** (SCSI) or the IBM/PC. Please specify 115 or 230 volt.

Original price was over $3000, now is your chance to purchase a DEST scanner for only $559.

Saba Scanner $359

~~$499~~

The Saba Scanner inputs a printed page of evenly spaced text in less than three seconds. Included OCR software allows your computer to transfer printed pages into ASCII files or directly to spreadsheets and most word processing programs.

Archival data, legal briefs... No problem. Simply inset the page into the Saba and in seconds the document is digested into your computer and ready for editing. Also does line drawings that do not require gray tones. Limited quantities available. Original price $1299; now only $359.

SCANNERS

SABA SCANNERS		
page scanner with OCR software	1299	359
hand held scanner with OCR soft.	799	159
DEST SCANNERS		
PC/651 scan+ 32 shades	3995	559
2000 edge feed scanner	935	719
MICROTECH300G 256 gray scales	2195	1759
DFI HandiScan 300 with Halo	359	199
PRINCETON GRAPHICS LS-300	1095	789
PANASONIC		
RS505 Image page scanner	1499	999
RS506 Page scanner	1899	1259

EGA Color Monitor $219

Ideal for CAD/CAM and Desk Top publishing applications. The Roland CD/240 color monitor has a resolution of 720 pixels by 400/480 lines on a .31mm dot pitch 12" non-glare screen. VGA specifications in text mode EGA in graphic mode.

California Digital has made a special purchase and is able to offer the CD/240 EGA/VGA RGB color monitor for only $219.

Full featured, 132 column, multi-resolution video color adapter card available for only $139 additional. Comparable card package would retail for $1095.

Color Graphics Terminal

Lear Siegler 7107

$659

~~$3995~~

Thirteen inch color graphic terminal is both VT-100/51 and Tektronix 4010/4014 compatible. The 7107 offers a pallette of 4,096 colors on a 640 pixel by 480 line non-glare black screen.

Horizontal pan and image zoom, to 16 times original size make the 7107 the ideal terminal for CAD/CAM applications.

NEC/890 Laser $3095

PC Magazine has chosen the NEC-890 best laser printer of the year. (Jan. 12, 1988). And its obvious why... the printer is Postscript, Hewlett Packard, and Apple compatible, and comes standard with three megabytes of memory. The 890 accepts data from parallel, serial and Apple-Talk devices.

PRINTERS

HEWLETT PACKARD		
Laser Printer II, 300x300	2595	1659
Laser Printer II/D double sided	3995	2995
QMS PS/810 2 Meg., 35 fonts, Post/S.	5495	3879
APPLE Laser Writter NT	4550	3659
NEC890 Postscript, 3 meg	4975	3095

DIGITIZERS

HITACHI		
HDG 1212 Puma 12x12"	595	359
HDG 1515 15x15	969	659
Tiger 1111C, 12x12 stylus extra	727	487
HDG 3648, 36x48"	5357	3995
SUMMAGRAPHICS		
Summa 1201 plus 12x12"	599	379
TB 3648, 36x48"	4748	3729
KYE Genius Tablet w/4 but. mouse	599	279
CALCOMP		
25180, 12x18"	1275	999
91480, 36x48"	4118	3389

MicroSoft Mouse

Your choice, MicroSoft "Inport Buss Mouse" or "Serial Mouse". The industry standard, list price $150, now available for only $59. Includes software and manual. Packaged in OEM boxes.

$59

$795

~~$2455~~

Hitachi "B" Plotter

Automatic Paper Feeder

FAST... 22 inches per second. Size "B" four pen with auto pen capping and 128K/byte buffer. **HPGL** compatible, 19 built-in character fonts and automatic sheet feeder make the Hitachi 673 a super buy at only $795. RS/232 and centronics parallel.

PLOTTERS

HOUSTON INSTRUMENTS		
DMP 41 single pen, 3 ips, C&D	2995	2295
DMP 52 single pen, 16 ips, C&D	3295	2495
DMP 56C size A-E, 16 ips	5695	3095
DMP61 single pen, 32 ips, A-D	4295	3095
PC695A 4 pen, size "B" 3 ips	799	595
CALCOMP PLOTTERS		
1023 Artisan A-D, 8 pen, 30 ips	4895	3795
1043GT size A-E, 8 pen, 24 ips	7995	5495
HEWLETT PACKARD		
7475A 6 pen size "B"	1895	1495
7550A 8 pen size "B" 32 ips	3900	2995
7595A 8 pen, size A-E, 24 ips	9990	7595
HITACHI PLOTTERS		
673/BM 4 pen, size "B" auto feed	2455	795
675 size "A-D" 8 pen	5600	2995
FUJITSU Imagegraph, 6 pen, 11x32	1295	895
IOLINE PLOTTERS		
LP3700 size E, 10 ips	4195	3195
LP3700MP 8 pen size "E" 10 ips	4695	3495
ROLAND PLOTTERS		
DPX2000 size "C" 8 pen with stand	2995	2195
DPX3300size"D" 8 pen with stand	4995	3495
ENTER COMPUTER		
SP600 size "B" 6 pen	995	659
SP1000 single pen size A-D	3995	2795
JDL 850, size "C" one meg. memory	3845	2789
VERSATEC 8524 Electrostatic	16,900	13789
NUMONICS		
5460 size "A-D"	2495	1859
5860 size "A-D" 8 pen	7495	5759

CAD SOFTWARE

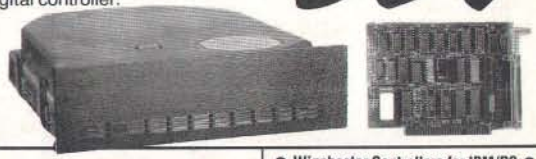
AUTODESK		
AutoCad version 10,	2995	2195
AutoSketch Std & Enhanced 2.0	99	79
VERSACAD Designer	2995	1995
GENERIC CAD level 1	49	35
AMERICAN SM. BUS'N. Design Cad	299	179

40 Megabyte Hard Disk Kit

$359

Forty megabyte internal hard disk drive, controller and cables all for only $359.

The kit includes the a 40 millisecond Miniscribe 3650 drive and a half slot Western Digital controller.



Five Inch Winchester Disk Drives

Price does not include controller.	each	two+
SEAGATE 225 20 Meg. ½ Ht.	239	229
SEAGATE 238 30 Meg. RLL	259	249
SEAGATE 251/1 51 M. 28mS.	459	445
SEAGATE 4096 96 M. 35mS.	559	539
MINISCRIBE 8425 25 M 65ms.	239	227
MINISCRIBE 3650 50M 61 ms.	319	309
MINISCRIBE 6085 90 meg.	459	435
MINISCRIBE 3053 25 ms. ½ ht.	359	339
FUJITSU 2242 55 M. 35mS.	1299	1229
FUJITSU 2243 86 M. 35mS.	1695	1619
RODIME RO-204E 53 Meg.	895	859
MAXTOR XT1140 140 Meg.	1495	1450
MAXTOR XT2190 192 Meg.	1919	1875
TOSHIBA MK56 70 M. 30mS.	1289	1229
CONTROL DATA WREN "V"	call	

● Winchester Controllers for IBM/PC ●

DTC 6280 AT/ESDI 1:1 interleave	229
DTC 5150 XT/MFM hard drive	69
DTC 7280 AT/MFM 1:1 interleave	189
ADAPTEC 2072 RLL controller	89
ADAPTEC 2372A 1:1 interleave	159
WESTERN DIGITAL WD/1002GEN	89
WESTERN DIG. 1006VMM2 1:1 & fpy.	139
WESTERN DIGITAL 1007VMM2 ESDI	239

● SCSI/SASI Winchester Controllers ●

ADAPTEC 5¼" foot print	259
WESTERN DIGITAL 1002-05E 5¼"	229
OMTI 20L	89

● Winchester Accessories ●

Dual floppy enc. and powersupply	59
Winchester enclosure and supply	139
Switching power supply	49

MMC MICROCOMPUTER MARKETING COUNCIL DIRECT MARKETING ASSOCIATION

master charge VISA

8:00 AM to 5:00 PM Pacific Time

Every year since 1973, customers from virtually every nation in the free World have chosen California Digital for their data processing requirements. **If its computer, California Digital has it...** complete minisystem or just one microchip. California Digital offers over 10,000 unique computer products. Regardless of how specialized your data processing requirements... California Digital is your one stop shopping solution.

TECHNICAL & CALIFORNIA
(213) 217-0500
TOLL FREE ORDER LINE
(800) 421-5041

Telefax ● (213) 217-1951

JDR Microdevices®

MMC MICROCOMPUTER MARKETING COUNCIL of the Direct Marketing Association, Inc.

30 DAY MONEY BACK GUARANTEE • 1 YEAR WARRANTY ON ALL PRODUCTS • TOLL-FREE TECHNICAL SUPPORT

MEMORY

DYNAMIC RAMS

PART#	SIZE	SPEED	PINS	PRICE
4116-150	16384x1	150ns	16	.99
4164-150	65536x1	150ns	16	2.49
4164-120	65536x1	120ns	16	2.89
4164-100	65536x1	100ns	16	3.39
TMS4464-12	65536x4	120ns	16	9.95
41256-150	262144x1	150ns	16	4.49
41256-120	262144x1	120ns	16	4.99
41256-100	262144x1	100ns	16	5.49
41256-80	262144x1	80ns	16	5.99
41256-60	262144x1	60ns	16	7.99
414256-100	262144x4	100ns	20	14.95
414256-80	262144x4	80ns	20	16.95
1 MB-120	1048576x1	120ns	18	13.95
1 MB-100	1048576x1	100ns	18	14.95
1 MB-80	1048576x1	80ns	18	15.95

SIMM MODULES

PART#	SIZE	SPEED	FOR	PRICE
41256A9B-12	256K x 9	120ns	PC	59.95
41256A9B-80	256K x 9	80ns	PC	69.95
421000A8B-10	1MB x 8	100ns	MAC	169.95
421000A9B-10	1MB x 9	100ns	PC	169.95
421000A9B-80	1MB x 9	80ns	PC	179.95

STATIC RAMS

PART#	SIZE	SPEED	PINS	PRICE
TMM2016-150	2048x8	150ns	24	3.25
HM6116LP-2	2048x8	120ns	24	5.49
HM6264LP-15	8192x8	150ns	28	8.95
HM6264LP-12	8192x8	120ns	28	9.95
HM43256LP-15	32768x8	150ns	28	19.95
HM43256LP-12	32768x8	120ns	28	21.95
HM43256LP-10	32768x8	100ns	28	24.95

MATH COPROCESSORS

intel 5 YEAR WARRANTY

8-BIT COPROCESSORS			
8087	5 MHz	89.95	
8087-2	8 MHz	129.95	
8087-1	10 MHz	169.95	
16-BIT COPROCESSORS			
80287	6 MHz	139.95	
80287-8	8 MHz	209.95	
80287-10	10 MHz	239.95	
32-BIT COPROCESSORS			
80387-16	16 MHz	359.95	
80387-SX	16 MHz	319.95	
80387-20	20 MHz	399.95	
80387-25	25 MHz	499.95	
80387-33	33MHz	649.95	

INCLUDES MANUAL & SOFTWARE GUIDE

74 SERIES LOGIC

7400	.19	74LS32	.18	74LS245	.79
74LS00	.16	74LS73	.29	74LS273	.79
74LS02	.17	7474	.33	74S288	1.69
7404	.19	74LS74	.24	74LS322	3.95
74LS04	.16	74S74	.49	74LS367	.39
74S04	.29	74LS138	.39	74LS373	.79
7406	.29	74LS155	.59	74LS374	.79
7408	.24	74LS163	.39	74LS393	.79
74LS08	.18	74LS240	.69	74LS682	3.20
7432	.29	74LS244	.69	74LS688	2.40

C.P.U.'s

8000	
8052AH BASIC	34.95
8088	5.99
8250	6.95
8251A	1.69
8253-5	1.95
8254	9.95
8255-5	2.49
8741	9.95
8748	7.95
8749	9.95
8755	14.95
6500	
65C02*	7.95
6522	2.95
V-20	
V20	6.95
V20-8	8.95
V20-10	11.95
V30	13.95

MISC

DAC0800	3.29
1793	9.95
COM8116	8.95
MC146818	5.95
MM58167	9.95
INS8250	6.95
NS16450	10.95
LM317T	.69
NE555	.29
LM741	.29
7805T	.49
7812T	.49
75150	1.95
75154	1.95
14411	9.95

CRYSTAL OSCILLATORS

1.0MHz	5.95
1.8432	5.95
20.0	4.95
24.0	4.95

PALS

16L8	2.95
16R4	2.95
16R6	2.95
16R8	2.95
20L8	4.95
20R4	4.95
20R6	4.95
20R8	4.95
20X8	4.95

PAL KIT

AN ENTRY-LEVEL COMPLETE PAL DEVELOPMENT KIT FROM CUPL. FULL SUPPORT FOR 16L8, 16R4, 16R6, 16R8, 20L8, 20R4, 20R6, 20R8, AND 20X8.
MOD-MPL-SOFT $99.95

Derick's HIGH-TECH SPOTLIGHT

Call our BBS: (408) 559-0253 for more info in SIG file"Hitech"

This month's topic is floppy drive compatibility. There are 360K 5-1/4", 720K 3-1/2", 1.2Meg 5-1/4" and 1.44Meg 3-1/2" drives, any of which can be used on most PC's and PC clones. *Recent improvements in floppy controllers make using high density drives on 8088-based machines a viable option.*

To simplify, we'll eliminate the redundant choices. A 1.2Meg drive can work with both high density 1.2Meg floppies and low density 360K floppies.* A high density 3-1/2" 1.44Meg drive can use both the high density1.44Meg and the low density 720K disks. Unless you know that you will never need high density capability, a good universal standard is one 3-1/2" and one 5-1/4" high density drive.

Now for the bomb! Big Blue uses a different method to distinguish between 720K and 1.44Meg drives. While most of the manufacturers look for and detect the High Density hole in a high density diskette, they read the data to make that determination. This causes a problem when a Low Density disk without the hole is written in the high density mode. So if you get a 3-1/2" disk that a friend says is formatted at 1.44Meg, make sure it has a High Density hole or it probably won't read in your clone.

Derick Moore, Director of Engineering

*An infrequent problem can occur when a 360K drive is written in a 1.2Meg drive and is then read in a 360K drive.

EPROMS

PART#	SIZE	SPEED	Vpp	PINS	PRICE
2708	1024x8	450ns	25V	24	4.95
2716	2048x8	450ns	25V	24	3.49
2716-1	2048x8	350ns	25V	24	3.95
2732A	4096x8	250ns	21V	24	3.95
2764	8192x8	450ns	12.5V	28	3.49
2764-250	8192x8	250ns	12.5V	28	3.69
2764-200	8192x8	200ns	12.5V	28	4.25
27C64	8192x8	250ns	12.5V	28	4.95
27128	16384x8	250ns	12.5V	28	4.25
27128A-200	16384x8	200ns	12.5V	28	5.95
27256	32768x8	250ns	12.5V	28	4.95
27256-200	32768x8	200ns	12.5V	28	5.95
27C256	32768x8	250ns	12.5V	28	5.95
27512	65536x8	250ns	12.5V	28	8.95
27C512	65536x8	250ns	12.5V	28	9.95
27C101-20	131072x8	200ns	12.5V	32	29.95

EPROM ERASERS

DATARASE II $39.95
- SHIRT POCKET SIZE!
- ALL SIZES UP TO 4 AT A TIME
- ERASES MOST EPROMS IN 3 MINUTES

DATARASE II

SPECTRONICS CORPORATION

Model	Timer	# of Chips	Intensity (uW/Cm²)	Unit Cost
PE-140	NO	9	8,000	$ 89
PE-140T	YES	9	8,000	$139
PE-240T	YES	12	9,600	$189
PL-265T	YES	30	9,600	$255

POWER SUPPLIES

135 WATT POWER SUPPLY
- UL APPROVED
- +5V @15A, +12V @ 4.2A, -5V @ .5A, -12V @ .5A

PS-135 $59.95
PS-150 150W SUPPLY $69.95

200 WATT POWER SUPPLY
- UL APPROVED
- +5V @ 20A, +12V @ 7A, -5V @ .5A, -12V @ .5A

PS-200 $89.95

APPLE TYPE SUPPLY
- WITH APPLE CONNECTOR
- +5V @ 6A, +12V @ 3A, -5V @ 1A, -12V @ 1A

PS-A $59.95

PROTOTYPE CARDS

FR-4 EPOXY GLASS LAMINATE WITH GOLD PLATED EDGECARD FINGERS AND SILK SCREENED LEGENDS

FOR XT		
JDR-PR1	WITH +5V AND GROUND PLANE	27.95
JDR-PR2	ABOVE WITH I/O DECODING LAYOUT	29.95
JDR-PR2-PK	PARTS KIT FOR JDR-PR2 ABOVE	8.95
FOR AT		
JDR-PR10	BIT WITH I/O DECODING LAYOUT	34.95
JDR-PR10-PK	PARTS KIT FOR JDR-PR10 ABOVE	12.95
FOR PS/2		
JDR-PR32	32 BIT PROTOTYPE CARD	69.95
JDR-PR16	16 BIT WITH I/O DECODING LAYOUT	49.95
JDR-PR16-PK	PARTS KIT FOR JDR-PR16 ABOVE	15.95
JDR-PR16V	16 BIT FOR VIDEO APPLICATIONS	39.95
EXTENDER CARDS		
SIMPLIFY PROTOTYPING AND TESTING		
EXT-8088	8-BIT FOR 8088 MOTHERBOARDS	29.95
EXT-80286	16-BIT FOR 286/386 MOTHERBOARDS	39.95
EXT-16	MICROCHANNEL 16-BIT	69.95
EXT-32	MICROCHANNEL 32-BIT	99.95

PC BREADBOARD-ON-A-CARD

- 62 BUS LINES
- USE UP TO 24 14-PIN ICS
- 1940 TIE POINTS
- DB25 D-SUB CONNECT.

PDS-604 $49.95

SOLDER STATION

- UL APPROVED
- ADJUSTABLE HEAT SETTING
- TIP TEMPERATURE READOUT
- REPLACEMENT TIPS @ $2.95

168-3C $59.95

IC SOCKETS/DIP CONNECTORS

SOLDERTAIL		WIREWRAP		ZIF SOCKETS	
8 PIN ST	.11	8 PIN WW	.59	ZIF-14	5.95
14 PIN ST	.11	14 PIN WW	.69	ZIF-16	5.95
16 PIN ST	.12	16 PIN WW	.69	ZIF-20	6.95
18 PIN ST	.15	18 PIN WW	.99	ZIF-24	7.95
20 PIN ST	.18	20 PIN WW	1.09	ZIF-28	7.95
24 PIN ST	.20	24 PIN WW	1.49	ZIF-40	10.95
28 PIN ST	.22	28 PIN WW	1.69		
40 PIN ST	.30	40 PIN WW	1.99		

VOLUME DISCOUNTS CALL!

SOLDER-CUP D-SUBS

MALE		FEMALE	
DB09P	.45	DB09S	.49
DB15P	.59	DB15S	.69
HDB15P	1.49	HDB15S	1.59
DB19P	.69	DB19S	.75
DB25P	.69	DB25S	.75
DB37P	1.35	DB37S	1.39
DB50P	1.85	DB50S	2.29

IDC'S

IDE20	.55
IDE34	.89
IDS20	.65
IDS34	.75
IDB09P	1.39
IDB09S	1.45
IDB25P	2.25
IDB25S	2.35

CABLES AND GENDER CHANGERS

MOLDED; GOLD-PLATED CONTACTS; 100% SHIELDED

CBL-PRINTER	6 FT. PC PRINTER CABLE	9.95
CBL-PRNTR-25	25 FT. PC PRINTER CABLE	15.95
CBL-PRINTR-RA	RIGHT ANGLE PRINTER CABLE	15.95
CBL-DB25-MM	DB25 MALE-DB25 MALE 6 FT.	9.95
CBL-DB25-MF	DB25 MALE-DB25 FEMALE 6 FT.	9.95
CBL-9-SERIAL	DB9 FEMALE-DB25 MALE 6 FT.	6.95
CBL-KBD-EXT	5 FT. KEYBOARD EXTENSION	7.95
CBL-CNT-MM	36-PIN CENTRONICS -M/M	14.95
CBL-FDC-EXT	37-PIN EXT. FLOPPY CABLE	9.95
CBL-MNT-9	9-PIN MONITOR EXTENSION	6.95
CBL-MNT-15	15-PIN MONITOR EXTENSION CABLE	9.95
CBL-MODEM	MODEM -DB25-DB25 FEMALE	6.95
GENDER-VGA	DB9-DB15 ADAPTOR	4.95
GENDER-9-25	DB9-DB25 SERIAL ADAPTOR	4.95

PARTIAL LISTINGS ONLY—CALL FOR FREE 84-PG CATALOG!

JDR MICRODEVICES AND THE JDR MICRODEVICES LOGO ARE REGISTERED TRADEMARKS OF JDR MICRODEVICES. IBM, AT, PS/2 ARE TRADEMARKS OF INTERNATIONAL BUSINESS MACHINES.

Circle 140 on Reader Service Card

FULL SIZE SLIDE CASE $89

- DESIGNED FOR FULL SIZE 286/386 MOTHERBOARDS
- USES STANDARD AT-COMPATIBLE POWER SUPPLIES
- DRIVE MOUNTS FOR THREE FLOPPY AND TWO HARD DRIVES
- RESET SWITCH AND KEYLOCK
- POWER-ON, TURBO AND DISK LEDS
- INCLUDES ALL MOUNTING HARDWARE

CASE-70
CASE-50 FOR 8088 OR MINI-86 MOTHERBOARDS **$59.95**
CASE-FLIP FLIP-TOP XT-STYLE CASE **$39.95**
CASE-SLIDE SLIDE TYPE XT-STYLE CASE **$39.95**
CASE-JR **$149.95**
WITH 150W POWER SUPPLY. FOR 8088 OR MINI-286 BOARDS.
CASE-JR-200 ..... **$189.95**
WITH 200W POWER SUPPLY. FOR 8088 OR MINI-286 BOARDS.

UPRIGHT CASE $299.95

SLEEK DESIGN SAVES DESK SPACE, ADDS STYLE !

- ACCOMODATES ALL SIZES OF MOTHERBOARDS
- INCLUDES 250 WATT POWER SUPPLY
- MOUNTS FOR 3 FLOPPY AND 4 HARD DRIVES
- TURBO AND RESET SWITCHES
- SPEED DISPLAY, POWER, DISK LEDS
- MOUNTING HARDWARE, FACEPLATES AND SPEAKER INCLUDED

CASE-100

" I just had to write and express our gratitude for your fine, service oriented business. We have found your firm to be very friendly, prompt and professional!"
— Tim Brown, Galesburg, IL

intel INBOARD 386 $649

RUN YOUR XT COMPATIBLE UP TO 10 TIMES FASTER! REPLACES YOUR 8088 PROCESSOR WITH AN 80386 WHILE STILL USING YOUR EXISTING COMPONENTS.

- 16 MHZ 80386 MICROPROCESSOR • 1MB RAM INSTALLED
- SOCKETED FOR 80387 MATH COPROCESSOR • OPTIONAL 1MB OR 2MB PIGGYBACK MEMORY BOARD

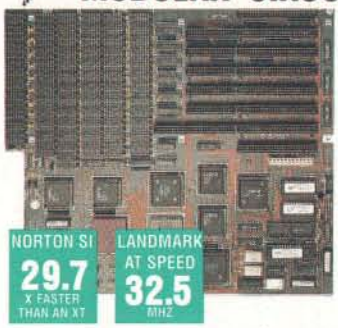
PCIB1200
PCIB1210 1MB PIGGYBACK MEMORY BOARD **$475.00**
PCIB1220 2MB PIGGYBACK MEMORY BOARD **$895.00**

EPROM PROGRAMMER $129.95

- PROGRAMS 27XX AND 27XXX EPROMS UP TO 27512
- SPLIT OR COMBINE CONTENTS OF SEVERAL EPROMS OF DIFFERENT SIZES
- SUPPORTS VARIOUS PROGRAMMING FORMATS AND VOLTAGES
- READ, WRITE, COPY, BLANK CHECK AND VERIFY
- SOFTWARE FOR HEX AND INTEL HEX FORMATS

MOD-EPROM

MODULAR CIRCUIT TECHNOLOGY



25MHZ 386 $1049

THE INTELLIGENTLY DESIGNED BOARD INCORPORATES THE BEST FEATURES OF CURRENT 386 TECHNOLOGY.

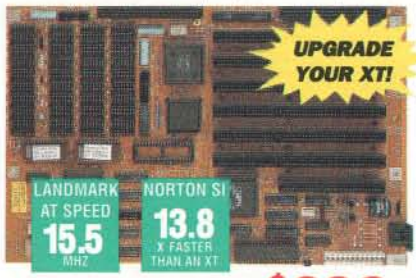
- ACCELERATED 80386 MPU RUNS AT 25MHZ • 10MHZ/25MHZ KEYBOARD SELECTABLE SPEEDS • 16MB RAM CAPACITY: 8MB ON BOARD, 8MB USING OPTIONAL RAM CARD (ØKB INSTALLED) • USES 256K OR 1MB DRAMS (80NS FOR 1 WAIT, 60NS FOR Ø WAITSTATES) • SHADOW RAM FOR BIOS AND VIDEO • 8 EXPANSION SLOTS (ONE 32-BIT, FIVE 16-BIT, TWO 8-BIT) • ADJUSTABLE BUS SPEEDS • INTERLEAVED MEMORY • NEAR ZERO WAIT STATE OPERATION • AMI BIOS

MCT-386MB25
MCT-386MB20 20MHZ VERSION **$849.00**
MCT-386-M 8MB RAM CARD (ØKB) **$149.95**

20MHZ 286 $589.95

- BENCHMARK SPEEDS UP TO 25.8MHZ • EXPRESS RAM SLOT FOR 8MB OF Ø WAIT STATE RAM USING AN OPTIONAL RAM CARD • 10MHZ/20MHZ KEYBOARD SELECTABLE SPEEDS • 1MB ON-BOARD RAM CAPACITY (ØKB INSTALLED) • USES 256K DRAMS (60NS FOR Ø WAITS, 80/100NS FOR NEAR ZERO WAITS) • 8 EXPANSION SLOTS: ONE EXPRESS RAM SLOT, ONE 8-BIT AND SIX 16-BIT SLOTS • PHOENIX BIOS • 8MHZ BUS SPEED
- SOCKETED FOR 80287 COPROCESSOR
- 8-1/2" X 13" WITH XT HOLE SPACING

MCT-M286-20
MCT-M286-16 8MHZ/16MHZ VERSION **$489.95**
MCT-M286-M 8 MB RAM CARD (ØKB) **$119.95**
MCT-M286-MIO **$149.95**
8 MB RAM CARD WITH PARALLEL AND SERIAL PORTS (ØKB INSTALLED)



12MHZ 286 $299

- AT COMPATIBLE OPERATES AT 8/12 MHZ • KEYBOARD SELECTABLE CLOCK SPEEDS • NOW EXPANDABLE TO 4MB ON BOARD USING 1MB DRAMS (ØKB INSTALLED) • USES 256K OR 1MB DRAMS (100NS FOR 1 WAIT, 80NS FOR Ø WAITSTATES) • SIX 16-BIT AND TWO 8-BIT SLOTS, 8MHZ BUS SPEED • AMI BIOS • AUTO RECHARGING NICAD BATTERY • SUPPORT FOR POWER-ON AND SPEED INDICATORS • KEYLOCK AND RESET SWITCHES
- 8-1/2" X 13" WITH XT HOLE SPACING

MCT-M286-12
MCT-M286 10 MHZ VERSION **$269.95**

10MHZ 8088 $99.95

GET IMPROVED RELIABILITY AND LESS POWER CONSUMPTION WITH THIS "SINGLE CHIP" DESIGN!

- XT COMPATIBLE; OPERATES AT 4.77/10MHZ • KEYBOARD SELECTABLE CLOCK SPEEDS • SOCKETED FOR 8087-1 COPROCESSOR • 8 EXPANSION SLOTS • MCT BIOS
- 640K RAM CAPACITY (ØKB INSTALLED) • SUPPORTS KEYLOCK, RESET AND TURBO SWITCHES • POWER-ON & TURBO-MODE LEDS SUPPORTED • ONLY 8-1/2" X 9"

MCT-TURBO-10
MCT-TURBO 4.77/8 MHZ TURBO MOTHERBOARD **$95.95**
MCT-XMB 4.77 MHZ MOTHERBOARD **$87.95**

MODULAR PROGRAMMING SYSTEM

OUR INTEGRATED MODULAR SYSTEM EASILY EXPANDS! ALL THE MODULES USE A COMMON HOST ADAPTOR CARD—USE JUST ONE SLOT TO PROGRAM EPROMS, PROMS, PALS & MORE!

COMMON HOST ADAPTOR CARD $29.95

- UNIVERSAL INTERFACE FOR ALL THE PROGRAMMING MODULES!
- SELECTABLE ADDRESSES PREVENTS CONFLICTS
- MOLDED CABLE

MOD-MAC

UNIVERSAL MODULE $499.95

- PROGRAMS EPROMS, EEPROMS, PALS, BI-POLAR PROMS, 8748 & 8751 SERIES DEVICES; 16V8 AND 20V8 GALS (GENERIC ARRAY LOGIC) FROM LATTICE,NS, SGS • TESTS TTL, CMOS, DYNAMIC & STATIC RAMS • LOAD DISK, SAVE DISK, EDIT, BLANK CHECK, PROGRAM, AUTO, READ MASTER, VERIFY AND COMPARE • TEXTOOL SOCKET FOR .3" TO .6" WIDE IC'S (8-40 PINS)

MOD-MUP

EPROM MODULE $119.95

- PROGRAMS 24-32 PIN EPROMS, CMOS EPROMS & EEPROMS FROM 16K TO 1024K • HEX TO OBJ CONVERTER • AUTO, BLANK CHECK/PROGRAM/VERIFY • VPP 5, 12.5, 12.75, 13, 21 & 25 VOLTS • NORMAL, INTELLIGENT, INTERACTIVE & QUICK PULSE PROGRAMMING ALGORITHMS

MOD-MEP
MOD-MEP-4 4-EPROM PROGRAMMER **$169.95**
MOD-MEP-8 8-EPROM PROGRAMMER **$259.95**
MOD-MEP-16 16-EPROM PROGRAMMER **$499.95**

DIGITAL IC MODULE $129.95

- TESTS TTL, CMOS, DYNAMIC & STATIC RAM
- AUTO SEARCH FOR UNKNOWN PART NUMBERS
- USER-PROGRAMMABLE TEST PROCEDURES

MOD-MIC

PAL MODULE $249.95

- PROGRAMS MMI, NS, TI 20 & TI 24 PIN DEVICES
- BLANK CHECK, PROGRAM, AUTO, READMASTER, VERIFY & SECURITY FUSE BLOW

MOD-MPL

CUPL SOFTWARE $99.95

COMPLETE ENTRY-LEVEL PAL DEVELOPMENT KIT.

MOD-MPL-SOFT

VISA MasterCard

ORDER TOLL-FREE 800-538-5000

MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 10 A.M. TO 3 P.M. (PST)

COPYRIGHT 1989 JDR MICRODEVICES

JDR MICRODEVICES 2233 BRANHAM LANE.
SAN JOSE, CA 95124 (408) 559-1200
FAX (408) 559-0250 TELEX 171-110

RETAIL STORE: 1256 S. BASCOM AVE.,
SAN JOSE, CA (408) 947-8881
HOURS: M-F 9-7, SAT. 9-5, SUN. 12-4

JDR Microdevices®

MMC MICROCOMPUTER MARKETING COUNCIL of the Direct Marketing Association, Inc.

30 DAY MONEY BACK GUARANTEE • 1 YEAR WARRANTY ON ALL PRODUCTS • TOLL-FREE TECHNICAL SUPPORT

VGA graphics

RELISYS
VGA MONITOR $359
14" ANALOG VGA MONITOR WITH GLARE-RESISTANT SCREEN • 720 X 480 MAXIMUM RESOLUTION • TILT/SWIVEL BASE • CONTRAST AND BRIGHTNESS CONTROLS
VGA-MONITOR

SAMSUNG FLAT $129.95
ONE OF THE BEST MONOCHROME MONITORS! • 12" FLAT SCREEN REDUCES DISTORTION • AMBER DISPLAY • 720 X 350 RESOLUTION
MONO-SAMSUNG

RELISYS **MULTISYNCH $429**
AN EXCEPTIONAL VALUE ON AN OUTSTANDING DISPLAY! • 14" NON-GLARE SCREEN • 1024 X 768 MAXIMUM HIGH RESOLUTION • CGA/EGA/VGA COMPATIBLE • TTL OR ANALOG MODE OPERATION
JDR-MULTI

NEC MULTISYNC 3D $649.95
• 1024 X 768 MAX RESOLUTION • CGA/EGA/VGA/MCGA/PGC COMPATIBLE • HERCULES AND OTHER STANDARD ADAPTORS
NEC-MULTI

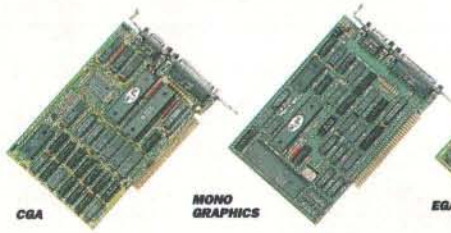
RGB COLOR $239.95
• CGA MODE DISPLAYS UP TO 16 COLORS, MONOCHROME MODE FOR TEXT • 14" GLARE-RESISTANT SCREEN • 640 X 200 MONOCHROME • 320 X 200 COLOR RESOLUTION
JDR-RGB

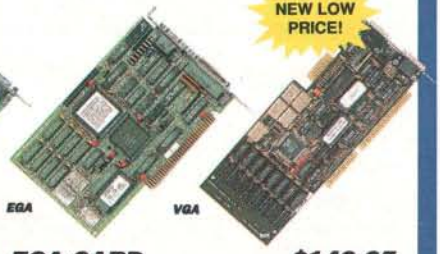
VGA PACKAGE $499
VGA COLOR AND CLARITY AT AN EGA PRICE! • 8-BIT VGA CARD IS FULLY COMPATIBLE WITH IBM VGA • 720 X 540 MAXIMUM RESOLUTION, 640 X 480 IN 16 COLORS • 528 X 480 RESOLUTION IN 256 COLORS • IBM STYLE, HIGH RESOLUTION ANALOG MONITOR • EGA/CGA/MONCHROME AND HERCULES COMPATIBLE • DRIVERS FOR WINDOWS, GEM, 1-2-3, SYMPHONY, AUTOCAD AND VENTURA
VGA-PKG

EGA MONITOR $339.00
• 14" NON-GLARE SCREEN WITH 640 X 350 MAXIMUM RESOLUTION • DISPLAY 16 COLORS SIMULTANEOUSLY
EGA-MONITOR

LARGE SCREEN MONO $139
• GLARE-RESISTANT 14" SCREEN WITH AMBER DISPLAY • 720 X 350 RESOLUTION • TILT/SWIVEL BASE • FRONT MOUNTED CONTROLS
GM-1488

PAPER WHITE VGA $119.95
GRAY SCALE MONITOR— PERFECT FOR DESKTOP PUBLISHING! • ULTRA HIGH-RESOLUTION 800 X 480 • 14" GLARE RESISTANT SCREEN • TILT/SWIVEL BASE
MONO-VGA





CGA CARD $49.95
IBM-COMPATIBLE ADAPTOR FOR RGB MONITORS • 640 X 200 MONO, 320 X 200 COLOR RESOLUTION • DISPLAYS 4 COLORS SIMULTANEOUSLY • LIGHT PEN INTERFACE
MCT-CG
MCT-CGP WITH PRINTER PORT $59.95
CG-COMP COMPOSITE ADAPTOR $4.95

MONO GRAPHICS $59.95
XT AND AT-COMPATIBLE • HERCULES COMPATIBLE MONOGRAPHICS • SUPPORTS LOTUS 1-2-3 • HIGH RESOLUTION 720 X 348 DISPLAY • VLSI CHIPS • CONFIGURE THE PARALLEL PRINTER PORT AS LPT1 OR 2
MCT-MGP

EGA CARD $149.95
• 640 X 350 HIGH RESOLUTION • DISPLAYS 16 COLORS AT A TIME • COMPATIBLE WITH HERCULES, CGA AND IBM MONOCHROME • SOFTWARE DRIVERS FOR WINDOWS, LOTUS, CAD, AND MORE • 256K VIDEO RAM.
MCT-EGA

16-BIT VGA $249.95
• 1024 X 768 RESOLUTION • 256K VIDEO RAM EXPANDABLE TO 512K • 64 LEVELS OF GRAY SCALE
MCT-VGA-16
MCT-VGA-8 8-BIT VERSION $199.95

FEDERAL EXPRESS **NEED IT TOMORROW?**

No problem! Just place your order by 10:00 (PST) today, and ask us to ship it Federal Express® overnight delivery.

CALL OUR 24-HR BBS
(408) 559-0253
• ON-LINE ORDERING • CONFERENCING • • TECHNICAL INFORMATION •

ENHANCED 101-KEY KEYBOARD $69.95
• ENHANCED 101-KEY LAYOUT • EXTRA LARGE SHIFT & RETURN KEYS • AUTO-REPEAT • XT OR AT COMPATIBLE • LEDS FOR SCROLL, CAPS AND NUM LOCK
BTC-5339
BTC-5339R COMPACT 101-KEY $79.95
MAX-5339 MAXI-SWITCH 101-KEY $84.95
K103-A AUDIBLE " CLICK" 101-KEY $84.95

STANDARD 84-KEY KEYBOARD $59.95
• AUTO ADJUSTS FOR XT OR AT • AT STYLE LAYOUT • EXTRA LARGE SHIFT AND RETURN KEYS • AUTO REPEAT • LEDS FOR SCROLL, CAPS AND NUM LOCK
BTC-5060
MAX-5060 MAXI-SWITCH 84-KEY $64.95
BTC-5150 XT-STYLE 83-KEY $59.95

MODULAR CIRCUIT TECHNOLOGY

DRIVE CONTROLLERS

FLOPPY DISK CONTROLLER $29.95
• INTERFACES UP TO 4 FLOPPY DRIVES TO IBM PC OR COMPATIBLE • DS/DD AND DS/DQ COMPATIBLE
MCT-FDC

1.44MB FLOPPY CONTROLLER $49.95
• SUPPORTS 2 FLOPPY DRIVES (360K, 720K, 1.2MB & 1.44MB) • ELIMINATES THE NEED FOR SOFTWARE DEVICE DRIVERS
MCT-FDC-HD
MCT-FDC-HD4 4 DRIVE CONTROLLER $59.95

HARD DISK CONTROLLER $79.95
• SUPPORTS 16 DRIVE SIZES INCLUDING 10, 20, 30 AND 40MB • CAN DIVIDE 1 LARGE DRIVE INTO 2 LOGICAL DRIVES
MCT-HDC

RLL CONTROLLER $89.95
• SUPPORTS 2 RLL HARD DRIVES • 50% FASTER DATA TRANSFER • DESIGNED FOR XT-COMPATIBLES
MCT-RLL

286/386 F/H CONTROLLER $149.95
• FLOPPY/HARD DISK CONTROL IN AN AT DESIGN • FOR UP TO 2 FLOPPIES (360K/720K/1.2MB/1.44MB) & 2 HARD DRIVES
MCT-AFH

286/386 RLL CONTROLLER $199.95
• IMPROVES AT COMPATIBLE'S SPEED & STORAGE • FOR UP TO 2 RLL HDD'S & 2 FDD'S (360K/720K/1.2MB 1.44MB)
MCT-AFH-RLL

MULTIFUNCTION I/O CARDS

MULTI I/O FLOPPY CONTROLLER $79.95
• SUPPORTS UP TO 2 360K FLOPPIES • SERIAL, PARALLEL, GAME PORT AND CLOCK/CALENDAR
MCT-MIO

MULTI I/O CARD $59.95
• SERIAL PORT • CLOCK/CALENDAR WITH BATTERY • PARALLEL PORT IS ADDRESSABLE AS LPT1 OR LPT2
MCT-IO

286/386 MULTIFUNCTION $139.95
• ADDS 1.5MB TO YOUR AT 3MB W/ OPTIONAL PIGGYBACK CARD (ØK INSTALLED) • SERIAL, PARALLEL PORTS.
MCT-AMF
MCT-AMF-MC 1.5MB PIGGYBACK BOARD $29.95

286/386 MULTI I/O CARD $59.95
• SERIAL, PARALLEL AND GAME PORTS • USES 16450 SERIAL SUPPORT CHIPS FOR HIGH SPEED OPERATION
MCT-AIO

MONOGRAPHICS MULTI I/O $119.75
• CONTROL 2 FLOPPIES • SERIAL, PARALLEL, GAME PORT, CLOCK/CALENDAR • RUNS COLOR GRAPHICS SOFTWARE ON YOUR BLACK AND WHITE MONITOR.
MCT-MGMIO

COPYRIGHT 1989 JDR MICRODEVICES. IBM, AT AND PS 2 ARE REGISTERED TRADEMARKS OF INTERNATIONAL BUSINESS MACHINES APPLE AND MACINTOSH ARE TRADEMARKS OF APPLE COMPUTER INC.

Circle 141 on Reader Service Card

$99.95 1.44MB 3-1/2" DRIVE

- 80 TRACKS • 135 TPI • ULTRA HIGH DENSITY
- READ/WRITE 720K DISKS, TOO
- INCLUDES ALL NECESSARY MOUNTING HARDWARE

FDD-1.44X BLACK FACEPLATE
FDD-1.44A BEIGE FACEPLATE

FDD-1.44SOFT	SOFTWARE DRIVER	$19.95
FDD-3.5X	3-1/2" 720K (BLACK)	$97.95
FDD-3.5A	3-1/2" 720K (BEIGE)	$97.95
MF355A	3-1/2" MITSUBISHI 1.44MB, BEIGE	$129.95
MF355X	3-1/2" MITSUBISHI 1.44MB, BLACK	$129.95

5-1/4" FLOPPY DISK DRIVE $69.95

FDD-360	5-1/4" DOUBLE-SIDED DD 360K	$69.95
M2551A	5-1/4" FUJITSU DOUBLE-SIDED DD 360K	$89.95
FD-55B	5-1/4" TEAC DOUBLE-SIDED DD 360K	$99.95
FDD-1.2	5-1/4" DOUBLE-SIDED HD 1.2M	$95.95
M2553K	5-1/4" FUJITSU DOUBLE-SIDED HD 1.2M	$119.95
FD-55G	5-1/4" TEAC DOUBLE-SIDED HD 1.2M	$129.95
FD-55F	5-1/4" TEAC DOUBLE SIDED, QD720K	$119.95

ARCHIVE TAPE BACK-UPS

AR5240X	40 MB TAPE DRIVE FOR XT'S & AT'S	$369.95
AR5540A	FAST 40 MB TAPE DRIVE AT'S ONLY	$369.95
AR2020	EXTERNAL CHASSIS & INTERFACE	$159.95
AR20A	ADDITIONAL INTERFACE CARDS	$89.95
AR340	40 MB TAPE CARTRIDGE	$24.95

HANDY SCANNER 3000 PLUS DFI $219.95

- NEW IMPROVED IMAGE CLARITY
- NEW ERGONOMIC DESIGN • NOW 2 MORE ROLLERS FOR STRAIGHT TRACKING • NEW SPEED OVERRUN WARNING LIGHT • SCANNER CARD HAS BUILT-IN OPTIONAL MOUSE PORT • INCLUDES ZSOFT'S PC PAINTBRUSH PLUS AND IMAGE TOOLS • QUICKLY SCANS IMAGES UP TO 4" WIDE AT 100, 200, 300, OR 400 DPI IN BOTH DIRECTIONS • B&W AND THREE HALF-TONE MODES • 32 LEVELS OF GRAY SCALE
- HERCULES, EGA AND CGA COMPATIBLE
- DON'T MISS THIS EXCELLENT VALUE!

HS-3000
OCR-SOFT CHARACTER RECOGNITION SOFTWARE $99.95

SERIAL MOUSE $39.95 DFI

- 3-BUTTON OPTO-MECHANICAL
- 200 D.P.I. • 5-1/2' CABLE
- USES SERIAL PORT COM 1/2
- INCLUDES SOFTWARE DRIVERS

DMS-200E
MOUSE & HALO-DPE SOFTWARE.
DMS-200 $59.95

LOGITECH MICE

- THREE-BUTTON SERIES 9
- 320 DPI RESOLUTION
- SERIAL PS/2 COMPATIBLE.

LOGC9	SERIAL MOUSE	$98.95
LOGC9-C	SERIAL MOUSE*	$79.95
LOGC9-P	SERIAL MOUSE WITH PAINTSHOW	$109.95
LOGC9-PC	SERIAL MOUSE WITH PAINT/CAD	$154.95
LOGB9	BUS MOUSE	$89.95
LOGB9-P	BUS MOUSE WITH PAINTSHOW	$104.95
LOGB9-PC	BUS MOUSE WITH PAINT/CAD	$149.95

*NOT PS/2 COMPATIBLE

HARD DISKS

20 MB	$199	60 MB	$389
30 MB	$219	80 MB	$569
40 MB	$319		
28 MS	$389		

KITS

20 MB	$249
30 MB	$279

Seagate

NEW LOW PRICES!

KITS INCLUDE HARD DRIVE, DRIVE CONTROLLER, CABLES & INSTRUCTIONS.

SIZE	MODEL	AVG. SPEED	FORM FACTOR	DRIVE ONLY	XT KIT	AT F/H KIT
20MB	ST-225	65 MS	5-1/4"	$199	$249	$309
30MB RLL	ST-238	65 MS	5-1/4"	$219	$279	$379
40MB	ST-251	40 MS	5-1/4"	$319	$369	$429
40MB	ST-251-1	28 MS	5-1/4"	$389	$439	$499
60MB RLL	ST-277	40 MS	5-1/4"	$389	$449	$549
80MB	ST-4096	28 MS	5-1/4"	$569	—	$679
120MBRLL	ST-4144R	28 MS	5-1/4"	$699	$759	$859
20MB	ST-125	40 MS	3-1/2"	$259	$299	$373
30MB RLL	ST-138	40 MS	3-1/2"	$289	$339	$429

Seagate SCSI DRIVES

SIZE	MODEL	AVG. SPEED	FORM. FACTOR	PRICE
21.5MB	ST-125N	40MS	3-1/2"	$299
32.2MB	ST-138N	40MS	3-1/2"	$339
48.6MB	ST-157N	40MS	3-1/2"	$389
21.3MB	ST-225N	65MS	5-1/4"	$329
43.1MB	ST-251N	40MS	5-1/4"	$419
64.9MB	ST-277N	40MS	5-1/4"	$469
85MB	ST-296N	28MS	5-1/4"	$499

MODULAR CIRCUIT TECHNOLOGY

new!

4800/2400BAUD FAX/DATA MODEM $119

2400/4800 BAUD COMBINED DATA/FAX MODEM FOR LESS THAN MOST 2400 BAUD DATA MODEMS ALONE! BY SACRIFICING THE FAX RECEIVE FUNCTION WE CAN OFFER THIS REMARKABLE PRICE!

- 4800 BAUD FAX TRANSMISSION CAPABILITY TO ANY GROUP III FAX MACHINE • 2400 BAUD V.22BIS DATA MODEM • XT/AT COMPATIBLE HALF CARD
- CONVERTS DOS TEXT, PCX, AND TIFF FILES FOR FAX GROUP III TRANSMISSION • MENU DRIVEN SOFTWARE
- PHONE BOOK • MULTIPLE FAX TRANSMISSIONS TO GROUPED ADDRESSES • PROFAX FAX SOFTWARE

MCT-FAXM

2400 BAUD MODEM $89.95

- 2400/1200/300 BAUD • FULL HAYES COMPATIBILITY
- BUILT-IN SPEAKER • CONFIGURABLE AS COM1, COM2, COM3 OR COM4 • AUTO FUNCTIONS INCLUDE WAIT-FOR-DIAL TONE & AUTO-REDIAL ON BUSY • PROCOM M COMMUNICATIONS SOFTWARE • MADE IN USA

MCT-24I
MCT-12I 1200 BAUD VERSION $59.95

MICROPOLIS HIGH SPEED HIGH DENSITY HARD DRIVES

150MB 5-1/4" DRIVE $949

FULL HEIGHT ESDI DRIVE, 23MS AVERAGE ACCESS TIME.
1355
1355-PKG DRIVE WITH ESDI CONTROLLER ... $1049.00

FULL HEIGHT SCSI DRIVE, 23MS AVERAGE ACCESS TIME.
1375 ..... $999.00
1375-PKG DRIVE WITH SCSI CONTROLLER .. $1099.00

340MB 5-1/4" DRIVE $1619

FULL HEIGHT ESDI DRIVE,18MS AVERAGE ACCESS TIME
1558
1558-PKG DRIVE WITH ESDI CONTROLLER $1799.00

FULL HEIGHT SCSI DRIVE,18MS AVERAGE ACCESS TIME
1578 ..... $1619.00
1578-PKG DRIVE WITH SCSI CONTROLLER $1799.00

680MB 5-1/4" DRIVE $2499

FULL HEIGHT ESDI DRIVE, 16MS AVERAGE ACCESS TIME.
1568

FULL HEIGHT SCSI DRIVE, 16MS AVERAGE ACCESS TIME.
1588 ..... $2499.00

PROMETHEUS

new!

9600 BAUD MODEM $699.95

HIGH SPEED MODEM FEATURES MICROCOM NETWORK PROTOCOL (MNP) AND V.32 COMPATIBILITY • 9600/4800/2400/1200 BPS OPERATION • FULL DUPLEX • CALL BACK SECURITY • NON-VOLATILE RAM STORAGE FOR 10 PHONE NUMBERS • ASYNCHRONOUS/SYNCHRONOUS • FULLY COMPATIBLE WITH CCITT V.32/V.22BIS/V.22, BELL/212A

- MNP-5 FOR 100% ERROR FREE TRANSMISSIONS
- DATA COMPRESSION FOR THROUGHPUT TO 19.2K BAUD
- COMPATIBLE WITH MNP OR NON-MNP MODEMS

PRO-96E

INTERNAL 2400 BAUD $99.95

- AUTO DIAL/ANSWER
- SELF-TEST ON POWER-UP
- FULL OR HALF DUPLEX • TOUCHTONE OR PULSE DIALING
- HAYES AND BELL SYSTEMS COMPATIBLE • HALF CARD SIZE • MIRROR II COMMUNICATIONS SOFTWARE

PRO-24I
PRO-12I 1200 BAUD 1/2 CARD $69.95

EXTERNAL 2400 BAUD $149.95

- 2400/1200/300 BAUD • 8 STATUS LIGHTS • REQUIRES SERIAL PORT AND CABLE

PRO-24E
PRO-12E 1200 BAUD EXTERNAL MODEM $99.95

JIM'S BARGAIN HUNTERS CORNER

Jim Wharton
JDR's VP Sales

$39.95

DFI SERIAL MOUSE PLUS HALO-DPE SOFTWARE

REGULARLY $59.95

- THREE-BUTTON OPTO-MECHANICAL MOUSE WITH 200 DPI RESOLUTION • USES SERIAL PORT COM1 OR COM2 • WITH SOFTWARE DRIVERS, 5-1/2 FT. CABLE • INCLUDES HALO-DPE, A SOPHISTICATED DESKTOP PUBLISHING EDITOR

DMS-200 EXPIRES 10/31/89

CALL FOR OUR FREE 84-PAGE CATALOG!

VISA MasterCard

ORDER TOLL-FREE 800-538-5000

MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 10 A.M. TO 3 P.M. (PST)

Terms: minimum order $10.00. For shipping & handling include $3.50 for ground and $4.50 for air. Orders over 1 lb. and foreign orders may require additional shipping charges —contact the Sales department for the amount. Ca residents must include applicable sales tax. Prices subject to change withoug notice. We are not responsible for typographical errors. We reserve the right to limit quanitities and to substitute manufacturer. All merchandise subject to prior sales. A full copy of our terms is available upon request. Items pictured may only be representative.

EDITORIAL INDEX BY COMPANY

Index of companies covered in articles, columns, or news stories in this issue
Each reference is to the first page of the article or section in which the company name appears

INQUIRY #	COMPANY	PAGE
1141	AAPPS	49
989	ACCOLADE	115
982	ADVANCED GRAPHIC APPLICATIONS	133, 160, 266
1071		
1181		
1147	ADVANCED PRODUCTS & TECHNOLOGIES	49
	AGILIS	17
1124	AJIDA TECHNOLOGIES	64
1002	ALDUS	81
1182	ALPHATRONICS	266
1121	AMERICAN IMAGING SYSTEMS	64
855	AMERICAN MITAC	181
	AMETEK	287
	AMOCO LASER	249
1105	ANNABOOKS	64
	APPLE COMPUTER	98, 139, 149, 287
1183	AQUIDNECK SYSTEMS INTERNATIONAL	266
986	ARITY	133
	ASHTON-TATE	17
	AST RESEARCH	17
	AT&T UNIX SOFTWARE OPERATION	17
	ATARI	17
1116	BIOPAC SYSTEMS	64
	BIPOLAR INTEGRATED TECHNOLOGY	17
1104	BLAISE COMPUTING	64
860	BORLAND INTERNATIONAL	111
1131	BUSINESS FORECAST SYSTEMS	64
	CALTECH/JPL MARK	287
	CANON	17
1118	CIMTECHNOLOGIES	64
	COMPUTER PROFESSIONALS FOR SOCIAL RESPONSIBILITY	17
1184	COMPUTER UPGRADE	266
1072	COREL SYSTEMS	160, 266
1152	CORVUS SYSTEMS	49
997	CRESCENT SOFTWARE	115
1139	CUMULUS	49
	DATA GENERAL	17
	DATA TRANSLATION	17
984	DAVE BRICCETTI AND ASSOCIATES	133
	DAVID SARNOFF RESEARCH CENTER	239
1006	DAYNA COMMUNICATIONS	81
1144	DAYSTAR DIGITAL	49
1186	DELTA MICROSYSTEMS	266
1187	DELTAIC SYSTEMS	266
1154	DIGITAL COMMUNICATIONS ASSOCIATES	49
1134	DIGITAL EQUIPMENT	49
852	EASTMAN KODAK	191
994	ELECTRONIC ARTS	115
	ENVIRONMENTAL PROTECTION AGENCY	17
	EPSON	17
	FIFTH GENERATION SYSTEMS	17
1148	FRANKLIN COMPUTER	49
	FUJITSU	17
1123	GENERIC SOFTWARE	64
1143	GENESYS	49
	GEORGE MORROW	17
	GEORGIA INSTITUTE OF TECHNOLOGY	231
990	GROLIER ELECTRONIC PUBLISHING	115
995	HAMMERLY COMPUTER SERVICES	115
1133	HEADSTART TECHNOLOGIES	49
1115	HEM DATA	64
	HEWLETT-PACKARD	17, 49, 81
983	HILGRAEVE	81, 133
1005		
	HITACHI/MAXWELL	17
854	IBM	17, 145, 181, 249
1101		
	IMC NETWORKS	17
1136	IMPRIMIS TECHNOLOGY	49
1073	INFORMATION STORAGE	160, 266
1188		
	INTEL	17, 287
883	INTERACTIVE SYSTEMS	201
1130	ISOGON	64
	JAPANESE ELECTRONICS INDUSTRY & DEVELOPMENT ASSOCIATION	17
1103	JENSEN & PARTNERS INTERNATIONAL	17, 64
	KNIGHTS TECHNOLOGY	249
	KODAK	249
1112	KORN INDUSTRIAL CONSULTANTS	64
1151	LAN SYSTEMS	49
1120	LANDCADD	64
1074	LASERDRIVE	160, 266
1189		
885	LOGITECH	64, 115, 195
991		
1102		
	LOTUS DEVELOPMENT	17
988	MAGIC 7 SOFTWARE	115
884	MAPPING INFORMATION SYSTEMS	211
	MATE	17
1075	MAXIMUM STORAGE	160, 266
1190		
1140	MEGAGRAPHICS	49
981	MICHTRON	133
	MICRION	249
1191	MICRO DESIGN INTERNATIONAL	266
998	MICROHELP	115
	MICROSOFT	17
1192	MITSUBISHI ELECTRONICS AMERICA	17, 266
1193	N/HANCE SYSTEMS	266
1129	NARDONI ASSOCIATES	64
	NATIONAL EDUCATION COMPUTING CONFERENCE	17
	NCR	17
	NCUBE	17, 287
1137	NEC HOME ELECTRONICS (U.S.A.)	17, 49
	NEWPORT	249
	NEXT	17
1135	NORMEREL USA	49
	NOVELL	149
1113	OCEAN ISLE SOFTWARE	64
	OKI ELECTRIC	17
	OLIVETTI	17
1194	ONLINE COMPUTER SYSTEMS	266
993	OXFORD UNIVERSITY PRESS	115, 360
1195	PANASONIC INDUSTRIAL	266
	PAUL MACE	17
1008	PERCEPTIVE SOLUTIONS	81
1196	PERIPHERAL LAND	266
	PHOENIX TECHNOLOGIES	17
1150	PHOTONICS	49
1076	PIONEER COMMUNICATIONS OF AMERICA	160, 266
1197		
	PIXAR	249
	POQET	17
	PRIME	17
1155	PROTEON	49

INQUIRY #	COMPANY	PAGE
	QUESTEK	249
1077	RACET COMPUTERS	160, 266
1198		
992	ROBERTA J. POURNELLE	115
1145	RUPP	17, 49
987	SAMNA	115
1138	SEIKO INSTRUMENTS USA	49
1000	SELECTRONICS	115
	SEMICON WEST	249
	SHARP	17
886	SILICON BEACH SOFTWARE	217
	SILICON GRAPHICS	249
1125	SOFTPRO	64
985	SOFTWARE DIRECTIONS	133
	SPECTRA-PHYSICS	249
	STANFORD UNIVERSITY	239
1078	STORAGE DIMENSIONS	160, 266
1199		
980	SUMMUS COMPUTER SYSTEMS	160, 266
1080		
1079	SUMO SYSTEMS	160, 266
1200		
	SUN MICROSYSTEMS	17, 149
1003	SYMANTEC	81
	SYMBOLICS	17
851	TEKTRONIX	187
1149	TELESYSTEMS SLW	49
	TERADYNE LASER SYSTEMS	249
	TEXAS INSTRUMENTS	17
996	THE PROICON GROUP	115
	3-D SYSTEMS	249
	TOPS	149
853	TOSHIBA AMERICA INFORMATION SYSTEMS	17, 191
999	TRAVELER'S GUILD	115
1128	TSM ASSOCIATES	64
	U.S. COMMERCE DEPARTMENT	17
	UNISYS	17
981	UNITED SYSTEMS	266
	UNIVERSITY OF ALABAMA	231
1153	VADIS	49
1132	WELLS AMERICAN	49
1001	WORDSTAR INTERNATIONAL	17, 115
	WORDTECH	17
	XRL	249
	ZENITH DATA SYSTEMS	17

COMING UP IN BYTE

Scheduled to appear in forthcoming issues of BYTE, the following list of articles represents work in progress.

PRODUCTS IN PERSPECTIVE:

With TIGA-based graphics just around the corner, we test a number of graphics coprocessor boards using the Texas Instruments 34010 chip in the November **Product Focus**.

Diskless workstations are becoming popular for use in LANs. We compare two new units from Wyse Technology and TeleVideo Systems in **system reviews**.

In a **peripheral review**, we evaluate two high-speed network nodes from Dayna Communications and TOPS that claim to quadruple data transfer rates on Apple networks.

Software reviews look at the following two products: ExperTelligence's Action! is an applications development program that runs on the Macintosh II/Texas Instruments MicroExplorer combination, and Alpha Four from Alpha Software is a relational database designed for nonprogrammers.

IN DEPTH:

The November Expanded In Depth will explore the hardware and software capabilities, challenges, and problems associated with **32 bits and above**. This may sound futuristic, but it isn't, because 32-bit hardware is here in 80386, 68020, and 68030 machines. And as the 80486 is here now, can the 68040 be far behind? What are some of the challenges associated with bringing software to these machines that actually use their 32-bit capabilities? How do 32-bit systems handle memory? And where will they go from here? Is the direction onward and upward? 64 bits? 128 bits? Is there a limit? Do we reach a point of diminishing returns? These are some of the questions that will be answered.

FEATURES:

We'll take a look at **helical scan technology**, a method of storing data on magnetic tape that owes a great deal to the VCR. Additionally, we'll explore **Intel's new 80860 chip**, take a guided tour of the **NeXT machine's Mach operating system**, and get an overview of the activities at **MIT's Media Lab**.

In **Under the Hood**, Brett Glass takes a look at EISA, the newest industry bus standard; in **Some Assembly Required**, Rick Grehan continues his "Two Tin Cans . . . " article on network interfaces with a look at NetBIOS.

As always, our columns, Computing at Chaos Manor, The Unix /bin, Down to Business, Macinations, OS/2 Notebook, and NetWorks, offer **Expert Advice** on a whole raft of problems, from the exotic to the mundane.

Industry news and the latest information on hardware and software are the core of our **Microbytes**, **What's New**, and **Short Takes** sections. These departments, written by BYTE reporters and editors, provide a focus on the important events in microcompting that is unequaled by any other source.

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company.

Alphabetical Index to Advertisers

Inquiry No.		Page No.
8	2001 SALES	220
9	2001 SALES	220
10	2500 AD SOFTWARE	144
11	ACS COMMUNICATIONS	344
13	ADVANCED LOGIC RESEARCH	2,3
14	ADVANCED LOGIC RESEARCH	2,3
15	ADVANCED MATRIX TECH	185
16	ADVANTAGE SOFTWARE	119
17	AK SYSTEMS	342
18	ALL REGULATOR AB	333
19	ALL REGULATOR AB	333
20	ALPHA PRODUCTS	336
21	AMERICAL GROUP	328
23	AMERICAN SMALL BUS.COMP.	114
*	AMPRO	124
25	ANNABOOKS	321
*	ANTHRO	42
27	ATI TECHNOLOGIES	171
29	ATTACHMATE CORP.	154
30	A/SOFT DEVELOPMENT,INC.	132
31	B & B ELECTRONICS	333
32	BARADINE PRODUCTS	334
33	BAYTECH	186
34	BAYTECH	186
35	BE AWARE INC.	86
36	BE AWARE INC.	86
37	BINARY TECHNOLOGY	338
38	BIT WISE	144C
39	BIT WISE	144C
450	BIX	358,359
41	BLAISE COMPUTING	48C
42	BORLAND INTERNATIONAL	13
43	BORLAND INTERNATIONAL	13
44	BP MICROSYSTEMS	341
45	BP MICROSYSTEMS	341
*	BUYERS MART	310–320
*	BYTE BACK ISSUES	326
46	BYTE BITS	331
*	BYTE SUB MESSAGE	42
47	BYTEK COMPUTER CORP.	337
*	BYTE PUBLICATIONS	72,73
*	BYTEWEEK/NEWSLETTER	363
48	B&C MICRO	331
49	B&C MICRO	331
323	B&C MICRO	333
28	CADRE TECHNOLOGIES INC	31
*	CALIFORNIA DIGITAL	345
50	CH PRODUCTS	125
51	CH PRODUCTS	125
52	CLONE COMPUTER	327
318	CLUB AMERICAN TECH	265
53	COMMUNICATION RESEARCH GR	274
54	COMMUNICATION RESEARCH GR	274
55	COMPACT DISK PRODUCTS	169
56	COMPUCLASSICS	142
57	COMPUCOM	322
59	COMPUSERVE	257
60	COMPUTER ASSOCIATES	28,29
305	COMPUTER DIRECT	294,295
61	COMPUTER DISC.WAREHOUSE	144A
62	COMPUTER FRIENDS	144H
63	COMPUTER MAIL ORDER	176,177
64	COMPUTER MAIL ORDER	178,179
65	COMPUTER MAIL ORDER	208,209
322	COMPUTER PERIPHERALS INC	75
*	COMPUTER PROFESSIONALS	112A–B
268	COMPUTER PROFESSIONALS BK	113
66	COMPUTERLANE	330
67	COMPUTRADE	78
68	CONTECH COMPUTER CORP.	344
69	CONTROL VISION	341
70	COREL	238
71	CORPORATE COMPUTERS OF IOWA	76,77
72	CORPORATE COMPUTERS OF IOWA	76,77
73	COVOX	334
74	CRICHLOW	328
75	CSS LABORATORIES INC	180
76	CSS LABORATORIES INC	180
*	CUBIX CORPORATION	44
*	DAMARK	247
78	DATA TRANSLATION INC	45
79	DAYTRON	344
80	DELL COMPUTER	CII,1
*	DELL COMPUTER	64A–B
81	DELL COMPUTER	65
82	DELTA COMPUTING TECH.	342
306	DIGIBOARD	296
83	DIGITAL RESEARCH	197
84	DIGITAL RESEARCH	197
85	DIGITALK	24,25
86	DIGI-DATA	342
88	DISKCOTECH	341
89	DISKETTE CONNECTION	337
90	DIVERSIFIED COMPUTER	337
87	DOCUBASE SYSTEMS	206
91	DYNAMIC ELECTRONICS	321
*	ECOSOFT	70
92	EDC GMBH	276
93	ELEXOR	341
94	ELITE MICROSYSTEMS INC	117
95	ELLIS COMPUTING	133
304	ELS ENTERPRISES,LTD	286
96	ELTECH RESEARCH	271
97	EMERALD COMPUTERS,INC.	35
*	EPSON	20,21
98	EXECUTIVE PHOTO & SUPPLY	194
314	EXSEL	357
99	FOCUS RESEARCH,INC	338
100	FORESIGHT RESOURCES	23
101	FORESIGHT RESOURCES	23
102	FORTRON	37
103	FORTRON	37
213	FRANKLIN/PROXIMITY	308
214	FRANKLIN/PROXIMITY	308
104	FRANKLIN SOFTWARE	86
105	FTG DATA SYSTEMS	342
106	FUJACORP INC	321
107	G-TEK, INC.	48D
108	G-TEK, INC.	48D
109	GATEWAY 2000	10,11
110	GE INFO SERVICES	216
112	GOODWAY	144B
26	G.REED,INC.	328
113	HAMMERLY COMPUTER SERV.	272
114	HAMMERLY COMPUTER SERV.	273
303	HAUPPAUGE COMPUTER	285
115	HEATH COMPANY	237
116	HEWLETT-PACKARD PERIPH.	14,15
117	HEWLETT-PACKARD PERIPH.	144G
118	HEWLETT-PACKARD PERIPH.	145
119	HIGH RES. TECHNOLOGIES	328
120	HITECH EQUIPMENT CORP.	344
121	HOME SMART COMPUTING	328
122	HOUSTON INSTRUMENT	189
123	HYPERKINETIX	110
124	HYPERKINETIX	110
125	H.I.M.S.TECHNOLOGIES	278
*	IBM OS/2	167
*	IBM PS/2	48–48A
126	IC EXPRESS	337
127	IMAGENET SYSTEMS	331
128	IMAGENET SYSTEMS	331
129	IMES GMBH	338
130	INMAC	246
131	INTEGRAND	218
132	INTELLIGENCEWARE	71
133	IO COMM	243
134	IO TECH	204
135	IO TECH	331
136	JADE COMPUTER PRODUCTS	339
137	JAMECO	324,325
138	JB TECHNOLOGIES	133
139	JB TECHNOLOGIES	133
*	JENSEN & PARTNERS	127
140	J.D.R. MICRODEVICES	346,347
141	J.D.R. MICRODEVICES	348,349
142	KADAK	342
143	KEA SYSTEMS	341
144	KILA SYSTEMS	331
145	KNOWLEDGE GARDEN	361
148	KORE,INC.	331
149	KUSTEM DATA SERVICES	331
150	K.E.M. ELECTRONICS	334
151	LAHEY COMPUTER SYS.	144F
152	LANTANA TECHNOLOGY	298
153	LANTANA TECHNOLOGY	298
154	LAWSON LABS	342
155	LINK COMPUTER GRAPHICS	328
156	LOGIC VISION	74
157	LOGICAL DEVICES	344
158	LOGICAL DEVICES	344
159	LOGICAL DEVICES	344
160	LOGICAL DEVICES	344
161	LOGITECH	54,55
162	LOGITECH	54,55
310	LOGITECH	46
311	LOGITECH	46
163	MAP INFO	32
164	MARYMAC	334
165	MATHSOFT	51
166	MATRIX	207
167	MAXCIMA	322
169	MEAD COMPUTER	332
170	MEGATEL	88
171	MERRITT COMPUTER	284
172	MEXTEL	256
173	MEXTEL	256
*	MICROCOMPUTER MKTG CNCL.	343
174	MICRO SOLUTIONS COMP.PROD.	74
175	MICROCOM	219
176	MICROPROCESSORS UNLTD.	328
*	MICROSOFT	6,7
*	MICROSOFT	19
178	MICROSOFT	85
179	MICROSPEED	34
180	MICROSPEED	34
181	MICROTRON TRADE SERVICE	248
*	MICROWAY	173
182	MICROWAY	275
22	MITAC	190
184	MIX SOFTWARE	305
185	MKS	123
*	MONTGOMERY GRANT	130
186	NAGAN CORP.	344
187	NANTUCKET	199
188	NATIONAL INSTRUMENT	CIII
189	NEC HOME ELECTRONICS	38,39
190	NEC HOME ELECTRONICS	41
191	NETWORK TECHNOLOGIES	342
192	NOHAU CORPORATION	299
193	NOHAU CORPORATION	333
*	NORTHGATE COMPUTER	134,135
*	NORTHGATE COMPUTER	136,137
*	NORTHGATE COMPUTER	138,139
*	NORTHGATE COMPUTER	140,141
194	NUMONICS	210
195	NU-MEGA TECHNOLOGIES	121
196	ON LINE STORE	335
*	ORACLE	57
197	OVERLAND DATA,INC.	321
198	PACIFIC COMPUTERS	323
199	PACIFIC DATA PRODUCTS	89
200	PACIFIC DATA PRODUCTS	89
201	PANASONIC	175
202	PARA SYSTEMS	79
203	PARSONS TECHNOLOGY	87
204	PATTON & PATTON	118
205	PERISCOPE	144D
206	PERISCOPE	144D
319	PETER NORTON	255
207	PHAR LAP	198
216	PI COMPUTER CORPORATION	322
312	PINNACLE MICRO	258
313	PINNACLE MICRO	258
315	PINNACLE PUBLISHING	302
209	PRIORITY ONE COMPUTER	230
210	PROGRAMMER'S PARADISE	60,61
211	PROTECH MARKETING	59
212	PROTECH MARKETING	59
208	PSI	323
217	P.C. NETWORK	43
218	P.C.BRAND	221
219	P.C.BRAND	222,223
220	P.C.BRAND	224,225
221	P.C.BRAND	226,227
222	QMS	107
223	QMS	107
224	QMS	193
225	QMS	193
226	QUA TECH	328
227	QUA TECH	328
228	QUALSTAR CORPORATION	342
229	QUANTUM SOFTWARE	69
230	QUARTERDECK	128,129
231	QUARTERDECK	128,129
232	QUARTERDECK	128,129
233	QUARTERDECK	128,129
234	RADIO SHACK	CIV
*	RAIMA	53
*	RAIMA	112
235	RAINBOW TECHNOLOGIES	150
236	RAINBOW TECHNOLOGIES	150
237	REAL TIME DEVICES	338
238	ROSE ELECTRONICS	157
239	ROSE ELECTRONICS	157
240	RUPP CORPORATION	215
241	RUPP CORPORATION	215
242	RUPP CORPORATION	215
243	RUPP CORPORATION	215
244	RUPP CORPORATION	215
245	RUPP CORPORATION	215
309	SAELIG COMPANY	334
246	SAFEWARE	341
301	SAMSUNG	66,67
302	SAMSUNG	66,67
248	SANTA CRUZ OPERATION	63
249	SCHWAB COMPUTER	333
250	SCIENTIFIC ENDEAVORS	338
251	SCIENTIFIC ENDEAVORS	338
252	SCIENTIFIC ENDEAVORS	338
253	SCIOTO COMPUTERS	337
*	SEAGATE	203
254	SILICON SHACK	338
*	SMALL COMP BOOK CLUB	32A–B
*	SMALL COMP BOOK CLUB	33
*	SOFTWARE DEVELOPMENT SYS	83
255	SOFTWARE LINK	213
256	SOFTWARE LINK	213
257	SOFTWARE SECURITY	200
258	SPECTRUM	103
259	STATSOFT	47
260	STEINCO A/S	144B
261	STORAGE DIMENSIONS (N.AMER)	165
262	STORAGE DIMENSIONS (N.AMER)	165
316	STORAGE DIMENSIONS (INT'L)	165
317	STORAGE DIMENSIONS (INT'L)	165
263	STSC	27
264	SUPERSOFT	80
265	SURAH, INC.	344
266	SWIRLSOFT	341
267	S'NW COMPUTER	214
269	TALKING TECHNOLOGY	334
270	TECHNOLOGY POWER	342
271	THE IDEA WORKS	344
272	TMI,INC.	88
273	TOSHIBA	158,159
274	TOSHIBA	158,159
277	TOUCHBASE SYSTEMS,INC.	36
278	TRACE,INC.	109
279	TRAVELING SOFTWARE	105
307	TUSSEY COMPUTER PROD.	146,147
308	TUSSEY COMPUTER PROD.	148,149
280	T.P.C.	326
281	ULTIMATE TECHNOLOGY	338
282	UNITEX	340
*	UNIXWORLD	329
*	VERMONT CREATIVE	16
284	WAREHOUSE DATA	205
285	WATCOM	120
286	WELLS AMERICAN (N.AMER)	153
287	WELLS AMERICAN (N.AMER)	153
320	WELLS AMERICAN (INT'L)	153
321	WELLS AMERICAN (INT'L)	153
288	WELLS AMERICAN	277
289	WELLS AMERICAN	277
290	WIESEMANN & THEIS	284
400	WINTEK	9
291	WINTEK	337
324	WINTEK	337
292	XELTEK	333
294	Z-WORLD	334
295	ZENITH DATA SYSTEMS	48B
296	ZEOS INTERNATIONAL	90,91
297	ZEOS INTERNATIONAL	92,93
298	ZEOS INTERNATIONAL	94,95
299	ZEOS INTERNATIONAL	96,97
300	ZORTECH	233

INTERNATIONAL SECTION 80 IS 1–72
No North American Inquiries please.

401	06 SOFTWARE CENTRE EUROPE	IS-58
402	06 SOFTWARE CENTRE EUROPE	IS-59
403	ABC COMPUTER CO,LTD	IS-61
404	ACER,INC	IS-44,45
405	ACME TECHNOLOGY CORP	IS-38
409	ADVANTEK INT'L LTD	IS-10
406	AGC ELECTRONICS CORP.	IS-51
407	ALADDIN KNOWLEDGE SYS.	IS-55
408	AQUARIUS SYSTEMS INC.	IS-39
410	BIX	IS-71
411	BLUE CHIP TECHNOLOGY	IS-56
469	BRITISH TELECOM	IS-2,3
*	BYTE BACK ISSUES	IS-68
*	BYTE PUBLICATIONS	IS-70
*	BYTE PUBLICATIONS	IS-72
412	CLARION SOFTWARE	IS-29
413	CLARION SOFTWARE	IS-29
414	CLEO COMMUNICATIONS	IS-33
468	COBALT BLUE	IS-46
415	CONTROL TELEMETRY	IS-38
416	COPAM ELECTRONICS CORP	IS-67
417	C&D TECHNOLOGY,INC	IS-36
*	DATA COMMUNICATIONS	IS-48A–B
*	DATA COMMUNICATIONS	IS-49
418	D-LINK SYSTEM,INC	IS-16
419	DIETRICH	IS-52
*	ELONEX	IS-19
421	FAST ELEKTRONIK GMBH	IS-42
470	FASTFAME CO.,LTD	IS-40
422	FOCUS ELECTRONIC CO,LTD	IS-57
*	FORTE COMMUNICATIONS	IS-14
424	GALAXY MICROCRAFT SYS	IS-52
425	GAMMA	IS-12
426	GENOA SYSTEMS	IS-4
427	GREY MATTER	IS-65
428	GTCO	IS-20
429	GTCO	IS-20
430	HWA HSIN ELECTRONIC CO	IS-24
431	I X I LTD.	IS-56
432	INES	IS-48
434	INTERQUADRAM	IS-7
435	INTERQUADRAM	IS-9
436	INWIN DEVELOPMENT INC	IS-40
437	KAYPRO	IS-37
438	MAYFAIR MICROS	IS-63

READER SERVICE

Inquiry No.		Page No.
440	MICROMINT	IS-34
441	NOVELL	IS-25
442	ORCAD SYSTEMS CORP	IS-15
443	PERICOM	IS-31
444	PHILIPS MONITORS	IS-11
445	PRICE TREND	IS-6
446	PROCOMP,USA INC.	IS-48
447	PROCOMP,USA INC.	IS-48
448	QUOTHA 32	IS-46
449	SAMSUNG ELECTRONICS	IS-53
*	SCANDEC TRIBUTOR	IS-69
451	SCOTTSDALE SYSTEMS	IS-13
*	SOFTLINE CORPORATION	IS-35
452	SOFTWARE CONSTRUCTION	IS-43
453	SOFTTEK COMPUTER	IS-56
454	STONY BROOK SOFTWARE	IS-27
455	STONY BROOK SOFTWARE	IS-27
456	SUPERTRON ELECTRIC CO,LTD	IS-41
458	TOPLINK COMPUTER CO.LTD.	IS-32
459	TRIANGLE DIGITAL SERVICES	IS-46
461	TRITON TECHNOLOGIES	IS-8
462	TRITON TECHNOLOGIES	IS-8
463	TWINHEAD INT'L CORP.	IS-50
464	UNIBIT	IS-47
465	UNITECH COMP.CO,LTD.	IS-26
466	USA SOFTWARE	IS-23
471	WORLD WIDE COPIER PARTS	IS-52

INT'L DIRECT RESPONSE POSTCARDS

*	BYTE INTERNATIONAL	IS
*	BYTEWEEK	IS
*	C GAZETTE MAGAZINE	IS
*	ITC INC	IS
*	METRABYTE	IS
*	MICRO SIM	IS
*	REASONABLE SOLUTIONS	IS
*	SIGS PUB/JOURNAL OF OBJEC	IS
*	SOFTWARE EXCITEMENT	IS
*	TELETEK	IS
*	TOUCHBASE	IS
*	TRIPP LITE	IS

REGIONAL SECTIONS

Midwest 80 MW1–8

*	BYTEWEEK/NEWSLETTER	MW-2
*	COMP.FOR THE BLIND	MW-4
476	DAKOTA COMPUTER	MW-3
*	DATA COMMUNICATIONS	MW-8
477	HALSKAR SYSTEMS	MW-6
478	HALSKAR SYSTEMS	MW-6
479	NEXT WORKS, THE	MW-1
480	NEXT WORKS, THE	MW-1
481	Y.E.S.SYSTEMS CORP.	MW-5
482	Y.E.S.SYSTEMS CORP.	MW-5
483	ZERICON	MW-7

Northeast 80 NE1–36

523	ADTECH	NE-31
524	ADTECH	NE-31
521	ADVANCED DIGITAL CORP.	NE-3
522	ADVANCED DIGITAL CORP.	NE-3
525	A-TRONIC COMPUTER	NE-21
526	BLUE CIRCLE GROUP,INC	NE-6
527	BLUE CIRCLE GROUP,INC	NE-6
528	COMPFAX	NE-5
529	COMPFAX	NE-5
530	COMPUTER EXPERT,INC	NE-32
531	COMPUTER EXPERT,INC	NE-32
*	DATA COMMUNICATIONS	NE-24
532	DAYTRON ELECTRONICS,INC	NE-22
533	DRAGONSLAYER SYSTEMS	NE-33
534	EDI	NE-20
535	EDI	NE-20
536	ELECTRIFIED DISCOUNTERS	NE-25
537	FOUNTAIN TECHNOLOGIES,INC.	NE-15
538	FUTURA SYSTEMS	NE-4
539	FUTURA SYSTEMS	NE-4
540	HALSKAR SYSTEMS	NE-8
541	HALSKAR SYSTEMS	NE-8
542	HARMONY COMPUTERS	NE-1
543	HARMONY COMPUTERS	NE-1
544	HARVARD INFO SYSTEMS	NE-6
545	HERTZ	NE-7
546	HY-TEC	NE-12
547	HY-TEC	NE-12
548	LAPTOPS ETC.	NE-28
549	L&W MICROCOMPUTING	NE-23
550	L&W MICROCOMPUTING	NE-23
551	MINTA TECHNOLOGIES	NE-9
552	MPM	NE-36
553	MPM	NE-36
554	M.S.C.	NE-29
555	NOCONA ELECTRONICS	NE-22
556	ON LINE COMPUTER	NE-27
557	ON LINE COMPUTER	NE-27
558	ONLINE PRODUCTS CORP.	NE-17
559	ONLINE PRODUCTS CORP.	NE-17
560	PC LINK	NE-16
561	PC PLUS TECHNOLOGIES	NE-19
562	PC PLUS TECHNOLOGIES	NE-19
563	RENEGADE CORP	NE-35
564	SUMMA COMPUTER	NE-34
565	TELETEK	NE-11
566	TELETEK	NE-11
567	TRANS-M CORP.	NE-13
568	TRANS-M CORP.	NE-13
569	TRANS-M CORP.	NE-13
570	TRANS-M CORP.	NE-13
571	ZEPHYR SERVICES	NE-2

Pacific Coast 80 PC1–16

499	3-F ASSOCIATES	PC-8
502	BI-LINK	PC-7
*	BYTEWEEK/NEWSLETTER	PC-4
503	CDS	PC-9
*	DATA COMMUNICATIONS	PC-16
504	DATAMAG,INC	PC-2
505	DATAMAG,INC	PC-2
506	HEALD INSTITUTE OF TECH.	PC-13
507	KEYBOARD COMEDY	PC-11
508	ORCAD SYSTEMS,INC	PC-15
509	PEOPLESMITH SOFTWARE	PC-13
510	SOFTWARE ENGINEERING STR	PC-12
511	TELETEK	PC-3
512	TELETEK	PC-3
513	TRAN COMPUTER NETWORK	PC-1
514	TRAN COMPUTER NETWORK	PC-1
515	WINTIME TECH.	PC-14
516	ZERICON	PC-10

South 80 SO1–12

486	A-TRONIC COMPUTER	SO-11
*	BYTEWEEK/NEWSLETTER	SO-4
487	COMPUTER WHOLESALERS	SO-5
488	COMPUTER WHOLESALERS	SO-5
*	DATA COMMUNICATIONS	SO-12
489	MIGHTY MICRO	SO-1
490	MIGHTY MICRO	SO-1
491	OCTAGON TECHNOLOGIES	SO-7
492	OCTAGON TECHNOLOGIES	SO-7
493	SQUAREFIELD	SO-2
494	SQUAREFIELD	SO-2
495	SUMMA COMPUTER	SO-3
496	ZERICON	SO-8

** Correspond directly with company.*

BYTE ADVERTISING SALES STAFF:

Steven M. Vito, Associate Publisher/V.P. of Marketing, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281
Arthur Kossack, Eastern Regional Sales Manager, 645 North Michigan Ave., Chicago, IL 60611, tel. (312) 751-3700
Jennifer L. Bartel, Western Regional Sales Manager, 8111 LBJ Freeway, Suite 1350, Dallas, Tx 75251, tel. (214) 644-1111
Liz Coyman, Inside Sales Director, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-2518

NEW ENGLAND
ME, NH, VT, MA, RI, ONTARIO CANADA & EASTERN CANADA
John C. Moon **(617) 262-1160**
McGraw-Hill Publications
575 Boylston Street
Boston, MA 02116
FAX: (617) 262-6430

ATLANTIC
NY, NYC, CT, NJ (NORTH)
Kim Norris **(212) 512-2645**
McGraw-Hill Publications
1221 Avenue of the Americas—28th Floor
New York, NY 10020
FAX: (212) 512-3520

EAST
PA, NJ (SOUTH), MD, W.VA, DE, D.C.
Thomas J. Brun **(215) 496-3833**
McGraw-Hill Publications
Three Parkway
Philadelphia, PA 19102
FAX: (215) 496-3828

SOUTHEAST
NC, SC, GA, FL, AL, TN, VA, MS
Thomas Tolbert **(404) 252-0626**
McGraw-Hill Publications
4170 Ashford-Dunwoody Road
Suite 420
Atlanta, GA 30319
FAX: (404) 252-4056

MIDWEST
IL, MO, KS, IA, ND, SD, MN, KY, OH, WI, NB, IN, MI
Kurt Kelley **(312) 751-3740**
McGraw-Hill Publications
Blair Building
645 North Michigan Ave.
Chicago, IL 60611
FAX: (312) 751-3767

SOUTHWEST, ROCKY MOUNTAIN
CO, WY, OK, TX, AR, LA
Karl Heinrich **(713) 462-0757**
McGraw-Hill Publications
7600 W. Tidwell Rd.—Suite 500
Houston, TX 77040
FAX: (713) 462-6526

SOUTH PACIFIC
SOUTHERN CA, AZ, NM, LAS VEGAS
Ron Cordek **(714) 557-6292**
McGraw-Hill Publications
3001 Red Hill Ave.
Building #1—Suite 222
Costa Mesa, CA 92626
FAX: (714) 557-2219

Tom Harvey **(213) 480-5243**
McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010
FAX: (213) 480-5249

NORTH PACIFIC
HI, WA, OR, ID, MT, NORTHERN CA, NV (except LAS VEGAS), W. CANADA, UT
Christine Kopec **(415) 362-4600**
McGraw-Hill Publications
425 Battery Street
San Francisco, CA 94111
FAX: (415) 954-9786

Bill McAfee **(408) 879-0371**
McGraw-Hill Publications
1999 South Bascom Ave.
Suite #210
Campbell, CA 95008
FAX: (408) 879-9067

BYTE BITS (2x3)
Mark Stone **(603) 924-6830**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

The Buyer's Mart (1x2)
Brian Higgins **(603) 924-3754**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Regional Advertising
Larry Levine **(603) 924-4379**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Barry Echavarria **(603) 924-2574**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

National Sales
Scott Gagnon **(603) 924-4380**
Mary Ann Goulding **(603) 924-2664**
Elisa Lister **(603) 924-2665**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE Deck Mailings
Ed Ware **(603) 924-6166**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

A/E/C Computing Deck Computing for Engineers
Dan Harper **(603) 924-2598**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Peterborough, NH Office
Advertising Fax: 603-924-7507

International Advertising Sales Staff:

Frank Tanis, European Sales Manager, BYTE Publications,
Batenburg 103, 3437 AB Nieuwegein, The Netherlands, tel: 31 34 02 49496, fax: 31 34 02 37944

Karen Lennie
McGraw-Hill Publishing Co.
34 Dover St.
London W1X 4BR
England 01 493 1451
FAX: 01 493 9896

Ros Weyman
Serving Germany, Austria, & Switzerland
McGraw-Hill Publishing Co.
34 Dover St.
London W1X 4BR
England 01 493 1451
FAX: 01 493 9896

Alessandro Coari
McGraw-Hill Publishing Co.
Via Flavio Baracchini 1
20123 Milan, Italy
(2) 89010103
FAX: (2) 879 400

Mrs. Maria Sarmiento
Pedro Teixeira 8, Off. 320
Iberia Mart 1
Madrid 4, Spain
1 45 52 891

Masaki Mori
McGraw-Hill Publishing Co.
Overseas Corp.
Room 1528
Kasumigaseki Bldg.
3-2-5 Kasumigaseki, Chiyoda-Ku
Tokyo 100, Japan
3 581 9811
FAX: 81-3-581-4018

Seavex Ltd.
503 Wilson House
19-27 Wyndham St.
Central, Hong Kong
Tel: 5-260149
Telex: 60904 SEVEX HX
FAX: 852 5 810 1283

Seavex Ltd.
400 Orchard Road, #10-01
Singapore 0923
Republic of Singapore
Tel: 734-9790
Telex: RS35539 SEAVEX
FAX: 65 732 5129

Mr. Ernest McCrary
Empresa Internacional de Comunicacoes Ltda.
Rua da Consolacao, 222
Conjunto 103
01302 Sao Paulo, S.P., Brasil
Tel: (11) 259-3811
Telex: (100) 32122 EMBN

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company.

Index to Advertisers by Product Category

HARDWARE

800 ADD INS

Inquiry No.		Page No.
404	ACER,INC	IS-44,45
521	ADVANCED DIGITAL CORP	NE-3
522	ADVANCED DIGITAL CORP	NE-3
20	ALPHA PRODUCTS	336
27	ATI TECHNOLOGIES	171
31	B & B ELECTRONICS	333
411	BLUE CHIP TECHNOLOGY	IS-56
526	BLUE CIRCLE GROUP,INC	NE-6
527	BLUE CIRCLE GROUP,INC	NE-6
48	B&C MICRO	331
69	CONTROL VISION	341
73	COVOX	334
417	C&D TECHNOLOGY,INC	IS-36
78	DATA TRANSLATION INC	45
92	EDC GMBH	276
105	FTG DATA SYSTEMS	342
425	GAMMA	IS-12
426	GENOA SYSTEMS	IS-4
107	G-TEK, INC.	48D
108	G-TEK, INC.	48D
115	HEATH COMPANY	237
119	HIGH RES. TECHNOLOGIES	328
121	HOME SMART COMPUTERS	328
432	INES	IS-48
435	INTERQUADRAM	IS-9
133	IO COMM	243
134	IO TECH	204
135	IO TECH	331
143	KEA SYSTEMS	341
154	LAWSON LABS	342
167	MAXCIMA	322
440	MICROMINT	IS-34
190	NEC HOME ELECTRONICS	41
192	NOHAU CORPORATION	299
193	NOHAU CORPORATION	333
205	PERISCOPE	144D
206	PERISCOPE	144D
216	PI COMPUTER CORPORATION	322
445	PRICE TREND	IS-6
446	PROCOMP,USA INC.	IS-48
447	PROCOMP,USA INC.	IS-48
208	PSI	323
227	QUA TECH	328
240	RUPP CORPORATION	215
241	RUPP CORPORATION	215
242	RUPP CORPORATION	215
243	RUPP CORPORATION	215
244	RUPP CORPORATION	215
245	RUPP CORPORATION	215
254	SILICON SHACK	338
260	STEINCO A/S	144B
263	STSC	27
495	SUMMA COMPUTER	SO-3
565	TELETEK	NE-11
566	TELETEK	NE-11
511	TELETEK	PC-3
512	TELETEK	PC-3

801 DRIVES

Inquiry No.		Page No.
55	COMPACT DISK PRODUCTS	169
181	MICROTRON TRADE SERVICE	248
*	SEAGATE	203

802 FACSIMILE

Inquiry No.		Page No.
528	COMPFAX	NE-5
529	COMPFAX	NE-5

803 HARDWARE PROGRAMMERS

Inquiry No.		Page No.
32	BARADINE PRODUCTS	334
44	BP MICROSYSTEMS	341
45	BP MICROSYSTEMS	341
47	BYTEK COMPUTER CORP.	337
49	B&C MICRO	331
323	B&C MICRO	333
148	KORE,INC.	331
150	K.E.M. ELECTRONICS	334
155	LINK COMPUTER GRAPHICS	328
157	LOGICAL DEVICES	344
158	LOGICAL DEVICES	344
159	LOGICAL DEVICES	344
160	LOGICAL DEVICES	344
292	XELTEK	333

804 INSTRUMENTATION

Inquiry No.		Page No.
18	ALL REGULATOR AB	333
19	ALL REGULATOR AB	333
93	ELEXOR	341
237	REAL TIME DEVICES	338

805 KEYBOARDS/MICE

Inquiry No.		Page No.
50	CH PRODUCTS	125
51	CH PRODUCTS	125
422	FOCUS ELECTRONIC CO.	IS-57
*	FORTE COMMUNICATIONS	IS-14
428	GTCO	IS-20
429	GTCO	IS-20
172	MEXTEL	256
173	MEXTEL	256
179	MICROSPEED	34
180	MICROSPEED	34
*	NORTHGATE COMPUTER	138,139
194	NUMONICS	210

806 MASS STORAGE

Inquiry No.		Page No.
17	AK SYSTEMS	342
68	CONTECH COMPUTER CORP.	344
504	DATAMAG,INC	PC-2
505	DATAMAG,INC	PC-2
86	DIGI-DATA	342
138	JB TECHNOLOGIES	133
139	JB TECHNOLOGIES	133
174	MICRO SOLUTIONS COMP.PROD	74
181	MICROTRON TRADE SERVICE	248
558	ONLINE PRODUCTS CORP.	NE-17
559	ONLINE PRODUCTS CORP.	NE-17
197	OVERLAND DATA,INC.	321
312	PINNACLE MICRO	258
313	PINNACLE MICRO	258
228	QUALSTAR CORPORATION	342
261	STORAGE DIMENSIONS (N.AMER)	165
262	STORAGE DIMENSIONS (N.AMER)	165
316	STORAGE DIMENSIONS (INT'L)	165
317	STORAGE DIMENSIONS (INT'L)	165

807 MISCELLANEOUS

Inquiry No.		Page No.
33	BAYTECH	186
34	BAYTECH	186
419	DIETRICH	IS-52
99	FOCUS RESEARCH,INC	338
131	INTEGRAND	218
436	INWIN DEVELOPMENT INC	IS-40
171	MERRITT COMPUTER	284
226	QUA TECH	328
*	SCANDEC TRIBUTOR	IS-69
278	TRACE,INC.	109
290	WIESEMANN & THEIS	284
515	WINTIME TECH.	PC-14

808 MODEMS/MULTIPLEXORS

Inquiry No.		Page No.
414	CLEO COMMUNICATIONS	IS-33
57	COMPUCOM	322
322	COMPUTER PERIPHERALS INC	75
277	TOUCHBASE SYSTEMS,INC.	36

809 MONITORS

Inquiry No.		Page No.
404	ACER,INC	IS-44,45
94	ELITE MICROSYSTEMS INC	117
434	INTERQUADRAM	IS-7
189	NEC HOME ELECTRONICS	38,39
201	PANASONIC	175
444	PHILIPS MONITORS	IS-11

810 NETWORK HARDWARE

Inquiry No.		Page No.
469	BRITISH TELECOM	IS-2,3
75	CSS LABORATORIES INC	180
76	CSS LABORATORIES INC	180
*	CUBIX CORPORATION	44
306	DIGIBOARD	296
418	D-LINK SYSTEM,INC	IS-16
112	GOODWAY	144B
549	L&W MICROCOMPUTING	NE-23
550	L&W MICROCOMPUTING	NE-23
175	MICROCOM	219
191	NETWORK TECHNOLOGIES	342
301	SAMSUNG	66,67
302	SAMSUNG	66,67
567	TRANS-M CORP.	NE-13
568	TRANS-M CORP.	NE-13
569	TRANS-M CORP.	NE-13
570	TRANS-M CORP.	NE-13

811 PRINTERS/PLOTTERS

Inquiry No.		Page No.
15	ADVANCED MATRIX TECH	185
*	EPSON	20,21
106	FUJACORP INC	321
116	HEWLETT-PACKARD PERIPH.	14,15
117	HEWLETT-PACKARD PERIPH.	144G
118	HEWLETT-PACKARD PERIPH.	145
122	HOUSTON INSTRUMENT	189
222	QMS	107
223	QMS	107
224	QMS	193
225	QMS	193
483	ZERICON	MW-7
496	ZERICON	SO-8
516	ZERICON	PC-10

812 PRINTERS RIBBONS

Inquiry No.		Page No.
199	PACIFIC DATA PRODUCTS	89
200	PACIFIC DATA PRODUCTS	89
471	WORLD WIDE COPIER PARTS	IS-52

813 SCANNERS/IMAGE PROCESSORS

Inquiry No.		Page No.
161	LOGITECH	54,55
162	LOGITECH	54,55
493	SQUAREFIELD	SO-2
494	SQUAREFIELD	SO-2

814 SOFTWARE SECURITY

Inquiry No.		Page No.
407	ALADDIN KNOWLEDGE SYS.	IS-55
415	CONTROL TELEMETRY	IS-38
421	FAST ELEKTRONIK GMBH	IS-42
156	LOGIC VISION	74
211	PROTECH MARKETING	59
212	PROTECH MARKETING	59
235	RAINBOW TECHNOLOGIES	150
236	RAINBOW TECHNOLOGIES	150
238	ROSE ELECTRONICS	157
239	ROSE ELECTRONICS	157
257	SOFTWARE SECURITY	200

815 SYSTEMS

Inquiry No.		Page No.
403	ABC COMPUTER CO,LTD	IS-61
405	ACME TECHNOLOGY CORP	IS-38
523	ADTECH	NE-31
524	ADTECH	NE-31
13	ADVANCED LOGIC RESEARCH	2,3
14	ADVANCED LOGIC RESEARCH	2,3
409	ADVANTEK INT'L LTD	IS-10
406	AGC ELECTRONICS CORP.	IS-51
*	AMPRO	124
408	AQUARIUS SYSTEMS INC.	IS-39
38	BIT WISE	144C
39	BIT WISE	144C
502	BI-LINK	PC-7
503	CDS	PC-9
318	CLUB AMERICAN TECH	265
67	COMPUTRADE	78
416	COPAM ELECTRONICS CORP	IS-67
71	CORPORATE COMPUTERS OF IOWA	76,77
72	CORPORATE COMPUTERS OF IOWA	76,77
80	DELL COMPUTER	CII,1
*	DELL COMPUTER	64A–B
81	DELL COMPUTER	65
96	ELTECH RESEARCH	271
470	FASTFAME CO.,LTD	IS-40
102	FORTRON	37
103	FORTRON	37
537	FOUNTAIN TECHNOLOGIES	NE-15
538	FUTURA SYSTEMS	NE-4
539	FUTURA SYSTEMS	NE-4
424	GALAXY MICROCRAFT SYS.	IS-52
109	GATEWAY 2000	10,11
303	HAUPPAUGE COMPUTER	285
545	HERTZ	NE-7
120	HITECH EQUIPMENT CORP.	344
430	HWA HSIN ELECTRONIC CO	IS-24
125	H.I.M.S.TECHNOLOGIES	278
*	IBM PS/2	48,48A
437	KAYPRO	IS-37
144	KILA SYSTEMS	331
149	KUSTEM DATA SERVICES	331
170	MEGATEL	88
551	MINTA TECHNOLOGIES	NE-9
22	MITAC	190
*	NORTHGATE COMPUTER	134,135
*	NORTHGATE COMPUTER	136,137
*	NORTHGATE COMPUTER	140,141
491	OCTAGON TECHNOLOGIES	SO-7
492	OCTAGON TECHNOLOGIES	SO-7
556	ON LINE COMPUTER	NE-27
557	ON LINE COMPUTER	NE-27
561	PC PLUS TECHNOLOGIES	NE-19
562	PC PLUS TECHNOLOGIES	NE-19
216	PI COMPUTER CORPORATION	322
445	PRICE TREND	IS-6
234	RADIO SHACK	CIV
563	RENEGADE CORP	NE-35
309	SAELIG COMPANY	334
449	SAMSUNG ELECTRONICS	IS-53
253	SCIOTO COMPUTERS	337
456	SUPERTRON ELECTRIC CO.	IS-41
270	TECHNOLOGY POWER	342
272	TMI,INC.	88
458	TOPLINK COMPUTER CO.	IS-32
273	TOSHIBA	158,159
274	TOSHIBA	158,159
459	TRIANGLE DIGITAL	IS-46
307	TUSSEY COMPUTER PROD.	146,147
308	TUSSEY COMPUTER PROD.	148,149
464	UNIBIT	IS-47
286	WELLS AMERICAN (N.AMER)	153
287	WELLS AMERICAN (N.AMER)	153
320	WELLS AMERICAN (INT'L)	153
321	WELLS AMERICAN (INT'L)	153
288	WELLS AMERICAN	277
289	WELLS AMERICAN	277
400	WINTEK	9
295	ZENITH DATA SYSTEMS	48B
296	ZEOS INTERNATIONAL	90,91
297	ZEOS INTERNATIONAL	92,93
298	ZEOS INTERNATIONAL	94,95
299	ZEOS INTERNATIONAL	96,97

816 TERMINALS

Inquiry No.		Page No.
97	EMERALD COMPUTERS,INC.	35
465	UNITECH COMP.CO,LTD	IS-26

READER SERVICE

Inquiry No.		Page No.
817		UPS
202	PARA SYSTEMS	79

SOFTWARE

818 APPLE/MAC APPLICATIONS Scientific/Technical

Inquiry No.		Page No.
70	COREL	238

819 IBM/MSDOS APPLICATIONS Business/Office

Inquiry No.		Page No.
412	CLARION SOFTWARE	IS-29
413	CLARION SOFTWARE	IS-29
60	COMPUTER ASSOCIATES	28,29
132	INTELLIGENCEWARE	71
187	NANTUCKET	199
441	NOVELL	IS-25
*	ORACLE	57
509	PEOPLESMITH SOFTWARE	PC-13
*	RAIMA	53
*	RAIMA	112
271	THE IDEA WORKS	344

820 IBM/MSDOS APPLICATIONS Scientific/Technical

Inquiry No.		Page No.
25	ANNABOOKS	321
35	BE AWARE INC.	86
36	BE AWARE INC.	86
83	DIGITAL RESEARCH	197
84	DIGITAL RESEARCH	197
165	MATHSOFT	51
*	MICROSOFT	6,7
188	NATIONAL INSTRUMENT	CIII
204	PATTON & PATTON	118
258	SPECTRUM	103
259	STATSOFT	47

821 IBM/MSDOS APPLICATIONS Miscellaneous

Inquiry No.		Page No.
123	HYPERKINETIX	110
124	HYPERKINETIX	110
507	KEYBOARD COMEDY	PC-11
571	ZEPHYR SERVICES	NE-2

822 IBM/MSDOS APPLICATIONS Word Processing

Inquiry No.		Page No.
213	FRANKLIN/PROXIMITY	308
214	FRANKLIN/PROXIMITY	308

823 IBM/MSDOS — CAD

Inquiry No.		Page No.
23	AMERICAN SMALL BUS.COMP.	114
100	FORESIGHT RESOURCES	23
101	FORESIGHT RESOURCES	23
127	IMAGENET SYSTEMS	331
128	IMAGENET SYSTEMS	331
442	ORCAD SYSTEMS CORP.	IS-15
508	ORCAD SYSTEMS CORP.	PC-15
281	ULTIMATE TECHNOLOGY	338
291	WINTEK	337
324	WINTEK	337
400	WINTEK	9

824 IBM/MSDOS COMMUNICATIONS

Inquiry No.		Page No.
11	ACS COMMUNICATIONS	344
53	COMMUNICATION RESEARCH GR	274
54	COMMUNICATION RESEARCH GR	274
90	DIVERSIFIED COMPUTER	337
143	KEA SYSTEMS	341
443	PERICOM	IS-31
269	TALKING TECHNOLOGY	334
461	TRITON TECHNOLOGIES	IS-8
462	TRITON TECHNOLOGIES	IS-8

825 IBM/MSDOS — GRAPHICS

Inquiry No.		Page No.
79	DAYTRON	344
532	DAYTRON ELECTRONICS	NE-22
*	ECOSOFT	70
127	IMAGENET SYSTEMS	331
128	IMAGENET SYSTEMS	331
163	MAP INFO	32
315	PINNACLE PUBLISHING	302
250	SCIENTIFIC ENDEAVORS	338
251	SCIENTIFIC ENDEAVORS	338
252	SCIENTIFIC ENDEAVORS	338

826 IBM/MSDOS — LAN

Inquiry No.		Page No.
533	DRAGONSLAYER SYSTEMS	NE-33
*	ELONEX	IS-19
453	SOFTTEK COMPUTER	IS-56
564	SUMMA COMPUTER	NE-34

827 IBM/MSDOS — LANGUAGES

Inquiry No.		Page No.
10	2500 AD SOFTWARE	144
42	BORLAND INTERNATIONAL	13
43	BORLAND INTERNATIONAL	13
85	DIGITALK	24,25
95	ELLIS COMPUTING	133
*	JENSEN & PARTNERS	127
151	LAHEY COMPUTER SYS.	144F
*	MICROSOFT	19
184	MIX SOFTWARE	305
454	STONY BROOK SOFTWARE	IS-27
455	STONY BROOK SOFTWARE	IS-27
285	WATCOM	120
300	ZORTECH	233

828 IBM/MSDOS — UTILITIES

Inquiry No.		Page No.
29	ATTACHMATE CORP.	154
41	BLAISE COMPUTING	48C
28	CADRE TECHNOLOGIES INC	31
468	COBALT BLUE	IS-46
79	DAYTRON	344
113	HAMMERLY COMPUTER SERV.	272
114	HAMMERLY COMPUTER SERV.	273
431	I X I LTD.	IS-56
129	IMES GMBH	338
152	LANTANA TECHNOLOGY	298
153	LANTANA TECHNOLOGY	298
310	LOGITECH	46
311	LOGITECH	46
178	MICROSOFT	85
184	MIX SOFTWARE	305
185	MKS	123
195	NU-MEGA TECHNOLOGIES	121
203	PARSONS TECHNOLOGY	87
509	PEOPLESMITH SOFTWARE	PC-13
319	PETER NORTON	255
207	PHAR LAP	198
230	QUARTERDECK	128,129
231	QUARTERDECK	128,129
232	QUARTERDECK	128,129
233	QUARTERDECK	128,129
452	SOFTWARE CONSTRUCTION	IS-43
264	SUPERSOFT	80
266	SWIRLSOFT	341
279	TRAVELING SOFTWARE	105
*	VERMONT CREATIVE	16

829 OTHER APPLICATIONS Business/Office

Inquiry No.		Page No.
74	CRICHLOW	328
87	DOCUBASE SYSTEMS	206

830 OTHER APPLICATIONS Scientific/Technical

Inquiry No.		Page No.
30	A/SOFT DEVELOPMENT,INC.	132
37	BINARY TECHNOLOGY	338

831 OTHER — CROSS DEVELOPMENT

Inquiry No.		Page No.
*	SOFTWARE DEVELOPMENT SYS	83

832 OTHER — LANGUAGES

Inquiry No.		Page No.
104	FRANKLIN SOFTWARE	86
294	Z-WORLD	334

833 DESKTOP PUBLISHING

Inquiry No.		Page No.
166	MATRIX	207

834 EDUCATIONAL/ INSTRUCTIONAL

Inquiry No.		Page No.
410	BIX	IS-71
*	BYTE BACK ISSUES	326
*	BYTE BACK ISSUES	IS-68
46	BYTE BITS	331
*	BYTE PUBLICATIONS	72,73
*	BYTE PUBLICATIONS	IS-70
*	BYTE PUBLICATIONS	IS-72
*	BYTE SUB MESSAGE	42
*	BYTEWEEK/NEWSLETTER	363
*	BYTEWEEK/NEWSLETTER	MW-2
*	BYTEWEEK/NEWSLETTER	PC-4
*	BYTEWEEK/NEWSLETTER	SO-4
55	COMPACT DISK PRODUCTS	169
*	COMPUTER PROFESSIONAL	112A-B
268	COMPUTER PROFESSIONALS BK	113
*	COMP.FOR THE BLIND	MW-4
*	DATA COMMUNICATIONS	IS-49
*	DATA COMMUNICATIONS	MW-8
*	DATA COMMUNICATIONS	NE-24
*	DATA COMMUNICATIONS	PC-16
*	DATA COMMUNICATIONS	SO-12
*	DATA COMMUNICATIONS	IS-48A–B
506	HEALD INSTITUTE OF TECH	PC-13
145	KNOWLEDGE GARDEN	361
*	SMALL COMP BOOK CLUB	32A–B
*	SMALL COMP BOOK CLUB	33
*	UNIXWORLD	329

835 MAIL ORDER/ RETAIL

Inquiry No.		Page No.
401	06 SOFTWARE CENTRE EUROPE	IS-58
402	06 SOFTWARE CENTRE EUROPE	IS-59
499	3-F ASSOCIATES	PC-8
16	ADVANTAGE SOFTWARE	119
21	AMERICAL GROUP	328
486	A-TRONIC COMPUTER	SO-11
525	A-TRONIC COMPUTER	NE-21
*	CALIFORNIA DIGITAL	345
52	CLONE COMPUTER	327
56	COMPUCLASSICS	142
305	COMPUTER DIRECT	294,295
61	COMPUTER DISC.WAREHOUSE	144
530	COMPUTER EXPERT,INC	NE-32
531	COMPUTER EXPERT,INC	NE-32
62	COMPUTER FRIENDS	144H
63	COMPUTER MAIL ORDER	176,177
64	COMPUTER MAIL ORDER	178,179
65	COMPUTER MAIL ORDER	208,209
487	COMPUTER WHOLESALERS	SO-5
488	COMPUTER WHOLESALERS	SO-5
66	COMPUTERLANE	330
476	DAKOTA COMPUTER	MW-3
*	DAMARK	247
82	DELTA COMPUTING TECH.	342
88	DISKCOTECH	341
89	DISKETTE CONNECTION	337
91	DYNAMIC ELECTRONICS	321
534	EDI	NE-20
535	EDI	NE-20
536	ELECTRIFIED DISCOUNTERS	NE-25
304	ELS ENTERPRISES,LTD	286
98	EXECUTIVE PHOTO & SUPPLY	194
314	EXSEL	357
427	GREY MATTER	IS-65
26	G.REED,INC.	328
477	HALSKAR SYSTEMS	MW-6
478	HALSKAR SYSTEMS	MW-6
540	HALSKAR SYSTEMS	NE-8
541	HALSKAR SYSTEMS	NE-8
542	HARMONY COMPUTERS	NE-1
543	HARMONY COMPUTERS	NE-1
544	HARVARD INFO SYSTEMS	NE-6
546	HY-TEC	NE-12
547	HY-TEC	NE-12
126	IC EXPRESS	337
130	INMAC	246
136	JADE COMPUTER PRODUCTS	339
137	JAMECO	324,325
140	J.D.R. MICRODEVICES	346,347
141	J.D.R. MICRODEVICES	348,349
548	LAPTOPS ETC.	NE-28
164	MARYMAC	334
438	MAYFAIR MICROS	IS-63
169	MEAD COMPUTER	332
*	MICROCOMPUTER MKTG CNCL	343
176	MICROPROCESSORS UNLTD	328
*	MICROWAY	173
182	MICROWAY	275
489	MIGHTY MICRO	SO-1
490	MIGHTY MICRO	SO-1
*	MONTGOMERY GRANT	130
552	MPM	NE-36
553	MPM	NE-36
554	M.S.C.	NE-29
186	NAGAN CORP.	344
479	NEXT WORKS, THE	MW-1
480	NEXT WORKS, THE	MW-1
555	NOCONA ELECTRONICS	NE-22
196	ON LINE STORE	335
198	PACIFIC COMPUTERS	323
560	PC LINK	NE-16
209	PRIORITY ONE COMPUTER	230
210	PROGRAMMER'S PARADISE	60,61
217	P.C. NETWORK	43
218	P.C.BRAND	221
219	P.C.BRAND	222,223
220	P.C.BRAND	224,225
221	P.C.BRAND	226,227
448	QUOTHA 32	IS-46
249	SCHWAB COMPUTER	333
451	SCOTTSDALE SYSTEMS	IS-13
*	SOFTLINE CORPORATION	IS-35
510	SOFTWARE ENGINEERING	PC-12
265	SURAH, INC.	344
267	S'NW COMPUTER	214
513	TRAN COMPUTER NETWORK	PC-1
514	TRAN COMPUTER NETWORK	PC-1
280	T.P.C.	326
282	UNITEX	340
466	USA SOFTWARE	IS-23
284	WAREHOUSE DATA	205
481	Y.E.S.SYSTEMS CORP.	MW-5
482	Y.E.S.SYSTEMS CORP.	MW-5

836 MISCELLANEOUS

Inquiry No.		Page No.
*	ANTHRO	42
246	SAFEWARE	341
463	TWINHEAD INT'L CORP.	IS-50

837ON-LINE SERVICES

Inquiry No.		Page No.
450	BIX	358,359
59	COMPUSERVE	257
110	GE INFO SERVICES	216

838 OPERATING SYSTEMS

Inquiry No.		Page No.
8	2001 SALES	220
9	2001 SALES	220
*	IBM OS/2	167
142	KADAK	342
229	QUANTUM SOFTWARE	69
248	SANTA CRUZ OPERATION	63
255	SOFTWARE LINK	213
256	SOFTWARE LINK	213
453	SOFTTEK COMPUTER	IS-56
263	STSC	27

REQUEST FREE INFORMATION BY FAX

Attention BYTE Readers!! Now you can fax your requests for free product and advertiser information featured in this issue.

Just fax this page to 1-413-637-4343. You'll save time because your request for information will be processed as soon as your fax is received.

1 Circle the numbers below which correspond to the numbers assigned to advertisers and products that interest you.

2 Check off the answers to questions "A" through "C".

3 Print your name, address, and fax number clearly on the form.

4 Remove this page or copy this page clearly and fax it to the number above.

Fill out this coupon carefully. PLEASE PRINT.

Name

Title

Company

Address

City

State/Province Zip

Country

( ) Phone Number ( ) Fax Number

A. What is your level of management responsibility?

1 ☐ Senior-level Management
2 ☐ Other Management
3 ☐ Non-Management

B. What is your primary job function/principal area of responsibility? (Check one.)

4 ☐ Administration
5 ☐ Accounting/Finance
6 ☐ MIS/DP/Information Center
7 ☐ Product Design and Development
8 ☐ Research and Development
9 ☐ Manufacturing
10 ☐ Sales/Marketing
11 ☐ Purchasing
12 ☐ Personnel
13 ☐ Education/Training
14 ☐ Other: _____

C. Please indicate your organization's primary business activity: (Check one.)

Computer-Related Businesses:

15 ☐ Manufacturer (Hardware, Software)
16 ☐ Computer Retail Stores
17 ☐ Consultants
18 ☐ Service Bureau/Planning
19 ☐ Distributor/Wholesaler
20 ☐ Systems House/Integrator/VAR
21 ☐ Other: _____

Non-Computer-Related Businesses:

22 ☐ Manufacturing
23 ☐ Finance, Insurance, Real Estate
24 ☐ Retail/Wholesale
25 ☐ Education
26 ☐ Government
27 ☐ Military
28 ☐ Professions (Law, Medicine, Engineering, Architecture)
29 ☐ Consulting
30 ☐ Other Business Services
31 ☐ Transportation, Communications, Utilities
32 ☐ Other: _____

☐ *I already subscribe to BYTE.*

☐ *Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.*

BYTE McGraw Hill

OCTOBER 1989

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440
441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460
461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500
501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520
521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560
561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580
581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620
621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640
641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680
681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700
701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740
741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760
761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780
781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820
821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860
861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880
881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920
921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940
941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980
981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040
1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060
1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100
1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120
1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140
1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160
1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180
1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200

continued from page 308

requester and responder delete their names from the network by calling `RemoveName`, and the responder releases the socket used for servicing requests by calling `CloseATPSocket`.

The requester had actually opened two sockets, one to pass to `RegisterName` and another with which to carry out a transaction during the `SendRequest` call. The program doesn't explicitly open the second socket; ATP does that automatically in `SendRequest`. When the request arrives at the responder's end, the `GetRequest` function passes a "return address" to the responder's application program, so it knows where to send the response packet. The requester never really knows, nor needs to know, its own socket number.

Now You're Talking

Communicating with AppleTalk is more or less a matter of filling entries in a parameter block (a block of memory of predefined fields), loading register A0 with a pointer to the parameter block, and calling the proper function. A general road map of the parameter block would be difficult to construct, since it changes depending on whether you're calling NBP or ATP. Your best bet is to keep a copy of *Inside Macintosh* on hand. The pseudocode in listing 1 indicates those locations where the program is filling the fields of the parameter block with an `IN Parameterblock DO` structure (vaguely similar to Pascal's `WITH` construct). I have tried to keep the field names as close to the mnemonics given in *Inside AppleTalk* as possible.

The pseudocode follows the process I outlined above. Each side (sender and receiver) opens a socket, registers a name on the network, and then performs a `LookupName( )` to locate the other side. The program branches to one of two processes, depending on whether it's sending or receiving.

The sender begins reading the file, transmitting 512-byte blocks via `SendRequest( )`. The receiver reads the requests with `GetRequest( )`, writes the data to the destination file, and then acknowledges its receipt with a `SendResponse( )`. (Note that there's no real content to the response; it serves as an acknowledgment signal.) When the last block is transmitted (signaled by a block smaller than 512 bytes), both sides close their files and remove their names from the name table.

There are two data structures of special note that are too complex to describe in the pseudocode. The first is the buffer data structure (BDS). Before a program can send a request, it has to get its house in order for the response(s) it's certain to receive. (Remember that a given request can trigger up to eight responses.) ATP's `SendRequest` routine requires that you construct a BDS describing where incoming responses are routed.

Each element of a BDS—there can be up to eight—contains a pointer to available memory for the associated response, a byte count telling how big that memory is, and another byte count for how many bytes were actually received (see figure 2). When the first response comes in, it looks in BDS element 0 to figure out where to put the response data. When the second response comes in, it looks in BDS element 1, and so on. Since my program expects only one response consisting of a doubleword, this requires a single BDS element pointing to a 4-byte buffer.

The second data structure is used exclusively by NBP and is described in figure 3. The names table entry (NTE) is a member of a linked list that NBP keeps in memory. Each member corresponds to a name on the network associated with your node. NBP knows what names go with what network number, node, and socket. Whenever you register a name, you have to set aside memory space for that name's NTE. Furthermore, the NTE's memory block must be locked as long as that name is active (or it could get lost if memory moves during a heap compaction).

Done Talking

This concludes my romp through AppleTalk. Next month, I'll do the same for NetBIOS. The source code for this month's program is available via the usual routes under filename ATTRANS (see page 5 for details). It's written in Palo Alto's Mach 2 Forth but should be readily adaptable to any other Forth dialect (and, with the help of the pseudocode, to other languages).

I plan to take a look at AppleTalk's Extended Protocol Package (XPP) in this column sometime in the near future. Stay tuned. ■

Rick Grehan is the director of the BYTE Lab. He has a B.S. in physics and applied mathematics and an M.S. in computer science/mathematics from Memphis State University. He can be reached on BIX as "rick_g."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Circle 314 on Reader Service Card

EXSEL™ INC.

We Buy
NEW/USED
Computer Equipment

CALL EXSEL™ INC.
...when you are buying a computer.

CALL EXSEL™ INC.
...when you need a better trade-in.

CALL EXSEL™ INC.
...when you are selling your computer.

CALL EXSEL™ INC.
...when you are upgrading your system.

CALL EXSEL™ INC.
...when you are looking for that extra terminal.

CALL EXSEL™ INC.
...when you need an outlet for your used equipment.

EXSEL™ INC.
"The Alternative Source for the Future"
716-272-8770
Rochester, NY
800-624-2001

BIX CALENDAR

OCTOBER

Display this month's BIX activities

O C T O B E R

Let the interactive games begin!

BIX's newest exchange, the *Interactive Game Exchange,* is dedicated to interactive recreation on line. Action continues every night, and you can access it via your computer and BIX. Just as you can access all the other BIX exchanges—*Bulletin, IBM, Macintosh,* and *User's Group*—and all the BIX conferences.

SUNDAYS, 9 PM EST. Poetic Liberties

Poetry, art, music and stories from by gone days to yet-to-come days are featured in this conference. (join fun.n.games/game.room)

SUNDAYS, 9:30 PM EST. School Night

Learn about role-playing games on line and off line at Fantasy Foundation College. (join ff/ff.col)

MONDAYS, 9 PM–Midnight EST. Check into the Meade & Mirth Inn

A free-form game set in the Middle Ages or far into the future. (join mnm/inn)

TUESDAYS & WEDNESDAYS, 9:30 PM EST. As the Ledinworld Turns

Ledinworld is the advanced D&D center of the Exchange. Enjoy real-time fantasy role-playing games as well as message-based player interaction. (join lworld/ledinworld)

THURSDAYS, 9 PM EST. Meanwhile, Back at the Inn . . .

. . . the free-form, role-playing games continue as the mead and mirth flow. (join mnm/inn)

THURSDAYS, 10:15 PM EST. Pandemonium

Contemporary parlor games and social activities. (join fun.n.games/game.room)

FRIDAYS, 9 PM EST. Trivia . . .

Begin your T.G.I.F. nights in the pursuit of trivia. (join fun.n.games/game.room)

FRIDAYS, 9:30 PM EST. . . . & Other Pursuits

. . . such as *"Argonauts,"* the futuristic role-playing game. (join encounters/new.worlds)

SATURDAYS, 8:30 PM EST. Fantasy Meeting You Here

Play *"One Night In Waterdeep"* and other real-time fantasy role-playing games. (join lworld/ledinworld)

SATURDAYS, 9 PM EST. More Meade & Mirth

And you can add to the mirth every Saturday night. (join mnm/inn)

All-Month Conferences and Special Events

Macintosh Exchange—We expand BYTE's optical-devices product focus and in-depth coverage in the Macintosh Exchange this month by looking at some of the available optical-storage devices for the Mac. With rewritable optical media routinely able to store 600 megabytes, what can the Mac user expect to use such devices for? (join mac.hack)

Blue Tuesdays—Every Tuesday in October (9PM EST), join Barry Nance, IBM Exchange Editor, and the IBM conference moderators as they discuss issues and answer your questions about IBM and workalike computers. (join the main CBix area, channel 1, band B)

Wizards of OS.9—You're off to meet the wizards in this special focus on CD-I/CD-RTOS with guest experts. (join os.9)

New Conferences

journalism—Let practicing journalists show you how, what, when, where and why. (join journalism)

journalism.pro—A closed conference for professional journalists. Contact 'janziff' or 'jonhall' for details on how to join this conference.

sfwa—A closed conference for members of the *Science Fiction Writers of America.* Contact 'mike__banks' for details.

mac.macappda—Join with members of the *Macintosh Applications Developers Association* as they create new software for the Macintosh series. (join mac.macappda)

Circle 450 on Reader Service Card.

Finally. An on-line service that doesn't nickel and dime you.

It's BIX's flat-fee service.
BIX is short for BYTE Information Exchange. The on-line information service that's yours for an unheard-of flat fee of just $39 for three months*—an amount you could easily waste in just two to four hours with an *hourly rate,* on-line service. (Not to mention the fact that you'd be nickel-and-dimed for its monthly minimums.)

And here's another distinction: BIX is strictly for microcomputer pros; it contains no "fluff." As a subscriber, here's what you've got coming to you:

- ☐ All the information and ideas exchanged in more than 150 microcomputer-related conferences—a give-and-take in which you can participate.
- ☐ *Microbytes Daily*—up-to-the-minute industry news and new product information.
- ☐ Plus support from hardware vendors and software publishers, access to extensive software libraries, and the use of our electronic mail service—which allows *binary attachments.*

Subscribe to BIX right now—using your computer and modem.
Set your telecommunications program for full duplex, 8 bits, no parity, 1 stop bit, or 7 bits, even parity, 1 stop bit. Now dial BIX at 617-861-9767, hit the return key, and respond as follows:

Prompt:	**You Enter**
login (enter"bix"):	bix
Name?	bix.flatfee

You can charge your BIX subscription to major credit cards, or have it billed to your company. You may also purchase unlimited off-peak access via Tymnet for just $15 per month, or $2 per off-peak hour, in the continental US**. For more information, including your local Tymnet access number, call 800-227-2983 (in New Hampshire and outside the United States, call 603-924-7681).

**Based on a $156 annual fee, billed quarterly —a subscription you may cancel at any time without future charges. You may also subscribe for a 3-month trial at just $59.*

***For international rates, please consult your local PTT. Our international packet network address is 310690157800.*

BIX

One Phoenix Mill Lane
Peterborough, NH 03458
800-227-2983. In NH 603-924-7681.

Hugh Kenner

Curtains for Lady Buxley

THE HUMANITIES COMPUTING YEARBOOK: 1988

edited by Ian Lancashire and Willard McCarty

The Macintosh requests a decision. You are Denis Marin, born 1638, and in the French society of that era, your aim is (what else?) to maximize family prestige. Economic, political, marital opportunities abound. A flow of correspondence has kept you informed. You want a wife who will bring fortune and connections. Propose to Mlle. X? Ah, best check her status. If yours is lower, a refusal would ghettoize you for years. Such were seventeenth-century French realities.

In fact, you are an undergraduate studying the ancien régime. You are running a program called The Would-Be Gentleman, which lets you guide the Marin family through two generations, to 1715. A sort of pedagogical Zork, it calls for some 154 decisions (buy? sell? marry? beget?), and "when students act from twentieth-century motivations rather than from seventeenth-century assumptions, they fall neatly into traps set for them. A common way of losing the game is to arrive at 1715 with loads of cash and a high status but without any children to inherit them." That's no way to set up a dynasty.

This program, available for a mere $7, engages students in "historical concepts otherwise very difficult to teach"; they learn, interactively, what it was like to live at that level of ambition in those years. It's described on page 150 of *The Humanities Computing Yearbook*, a work indispensable for anyone engaged in the field. (A *huge* field; in a moment, I'll try to describe it.) This first volume attempts a comprehensive survey from earliest times (the 1960s) through 1988. Hereafter, annual updates are promised.

All right, the "field": nearly anything that turns on "our writing system, the printing press, the public library," also art history, biblical studies, creative writing, editing and publishing, history, languages and literatures, text analysis...on and on. It's easier to say what's not included: no business applications, no engineering ones. To this broad domain, some 400 pages of fairly small print now offer a well-organized annotated bibliography, plus lists (with sources) of available software.

There are many surprises. Two decades ago, David Packard, a classicist who happens to be a Hewlett-Packard Packard, was reflecting that much of classical scholarship has always amounted to numb pattern-matching. (Find, in the corpus of Greek literature, every instance of the word *oinope*. Bleary-eyed insomniacs, century after century, fingered parchment to accomplish chores like that.)

Packard's ruminations (I'm simplifying) led to section 19.7.1, "The A.P.A. Corpus: a repository of Greek and Latin texts in machine-readable form," developed by the Packard Humanities Institute and described in *Classical Journal* as long ago as 1977. (A.P.A. is the American Philological Association.) Since "Greek and Latin literature" can be rather strictly defined, it's possible to claim that the "Corpus" is virtually complete. So the humanities discipline long deemed the very stuffiest got computerized ahead of all the rest.

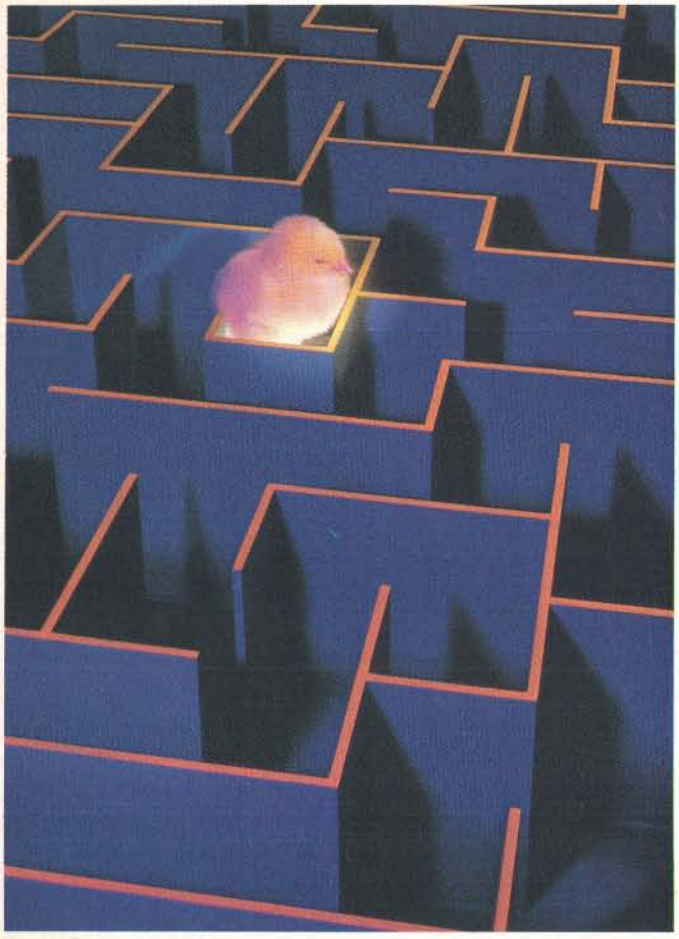
No trick now to turn up all those instances of *oinope*. Homer applied it 10 times to the sea—hence the familiar translation, "wine-dark." But he also used it once for oxen, and Sophocles used it for a human forearm. A wine-dark arm? Perhaps we'd best rethink. Oxen sweat; so do arms. The sea too flashes back light from its fluent surface. May that word point not to color but—ah—to gleam?

The work with *oinope* was long since done, by hand. It's also had to be checked by repeated redoing; human eyes wander, human memories leak. So, post-Packard, we find machines dedrudging processes centuries-long defined. To deduce what old words may connote requires collections of instances to scrutinize. No better collector than a PDP-11.

continued

ILLUSTRATION: CARY HENRIE © 1989

Knowledge Processing



Don't leave your users lost in a maze of information!

A knowledge processor communicates knowledge - the natural extension of everything we do on a computer.

It's the intelligent integration of everyday resources like data, text, logic, graphics, and video that turns information into knowledge.

KnowledgePro is the first knowledge processor. It combines a high-level, object-oriented programming language with hypertext and expert systems technology.

KnowledgePro gives you a total development environment with the tools you need to create intelligent multi-media applications.

PC Magazine, Holland... *"KnowledgePro is the first of a new generation of software, the knowledge processor...it has the power of, for example, Pascal or PROLOG, but the programmer isn't troubled with the technical details."*

PC Week, USA... *"It's rare, but every so often a PC application comes along that breaks new ground and creates a fundamentally different way to use computers. According to its corporate users...KnowledgePro does just that."*

Infoworld... *"We don't live in a computational world. If we're going to move knowledge around we need tools...The same person who will learn macros in Lotus can learn this."*

KnowledgePro costs $495 with no runtime fees. It runs on IBM PC, XT, AT and PS/2 compatible machines with 640k of memory and a hard disk. A working demo with a 100 page manual is available for $33 including shipping ($38 foreign) with credit towards purchase of the full system.

Find out what knowledge processing is all about. Call 518-766-3000 (FAX 518-766-3003) or write to Knowledge Garden Inc., 473A Malden Bridge Rd., Nassau, NY 12123, USA. Amex, Visa or M/C accepted.

KnowledgePro®
The intelligent way out

Another intelligent tool from

Knowledge GARDEN Inc.

Circle 145 on Reader Service Card

KnowledgePro is a registered trademark of Knowledge Garden Inc. IBM, PC, XT, AT and PS/2 are trademarks of International Business Machines Corp.

Technology doing what was long done by hand: That's the story in field after field. Databases, unsurprisingly, are everywhere. Art historians use them, lexicographers, philologists. There's even one of Texas cave paintings, with digitized images. Archaeology, keeping track of countless sites and objects (e.g., pots, bones, and buttons), enjoys not only relational databases but a shareware program to analyze them.

At this moment, some humanities computing seems to be in a state of free-fall. It's tool-driven, a bad way to be. Better, be situation-driven.

And some things now get done that our parents could never have thought of. When NASA's land-mapping techniques for digital image processing were turned on the *Mona Lisa*, they spotted areas where it had been altered.

Amid literary studies, though, things can get murky. No denying it, some things there are stably quantifiable. Think of letter- and word-frequency distributions. And there are writers whose manner we soon learn to recognize at a glance; Henry James comes to mind. So what it is that we're recognizing: might *that* be described by statistics? It's long been a tempting thought, and now we have computers. . . .

Computerized procedures, I'm serenely convinced, could well distinguish the prose of James from that of Mickey Spillane. I'm less certain that they could sort out—oh, three George Bush speechwriters; there, surely, the style of the genre swamps nuances of personality? Yet that's the kind of question some historian may one day be asking.

So we find section 25.1, "Authorship Analysis," a controversial procedure indeed that looks for a writer's "fingerprint" by number-crunching measures of vocabulary and syntax and then offers decisions about texts of unknown authorship. One problem area is the sheer impossibility of verifying its findings. Trajectory calculations we can verify by firing a bullet. Unknown authorship, by whatever means we guess, must remain, alas, unknown.

The procedure is amusingly spun off in section 12.2, "Tools for Composition," where an outfit called Glatt Plagiarism Services helps instructors put "the suspected student" into the hot seat while a paper gets fingerprinted for plagiarism.

You want to know how that's done? Well, it assumes (1) the uniqueness of your "fingerprint," and (2) no one's ability to emulate a fingerprint as well as its owner. You're presented with your paper, every fifth word blanked out. You're timed while you sweat at filling in the blanks. The result goes off to Glatt, where they combine time with total correct responses to estimate a PPS (plagiarism probability score). For this, the instructor pays $500 annually. A longtime instructor, I'm willing to trust hunches.

Or, if you've heard about text generators, over in section 7.3 there's Automatic Novel Writer, to generate 2100-word murder stories (which seem long enough) beginning, for example, "Wonderful smart Lady Buxley was rich. Ugly oversexed Lady Buxley was single." Or (7.4) Returner, "A program that analyzes Alberta T. Turner's poem 'Return' and simulates stanzas of a like kind." Spare me. One "Return" is enough.

Alberta T. Turner aside, I'm persuaded that interesting texts can be somehow spun out of existing texts. Charles Hartman and I have a book of poems in press; it fascinates us that you'd never guess what the computer derived them from (sentences for schoolchildren to analyze and parse). Somehow, a human core lingers. What constitutes it is a mystery. And the feel of our output differs from what's spawned by word lists plugged into sentence patterns. There's a great deal to be learned hereabouts.

Yes, some of this research seems trivial. Trivial too, if you had them all spread out before you, might be many of the findings of computer science. We're still learning what best to ask of our wondrously literal-minded slave. When a keystroke will give you a count of the letter *q* in a text, well, you're apt to request it, never mind what to think next. At this moment, some humanities computing seems in a state of free-fall. It's tool-driven, a bad way to be. Better, be situation-driven, the way the following narrative illustrates.

Fifty-some years ago, it occurred to Miles Hanley at the University of Wisconsin that James Joyce's *Ulysses* was one book for which a word index would be uniquely valuable, so deliberate had been Joyce's employment of isolate words. (He crossed them off long lists.) But, in 1936, a word index to a quarter-million-word text? Improbably, it got done, with cards and student slave labor and minuscule grants, and was circulated by mimeograph. And it made intellectual history, still not wholly reckoned, when its statistical tables—a seeming afterthought—caught the eye of a fanatic, Harvard's George Kingsley Zipf.

Zipf noted what has since been known as Zipf's law: an exact inverse correlation between frequency and appearance. There had been no statistics for a text of this size before. And lo, if the commonest word (*the*) occurred 16,000 times, then—as if to compensate—the count of *Ulysses* words that occurred but once was 16,000! And so on. A log-to-log graph of frequency versus occurrence is a straight slanting line. It gets pondered yet. Trying to lend it mathematical rigor was the effort of Benoit Mandelbrot's first published paper, and chapter 38 of *The Fractal Geometry of Nature* shows that line of thought pointing him toward what he's famous for.

The moral seems to be that Hanley knew what he wanted, an index to a unique text, and Zipf knew what he wanted, a pattern, and Mandelbrot knew what he wanted, a taxonomy of patterns. The tool-driven often don't quite know what they want, and they generate Automatic Writers of "novels" that no one is likely to dream of reading. I promise not to report another sentence about ugly oversexed Lady Buxley. ■

Oxford University Press, New York: 1988, 404 pages, $59

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times *and* Harper's. *His recent books include* A Sinking Island *and* Mazes. *He can be contacted on BIX as "hkenner."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Quality In... Quality Out

BYTEWEEK

NEWS AND ANALYSIS FOR PERSONAL COMPUTER PROFESSIONALS

DEC Deals A New Hand; Eases Back Into PC Market

Coming This Week:

Things To Watch For At SF MacWorld Expo

The Week In Review

No matter how well acquainted you are with making important personal computing decisions—decisions that may involve hundreds of thousands of dollars—the value of those decisions is only as good as the value of your information. Without quality information—it's hard to make quality decisions.

BYTEweek, McGraw-Hill's new weekly newsletter for professionals in the personal computer industry, is devoted to giving you that quality information through its timely and compact one-stop news format.

This new publication provides you with short, easy-to-read selections of the most important news and technological developments of the past week. And BYTEweek interprets this news with in-depth commentary and analysis.

Subscribe to BYTEweek for quality information. Remember, quality in . . . quality out.

Subscribe now and take advantage of the special one-year charter subscription rate of $395 ($495 outside the U.S. and Canada). This special price represents a savings of $100 off the regular rate. Your subscription includes 50 issues plus a free three-month subscription to BIX—a $49 value. Through BIX you can directly access the Microbytes Daily news service and communicate with other BIX users.

Don't miss this opportunity! In the U.S., call BYTEweek's toll-free number: **1-800-258-5485,** in N.H. and outside the U.S., call: 1-603-924-9281.

BYTEweek offers a *money-back guarantee* if you're not completely satisfied.

BYTEWEEK

News and Analysis for Professionals in the Personal Computing Industry

One Phoenix Mill Lane, Peterborough, NH 03458

GOODBYE, MR. CHIPS

The computer revolution is a success, and nothing will ever be the same

When I was in seventh grade in 1976, my friends and I discovered the phone number to access the nation's research network, ARPANET. We found an unattended teletype with a modem in a science lab of our forward-thinking junior high school and dialed away. ARPANET asked for a password, but we soon discovered that it didn't matter what we typed—the network would always let us in. Back then, life was free and easy in the world of computers, and nobody worried about security.

My friends and I spent the rest of the school year playing computer games, talking to people at MIT, experimenting with the software, and trying to find our way around a toy that was as big as all of the U.S. We never did anything damaging, and no one seemed to worry or even care that we were there.

In an earlier frontier—the American west—there was a sheriff, but he had plenty of ground to cover. The peace was kept by an unofficial code of what was good and bad. And just as the old gunfighter never shot anyone in the back, a hacker would never erase someone else's files. He or she might hide them or play some other clever prank that made him or her the most awesome weenie around, but the actions were never fatal. It was a wild West with a sense of humor, a Sergio Leone movie with Robin Williams instead of Clint Eastwood.

Now, though, the frontiers are closing in. As time goes by, there will be fewer and fewer leisurely raft trips through the electronic rivers for the Huck Finns among us who would rather avoid being civilized. Computer shenanigans are big news, and the people judging the mug shot in the paper are rarely going to relish the technical bravado. They are more likely to have a chip on the shoulder from the last time a computer screwed up one of their bills.

In the old days, the computer weenie caught slipping into forbidden machines was rarely dealt with in court. Although the crime was usually the equivalent of breaking and entering, the laws were vague and generally predated the transistor. The victims usually settled with the hacker out of court, in return for learning about the security holes in the system. Now, several years after the movie "War Games" hit the screens, prosecutors see electronic cat burglars as an interesting evolving part of the law—but not a technical problem beyond understanding.

In Syracuse, the story of Robert Morris, America's computing cover boy, continues to unwind. Morris is charged with creating the virus that brought ARPANET to its knees last November. The federal government will attempt to prosecute Morris under a 1986 law prohibiting unauthorized use of federal computers. This is an important case to the government; it doesn't want the case to end in an acquittal, thereby sending the wrong message to all the budding young computer geniuses out there.

Getting a conviction in this case will be difficult. The prosecution will have to deal successfully with the philosophical question of whether a person who programs a virus to invade a computer is guilty of invading the computer. And what constitutes evidence that the mastermind did it all? There is also the problem of intent; the law prohibits destroying or copying information, but the virus that crippled ARPANET was only out for a Sunday drive, albeit at light speed.

When the automobile was introduced, those who could afford to buy one were overcome by an incredible feeling of liberation. The automobile gave people the freedom to go anywhere. Henry Ford wasn't a great success because he built a clever assembly line, but because he turned the dream of being able to hop to the next town on a whim into reality. Unfortunately, too much of this four-wheeled freedom has come to mean smog, traffic jams, auto insurance, speed limits, and long lines at the Department of Transportation. Is California still known for being the untamed land at the end of the frontier? No; it's now just the home of the freeway.

Will the same thing happen with computers? I'm afraid so. It will take a while, but the power of civilization is too strong to resist. The computer revolution is threatened with the curse of succeeding. Once everyone starts using some new machine, the temptation to make everything right by regulation comes creeping in. One minute you're on the cutting edge of technology, and the next minute, there's a large, gray building in Washington overseeing your actions.

There really is no other way. When things get big and everyone gets involved, keeping the peace must be made more efficient. I guess that's what computer scientists would want if we were organizing the world the way they try to organize their software: justice completely and rigorously defined.

But somehow, it doesn't seem the same anymore. ■

Peter Wayner, a consulting editor for BYTE and a graduate student at Cornell University, recently completed a summer internship at Xerox Palo Alto Research Center. He can be reached on BIX as "pwayner."

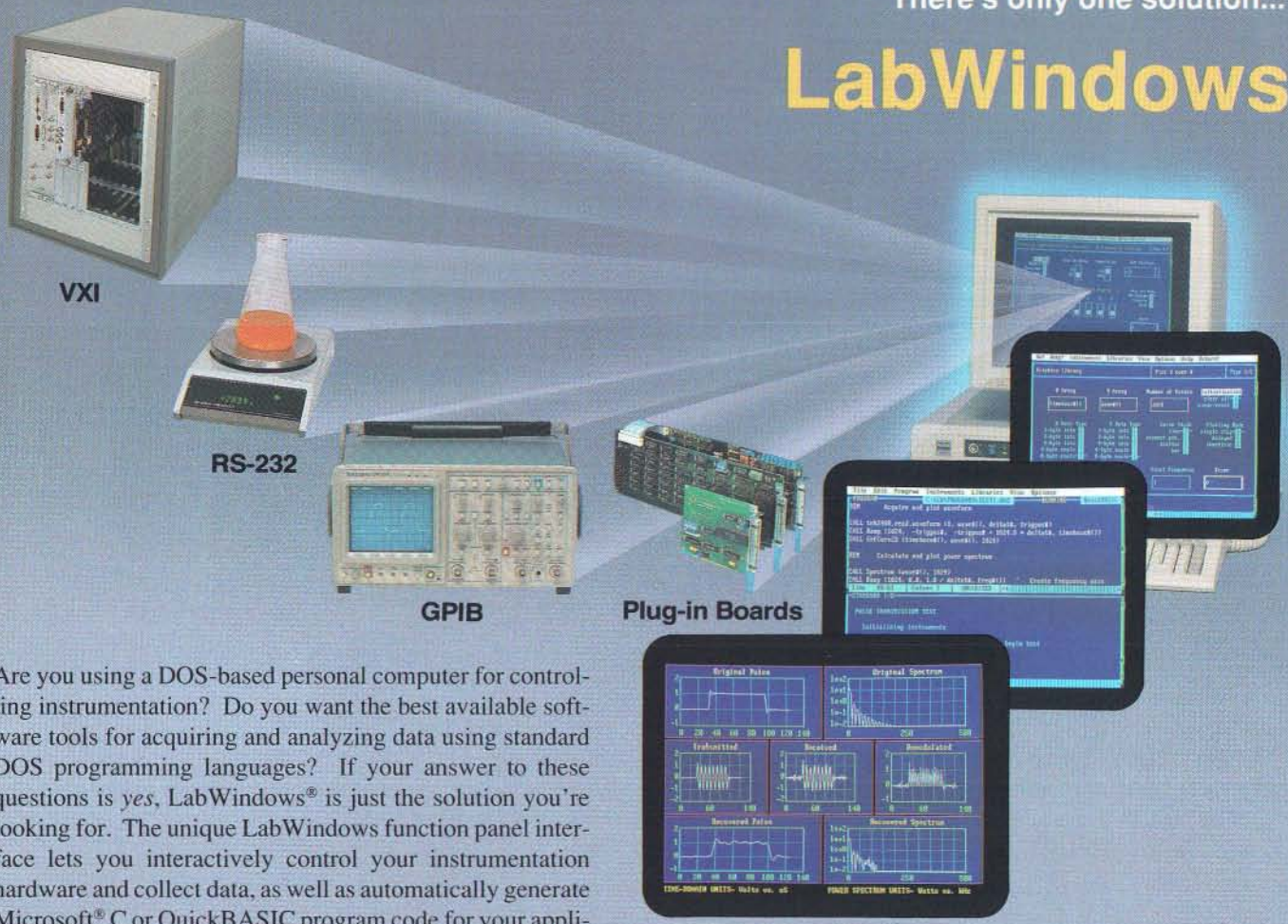
Stop Bit is an open forum for informed opinion on topics related to personal computing. The opinions expressed are those of the author and not necessarily those of BYTE or its staff. Your contributions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

ILLUSTRATION: MACIEK ALBRECHT © 1989

DOS + QuickBASIC or C + Instrumentation Code Generation = ?

There's only one solution...

LabWindows



Are you using a DOS-based personal computer for controlling instrumentation? Do you want the best available software tools for acquiring and analyzing data using standard DOS programming languages? If your answer to these questions is *yes*, LabWindows® is just the solution you're looking for. The unique LabWindows function panel interface lets you interactively control your instrumentation hardware and collect data, as well as automatically generate Microsoft® C or QuickBASIC program code for your application.

With LabWindows you can control GPIB, RS-232, or VXI instruments, or plug-in data acquisition cards for PS/2 and PC-AT computers. For standalone instrument users, the LabWindows instrument library has over 50 ready-to-use instrument drivers so you can program your instrument using intuitive instrument-specific function panels, without knowing the instrument inside-out.

Because acquiring data is only one element of your application, LabWindows has a complete set of QuickBASIC and C compatible libraries for data analysis, presentation, and storage. Manipulate arrays, create a histogram, or use the optional Advanced Analysis Library to perform operations such as Fast Fourier Transforms, digital filtering, and curve fitting. Give your programs a big performance boost using the specially optimized LabWindows analysis routines for computers with an 80387 numeric coprocessor. For your data presentation and storage needs, use the LabWindows Graphics Library to create multiplot graphs, bar charts, or scatter plots, and use the Data Formatting Library for data logging and file operations.

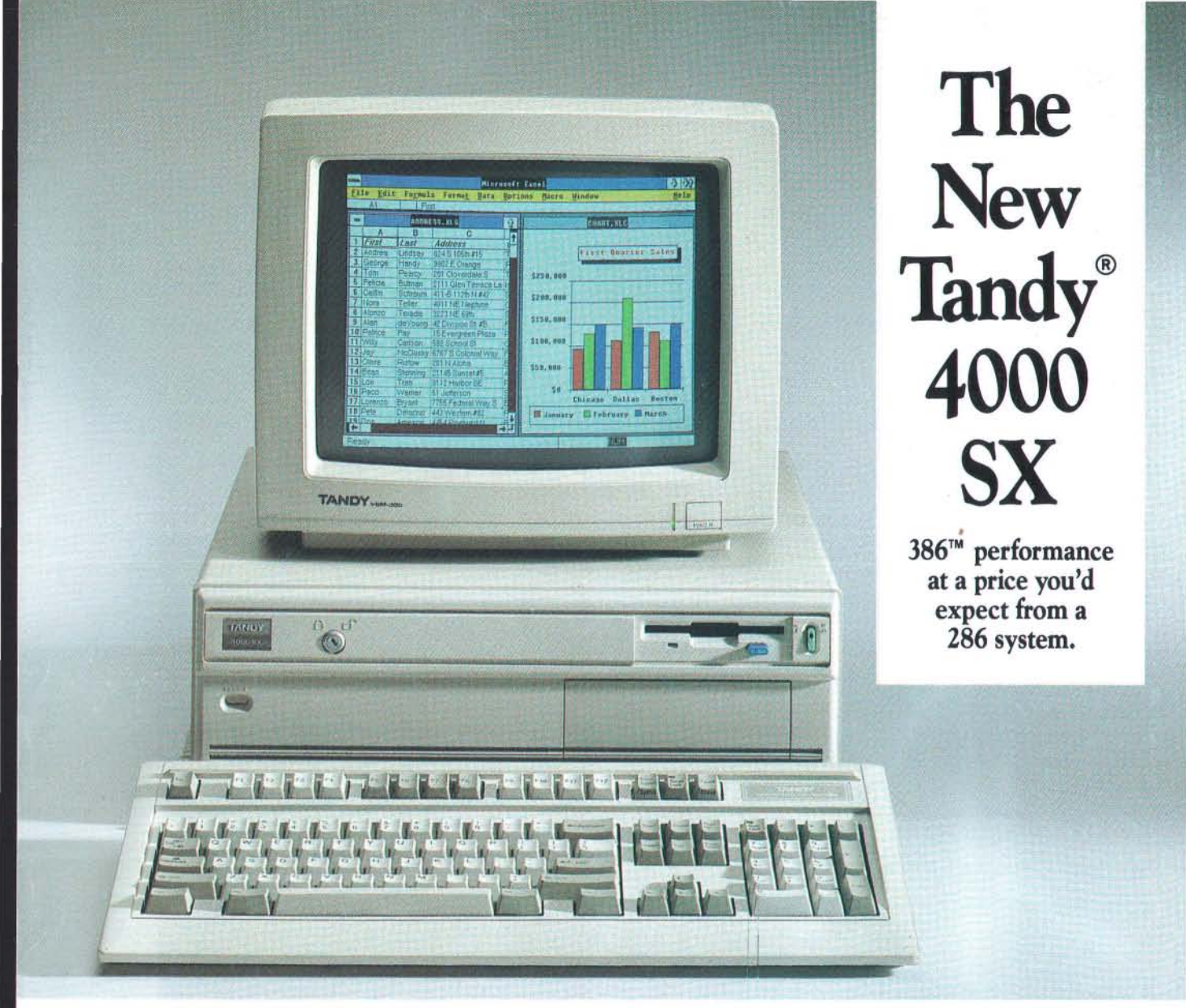
If you're looking for the right tools to take maximum advantage of your DOS computer using QuickBASIC or C for data acquisition and analysis, there is only one solution...LabWindows. Call National Instruments at (800) IEEE-488 to speak with a sales or applications engineer about how LabWindows can help you.

Ask for a *FREE* Catalog

NATIONAL INSTRUMENTS®
The Software is the Instrument™
12109 Technology Blvd.
Austin, Texas 78727-6204
(512) 794-0100

Circle 188 on Reader Service Card

NATIONAL INSTRUMENTS OF JAPAN (03) 788-1922 • **NATIONAL INSTRUMENTS OF FRANCE** (1) 486 53370 • **NATIONAL INSTRUMENTS UNITED KINGDOM** (06) 355-23545 • **ARGENTINA** (1) 46-5776 • **AUSTRALIA** (2) 736-2888 • **BELGIUM** (2) 466-8199 • **CANADA** (416) 890-2010, (613) 596-9300, (514) 747-7878, (403) 295-0822, (604) 988-2195 • **CHILE** (2) 225 3689 • **DENMARK** (2) 251-122 • **FINLAND** (0) 372 144 • **GREECE** (1) 361-1283 • **HONG KONG** (2) 0426-2707 • **IRELAND** (846) 661414, (3) 427-2282 • **ISRAEL** (3) 324 298 • **ITALY** (2) 984-91071-2-3 • **KOREA** (2) 776-5340 • **MEXICO**(5) 660-4323 • **THE NETHERLANDS** (7) 099-6360 • **NEW ZEALAND** (9) 444-2645 • **NORWAY** (2) 53-1250 • **PORTUGAL** (1) 545-313 • **SINGAPORE** (65) 336-4713 • **SOUTH AFRICA** (011) 787-0473 • **SPAIN** (1) 455-8112 • **SWEDEN** (8) 792-1100 • **SWITZERLAND** (6) 552-8949 • **TAIWAN/THE REPUBLIC OF CHINA** (02) 703-6280 • **THAILAND** (2) 234-9330 • **WEST GERMANY** (89) 80-7081



The New Tandy® 4000 SX

386™ performance at a price you'd expect from a 286 system.

A price/performance breakthrough for 386-based systems, the new Tandy 4000 SX combines more integrated features than ever in a machine at this price.

The Intel® 80386SX microprocessor combines the ability to run high-performance 80386 based software, as well as current 80286 and 8088 based software. You get the best of both worlds—32-bit performance with 16-bit hardware compatibility.

This means the Tandy 4000 SX insures your computer investment for the future. As a low-cost alternative to an expensive 386 system, you won't be left behind when you want to move on to more advanced 386 based applications, like MS® OS/2.

Built-in VGA graphics give you beautifully detailed, high-resolution displays. Add a color analog monitor and create astonishing graphics in up to 256 colors (from a palette of 256,000) for near-photographic clarity.

The 4000 SX's SmartDrive™ Integrated Drive Electronics (IDE) technology allows you to add high-performance hard disk drives without the need or expense of installing a separate disk controller.

Innovative technology. Quality engineering. Competitive pricing. Come see the new Tandy 4000 SX today. From the best-selling family of PC compatibles made in America.

Tandy Computers: Because there is no better value.℠

SmartDrive/TM Tandy Corp. Intel and 386/TM licensed from Intel Corp.
MS/licensed from Microsoft Corp.

Radio Shack®
COMPUTER CENTERS
A DIVISION OF TANDY CORPORATION

Circle 234 on Reader Service Card