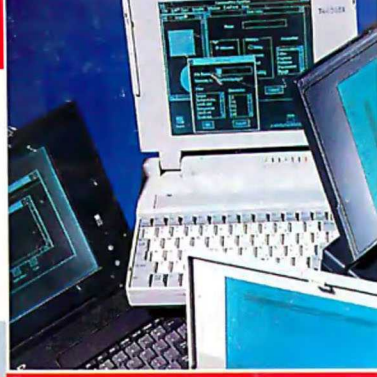
BYTE
THE WORLDWIDE COMPUTING AUTHORITY



Best New Notebooks
Pages 238, 249

Is Unix Dead?

Unix is at a crossroads. Soon, Unix will face its most powerful adversary to date: Microsoft Windows NT. Will Unix survive?

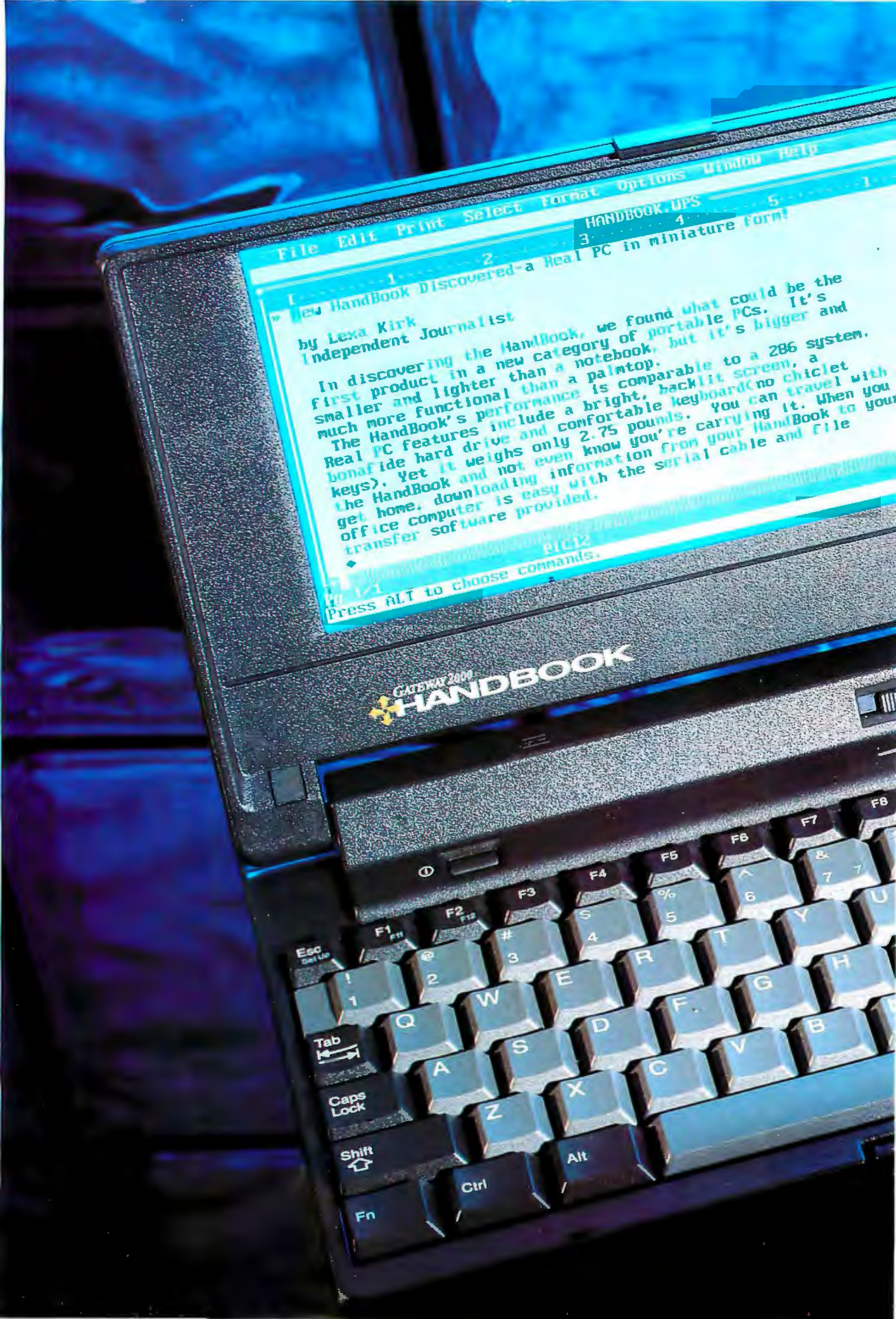
Turn to page 134

Major Upgrades for Ami Pro and PowerPoint

Green Computing Saves Money and the Planet

Report from Taiwan: Moving Beyond Clones

09
02662
0 440235 0
$3.50 U.S./$4.50 IN CANADA
A McGraw-Hill Publication/0360-5280


File Edit Print Select Format Options Window Help
HANDBOOK.WPS
New HandBook Discovered-a Real PC in miniature form!
by Lexa Kirk
Independent Journalist
In discovering the HandBook, we found what could be the first product in a new category of portable PCs. It's smaller and lighter than a notebook, but it's much more functional than a palmtop.
The HandBook's performance is comparable to a 286 system. Real PC features include a bright, backlit screen, a bonafide hard drive and comfortable keyboard(no chiclet keys). Yet it weighs only 2.75 pounds. You can travel with the HandBook and not even know you're carrying it. When you get home, downloading information from your HandBook to your office computer is easy with the serial cable and file transfer software provided.
Press ALT to choose commands.
GATEWAY 2000
HANDBOOK
Esc
Tab
Caps Lock
Shift
Ctrl
Alt
Fn

AC
Caps
Num
Pad
Scrl
<F1=HELP>
Del
Ins
BkSp
Scroll Lock
Enter
Shift
PgUp
PgDn
End
Home
Ctrl
Alt
Actual size and screen display

TRY OUR NEW LIGHT MENU.

The new HandBook™ from Gateway 2000 is lighter, smaller and thinner than regular notebook PCs. But don't let its diet size fool you. It's a real PC!

The HandBook uses Chips & Technologies' "PC on a chip," which minimizes the number of chips on the system board and, via superstate, allows software to control many functions that are normally hardware controlled. Less hardware means smaller size and less weight. The HandBook with battery weighs only 2.75 pounds, yet it runs all DOS applications with 286-class performance.

This HandBook photo was taken with the actual display running, and is printed in actual size so you can appreciate its brilliant screen, comfortable keyboard and tiny footprint. Imagine this little machine tucked into your briefcase. You'll never know you're carrying a notebook! You'll like the light price, too! Just give us a call for more information on the perfect portable for those who are weight-conscious.

HANDBOOK

- Weight 2.75 Lbs. (HandBook & Battery)
- Dimensions 5.9" x 9.75" x 1.4"
- 4.5-Hr.* NiMH Battery, 1.25 Lb. AC Adaptor/Charger, 6.5" x 2.5" x 1.5"
- Traveling Weight 4.0 Lbs. (HandBook, Battery & Charger)
- C & T® Processor, 286-Class Performance
- 1MB RAM upgradeable to 3MB
- 40MB hard drive
- Backlit 7.5" Double-Scan CGA Screen, 640 x 400 Resolution
- 1 Parallel/1 Serial Port
- 78-Key Keyboard, 101-Key Emulation, Inverted T Cursor Pad
- MS DOS® 5.0, File Transfer Software & Serial Download Cable
- Introductory Bonus Pack
- Carrying Case

$1295

Options: FieldMouse™ pointing device, 2400 bps modem, alkaline battery pack, portable printer, combo unit (3.5" floppy drive with serial port and parallel port), extra batteries.

**Battery life was measured using PC Magazine's Battery Rundown Test with power management enabled. Results may vary.*

GATEWAY2000

"You've got a friend in the business."

8 0 0 - 5 2 3 - 2 0 0 0

610 GatewayDrive • P.O. Box 2000 • N. Sioux City, SD 57049-2000 • 605-232-2000 • Fax 605-232-2023

All prices and configurations are subject to change without notice. Prices do not include shipping.
©1992 Gateway 2000, Inc. HandBook and FieldMouse are trademarks of Gateway 2000, Inc.
All other brands and product names are trademarks or registered trademarks of their respective companies.

ARE YOU [illegible] ABOUT WEIGHT?

INTERACTIVE™ UNIX®
OPERATING SYSTEM
INTERACTIVE™ UNIX®
OPERATING SYSTEM

So Powerful It Can't Be A PC.

Transform Your PC With The INTERACTIVE UNIX System.

Unleash the 32-bit power in your PC with the INTERACTIVE™ UNIX® System from SunSoft. Charge through applications at record speeds. Use real-world multitasking and networking. Get on the path to a distributed computing future.

Just Say No To SCO.

Why? The INTERACTIVE UNIX System is easy to use, simple to administer, all at a great price.

*Open Systems Today** says the INTERACTIVE UNIX "system management... is easier to use and more comprehensive" than SCO™ and "is simply a masterpiece of good design."

Looking Glass Professional™ desktop manager makes the INTERACTIVE UNIX System easy enough for novices, yet powerful enough for experienced UNIX users. And the award winning Easy Windows makes setting up graphic environments infinitely simpler.

You can't afford *not* to take advantage of the already low cost of the INTERACTIVE UNIX System.

And SCO UNIX/XENIX® users can save an additional 50% by switching to the INTERACTIVE UNIX System today. That's something to say yes to.

Everything You Like About Your PC—And A Lot More.

INTERACTIVE UNIX System V/386 Release 3.2 supports hundreds of the most popular Intel-based platforms and peripherals. So getting started is fast, easy, and cost-effective.

Thousands of UNIX and XENIX applications are at your command. And our VP/ix package runs virtually all DOS software. You get Lotus®, WordPerfect®, and Oracle®. You get SCO applications. You get it all.

See What Develops.

The INTERACTIVE UNIX System is the environment of choice for 80X86 application development. You get access to a full range of development tools including compilers, debuggers and libraries. And for graphical applications, the X11 INTERACTIVE environment is a revelation.

Partner With Power.

The INTERACTIVE UNIX System is a powerful business partner for companies who know something about power. Companies like BMW, Goodyear, Leica, and Dunlop to name a few. That power can be yours, too. All from SunSoft, the leading supplier of 32-bit UNIX system software.

Call today and save 50% on UNIX power that's so cost-effective, it can't be anything *but* a PC. 1-800-227-9227.

SunSoft
A Sun Microsystems, Inc. Business

*Issue date: April 13, 1992 ©1992 Sun Microsystems, Inc. Sun, Sun Microsystems, the Sun logo, SunSoft, the SunSoft Logo, VP/ix and Easy Windows are trademarks or registered trademarks of Sun Microsystems, Inc. INTERACTIVE is a trademark of INTERACTIVE Systems Corporation. UNIX is a registered trademark of UNIX System Laboratories, Inc. Looking Glass Professional is a trademark of Visix Software, Inc. All other trademarks and registered trademarks are the properties of their respective holders. The promotional discount is available to SCO UNIX/XENIX users and is subject to certain restrictions. Contact SunSoft for terms and conditions of promotion. SunSoft reserves the right to stop the promotion at any time. SunSoft can be reached at 2550 Garcia Avenue, Mountain View, CA 94043, (510) 460-3267.

B9/92

Circle 197 on Inquiry Card.

BYTE

September 1992 Volume 17, Number 9

COVER STORY

FEATURE

Is Unix Dead?

PAGE 134

NEWS

24 MICROBYTES
Kaleida, the Apple/IBM multimedia venture.

41 REPORT FROM MOSCOW
by Rich Friedman
Programming talent abounds here.

44 REPORT FROM TAIWAN
by Alan Joch
Vendors want to move from being low-cost providers to technology leaders.

46 FIRST IMPRESSIONS
AutoCAD Gets a Face-Lift
by Patrick Waurzyniak
And AST's Power Premium 4/50d.

63 Acquiring Data Through Windows
by Andy Reinhardt
Visual programming for data acquisition.

70 Olivetti Quaderno, a 2-pound subnotebook with Italian style

Acorn A4, this notebook shows the power of the ARM processor

Ami Pro 3.0, the feature battle rages

MacinStor, a portable gigabyte drive for the Mac

NetOctopus 1.1, a useful network manager with an odd name

Oxford English Dictionary, a 20-volume reference on CD-ROM

GammaFax MLCP-4/AEB, GammaLink broadcasts fax capability

88 WHAT'S NEW
HyperSpace Shuttle handles up to 3 GB of on-line storage; NetRunner integrates voice, fax, and network traffic; and more.

FEATURES

134 Is Unix Dead?
by Tom Yager and Ben Smith
Unix faces its toughest challenges yet.
Unix: A Child of a Thousand Parents
The history of Unix says much about its future.

147 The Greening of Computers
by Andy Reinhardt, Ed Perratore, Andy Redfern, and Rich Malloy
The computer industry wakes up to ecological concerns.

159 The Outlook for Pen Computing
by Nicholas Baran
Before it can deliver, pen-based computing has many rivers to cross.

STATE OF THE ART

PHOTONICS

168 Overview: Photonics: Revolution or Evolution?
by Jack Weber
Optical technologies are changing the way we process information.
Smart Pixels and Free-Space Interconnection
by H. Scott Hinton

179 Parallel Optical Memories
by Demetri Psaltis
A performance breakthrough.

183 Light Switches
by Mohammed N. Islam
The best way to switch an optical signal is with another optical signal.
SONET: A Standard for Today
by Mark A. Clarkson

189 Is What You See What You Get?
by David Casasent
Access to optical information processing is now easier.
Interconnecting the Pieces
by Sing H. Lee

195 Resource Guide: Optical Product Sampler

COVER ILLUSTRATION: ROGER GOODE © 1992

198 **SOLUTIONS FOCUS**
Profiles in Document Managing
by Raymond GA Côté and Ben Smith
The BYTE Lab looks at four PC-based document management systems.
Tools for Lassoing the Paper Cyclone
by D. Barker

215 **BYTE Lab Product Report**
Workhorse Computers
by Rick Grehan and Stan Wszola
The Lab evaluates the new low end of computing: 386SXes.

238 **Eight Notebooks Keep a Tight Grip on Power**
by Jim Carls
A thorough review of 386SL and 386SXL portables.
A New Thumper
by Howard Eglowstein

249 **486 Notebooks Double as Desktops**
by Barry Nance
Power to go.

263 **A New Illustrator for Windows**
by Cal Vornberger
A few problems temper the enthusiasm for Adobe's latest release of Illustrator for Windows.

267 **A Power Boost for PowerPoint**
by Shelley Cryan
Microsoft breaks new ground.

269 **IBM's New System Speaks for Itself**
by Tom Yager
The PS/2 Ultimedia.

273 **Microsoft's Lucky Number**
by Othar Hansson
Microsoft joins the C++ minions with its newest compiler.

279 **Animation Energizes Rio's World-Class Graphics**
by Tom Yager
Rio Animator brings a slick look to presentation graphics.

281 **Bringing the Outside into Windows**
by Steve Apiki
Outside In for Windows brings DOS documents into Windows.

283 **A/UX 3.0: The Mac's Odd Couple**
by Tom Thompson
Apple's latest version of Unix.

285 **Reviewer's Notebook**
by the BYTE Lab
A Personal Librarian for Windows and a low-cost bundle of applications for the Macintosh.

HANDS ON

291 **UNDER THE HOOD**
Inside QuickDraw
by Konstantin Othmer
A detailed look inside Apple's imaging engine.

297 **SOME ASSEMBLY REQUIRED**
A Shared Resource Access Manager, Part 2
by Rick Grehan
Introducing a resource access manager server and C client functions that you can link into your applications.

305 **SOFTWARE CORNER**
Software with Curves
by Barry Nance, Tom Thompson, and Ben Smith
Bézier curves under Windows, synchronizing PowerBooks, and the language of bit maps.

307 **BEYOND DOS**
In Search of an Object-Oriented File System
by Jon Udell
The future depends on it.

309 **ASK BYTE**
Choosing a Unix; TWAIN explained; and more.

BYTE (ISSN 0360-5280) is published monthly with additional issues in October and November by McGraw-Hill, Inc. U.S. subscriber rate $29.95 per year. In Canada and Mexico, $34.95 per year. European surface mail subscriptions $50, airmail $70. Non-European subscriptions, $50 surface mail or $75 airmail. All foreign subscriptions are payable in U.S. funds that can be drawn on a U.S. bank. Single copies $3.50 in the U.S., $4.50 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Registered for GST as McGraw-Hill, Inc., GST #123075673. Printed in the United States of America. Postmaster: Send address changes and fulfillment questions to BYTE Subscriptions, P. O. Box 552, Hightstown, NJ 08520.

COVER CORNER PHOTOGRAPHY: SCOTT PARKER / AVIS STUDIO © 1992

OPINIONS

113 **USER'S COLUMN**
The Amiga Revisited
by Jerry Pournelle
Jerry looks at the Amiga 3000T.

286 **BOOK AND CD-ROM REVIEWS**
The Origins of Hypertext
by Hugh Kenner, John Unger, and Stanford Diehl
Vannevar Bush and hypertext, street maps on CD-ROM, and Unix primers.

378 **STOP BIT**
The Artichoke Theory
by Nolan Bushnell
What applications can learn from PC games.

16 **EDITORIAL**
The Globalization of BYTE
by Dennis Allen

20 **LETTERS**
Color PostScript printers; SGML image editors; and other topics.

READER SERVICE
374 Editorial Index by Company
370 Alphabetical Index to Advertisers
372 Index to Advertisers by Product Category
Inquiry Reply Cards: 372A
313 **BUYER'S GUIDE**
Mail Order
Hardware/Software Showcase
Buyer's Mart

PROGRAM LISTINGS
From BIX: Join "listings/frombyte92"

INSIDE BYTE
PAGE 8

All the power of a desktop. And a lot better mileage.

You've dreamed about a computer like this.

One that would have power and display capabilities equal to, or greater than, the desktop computer you're using now.

One you could take along to all of those different places you need to work.

One you wouldn't need a furniture dolly to move.

And here it is.

The Toshiba T6400.

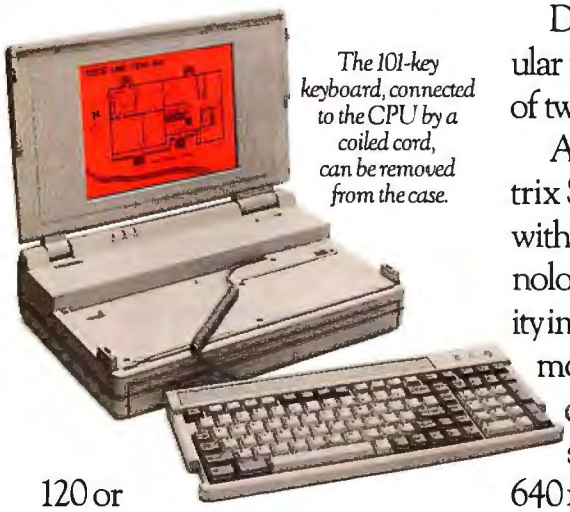
With dimensions of 15.4" W x 10.5" D x 3.3" H (4.1" H with the color screen), it's small enough to fit in a briefcase.

With a spirited clock speed of 33 MHz, a powerful 486 DX microprocessor, 8K internal cache and full 32-bit architecture, it's big enough to handle all those jobs normally performed in an impressive office building.

In addition to a 1.44MB floppy drive, you can choose a 120 or 200MB hard disk.

And if a combination like that doesn't make the T6400 portable better than the desktop computer you're currently using, we'll eat our collective hat.

This remarkable machine comes equipped with an internal 1.44MB, 3½" floppy drive and a 120 or 200MB hard disk. Plus 4MB RAM, expandable to 20MB. (Try finding any application that needs more memory than that.)



The 101-key keyboard, connected to the CPU by a coiled cord, can be removed from the case.

There's also a full-length, IBM-compatible, 16-bit expansion slot so you can take full advantage of your network card, SCSI controller or any of a myriad of other special purpose cards.

For even more expandability the T6400 comes complete with a 150-pin expansion port for direct input/output you to connect storage and communications devices. Plus an internal dedicated modem slot, as well as built-in parallel, serial, mouse and Super VGA video ports.

The AC-powered T6400 has full desktop expandability, including an IBM-compatible, 16-bit expansion slot.

Depending on your particular needs, you can choose one of two display screens.

A state-of-the-art active matrix Super VGA color display with Thin Film Transistor technology, to deliver a higher quality image than you can get with most desktop monitors, and capable of displaying 256 simultaneous colors at 640 x 480 resolution.

Or a gas plasma display featuring 16 gray scales, also at 640 x 480 resolution, and a 100:1 contrast ratio—seven times the contrast of standard LCD displays, with ten times the display speed.

Both have a diagonal measure of 10.4" and provide simultaneous viewing capability with external Super VGA displays.

To complete the metamorphosis from desktop to portable, we took a 101-key keyboard

© 1992 Toshiba America Information Systems, Inc. The Intel Inside logo is a trademark of Intel Corporation.

with full-size keys and key spacing, separate numeric keypad and eight dedicated cursor control keys, and nestled it into a compact 11.7 lb. package (12.9 lbs. with color screen). Then attached it to the CPU with a coiled cord, so you can remove it and use it on your lap (or other convenient surface).

Now, having read all of the above, you'd probably welcome more information on the T6400. If so, call us at 1-800-457-7777.

The more you learn about our products the more you'll come to understand the Toshiba philosophy: that portables are the future of personal computing.

Of course, with the introduction of the T6400 portable, it's a future that's already here.

In Touch with Tomorrow

TOSHIBA

Circle 175 on Inquiry Card.

INSIDE BYTE

BYTE Topic Index

This index helps you find articles that contain information on each of the listed topics. (The topic list changes each month.) Combined with the table of contents (page 4) and the Editorial Index by Company (page 374), you can identify articles by type, subject, title, author, or product discussed.

AMIGA
113

ANIMATION
279

BUSINESS
88, 198, 267

CAD
46

CD-ROM
24, 44, 70, 113, 168, 269, 283, 286

CHIPS
24, 70

COMMUNICATIONS
88, 113, 168, 189

COMPILERS
273

COMPUTER CRIME
24

DESKTOP
46

DEVELOPMENT
24

DIGITAL SIGNAL PROCESSORS
70, 88, 269

DOCUMENT MANAGEMENT
198

DOS
24, 41, 70, 134, 159, 198, 249, 273, 279, 281, 307, 309

DRIVES
70

E-MAIL
24

ENVIRONMENT
147

ETHERNET
70, 88, 113, 283

FAX/MODEM
70, 88

FILE SYSTEMS
307

486
46, 88, 249

FREEWARE/SHAREWARE
305

GRAPHICS
263, 267, 279, 291, 309

GREEN COMPUTING
147

HOLOGRAMS
168, 195

HYPERTEXT
286

IMAGING
20

LAPTOPS/NOTEBOOKS/PORTABLES
70, 88, 113, 238, 249

LOW-COST CLONES
24, 215

MACINTOSH
24, 63, 70, 88, 113, 215, 281, 283, 291, 305, 307, 309

MEMORY
179

MIDI
269

MONITORS
147

MULTIMEDIA
24, 113, 269

MULTIUSER
88

NETWORKING
44, 70, 88, 168, 183, 198, 285, 297

NEURAL NETWORKS
24

OBJECT-ORIENTED PROGRAMMING
273

OFFICE AUTOMATION
198, 378

OPTICAL COMPUTING
168, 179, 183, 189, 195

OPTICAL DRIVES
88

OS/2
24, 113, 134, 198, 249, 307, 309

PCMCIA
70

PEN COMPUTING
159

PHOTONICS
168

POSTSCRIPT
20, 88, 113

PRINTERS
20, 24, 88, 113, 147

PROGRAMMING
24, 41, 88, 113, 273, 291, 297, 307

RISC
70

SCIENCE/ENGINEERING
63, 88

SPARC
24

TEXT
198, 285

386SL
238

386SX
215

TUTORIAL
286

UNIX
24, 88, 134, 198, 215, 283, 286, 297, 305, 309

UTILITIES
281, 305

VGA
309

VIRUSES
88

VMS
24

VOICE
70

WINDOWS
24, 41, 63, 88, 113, 134, 159, 198, 249, 263, 267, 273, 281, 305, 307, 309

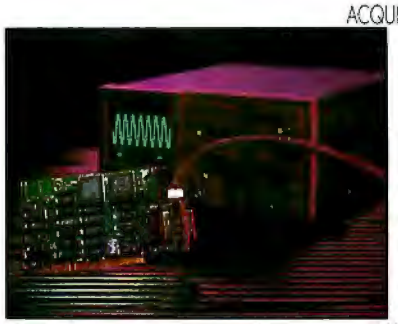
WORD PROCESSING
24, 70

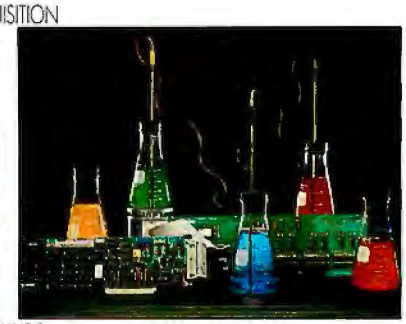
WORKSTATION
88

WORM
168

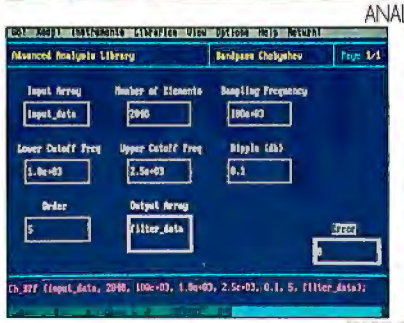
We've given you the best of both worlds...

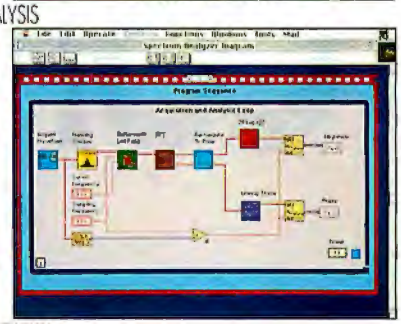
ACQUISITION



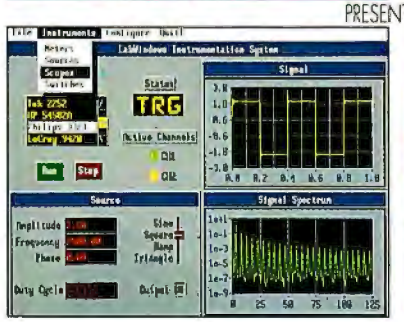


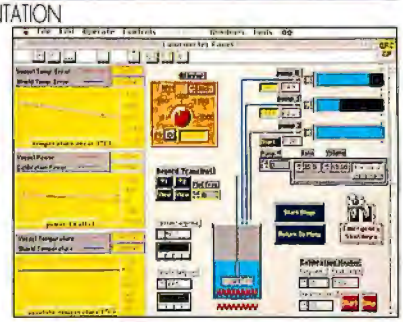
ANALYSIS





PRESENTATION





LabWindows® 2.0
for DOS-based computers

LabVIEW® 2
for Macintosh computers

All You Have To Do Is Choose!

In the 1980s, National Instruments pioneered two paths to the future of instrumentation. LabWindows, an automatic code generation and program development system for the C and BASIC programmer. And LabVIEW, the first graphical programming system to offer ease of use without sacrificing programming flexibility and performance.

LabWindows and LabVIEW address all of your instrumentation needs. You can control GPIB, VXI, and RS-232 instruments, and plug-in data acquisition boards. You con integrate dota analysis. And, you con build your own graphical user interfaces.

Today, LabWindows and LabVIEW are leading the revolution in instrumentation software. Through innovative programming methodologies and powerful development tools, LabWindows ond LabVIEW ore paving two poths to the future–a future in which *The Software is the Instrument.* All you have to do is choose!

Call for your free demo disks (512) 794-0100 or (800) 433-3488 (U.S. and Canada).

NATIONAL INSTRUMENTS®
The Software is the Instrument®

6504 Bridge Point Parkway
Austin, TX 78730-5039

Australia (03) 879 9422 • Canada – now direct – (800) 433 3488 • Denmark (45) 76 73 22 • France (1) 48 65 33 70
Germany (089) 714 5093 • Italy (02) 4830 1892 • Japan (03) 3788 1921 • Netherlands (01720) 45761 • Norway (03) 846 866
Spain (908) 604 304 • Sweden (08) 984 970 • Switzerland (056) 45 58 80 • U.K. (0635) 523 545

Product names listed are trademarks of their respective manufacturers. Company names listed are trademarks or trade names of their respective companies.
© Copyright 1991 National Instruments Corporation. All rights reserved.

Circle 133 on Inquiry Card.

Soon, Eight Ho
Computing Will

(actual size)

AMD Introduces The World's First 386 Microprocessor With 3-Volt Technology.

Two standard dry-cell batteries. There's really nothing special about them. Aside from the fact that they can run a powerful, portable 386 computer for a full eight hours. Provided, of course, that portable is built around a low-voltage Am386™ microprocessor.

The 25MHz DXLV and the 25MHz SXLV are available in PQFP packaging.

Thanks to the low-voltage Am386 microprocessors, laptop, palmtop and notebook computer designs will become smaller, lighter, and more powerful than ever before.

With battery life of up to eight hours or more. That's a full day's worth of 386 performance—the per-

901 Thompson Place, P.O. Box 3453, Sunnyvale, CA 94088 © 1991 Advanced Micro Devices, Inc. "We're Not Your Competition" is a service mark and Am386 is a trademark of Advanced Micro Devices, Inc.

urs Of Portable Look Like This.

formance you need to run sophisticated applications like Windows™ 3.0.

And rest assured, the low-voltage Am386 microprocessors are proven compatible and comply fully with JEDEC standards for low-power, 3-volt computing. We can even supply you with the 3-volt EPROMs your systems will need. Other 3-volt system logic is also readily available.

For more information on the low-voltage Am386 microprocessors call AMD today at **1-800-222-9323**. You'll never look at dry-cell batteries the same way again.

Advanced Micro Devices

"We're Not Your Competition."℠

All brand or product names mentioned are trademarks or registered trademarks of their respective holders. DURACELL is a registered trademark of Duracell International, Inc.

Circle 77 on Inquiry Card

BYTE

EDITOR IN CHIEF
Dennis Allen

PUBLISHER
Ronald W. Evans

EXECUTIVE EDITORS
New York: Rich Malloy
Peterborough: Rich Friedman

MANAGING EDITOR
Anne Fischer Lent

ASSISTANT MANAGING EDITOR
Lauren A. Stickler

NEWS
Peterborough:
News Editors, What's New: Martha Hicks, Carol Swartz, Amanda Waterfield
Microbytes: David L. Andrews
News Assistant: June Sheldon
San Francisco/West Coast:
Bureau Chief: Andrew Reinhardt
News Editor: Patrick Waurzyniak
Editorial Assistant: Barbara J. Caravello
Los Angeles:
Senior Editor: Gene Smarte
New York:
News Editor: Ed Perratore
UK/Europe:
Bureau Chief: Andrew Redfern

BYTE LAB
Senior Editor & Director: Alan Joch
Technical Director: Rick Grehan
Technical Editors:
Stephen Apiki: *systems, networking*
D. Barker: *applications software*
Stanford Diehl: *graphics software, add-ins, peripherals*
Tom Yager: *multimedia, Unix, operating systems, software development*
Testing Editors/Engineers: Raymond GA Côté, Howard Eglowstein, Ben Smith, Stanley Wszola
Lab Assistant: Selinda Chiquoine

STATE OF THE ART/FEATURES
Senior Editor: Michael Nadeau
Technical Editors: Janet J. Barron, John W. Donovan, Robert M. Ryan

SENIOR TECHNICAL EDITORS
At Large: Tom Thompson, Jon Udell
Columns: Rob Mitchell

ASSOCIATE TECHNICAL EDITORS
Ellen Bingham, Susan Colwell, Jeff Edmonds, Tom Kevan, Cathy Kingery, Margaret A. Richard, Warren Williamson

SENIOR CONTRIBUTING EDITOR
Jerry Pournelle

CONTRIBUTING EDITORS
Hugh Kenner, Barry Nance

CONSULTING EDITORS
Roger C. Alford, Jonathan Amsterdam, Nicholas Baran, Don Crabb, David Fiedler, Laurence H. Loeb, Trevor Marshall, Dick Pountain, Wayne Rash Jr., Kenneth M. Sheldon, Jane Morrill Tazelaar, Ellen Ullman, Peter Wayner

EDITORIAL ASSISTANTS
Office Manager: Peggy Dunham
Assistants: Linda C. Ryan, Janet A. Young

DESIGN
Director: Nancy Rice
Associate Director: Joseph A. Gallagher
Designer: Jan Muller
Designer: Rebecca Magill
Graphic Artist: Marilyn Fletcher

PRODUCTION AND FINANCE
Director: Claudia Flowers

PRODUCTION
Director: David M. Cohen
Production Manager: David R. Anderson
Senior Editorial Production Coordinator: Virginia Reardon
Editorial Production Coordinator: Barbara Busenbark
Systems Manager: Sherry Fiske
Applications Manager: Donna Sweeney
Typesetter: Christa Patterson
Creative Services Manager: Susan Kingsbury
Production Artist: Lillian J. Wise
Advertising Services Manager: Linda Fluhr
Senior Advertising Services Representative: Lyda Clark
Advertising Services Representatives: Dale J. Christensen, Karen Cilley, Rod Holden
Advertising Services Assistant: Roxanne Hollenbeck
Quality Control Manager: Wai-Chiu Li
Operations Assistant: Lisa Jo Steiner

FINANCE
Business Manager: Kenneth A. King
Financial Analyst: Kathleen Deguise
Assistants: Marilyn Parker, Diane Henry, JoAnn Walter, Jaime Huber, Agnes Perry

MARKETING AND PLANNING
Director: L. Bradley Browne
Administrative Assistant: Carol Cochran
Marketing Communications Manager: Pamela Petrakos
Public Relations Manager: Dawn Matthews
Marketing Art Director: Stephanie Warnesky
Associate Art Director: Sharon Price
Market Research Manager: Julie Perron
Copyrights Manager: Faith Kluntz
Reader Service: Cynthia Sands
Marketing Assistant: Carol Sanchioni

CIRCULATION
Director: Glyn Standen
Subscriptions Manager: Paul Ruess
Assistant Manager: Pam Wilder
Subscriptions Assistant: Christine Tourgee
Newsstand Manager: Vicki Weston
Assistant Manager: Karen Desroches
Back Issues: Louise Menegus
Direct Accounts Coordinator: Ellen Dunbar

Publisher's Assistant: Donna Nordlund

ADVERTISING SALES
National Sales Manager:
Jennifer L. Bartel (214) 701-8496

NEW ENGLAND
Michael Lamattina (617) 860-6344

EAST COAST
Kim Norris (212) 512-2645
Ariane Casey (212) 512-2368

SOUTHEAST
Mary Ann Goulding (404) 843-4782

MIDWEST
Kurt Kelley (312) 616-3328

SOUTHWEST, ROCKY MOUNTAIN
Jennifer Walker (214) 701-8496

SOUTH PACIFIC
Beth Dudas (714) 753-8140
Alan El Faye (213) 480-5243

NORTH PACIFIC
Bill McAfee (408) 879-0381
Roy J. Kops (415) 954-9728

INSIDE ADVERTISING SALES
Director: Liz Coyman (603) 924-2518
Assistants: Susan Monkton, Vivian Bernier

NATIONAL ADVERTISING SALES
Ed Ware (603) 924-2664
Patricia Payne (603) 924-2654
Jon Sawyer (603) 924-2665
Barry Echavarria (603) 924-2574
Joseph Mabe (603) 924-2662

THE BUYER'S MART (1×2)
Margot Gnade (603) 924-2656

HARDWARE/SOFTWARE SHOWCASE
Ellen Perham (603) 924-2598
Mark Stone (603) 924-2695

REGIONAL ADVERTISING SECTIONS
Brian Higgins (603) 924-2651
Barry Echavarria (603) 924-2574
Larry Levine (603) 924-2637

BYTE DECK
Brad Dixon (603) 924-2596

EURO-DECK
James Bail (603) 924-2533

INTERNATIONAL ADVERTISING SALES STAFF
See listing on page 371.

PERSONNEL
Human Resources Administrator:
Patricia Burke
Assistant: Fran Wozniak
Receptionist: Beverly Goss

HOW TO CONTACT THE EDITORS

We welcome your questions, comments, complaints, kudos, and submissions.
MAIN OFFICE: One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.
San Francisco: 425 Battery St., San Francisco, CA 94111, (415) 954-9718
Los Angeles: 15635 Alton Pkwy., Suite 290, Irvine, CA 92718, (714) 753-8140.
New York: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.
UK/EUROPE: Wimbledon Bridge House, One Hartfield Rd., Wimbledon, London SW19 3RU, England, 011-44-81-543-1234.
ELECTRONIC MAIL: On BIX, send to "editors." All BYTE editors and columnists also have individual mailboxes on BIX for easy access.
MCI: 250-0135 BYTE Magazine. Many editors also have individual MCI addresses in their own names.
OTHERS: Many editors also are reachable through uunet, AppleLink, CompuServe, and numerous other services.
U.S. fax: Editorial: (603) 924-2550
Advertising: (603) 924-7507
U.K. fax: 011-44-81-540-3833

SUBMISSIONS
Authors: We welcome article proposals and submissions. Unacceptable manuscripts will be returned if accompanied by sufficient return postage. Not responsible for lost manuscripts or photos.
Vendors: We welcome news of your new products; please call the News department or the BYTE Lab at the earliest possible date. We cannot be responsible for unsolicited product samples.

SUBSCRIPTION CUSTOMER SERVICE

Inside U.S. (800) 232-BYTE; outside U.S. (609) 426-7676. For a new subscription–(800) 257-9402 U.S. only, or write to BYTE Subscription Dept., P.O. Box 555, 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, $34.95 for one year, $64.95 for two years, $87.95 for three years. In Europe, £29 (U.S. $50) for fast surface delivery, £41 (U.S. $70) for air delivery. Non-European countries U.S. $50 for surface mail, or U.S. $75 for air mail. Single copy price is $3.50 in the U.S. and its possessions, $4.50 in Canada. 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.

PHOTOCOPY PERMISSION:
Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 27 Congress St., Salem, MA 01970, to photocopy any article herein for personal or internal reference use only 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, 27 Congress St., Salem, MA 01970. Specify ISSN 0360-5280, $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, U.K.

Copyright © 1992 by McGraw-Hill, Inc. All rights reserved. BYTE and BYTE are registered trademarks of McGraw-Hill, Inc. Trademark registered in the United States Patent and Trademark Office.

Member
Audit Bureau of Circulation

BIX INTERACTIVE ON-LINE SERVICE

DIRECTOR OF COMPUTER-RELATED SERVICES
Stephen M. Laliberte

SENIOR EDITOR, ON-LINE SERVICES
Anthony J. Lockwood

MEMBER SERVICES MANAGER
Kevin Plankey

EXCHANGE EDITORS
Amiga Exchange: Joanne Dow
Entertainment and Leisure Exchange: Rich Taylor
IBM Exchange: Barry Nance
Programmers Exchange: Bill Nicholls
Professionals Exchange: David Reed
Tojerry Exchange: Jerry Pournelle
Writers Exchange: Wayne Rash Jr.

BIX, owned and operated by General Videotex Corporation, is a worldwide, low-cost, on-line information service featuring industry news, downloadable software, powerful electronic mail, previews of upcoming BYTE articles, the full text of published issues of BYTE, and source and/or executable code for BYTE benchmarks and noncommercial software mentioned in feature articles. BIX also offers unmatched "conferences" on virtually every computer-related topic imaginable, where you can share information with thousands of other computer pros. To subscribe via modem, set your communications software to full duplex, 7 bits, even parity, 1 stop bit, and then call (800) 225-4129; in MA, call (617) 861-9767. International, call NU1310690157800. Then hit the Enter/Return key and enter "BIX" when asked to log in; then enter "BIX.VILLE" when asked for a name. For current fees and more information, call (800) 695-4775 or (617) 354-4137 on voice phone; fax: (617) 491-6642.

OFFICERS OF MCGRAW-HILL, INC.:
Founder: James H. McGraw (1860–1948).
Chairman, President and Chief Executive Officer: Joseph L. Dionne, *Executive Vice President, General Counsel and Secretary:* Robert N. Landes, *Executive Vice President–Operations:* Harold W. McGraw III, *Senior Vice President, Treasury Operations:* Frank D. Penglase.

COMPUTER LANGUAGE PRODUCTIVITY AWARD 1991

We slash interface development time across DOS, UNIX, POSIX, VMS...

(and we can prove it!)

C-Programmers: See for yourself how Vermont Views™ can help you create powerful user interfaces—whatever your environment!

If you want to create sophisticated user interfaces—and save *tremendous* time and effort doing it—Vermont Views is exactly what you need.

Vermont Views isn't just a common interface package. It's a deep, flexible, menu-driven screen designer supported by a C library of over 580 functions. It lets you create the ultimate user interfaces for complex database applications—in a fraction of the time it would take to code them yourself!

With Vermont Views, you create screens *interactively*. Designing is fast, and creative. And changes—both tiny adjustments and huge reworks—are incredibly easy.

Pull-down menus, window-based data-entry forms with tickertape or memo fields, scrollable form regions, choice lists, context-sensitive help... All these interface objects (and more) are immediately accessible. And with Vermont Views, even terminal-based applications can have the elegant features usually found only on micros.

©Copyright 1991
Vermont Creative Software

Fast prototypes, faster applications.

With most systems, you have to throw away your prototypes when coding begins. But with Vermont Views, *prototypes become the actual applications!*

Menus, data-entry forms, and all screen features are usable in the final applications without change. So not only do you avoid creating code from scratch once, you don't have to do it twice!

It's the universal solution.

Vermont Views operates completely independent of hardware, operating system, and database. Any interface you create can be ported easily among DOS, UNIX, POSIX, and VMS.

You can use Vermont Views with any database that has a C-language interface (including Oracle, Informix, db_Vista, and C-Tree). You can run it on PCs, DEC, NCR, HP, AT&T, and other systems. You don't have to pay runtime fees or royalties. And full library source is available, too.

What's more, your DOS applications can have full mouse control, and work in graphics as well as text modes!

Don't take our word for it—put Vermont Views to the test. Call or fax now for your personal, free demonstration kit. Or order Vermont Views with our 60-day, money-back guarantee.

Either way, you'll see immediately that Vermont Views is a cut above the rest.

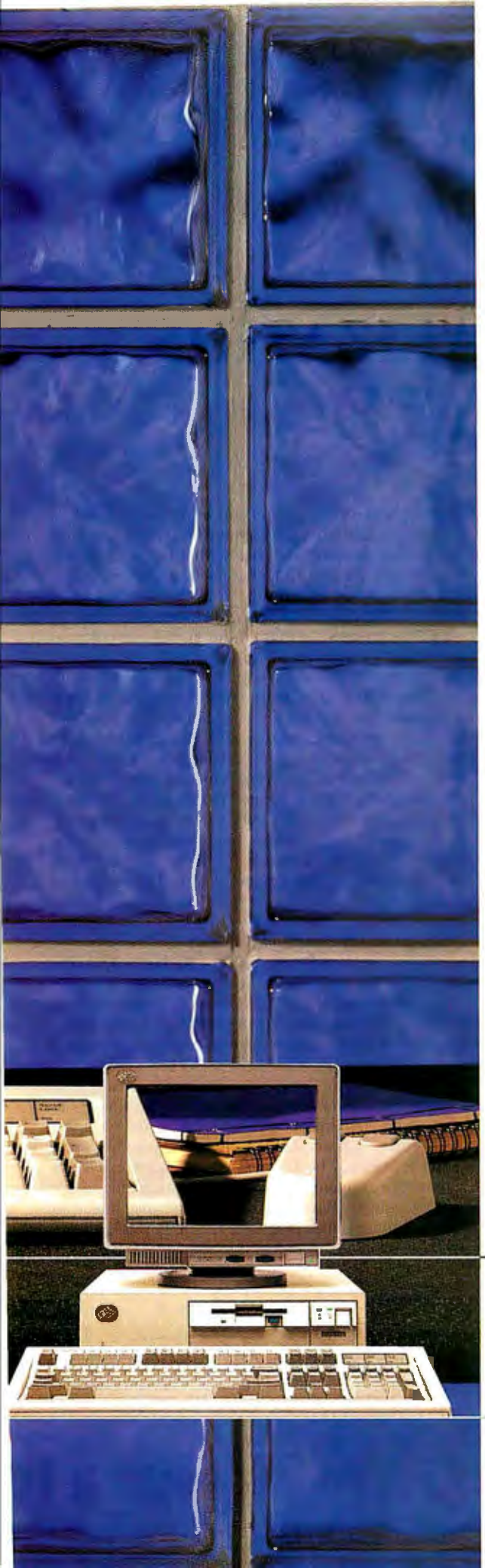
Call for your FREE demo kit! 800-848-1248

Vermont Creative Software
Pinnacle Meadows
Richford, VT 05476 USA
Phone: (802) 848-7731
FAX: (802) 848-3502

(Please Mention "Offer 343")

PS/2

*NSTL test conducted against 386 SX and 386 DX systems. **Sale or delivery of the IBM PS/2 486SLC2 Processor Upgrade is subject to FCC approval. Planned availability of the IBM PS/2 486SLC2 Processor Upgrade is 4th quarter 1992. Offer available from June 11 through October 1, 1992. HelpWare available only in U.S.A. IBM, PS/2 and OS/2 are registered trademarks and HelpWare is a trademark of International Business Machines Corporation. Windows is a trademark of Microsoft Corporation. © 1992 IBM Corp.



This PS/2 SLC is so fast, it comes with its own speeding ticket.

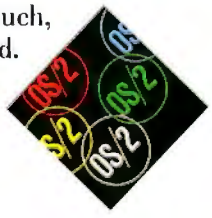
With our advanced SLC processor, the PS/2® Models 56 and 57 are clearly on a fast track. They're already the fastest systems in their class.* And with this special IBM PS/2 486SLC2 Processor Upgrade, we plan to keep them that way.

Buy a PS/2 Model 56 or 57 SLC before October 1, 1992, and you'll get information on how to upgrade to our powerful 486SLC2 processor at a special low price of $259.**

486SLC2 Power for $259**

OS/2® 2.0 comes pre-installed on both models, so you can run DOS, Windows™ and OS/2 applications. And every PS/2 comes with **HelpWare**,™ a full range of services and support including a toll-free number.

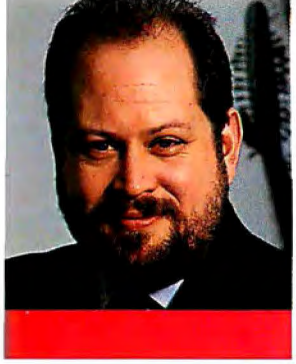
The PS/2 Models 56 and 57 offer so much, other computers might as well hit the road. For more information about our specially priced 486SLC2 upgrade or for the IBM authorized dealer near you, call our HelpCenter™ at 1 800 PS2-2227.



- *PS/2 486SLC2 Processor Upgrade for just $259.*
- *Faster than any system in its class.*
- *Comes pre-installed with IBM OS/2 2.0.*
- ***HelpWare**: services and support nobody else can touch.*
- *To learn more about our 486SLC2 upgrade, call **1 800 PS2-2227.***

IBM®

Circle 118 on Inquiry Card.



EDITORIAL

DENNIS ALLEN

THE GLOBALIZATION OF BYTE

Do you notice anything different about BYTE? On the cover, beneath the BYTE logo, look for our new tag line: "The worldwide computing authority." That statement is more than just a claim—it's a fact that is easily illustrated in this issue.

Notice the datelines in Microbytes and First Impressions. You'll find information on U.K.-based Acorn's new A4 notebook that uses the ARM (Advanced RISC machine) chip (page 72) and Italian computer maker Olivetti's new 2¼-pound subnotebook, called the Quaderno (page 70).

It's no longer possible to confine our news reports and articles to the U.S.

Read our feature article "The Greening of Computers" (page 147), and you'll learn how computer makers and users are taking ecology-minded steps in computing around the world. Read the lead article, "Photonics: Revolution or Evolution?" (page 168), in our State of the Art section, and you'll discover the newest developments in optical computing occurring in England, Germany, Japan, and the U.S.

Find out about fascinating computer industry happenings in the newly formed Commonwealth of Independent States by reading Rich Friedman's Report from Moscow (page 41). A recent trip there for a BYTE-sponsored computer show in Moscow gave Rich occasion to think about the programming talent in that country.

If you've been following the commodity price war of personal computers, you'll be interested in Alan Joch's Report from Taiwan (page 44). Alan and Rich Malloy visited the Computex show in Taipei to learn firsthand that Taiwanese clone manufacturers are trying to innovate products that bypass the commodity price war being fought by American manufacturers.

Why all this worldwide coverage? Simple. Computer technology, and therefore the computer industry, is not confined within the shorelines of North America. Nor does it stretch just to Japan. Exciting new developments are taking place worldwide.

Germany, for example, hosts the largest computer trade show in the world in Hannover. It's attended by more than half a million people. And that country is also the home of Siemens Nixdorf. Singapore, which has long been a major source for hard drive manufacturing, has a software development project that the country hopes will leapfrog the rest of the industry. Israel has both an active software development community and a community of hardware developers—many concentrating on LANs.

To be *the* authority on computing means being the *worldwide* authority, and that's what BYTE is doing. We know that it is not enough to focus just on what happens in the computer industry in North America while wearing blinders as to the rest of the world.

BYTE's unique standing in the global computer industry makes all this possible, and BYTE's unique publishing position is a tremendous strength. Not only is BYTE distributed in virtually every country in the world (our circulation outside the U.S. is larger than that of any other computer magazine), BYTE is also translated and reprinted in about a dozen languages. Our publishing partners and their local editorial offices are part of the BYTE network. They're located in Argentina, Australia, Brazil, France, Germany, Greece, Italy, Japan, Mexico, South Korea, Spain, Taiwan, and Turkey. Add to that BYTE's own editorial bureaus in London, New York, San Francisco, and Los Angeles, and you get an idea of BYTE's reach.

In my first editorial as Editor in Chief (February), I promised that BYTE would continue with its authoritative voice to separate truth from marketing hype and to put computing technology into a usable perspective. This globalization of BYTE is part of that commitment. BYTE's worldwide coverage provides you with a perspective that no other computer magazine offers, and it doesn't end there.

More to the point, look at our recent cover stories. In this issue, our writers and editors explore the answers to the question, "Is Unix Dead?" It's one of the most important computing stories of the year, and you won't find it anywhere else. The Unix-specific magazines cannot afford to raise the question, and the PC magazines don't cover the subject. Watch for more articles like this from BYTE in future issues. We think that it's exciting, and I hope you will, too.

—Dennis Allen
Editor in Chief
(BIX name "dallen")

Borland's Turbo Pascal is the fastest way from inspiration to application

Jump start your Windows or DOS application with object-oriented Turbo Pascal

When you're inspired to write a program, you want to spend your time developing code that solves your problems. Not hours and hours writing common routines for event handling, data management or user interface.

Now, you can jump start your applications development for either Windows or DOS by programming with the world's #1 Pascal compiler, Turbo Pascal.®

Application frameworks speed you along

Now you can take advantage of the power of application frameworks to boost your productivity and cut development time. ObjectWindows,™ the application framework included in Turbo Pascal for Windows, gives you a robust graphical user interface with pull-down menus, overlapping windows, mouse support and more in just a few lines of code. Turbo Vision,™ included with Turbo Pascal 6.0 for DOS, delivers a great-looking user interface in a character-based environment.

Borland's Turbo Pascal family of products spans the range of programming needs—select one that's right for you

NEW

	DOS	WINDOWS
Entry level	**TURBO PASCAL 6.0** with: • Turbo Vision application framework • Easy Integrated Development Environment (IDE) • Inline assembler • Fast compilation • Smart linker **Just $149.95***	**TURBO PASCAL FOR WINDOWS 1.5** with: • ObjectWindows application framework • Windows-hosted IDE • Visual Resource Editors • Turbo Debugger for Windows • Compilation at 85,000 lines per minute • Windows CRT that converts DOS programs to Windows • Color syntax highlighting **Supports MS-Windows 3.1**
Professional	**TURBO PASCAL PROFESSIONAL 6.0** with all the great features of Turbo Pascal 6.0, plus: • Turbo Debugger® • Turbo Assembler® • Turbo Profiler™ • Turbo Drive™ high-capacity compiler **$299.95***	

See your dealer today or call now,
1-800-331-0877, ext. 5460
In Canada, call 1-800-461-3327

B O R L A N D
The Leader in Object-Oriented Programming

Circle 83 on Inquiry Card (RESELLERS: 84).

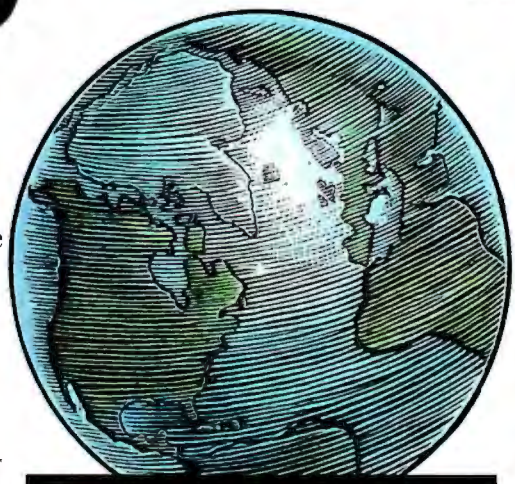
*Suggested retail price. Prices are in U.S. dollars. Dealer prices may vary. Copyright © 1992 Borland International, Inc. All rights reserved. All Borland products are trademarks of Borland International, Inc. BI 1391F

Borland's
Why it's smart

The #1-selling database

dBASE® is the #1-selling relational database in the world. It offers the most complete set of tools for developers and users to access and manage their corporate data.

Today, more than three mill on people use it to build applications that help them run their businesses and maintain a competitive edge. And with the world's largest community of trainers, consultants, and add-on software extensions, it's little wonder that dBASE is the standard for corporate applications development. Now, new dBASE IV version 1.5 makes it smarter than ever to go with #1.



The Worldwide Standard

New! Version 1.5 is here

Now there's an easier-to-use, faster, and more powerful dBASE. It's packed with the features you've asked for most, making it smarter than ever to use the world's #1 PC database.

Working smarter is faster

OPTIMIZATION IQ! TECHNOLOGY

With new dBASE IV, you get the job done faster because you work smarter. Smarter because new **IQ!**™ optimization technology automatically selects the fastest method to retrieve your data. Smarter because you can create tables, forms, reports, queries, and menus in record time—without programming.

What's new in dBASE IV v1.5:

40 Different Work Areas
New Commands

Smarter becau
different work
easier manage
of large applica-
tions. Plus
mouse suppor
fingertip acces
an enhanced R
popular DOS applications from within dBASE, and comprehensive multi-user capabilities. All of which means you maintain tight data integrity, more flexibility and more support than ever before.

Advanced design tools build applications faster

dBASE IV's easy-to-use Control Center comes complete w th an innovative set of design tools, including report, form, and label generators that help you create your applications quicker. And the Control Center's open architecture makes it easy to enhance or customize your own appl - cations by incorporating third-party add-on products available for dBASE.

Copyright © 1992 Borland International, Inc. All rights reserved. dBASE, dBASE IV, Borland, and Ashton-Tate are registered trademarks of Borland International, Inc. BI 1571

dBASE IV®

er to go with #1

Faster applications development

The industry-standard dBASE language comes with a host of improvements that speed development:

- Integrated debugger and a built-in applications generator
- More than 40 new commands, functions, and keywords—Template Language now included
- C language–like low-level file I/O
- IBM® SAA-compliant SQL
- Advanced BLANK support

100% commitment to dBASE

Now that it's from Borland, your investment in dBASE is secure. dBASE gives you all the benefits of complete compatibility and application portability that come with *the* database standard. And Borland is the acknowledged database technology innovator, so you're on the winning team for the long haul. Get dBASE IV v1.5 today. You'll see why it's smarter than ever to go with #1.

COMMITMENT 100% GUARANTEED

Get NEW dBASE IV v1.5 today and receive more than $250 in additional software,

60-DAY GUARANTEE MONEY-BACK

FREE!

See your dealer or call now 1-800-331-0877, ext. 6428.
In Canada, call 1-800-461-3327.

Send me my FREE Pro Pack Software!

Purchase dBASE IV v1.5 before September 30, 1992, and Borland will give you Central Point Software's Backup and Anti-Virus programs *free.** That's a suggested retail value of $258.

Check DOS disk size required: ☐ 5 1/4" ☐ 3 1/2"

dBASE IV v1.5 Serial #:_____

Name:_____

Company:_____

Address:_____ (We cannot ship to P.O boxes.)

City/State/Province:_____

Zip/Postal Code:_____ Phone: ( )_____ FAX: ( )_____

COMPLETE this coupon, ATTACH a copy of your sales receipt (or a copy of purchase order and billing invoice) AND ENCLOSE $9.00 U.S. for shipping and handling (check or money order payable to Borland International, Inc.).

Send to: Borland's Pro Pack Offer, P.O. Box 7243, San Francisco, California 94120-7243.

*Offer good in U.S. and Canada only on dBASE IV v1.5 purchases between June 1 and September 30, 1992. Only original coupons will be accepted. No responsibility is assumed for lost, late, misdirected, or destroyed mail. Please allow 4–6 weeks for delivery. Subject to all local, state, and federal regulations. Void where prohibited. Offer not valid for Upgrades, Competitive Upgrades, LAN Packs, Volume Packs, or any other Borland promotion except dBASE IV v1.5 products. Distributors and resellers not eligible to participate. Central Point is a registered trademark of Central Point Software.

BORLAND

dBASE IV from Ashton-Tate,® a Borland Company

Circle 85 on Inquiry Card (RESELLERS: 86).

LETTERS

Color PostScript Rebuttal

BYTE REVIEWS
Color at a Reasonable Price

Readers can print color PostScript documents for a fraction of the $8000 that the printers reviewed in "Color at a Reasonable Price" cost by using inexpensive color printers, such as Hewlett-Packard's DeskJet or PaintJet, and Ghostscript software. This program does all the work in the PC instead of in the printer, so you can improve printing performance by simply upgrading the PC. Ghostscript supports the full set of PostScript extended color operators.

Ghostscript is freely available on the Internet for personal or in-company use, and it is distributed as part of the GNU software collection. Aladdin Enterprises will supply it on disk, with permission to copy, for $28.

The freely available version comes with no support. A commercial license, with support, is available by writing to Aladdin Enterprises, P.O. Box 60264, Palo Alto, CA 94306.

L. Peter Deutsch
President, Aladdin Enterprises
Palo Alto, CA

The GNU Ghostscript PostScript language interpreter can be compiled for Unix, DOS, and VMS machines. You'll find version 2.4 in the "listings" area on BIX as "ghost24.01." The files are in Unix compressed `tar` *format.*—Eds.

Tom Thompson's review of color PostScript printers ("Color at a Reasonable Price," June) begins by giving credit to QMS for introducing the first color PostScript printer and then neglects to mention any of QMS's four offerings. This is a disservice to readers who are considering color printer options, and it may give readers who aren't familiar with the QMS ColorScript line the impression that QMS is not an active player in this market.

During the article's planning phase, we were told that QMS ColorScript printers would not be among those reviewed because BYTE had reviewed one of our older models in years past and this article was to focus on newer models. Unfortunately, the article never explains what criteria were used to select the products reviewed. This gives readers the impression that you canvassed the market for *all* solutions that cost less than $8000.

QMS offers two such printers: the $6995 ColorScript 100 Model 10 and the $5995 Model 10p. Furthermore, several of the printers featured in your article were not much newer than the latest QMS offerings.

Terry Harbin
Director, Marketing Communications
QMS, Inc.
Mobile, AL

We excluded the ColorScript 100 Model 10 because we reviewed it in the December 1989 issue (see "What Price Color PostScript?"). We inadvertently omitted the reference to this review in our June roundup of color PostScript printers. We contacted QMS about the Model 10p, but this unit was not available in time for inclusion in the June roundup.—Eds.

As lead development engineer at Seiko, I have some concerns after reading "Color at a Reasonable Price."

You neglected to mention that the Personal ColorPoint can print on postcards and B4-size paper.

The Personal ColorPoint, which comes with a parallel port only, has a list price of $3995; the ColorPoint PS, which has an AppleTalk port, lists for $4995. The review did not make this distinction clear; it sounded as if the customer would have to buy an extra board for our printer.

The CalComp ColorMaster Plus, Tektronix Phaser II PXi, and Seiko Personal ColorPoint all offer enhanced screening that improves halftoning. Yet the only printer you mention as having this feature is the Phaser II PXi.

Mark Bate
Seiko Instruments U.S.A., Inc.
San Jose, CA

The Scoop on Zinc

I'd like to clarify a few points made in "Zinc-Air Batteries: Long May You Run" (Microbytes, May, page 28). We designed our stand-alone 12-volt battery system to operate portable computers—not cars—for 10 to 30 hours. The battery will power a computer and a printer together for more than 16 hours.

The prototype battery demonstrated at Technologic Partners Pen Computing '92 weighs 2½ pounds. The battery pack weighs 1½ pounds, but that includes a 1-pound air manager. When the battery system is designed into a computer, the computer manufacturer incorporates the battery's air manager into the computer's housing. With proper design, the air manager will add no more than 1 or 2 ounces to the computer's weight.

Also, the prototype shown at the conference did not optimize the battery's footprint. We can fit a 5-V battery into an 8½- by 11-inch package.

Frank M. Harris
Vice President, Marketing and Sales
AER Energy Resources, Inc.
Atlanta, GA

Digital Deceptions

I enjoyed reading Steve Moore's "Digital Deceptions" (Stop Bit, May). While I agree with his statements on the possible misuses of digital manipulation, he far underestimates its potent effect. Had digital video manipulation been a bit more advanced at the time, we might have seen Saddam Hussein telling his troops to pull out of Kuwait

WE WANT TO HEAR FROM YOU. *Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, send BIXmail c/o "editors," or send Internet Mail to letters@bytepb.byte.com. Letters may be edited.*

All I really wanted to do was simplify my job.

So I bought Windows. I added extra RAM. I bought a bigger hard disk. I replaced my video card and monitor. I bought a half-dozen new programs, installed a mouse, configured the system, and as I sit here watching my spreadsheet crawl on my PC, I'm thinking to myself,

"This is making it easier?"

Then there's Macintosh. The only personal computer designed from the very first chip to work the way people work. That's why Peter Lewis of *The New York Times* wrote the Macintosh is simply "better than DOS or Windows." That's why *Byte* wrote, "If you use a GUI to keep your computing tasks sorted out, the Mac does it best..." That's why J.D. Power and Associates ranked Apple the #1 Personal Computer Company in Customer Satisfaction Among Business Users.* There's no personal computer on earth quite like it. And none more imitated. The affordable, compatible, connectable Macintosh personal computer. The power to be your best.®

Macintosh from Apple.

J.D. Power and Associates' 1991 Computer End User Satisfaction Study℠: Phase IV: Business End User Summary. Responses from 5,811 end users at 4,396 business sites. Peter Lewis quote from October 29, 1991, edition of The New York Times. ©1992 by The New York Times Company. Reprinted by permission. Byte quote from March 1992 issue. ©1992 Apple Computer, Inc. All rights reserved. Apple, the Apple logo, Mac, Macintosh and "The power to be your best" are registered trademarks of Apple Computer, Inc. Windows is a trademark of Microsoft Corporation.

LETTERS

long before multinational forces pushed them out. The technology for jamming and transmitting TV signals is here now, and believable digital impersonation will be here soon. The military applications of this technology will, without a doubt, have a profound effect on the way wars are fought in the future.

Don Barton
Grand Junction, CO

Electronic Books and IBM

I was in a state of shock after reading "Electronic Books" (June). I know that there are many people in the U.S. who automatically tune you out when you mention IBM, but when a company leads the industry in a particular area, it should at least get some sort of acknowledgment.

IBM has had a cross-platform product for reading and building on-line books for over five years. BookManager is available for VBS, VM, PC-DOS, and OS/2. It provides full hypertext linking and bookmarking, lets you add personal notes, and offers other features. It also lets you use the same source files for both hard-copy and on-line books.

BYTE shows a negative bias toward IBM by ignoring the availability of several thousand IBM manuals that are usable in both hard-copy and on-line form.

Roger A. Root
Raleigh, NC

Infoglut Solved!

Regarding Dennis Allen's editorial titled "Managing Infoglut" (June): The best-kept secret in the world can now be revealed. The best manager of information, whatever the format, is not a software product at all. It's a librarian! Hire one today.

Frank White
Automation Librarian
University of Windsor
Windsor, Ontario, Canada

Internet Kudos

Thank you for providing an Internet address for sending letters to the editor. I hope that this community inundates you with Internet mail so that the connection proves worthwhile.

Rich Oesterling
Idaho Falls, ID

Image Correction

In his review of WinRix 1.1 ("Image Magic," Windows Special Report, June), Dana Hudes erroneously reports that the package lacks several features.

WinRix supports calibration for scanner, screen, and printer. You accomplish this by creating a custom lookup file and applying it to the scanner, edit window, or printer. This allows you to not only calibrate the device but also calibrate for known differences in source or output attributes. For example, photos taken under fluorescent lighting have a more greenish tone than other photos. With the methodology that we at Rix Softworks have implemented, you can create a lookup file for these photos. In our opinion, you don't always want WYSIWYG.

Our scanner interface supports the changing of the scan resolution if the feature is available on the scanner that is being used. WinRix supports several scanners that were not listed in Hudes's review, including those from Logitech, Marstek, Genius, Ricoh, and OBM. It supports object and raster (i.e., bit-mapped) fonts and displays a visual sample of the selected text in the dialog box to assist user selection. WinRix custom lookups support individual RGB-channel or global adjustments and gamma-curve manipulation.

The package also fully supports rubber-band area-selection tools. You can stretch and relocate all selected areas before committing to the selection you've made. We intentionally reduced the number of icons to eliminate redundant screen clutter. The square and circle entries are only forms of the more general rectangle and ellipse.

We appreciate Hudes's testimonial to our display quality, but the choice of screen dithers is just that—a choice. You can choose ordered (Windows standard), diffused, or halftone dithering from the View Preferences Display menu.

As with our competition, you can use the WinRix 1.1 magic wand and other area-selection tools for bucket fills. The ScanRix scanning application for DOS does not ship with WinRix; SnapRix, our screen-capture application, does. WinRix costs $395.

In light of the aforementioned comparison deficiencies, we believe WinRix to be the best buy.

Joseph R. Fisher
Vice President, Marketing/Sales
Rix Softworks, Inc.
Burlington, NC

FIXES

- The correct toll-free number for Hercules Computer Technology, Inc. ("Flying Windows," June), is (800) 532-0600.
- The maximum storage configuration for the Sparcbook ("SPARCs on the Road," May) is not 125 MB. The Sparcbook can accommodate up to 240 MB of data on two internal hard drives.
- The sentence in "Displays: The Human Factor" (July) on page 196, column 3, paragraph 2 under the subhead "Luminance Perception" that says "Roufs's work is now a..." should read "Nonlinearity is now a...." On page 197, column 1, paragraph 4 under the subhead "Fixing Flicker," the sentence that states "display cost closely follows the field rate" should read "display cost closely follows the frame rate." In addition, Bernice E. Rogowitz's title is Research Staff Member at the IBM T. J. Watson Research Center.
- Prentice-Hall is the publisher of *The Decline and Fall of the American Programmer* (Book and CD-ROM Reviews, July). ■

I FEEL LIKE I'M BEING PECKED TO DEATH BY DUCKS.

At $149.95 per PC, Windows sounded like a deal. Then I bought all new programs at about $500 a pop. I shelled out a couple hundred per machine for extra memory. I ponied up $300 each for networking cards. The mouse ran $100 and a bigger hard disk ran $275. And as I stare at the invoice for what it's going to cost me to connect them all together, I think to myself,

"THIS IS MAKING IT EASIER?"

Then there's Macintosh.® There are no hidden costs. There are no cards to buy for networking, file sharing, sound, video or peripheral support. That's why *Computer Shopper* magazine said, "Let's not be coy: If you want the best GUI money can buy, get a Macintosh." That's why *MacWeek* said, "Apple has shown that it can be technologically brilliant and price competitive at the same time." And that's why J.D. Power and Associates ranked Apple the #1 Personal Computer Company in Customer Satisfaction Among Business Users.* There's no personal computer on earth quite like it. And none more imitated. The affordable, compatible, connectable Macintosh personal computer. The power to be your best.®

Macintosh from Apple.

*J.D. Power and Associates' 1991 Computer End User Satisfaction Study™: Phase IV: Business End User Summary. Responses from 5,811 end users at 4,396 business sites. Computer Shopper quote reprinted from April 1, 1992 issue. ©1992 Coastal Associates Publishing, L.P. MacWeek quote reprinted from October 22, 1991, issue. © 1991 Coastal Associates Publishing, L.P. © 1992 Apple Computer, Inc. All rights reserved. Apple, the Apple logo, Macintosh and "The power to be your best" are registered trademarks of Apple Computer, Inc. Windows is a trademark of Microsoft Corporation.

NEWS

MICROBYTES

Kaleida Hopes that X Marks the (Multimedia) Spot

When IBM and Apple announced their joint-venture software company Kaleida, officials said that the new company would license existing technology from the parent companies and create uniform specifications and file formats for multimedia data. Kaleida would then license these multimedia technologies back to IBM and Apple and other third parties.

IBM and Apple revealed little else about what Kaleida was developing, leaving observers to speculate about who would direct the company and the mysterious projects it was involved in that had names like Sweet Pea and Script X. In just one week in late June, however, all that changed.

First, Apple and IBM said that Kaleida's president and CEO will be Nat Goldhaber, venture capitalist and founder of the company that developed the TOPS distributed file-server LAN for incompatible computers. Once named Kaleida's CEO, Goldhaber revealed that Apple and other companies, such as Japanese consumer-electronics giants Sony and Toshiba, will use Kaleida technology in their PDA (Personal Digital Assistant) systems.

Goldhaber told BYTE that two technologies currently under development at Kaleida for hand-held personal multimedia/communications devices are Script X, a universal multimedia scripting language, and COS (consumer operating system), a real-time kernel designed for small portable devices. "We won't manufacture the devices but will play a major role [in their development], either through design or through creating the tools to do the design work," he said. Goldhaber said that the information units "require not only communication links and devices but also a big body of beautifully and intelligently wrought information software."

Goldhaber said Script X will provide the basis for the formation of these intelligent programs. It will execute on devices ranging from Sweet Pea, the CD-ROM-based PDA currently being developed, to the Mac and other future systems, including the PowerPC.

"Script X will be linked intimately to the TV set," Goldhaber said. "Script X is designed to be that language that, for the most part, an author of a title [i.e., an intelligent infotainment program] can produce that title just once for multiple platforms." Plans call for Script X to run on Macs, Windows, OS/2, and Unix platforms. "QuickTime will also be part of the Script X environment," Goldhaber said, adding that Script X–compliant PDAs will play QuickTime movies. He also said that Script X will execute natively on COS. Although he didn't discuss specific release dates, Goldhaber said that COS and Script X are fairly well along.

In discussing Kaleida and what he hoped it would provide for all people, Goldhaber referred to several speeches he delivered in the 1980s, including one he made in October 1989 to the Boston Computer Society. In that speech, Goldhaber spoke of a truly intuitive multimedia device that merged TV and the PC with an HDTV-quality display. Users would—through an interface that Goldhaber said would need to be far more intuitive than anything currently offered on PCs, Macs, or VCRs—be able to indicate the topics of interest to them and have those topics delivered to the system automatically. At Kaleida, Goldhaber has an opportunity to turn his vision into reality.

Goldhaber told BYTE that Kaleida will participate in projects that IBM is working individually with Time Warner and Bell Atlantic to provide video on-demand services. He added that Kaleida may also participate in a similar project with Hewlett-Packard.

—David Andrews

NANOBYTES

In discussing the technologies that Kaleida is now working on, newly appointed Kaleida CEO **Nat Goldhaber** said that one of the key considerations is to create products that present information in an entertaining way: "The problem with the computer metaphor is it's very intimidating for many people. It lacks that warm and fuzzy quality that makes it interesting to explore." He said that if a device is to succeed in providing information to all people, not just computer users, it must be accessible. □

Unconfirmed reports say **Apple** is asking companies, including Japanese consumer-electronics companies **Matsushita, Toshiba, and Sony**, to contribute millions of dollars to support its Bento multimedia specification. In return, the companies who support Bento will also get early access to technologies developed at Kaleida. Bento is a cross-platform standard for documents containing multiple data types. □

Toshiba Corp. of Japan is working with Apple to develop a CD-ROM-based multimedia player called **Sweet Pea**. Details on the system are scarce, but a Toshiba spokesperson told BYTE that the player will span the entertainment, information-on-demand, and lifelong-learning markets. It is expected to ship in mid-1993. Toshiba said it is also negotiating with Time Warner to provide consumers with a "wide spectrum" of multimedia titles for consumers. □

Sitting in coach between two sumo wrestlers,

I pull out my laptop and try to get some work done. I futz with the clip-on trackball. Untangle the cord. Meanwhile, my screen flickers at me like a dim bulb. I notice the guy across the aisle is struggling with a mouse, trying to use the back of the seat as a mousepad. And I think to myself,

"This is making it easier?"

Then there's Macintosh® PowerBook.™ The one notebook designed from the beginning for anywhere/anytime computing. The trackball is built into the keyboard. Palm rests make it extraordinarily comfortable to use. That's why *Byte* said, "These new Macs with their ability to read DOS floppy disks, transparently connect to an office's AppleTalk network, and print to fax, make on-the-go computing easier and more productive than ever." That's why PowerBook was the only personal computer to make the Product of the Year lists of *Business Week, Fortune* and *InfoWorld.* And the only notebook computer to be named one of the Best Designed Products of the Year by *Time.* That's why J.D. Power and Associates ranked Apple the #1 Personal Computer Company in Customer Satisfaction Among Business Users.* The affordable, compatible, connectable PowerBook personal computer. The power to be your best.®

Macintosh from Apple.

*J.D. Power and Associates' 1991 Computer End User Satisfaction Study™: Phase IV: Business End User Summary. Responses from 5,811 end users at 4,396 business sites. Byte quote from March 1992 issue. ©1992 Apple Computer, Inc. All rights reserved. Apple, the Apple logo, AppleTalk, Mac, Macintosh and "The power to be your best" are registered trademarks of Apple Computer, Inc. PowerBook is a trademark of Apple Computer, Inc.

NEWS

MICROBYTES

IBM Gets the Ambra Light

LONDON—In a roughly $15.2 million (£8 million) blaze of publicity more suited to a soft drink sales campaign, IBM has burst onto the European low-cost clone scene. Its new product range, comprising two desktops and a notebook, has been christened Ambra, with the first TV advertisement featuring images of taut young bodies exercising in a gymnasium. The machines, which have racy names like Sprinta, Hurdla, and Treka, come in various configurations at prices ranging from about $1600 (£885) to $2700 (£1449). The desktop PCs are powered by AMD's 25-MHz 386SX and the notebooks by a 20- or 25-MHz Intel 386SL. A 486 model is expected later this year. The machines are based around the ISA bus rather than IBM's Micro Channel architecture bus.

IBM's new wholly owned subsidiary company, called Individual Computer Products International, will source and sell the machines. It expects to sell up to a third of its machines directly, with the remainder being sold through the reseller channel and retailers such as the Wildings U.K. office equipment store. The PCs will also be shipped directly from the Far East to an IBM subsidiary in Canada.

ICPI's direct selling prices exclude VAT (value-added tax). They do, however, include preinstalled DOS and Windows, a one-year on-site warranty, and use of a technical-support hotline. Resellers can set their own prices as low as they like, but the IBM connection and the advertising may help retailers avoid a price war.

—David Tebbutt

VeriFone Banks on Synaptics' Neural-Network Chip

VeriFone has released the Gemstone Onyx check reader, a device for the PC that uses a neural-network chip designed by Synaptics to intelligently recognize and process numeric information that appears on bank checks. According to Ashok Narasihman, vice president and general manager of VeriFone, the new device, which processes image information in a manner similar to the way in which the human eye does, offers retailers a more efficient and faster method of processing checks than traditional motorized check readers. VeriFone and Synaptics say that the device is the first commercial application of neural-network technology, which mimics the way a human brain processes information.

At the heart of the Gemstone Onyx check reader is the Synaptics I-1000 neural-network chip. The I-1000 chip integrates an imager (with image preprocessing), an analog neural-network classifier, and digital electronics. A silicon eye in the device reads images through a lens at a resolution of 18 by 64 pixels; the image is then sent to the I-1000 chip, which determines what the object is. The Onyx check reader has achieved a 99.6 percent accuracy rate in recently completed independent lab tests conducted by SRI International.

—Patrick Waurzyniak

Department of Justice Official: Managers Need More Proactive Security

WASHINGTON, D.C.—Information systems managers need to be more proactive in detecting computer crimes, according to a U.S. Department of Justice official. Speaking to about 250 attendees at LAN/SEC 92, Scott Charney, chief of the Justice Department's Computer Crime Unit, noted that the appearance of inexpensive modems has helped spawn a criminal industry. Unfortunately, security devices and security practices are costly, and management is reluctant to pay for them when a problem is not immediately evident, Charney said.

Charney said that hackers' attempts to obtain passwords by running the entire dictionary past the password request work about 20 percent of the time. A more devious technique is to substitute a program that looks and acts identical to an actual sign-on screen.

"Don't wait until you're hit; use nondictionary passwords, educate users," Charney advised. If you are the victim of computer crime, "keep audit trails, keep the records in a safe place—not where intruders can find (and alter) them," he said.

—Stephen Banker

NANOBYTES

IBM's **Pennant Systems** (Norwalk, CT) and **Hitachi** (Tokyo) and its affiliate company **Hitachi Koki** have agreed to work together in developing what an IBM spokesperson said will be "the next generation of printers." Hitachi Koki will manufacture high-, medium-, and low-speed print engines for continuous and cut-form printers. Either Pennant Systems or Hitachi Koki will produce the controllers, and software will be developed by Pennant Systems. IBM will market the final products worldwide. □

Northgate Computer (Minneapolis, MN) and **Everex Systems** (Fremont, CA) have discontinued discussions regarding a possible merger. Soon after rumors surfaced that IBM might buy Northgate, Everex signed a letter of intent to buy it. Northgate now says that an investment group will purchase 51 percent of Northgate's common stock and provide at least $3 million in financing. □

Symantec (Cupertino, CA) has acquired **MultiScope** (Mountain View, CA), developer of MultiScope Debuggers for Windows, DOS, and OS/2, and **The Whitewater Group** (Evanston, IL), developer of the Whitewater Resource Toolkit and Actor, the OOP (object-oriented programming) language package for Windows application programming. Symantec's move brings it two steps closer to its master plan of being a multiplatform development tool provider, explained Neal Goldman, product manager of PC language products at Symantec. Both of the acquired companies will retain their corporate identity. □

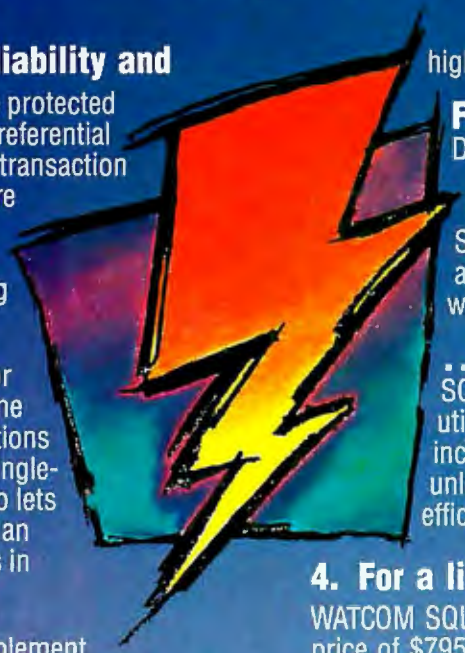
Starting this fall, Compaq's new **Peripherals Division** will release a series of network printers. The division will be headed by David Black, who previously directed the development of Compaq desktop and portable PCs. □

WATCOM SQL

PC-based Client/Server SQL Tools

Four Good Reasons to get your copy right away:

1. True Client/Server for reliability and performance Your databases are protected from corruption by features such as referential and entity integrity, as well as true transaction processing. Client/server architecture and our 32-bit database server software help deliver increased performance for applications running on your PC LANs.



2. Royalty-free run-time For just $99 you get royalty-free run-time support. It lets you distribute applications for standalone PCs and include our single-user run-time database server. It also lets you distribute your applications on an unlimited number of client machines in network environments.

3. Scalability Whether you implement applications using the ACME front-end or write them in C or C++, they can be designed to run without change in environments ranging from standalone 640K single-user PCs to large networks running our high-performance multi-user database server.

From entry level PCs... You can use DOS PCs with just 640K memory as database server machines for small networks. For single-user standalone environments, the SQL database server together with an application can run on DOS PCs equipped with a minimum of 640K memory.

...to high end servers. The WATCOM SQL database server automatically adapts to utilize the available memory on your system for increased performance. The 32-bit version unleashes the power of 386/486 PC's to efficiently serve many clients in large networks.

4. For a limited time it's yours for just $395 WATCOM SQL Developer's Edition has a suggested retail price of $795 but for a limited time you can get it at the introductory price of only $395. Even better, as a registered user of the Developer's Edition you'll be able to get a copy of the 6-user Network Server Edition for only $99 (Suggested retail price: $795).

Developer's Edition

Complete Client/Server Development Tools Package Including Standalone Single-user SQL Database Engine

The Developer's Edition allows you to develop and deploy single-user standalone applications, and to develop applications for use with the WATCOM SQL Network Server Edition. You get the **ACME (Application Creation Made Easy)** front-end application development system. It combines visual forms design with simple event-driven programming to allow rapid prototyping and development of client applications without C programming. The Developer's Edition also includes IBM SAA standard embedded SQL support for C/C++ application development with WATCOM, Microsoft and Borland compilers.

Package components include: Single-user standalone database server (both 16 and 32-bit versions) • Interactive SQL • ACME front-end application development system • Embedded SQL/C preprocessor • SQL libraries for use with WATCOM C, WATCOM C/386, Microsoft C/C++, and Borland C/C++.

System Requirements:
Hardware: IBM PC compatible with hard disk, 640K minimum memory
Software: DOS, Windows DOS box, or OS/2 DOS box

Special Introductory Offer: $395 (Suggested retail price: $795)

Special offers available to registered users: (details inside package)
- **Royal y-free run-time support:** $99
- **6-user Ne work Server Edition:** $99 (Suggested retail price: $795)

Network Server Edition

High-performance Multi-user SQL Database Server for PC LANs

The Network Server Edition provides client/server support for multiple concurrent users in a local area network environment. The WATCOM SQL database server supports ANSI standard SQL and provides advanced capabilities, including bi-directional scrollable updatable cursors, referential integrity, row-level locking and symmetric multiprocessing of requests. WATCOM SQL also gives you comprehensive security capabilities, data encryption and data compression. Compatible programming interfaces let you implement applications that run without change using either the standalone single-user database or the Network Server Edition.

Package components include: Multi-user network database server (both 16 and 32-bit versions) • Interactive SQL • Network requestor and request manager.

Client System Requirements:
Hardware: IBM PC compatibles, 640K minimum memory
Software: DOS, Windows DOS box, or OS/2 DOS box

Database Server System Requirements:
Hardware: IBM PC compatible with hard disk, 640K minimum memory
Software: DOS

Network Requirements: NetBIOS or Novell Netware (IPX)

Suggested Retail Price: 6-user version: $795
Unlimited version: $1,595

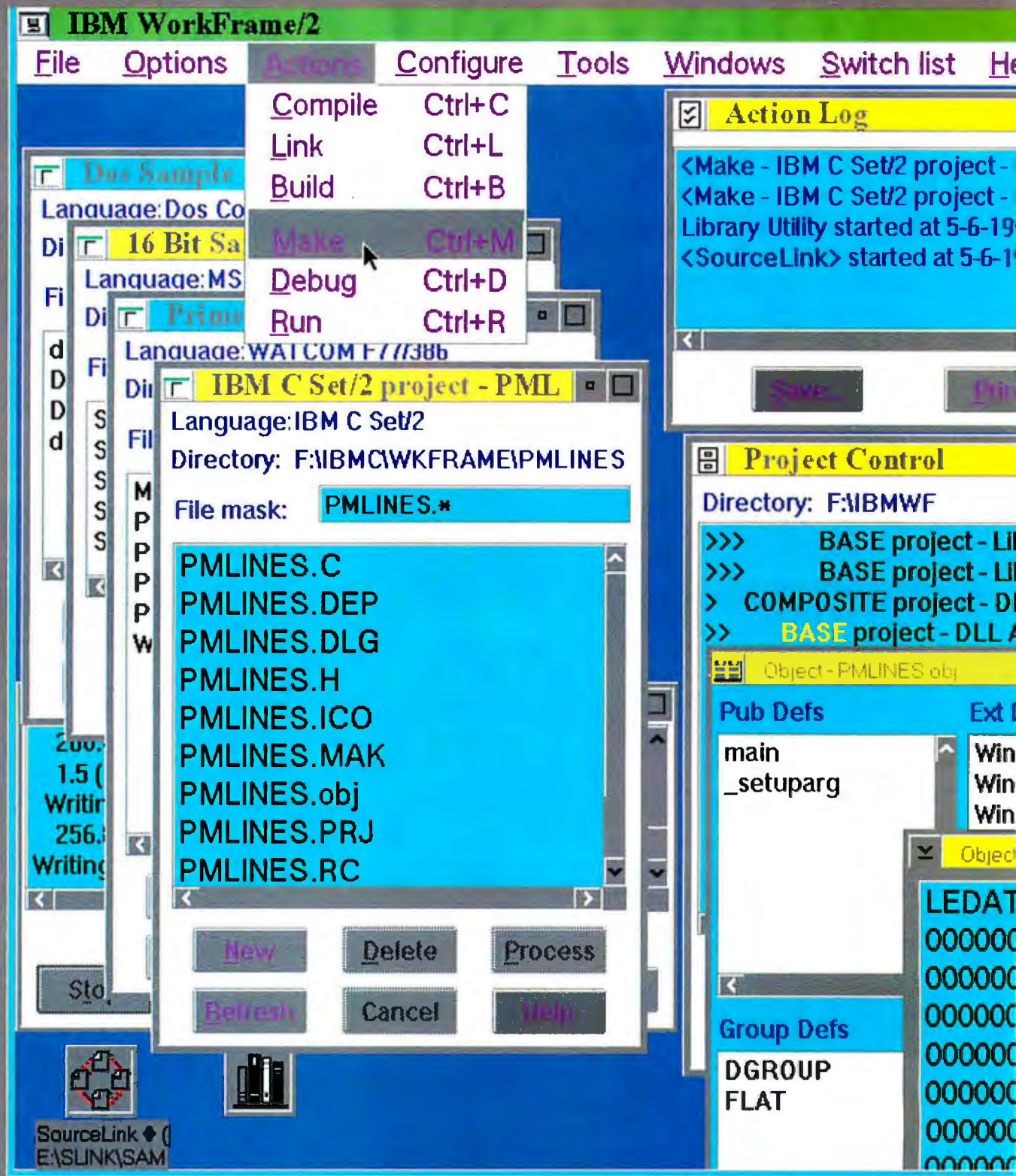
WATCOM, 415 Phillip Street, Waterloo, Ontario, Canada N2L 3X2
Telephone: (519) 886-3700, Fax: (519) 747-4971

Prices do not include freight and taxes where applicable. Authorized dealers may sell for less.
WATCOM SQL, the Lightning Device, and Application Creation Made Easy are trademarks of WATCOM International Corporation. Other trademarks are the properties of their respective owners.
Copyright 1992 WATCOM International Corporation.

WATCOM **1-800-265-4555**

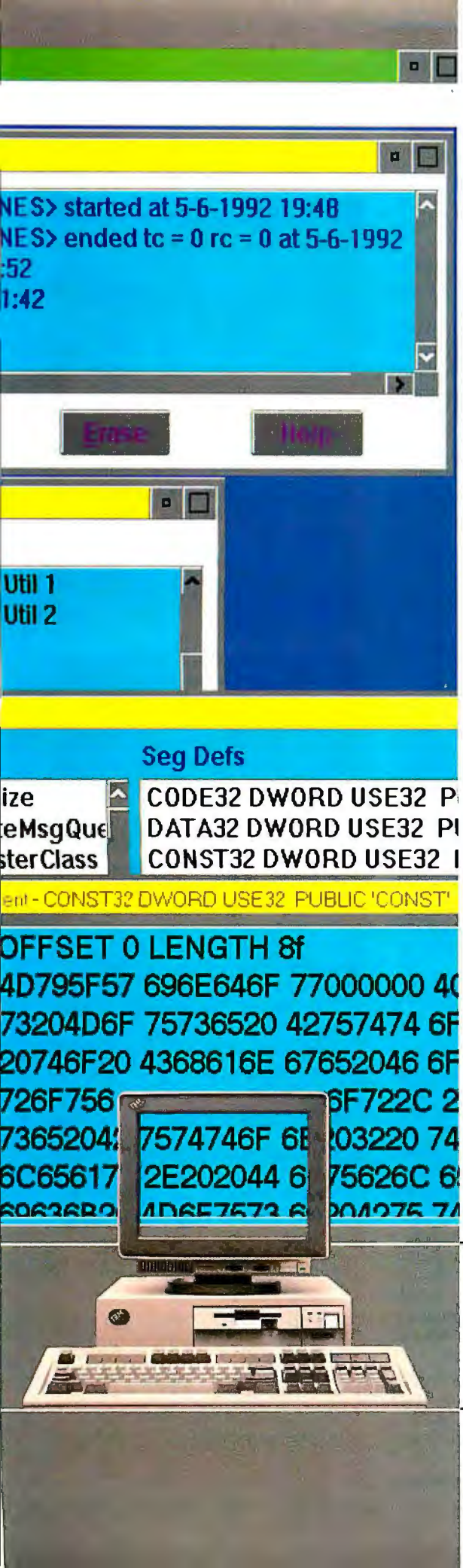
The Leader in Development Tools

Circle 186 on Inquiry Card.



OS/2

*In Canada, call 1 800 465-7999. HelpWare limited to U.S.A. only. IBM and OS/2 are registered trademarks and OS/2 Crash Protection and HelpWare are trademarks of International Business Machines Corporation. Windows is a trademark of Microsoft Corporation. CompuServe is a registered trademark of CompuServe, Inc. © 1992 IBM Corp.



To a software developer, this is what heaven looks like.

Most people wouldn't know what to make of a screen like this. But developers like you know a screen like this can help make all kinds of applications. With OS/2® 2.0, you can develop the DOS, Windows,™ OS/2 and host-based apps end users need. And you can do it faster and easier than ever before. Because OS/2 2.0 can make the most of your 386 or 486 processor.

Now you can edit in one window, compile in another, profile in a third and test in a fourth. Preemptive multitasking makes everything run smoothly and responsively. And OS/2 Crash Protection™ helps shield running applications from each other, so if one goes down it won't affect the others. Instead of rebooting, you just restart the affected app and continue. And since OS/2 2.0 is a 32-bit operating system, programs are easier to write and run faster, too. Which all adds up to improved productivity and reduced development cycle time.

But maybe the best part is that for less than the cost of DOS and Windows, OS/2 gives you a whole lot more. And to keep your cycle rolling, a full range of services and support are available, like on-line help through OS/2 Support line, Bulletin Board and IBM Link. Or you can join the IBMOS2 and OS2DEV conferences on CompuServe,® where you can meet IBMers, users and developers who can find fast answers to your questions. For an IBM authorized dealer near you, or to order OS/2 2.0 from IBM, call 1 800 3-IBM-OS2.*

- *OS/2 Crash Protection helps shield applications from each other.*
- *The integrating platform of choice for DOS, Windows and OS/2.*
- *Preemptive multitasking for responsive, reliable execution.*
- *32-bit flat address space for productive programming.*
- *A full range of IBM services and support.*

Circle 117 on Inquiry Card.

IBM®

WordPerfect Wises Up

WordPerfect (Orem, UT) is trying to position its market-leading word processor at the center of a universe that includes the supporting role of E-mail, group scheduler, and calendar through WordPerfect Office, and, in the future, new products such as forms creators and document managers. The new strategy, recently unveiled as WISE (WordPerfect Information System Environment), comprises three basic activities: information processing, information sharing, and information presentation. The company's development plans center around delivering applications within these three categories on six platforms. Complete interoperability—both of data and procedures—among DOS, Windows, OS/2, Macs, Unix, and VMS is a major engineering goal.

At the heart of the information-processing segment is the WordPerfect word processor. The company now sees the program as a vehicle for delivering information to the desktop. To position WordPerfect documents as the center of the office, the company will improve links between documents and other data. Better ties to spreadsheets and databases are in the works, and the company is developing an open API that will permit other programs to use WordPerfect support facilities (e.g., a third-party database could call the WordPerfect spelling checker). These changes will likely mean the end of DataPerfect and PlanPerfect, the company's database and spreadsheet products.

To promote information sharing, WordPerfect will reposition WordPerfect Office as an E-mail and multiuser scheduling facility. The company will also add support for methods of mail transport such as the emerging OCE (Open Computing Environment), VIM (Vendor-Independent Messaging), and MAPI (Messaging Application Programming Interface), and even the Open Software Foundation's DCE (Distributed Computing Environment) protocols. As part of its information-sharing thrust, WordPerfect plans to deliver document management and forms design and fill packages this year.

The final activity of WISE, information presentation, has support for printing, document viewing, and multimedia. Like viewers from Frame Technology, Interleaf, and Adobe, the document viewer will let you read WordPerfect and documents on systems that lack these creating applications.

The success of this new strategy may depend on how quickly WordPerfect can develop all these new products for six different environments. To speed up the process, WordPerfect is moving away from assembly language toward a portable C- and C++-based core-code design.

—Andy Redfern and Andy Reinhardt

Starlight Networks Adds Jostens as Investor in Network Multimedia

Starlight Networks (Mountain View, CA), a company that plans to announce this fall a network server and software that promise the transmission of stored video over a network without image degradation, has added Jostens Learning as an investor. Jostens Learning (San Diego, CA), a developer of instructional technology programs, has also signed a multiyear, multimillion-dollar contract with Starlight to use its technology in its recently announced Jostens Learning InterActive-Media curriculum products, Starlight says.

The transmission of stored video from a server to a client presents a problem for packet-based LANs. Unlike other types of data, video must be able to flow without interruptions, which degrade its quality. A Starlight Networks spokesperson said the company is developing a technology that lets workgroups have simultaneous access to full-motion video over current LANs and WANs (wide-area networks). Video applications will be able to coexist with desktop computer applications on the same network. Starlight Networks plans on supporting multiple types of LANs, including Ethernet, Token Ring, and FDDI (Fiber Distributed Data Interface).

Jostens Learning plans to use Starlight's products in what it is calling its next generation of instructional curricula, which is based on networked multimedia. A Jostens representative said that the curriculum relies on interactive full-motion video to grab and hold a student's attention.

Founded in 1990, Starlight Networks' investors include Bass Associates; Accel Partners; InterWest Partners; Merrill, Pickard, Anderson & Eyre; and Nynex Venture Company.

—David Andrews

NANOBYTES

To achieve better market leverage, **WordPerfect** is undertaking an aggressive program of partnering with other companies. WordPerfect has entered a cooperative product development and support program with Novell, the major element of which will be the creation of WordPerfect Office as an NLM (NetWare loadable module). Other announcements include the licensing of Adobe Type Manager's rendering technology and support for the TWAIN image and document manipulation specification already adhered to by Aldus, Caere, Kodak, Hewlett-Packard, and Logitech. □

In another break with the past, WordPerfect announced its first acquisition, Illinois-based **MagicSoft**, which makes the communications software used in WordPerfect Office. WordPerfect making acquisitions? This may be only the beginning. □

Olivetti (Milan, Italy) and **Novell** have signed a master business agreement that will expand the already-close relationship between the two companies. Included in the agreement are plans for full support of Novell NetWare under the Olivetti OSA (Open Systems Architecture), joint marketing events, and a new rigorous training program for technical employees. The first step toward NetWare integration calls for native NetWare support in OSA. □

A start-up company in Boston is developing a spreadsheet for Next workstations that reads and writes Lotus WKS and WK1 files and executes Lotus 1-2-3 release 2.3 macros. **Athena Design** ((617) 734-6372) says its Mesa spreadsheet is the only traditional spreadsheet written exclusively for the NextStep environment. David Pollak, president of Athena Design, says Mesa has received considerable interest from Wall Street financial houses that now use Next computers. □

Important News For The Power Hungry: Your Dinner's Ready.

Come and get it.

The new Amiga® 3000T multimedia workstation tower—the most expandable, flexible Amiga ever built.

Now powered by a 25 MHZ Motorola 68040 CPU, the A3000T is faster than ever before. (Current A3000T users can upgrade to a 040-based accelerator card for just $1,998.)

The A3000T features a 200MB hard disk drive. A 3.5" floppy disk drive. 5MB of RAM, expandable to 18MB. And 32 bit bus architecture to transfer mammoth amounts of information at breakneck speed. The truly power famished will be happy to know that the A3000T is stuffed with an abundant selection of expansion slots. There's a co-processor slot. A video slot for internal devices. Up to four PC s. And up to five Zorro III slots. Every Amiga 3000 series computer comes with Commodore-Express™ Gold Service options.* And convenient leasing terms are available.

Now, you'd expect a power feast like this to carry a fat price tag. But now through September 30, you can sit down to an Amiga 3000T with a monitor for just $5,998.** Which in itself is a powerful reason for seeing your Commodore dealer today.

For a dealer near you, call 1-800-66-AMIGA.

In Canada, call 1-800-661-AMIGA.

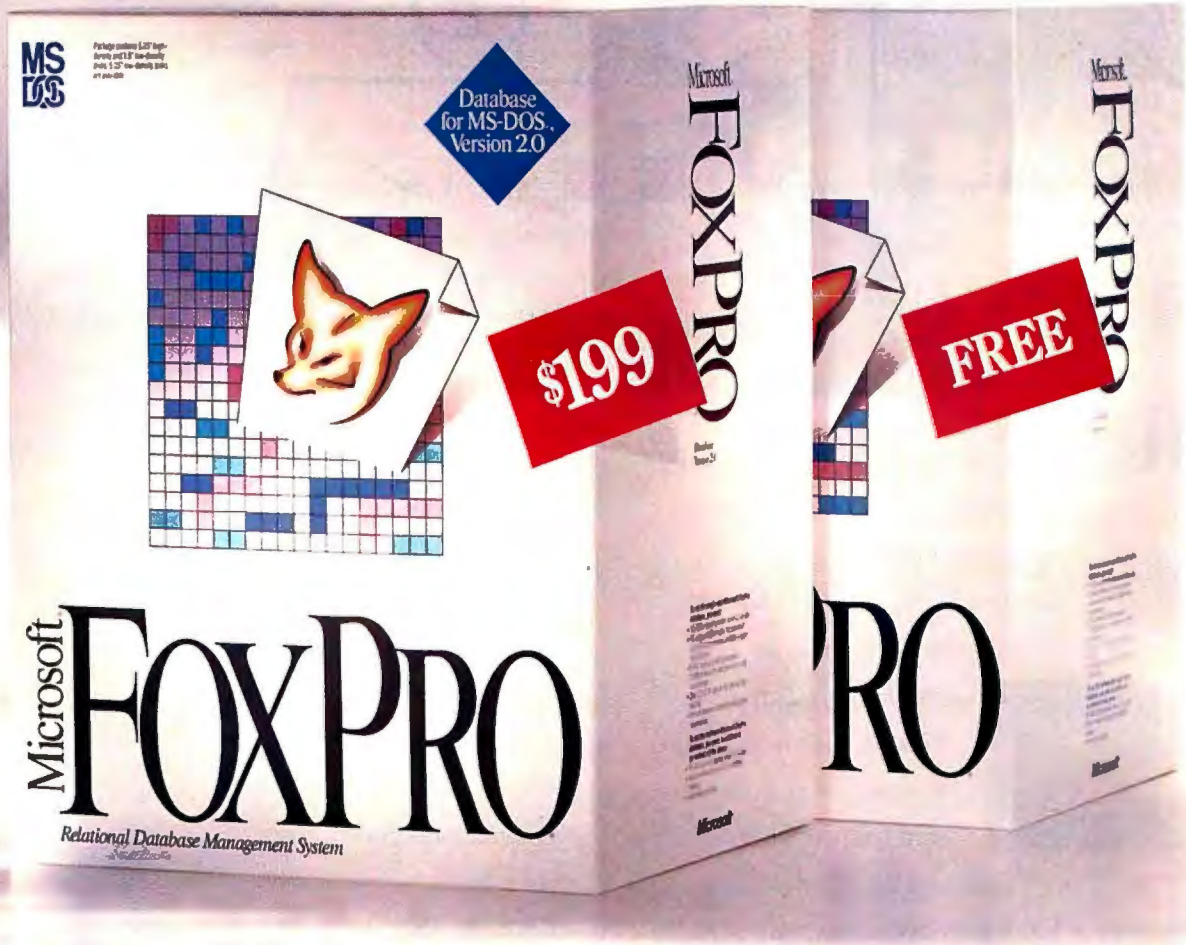
Bon appetit.

Commodore AMIGA

© 1992 Commodore Business Machines Inc. Commodore and the Commodore logo are registered trademarks of Commodore Electronics Ltd. Amiga is a registered trademark of Commodore-Amiga, Inc. Products available on GSA schedule GS-00K-91-AGS-5069. * Available only on systems purchased in the U.S. through an authorized Commodore-Amiga dealer. Customer activation required. Some optional programs include a charge. **MSRP

Circle 90 on Inquiry Card.

The world's fastest PC database comes with a commitment that will last forever.



And an offer that won't.

© 1992 Microsoft Corporation. All rights reserved. Printed in the USA. *Plus $10.00 freight and applicable sales tax. Reseller prices may vary. **Free; you don't even pay freight. † dBASE IV Benchmarks performed by Micro Endeavors, Inc. DB2 Benchmarks performed by Patrick O'Neil, "The Set Query Benchmark," in "The Benchmark Handbook for Database and Transaction Processing Systems," Morgan Kaufman Publisher, 1991. You must currently be a licensed user of a data base product to qualify for this special upgrade offer. To qualify for this offer at your reseller you must bring proof of purchase with your 1) the original disk from your program, 2) title page of the manual, or 3) a copy of the sales receipt. You must register your copy of Microsoft FoxPro 2.0 to qualify for a free upgrade to version 2.5. (If you get your upgrade directly from Microsoft, you will be automatically registered.) You will then be notified when your free upgrade is available.

Send me the Microsoft FoxPro 2.0 upgrade, fast! And Microsoft FoxPro 2.5, free!

To upgrade to the Microsoft® FoxPro® database version 2.0 with a free upgrade to version 2.5 as soon as it's available, complete and mail this order form with your payment. Or to order by phone, call **(800) 228-7007, Ext. AC9** (6:30 A.M. - 5:30 P.M., Pacific time).

If you are not completely satisfied, you may return the product within 90 days for a full refund.

1. Fill out your name and address.

Name

Company (if company licenses product)

Street Address (No P.O. boxes, please)

City State ZIP

( ) _____

Daytime phone (in case we have any questions about your order)

2. ☐ I'm a licensed user of a competitive database product. Please send me Microsoft FoxPro version 2.0 for $199* plus a free upgrade to version 2.5 as soon as it's available. (You will be notified when your free upgrade is available.)

NOTE: Offer limited to one copy of Microsoft FoxPro 2.0 and one free upgrade to version 2.5 per licensed competitive product.

3. Please check one disk size:
☐ 5.25-inch, high density (1.2 MB) ☐ 3.5-inch low density (720K)

4. Please complete payment information below:

	Qty.	Total
Microsoft FoxPro 2.0 competitive upgrade ($199 ea.)	_____	$_____
Sales tax if applicable** (see taxable state list below, then multiply cost by sales tax rate)		$_____
Freight Charge ($10.00 ea.)		$_____
Total cost		$_____

☐ Check/money order enclosed
☐ MasterCard ☐ American Express ☐ VISA

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Check or credit card number

Expiration date ☐☐-☐☐

_____
Cardholder's Signature

5. To qualify for this upgrade offer, I understand I must be a licensed user of any version of any of the products listed below. (Check all that apply.)

☐ dBASE® ☐ Arago® ☐ dBFast™ ☐ DataEase® ☐ Clipper®
☐ R:BASE® ☐ Paradox® ☐ Superbase® ☐ Other†_____

†Certain other products are also eligible. If your product is not listed above, call (800) 228-7007, Ext. AC9

My signature below certifies that I am a licensed user of at least one of the products listed above, which entitles me to acquire Microsoft FoxPro 2.0 at the special competitive upgrade price of just $199 and to qualify for a free upgrade to version 2.5 upon registration of the version 2.0 product. (If you get your upgrade directly from Microsoft, you will be automatically registered.)

_____
User's Signature

* Plus $10.00 freight and applicable sales tax. This offer expires December 31, 1992. **Add sales tax in the following states: AZ, CA, CO, CT, DC, FL, GA, HI, IA, ID, IL, IN, KS, KY, MA, MD, ME, MI, MN, MO, MS, NC, NE, NJ, NM, NV, NY, OH, OK, PA, RI, SC, TN, TX, UT, VA, WA, WI, WV and WY. Microsoft reserves the right to correct tax rates and/or collect the sales tax assessed by additional states as required by law without notice. (Please send payment in U.S. funds. *Do not send cash.* No purchase orders accepted. Payment will be charged to your credit card upon shipment of your order. Your check will be deposited immediately upon receipt by Microsoft.)

Kit No. 215-099-075 (5.25" disks) Kit No. 215-095-075 (3.5" disks) AC9

MOISTEN HERE AND ON SIDES, FOLD OVER AND SEAL WITH PAYMENT ENCLOSED.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
First-Class Mail Permit No. 53 Bothell, WA

POSTAGE WILL BE PAID BY ADDRESSEE

Microsoft FoxPro 2.0
Special Upgrade Offer
PO Box 3018
Bothell WA 98041-9907

Trade up to FoxPro 2.0 from other database products for only $199 and get a free 2.5 upgrade.

If you use dBASE,® Paradox,® Clipper™ or any other PC database, here's an offer you'll want to nab before it's gone forever: Microsoft® FoxPro® database version 2.0 for just $199,* and a free** upgrade to version 2.5 for MS-DOS® or for Windows™ operating systems as soon as it's released.

It's our way of celebrating the Microsoft and Fox merger. And of introducing you to the fastest, most powerful X-BASE solution available. This is a solution that's sure to stay at the head of the database pack, with Microsoft's full commitment.

The fastest PC database.

FoxPro 2.0 gets unequalled results, thanks to superior technology. Our Rushmore™ Query Optimization lets you get the fastest speed of any PC-based database — up to 4 times faster than DB2® and 10 times faster than dBASE IV.®†

The most productive environment.

It's intuitive and graphical to make your life easier. With Relational Query-By-Example (RQBE) you can simplify complex tasks. And with our exclusive Graphical Browse, you can choose the way you view your data.

With the Screen Builder you can quickly design data-entry forms by simply dragging objects into place. And for really quick turnaround, try the Application Generator. It creates complete, fast applications for you — applications you can then customize to fit your needs.

Then there are the other powerful tools like Trace and Debug windows, Project Manager, Menu Builder, Report Writer and Label Writer. With all these tools, you'll write the most powerful, robust apps imaginable.

Is it any wonder that FoxPro 2.0 received the *Byte* Award of Excellence, *InfoWorld* Product of the Year, *PC Magazine's* Technical Excellence Award and *PC Magazine's* Editors' Choice Award, as well as the *Data Based Advisor* and *DBMS* Readers Choice awards?

Your investment is secure.

It's so easy to learn and use, you won't have to worry about losing any time getting up to speed.

You won't lose any of the work you've done, either. Microsoft FoxPro 2.0 is compatible with dBASE III PLUS® and extends dBASE IV. This means you can move your apps over right away. In fact, you'll find they work even faster in FoxPro.

If you're thinking about what'll happen to your applications tomorrow, relax. The applications you build today under Microsoft FoxPro 2.0 will run on Microsoft FoxPro version 2.5 for Windows, MS-DOS, Macintosh® and UNIX.®

Special offer for users of FoxPro.

We have especially good news if you're a registered FoxBASE+ for MS-DOS or FoxPro 1.*x* user. You can upgrade to version 2.0 for only $175 with a free upgrade to version 2.5 when it is available.

The Microsoft commitment.

With Microsoft's resources and Fox's expertise, we're even better positioned to develop the best products and support in the industry. We've been meeting with Fox User Groups around the country. We're planning to hold the largest Fox Developers Conference ever in Phoenix this year. And we're keeping the dialog going on the popular CompuServe® forum, FOXFORUM.

Finally, we support the initiative to create an ANSI standard for the X-BASE language. We stand behind Microsoft FoxPro 2.0 with a full 90-day money-back guarantee and great product support.

But although our commitment is long-lived, this special offer is not. So get a move on and move up to Microsoft FoxPro 2.0, fast. Because when this offer is gone, it's gone forever.

Rush to your dealer. For the name of a dealer nearest you or to order by phone call now, toll-free:

(800) 228-7007, Ext. AC8

Microsoft®

Making it easier

Offer good only in the 50 United States. Offer expires December 31, 1992. Limit one copy of Microsoft FoxPro version 2.0 and one free upgrade to version 2.5 per product license. Please allow 2-4 weeks for delivery upon receipt of this order coupon by Microsoft. In the 50 United States, call (800) 228-7007, Ext. AC8. For information only: In Canada, call (800) 563-9048; outside the 50 United States and Canada, call (206) 936-8661. Microsoft, MS-DOS, FoxBASE+ and FoxPro are registered trademarks and Windows is a trademark of Microsoft Corporation. Macintosh is a registered trademark of Apple Computer, Inc. dBASE, dBASE III PLUS, dBASE IV and Paradox are registered trademarks of Borland International, Inc. CompuServe is a registered trademark of CompuServe, Inc. DB2 is a registered trademark of International Business Machines Corporation. Clipper is a trademark of Nantucket Corporation. UNIX is a trademark of UNIX Systems Laboratories.

NEWS

MICROBYTES

SPARC Vendors Enhance Chip Specification

BURLINGAME, Calif.—SPARC International has come out with a new chip specification offering several performance improvements, including a 64-bit address space that the nonprofit consortium claims will carry the SPARC architecture well into the next century.

Besides the SPARC architecture version 9, which extends SPARC's address space to 64 bits, the specification also includes an enhanced instruction set specifically designed for superscalar implementations, as well as improved support for the Unix operating system and better multiprocessing support.

"What we're doing is what's called 'roadmapping,'" said Sun Microsystems' chairperson and CEO Scott McNealy. "Seriously, you have to [look at the SPARC world's future] because people think you are dead if you don't," he commented. In response to the promise by DEC that its competing Alpha architecture will carry its customers through the next 25 years, McNealy said, "In keeping with that, version 9 will take you into the year 3000-beat that, Alpha!"

The SPARC version 9 specification offers full 64-bit extensions to the previous SPARC version 8, on which two recently introduced superscalar implementations, Texas Instruments' SuperSparc and Cypress Semiconductor's HyperSparc processors, are based. The version 9 specification extends all the version 8 integer registers to 64 bits, and all register commands work on the full 64-bit register with full hardware support for 64-bit arithmetic, including multiplication and division, according to SPARC International.

Several new instructions have been added to increase the performance of both superscalar and superpipelined machines. David R. Ditzel, who is chairperson of the SPARC architecture committee and the director of advanced systems at Sun Microsystems Laboratories, said the new specification adds about two dozen instructions to those of the previous SPARC version 8, bringing the total instruction set to slightly over 100.

The new SPARC specification provides fault-tolerance capabilities through a compare and swap instruction. The specification also includes a new fast-trap model and context switching for increased performance.

SPARC International emphasizes applications written for previous SPARC machines are compatible with the new specification.

—Patrick Waurzyniak

Symantec and Apple Announce Cross-Platform Development Tool

NEW YORK—Symantec (Cupertino, CA) and Apple announced at PC Expo that they have entered into a development and marketing agreement that will provide an application framework for developers that will allow the same code to run on both Macs and Windows-based PCs. Based on the "Bedrock" technology that Symantec has used internally for two years, both companies hope that the framework, which uses C++ and object-oriented approaches, will be extended in the future to support OS/2, Unix, Windows NT, and other operating systems.

An application framework provides a common set of building blocks, or *objects*, that provide the basic structure for an application. MacApp, Apple's framework, already provides an object structure for Mac developers. Apple and Symantec envision a framework that acts as a buffer between a program and the target platform of the processor and native operating system. Symantec is providing the Bedrock framework, which will be combined with elements of Apple's MacApp. Apple and Symantec officials said the two companies will use the Bedrock framework technology internally and work together to support the developers' transition to Bedrock. Symantec will own the technology.

Bedrock maps abstract objects such as Documents, Panes, and Menus into platform-specific functionality instead of just Mac-specific functionality. The three major elements of Bedrock include the Bedrock Class Library (i.e., components for building an application in C++), Bedrock Resource Information (e.g., view positioning, dialog boxes, and screens), and the Bedrock Utility Manager (i.e., machine-specific services).

Slated to be finished in the first half of 1993, the product will be available through both Apple and Symantec distribution channels. Apple said that it will provide an upgrade path for current MacApp users.

—Larry Loeb

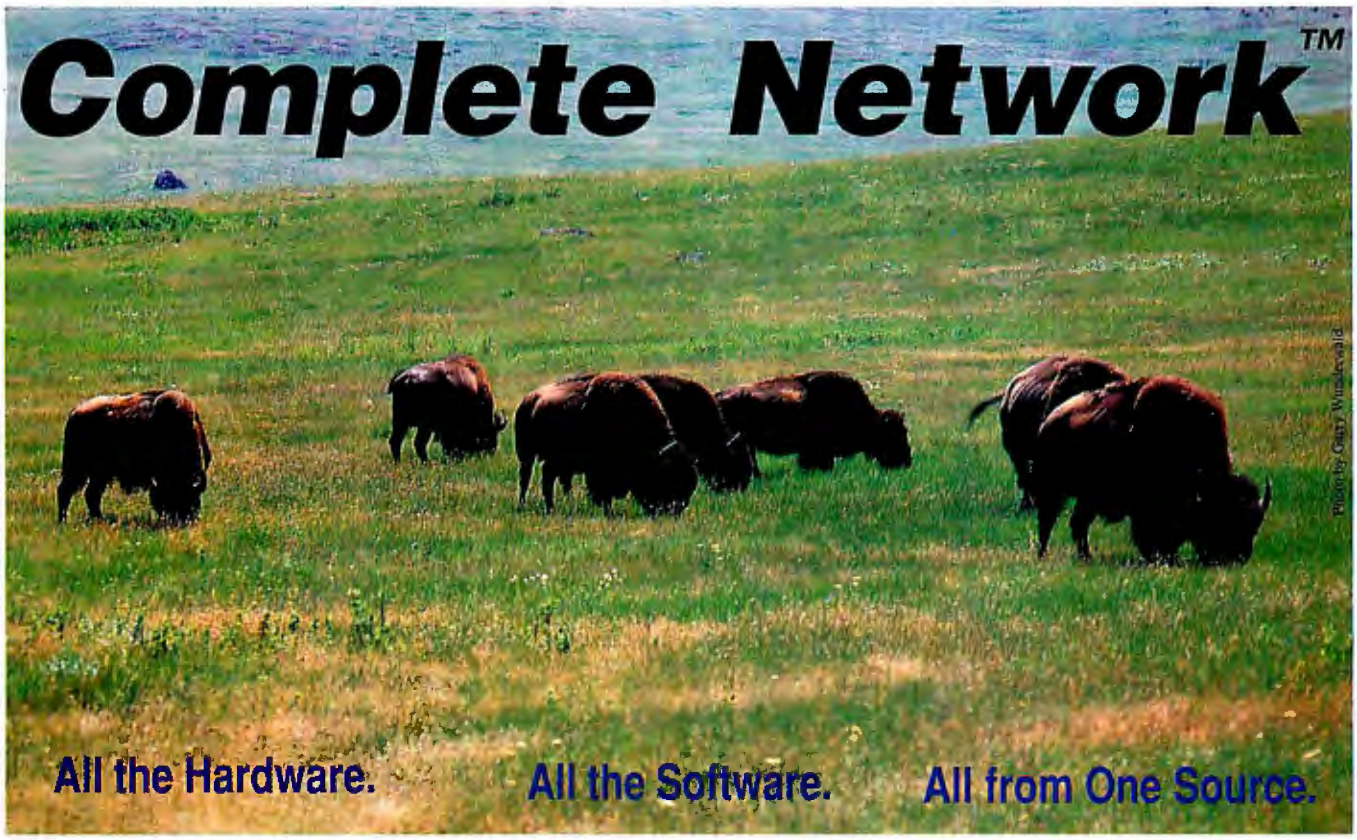
NANOBYTES

Palm Computing (Los Altos, CA), developer of software for consumer palmtop pen computers, has named **Donna Dubinsky**, former international vice president and cofounder of Claris, as its new president and CEO. "The technologies in miniaturization and handwriting recognition are getting us to the point where we can get a powerful open system in the palm of your hand," she said. But she added that companies are still researching what the market wants these applications to be, whether it's a pager, software player, Rolodex, or something else. "It's going to be a bit murky here for a while, and anytime you're developing an open system, it's going to be a battle of the platforms," Dubinsky said. □

Windows has been criticized for not being accessible to the visually impaired. However, thanks to Window Bridge from **Syntha-Voice Computers** (Hamilton, Ontario, Canada, (416) 578-0565), a new program that supports commercially available voice synthesizers, Windows applications can now be accessed via voice output by blind computer users. □

KnowledgePoint (Petaluma, CA, (707) 762-0333), a vendor of programs that enable you to write personnel policies and employee handbooks, has released **DescriptionsWrite Now**, a PC-based program that custom-writes complete job descriptions. KnowledgePoint says that the program helps companies comply with the new ADA (Americans with Disabilities Act): Written job descriptions are an important piece of evidence in both justifying and defending employment decisions, says Michael Troy, KnowledgePoint's president. □

BUFFALO®



Industry Standard Hardware

Complete Network has Intel® EtherExpress16™ LAN Adapters for your network connections. Installation is easy because the cards are totally software configurable and automatically adjust for 8 or 16 BIT card slots. These *Plug 'N' Forget*™ cards from Intel set the standards for Ethernet LAN adapters.

High Performance Software

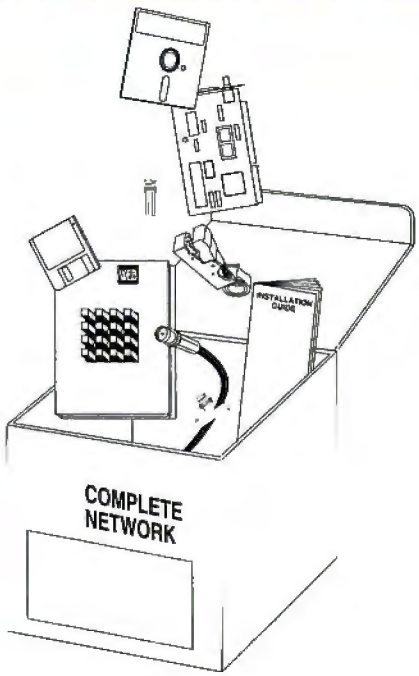
Complete Network features the WEB® 3.0 Network Operating System, winner of the LAN Times 1992 *Best of Times* award. WEB 3.0 is a fast and flexible system which is simple to learn and easy to use. It supports DOS and Windows™ and is Novell®compatible. WEB 3.0 provides the first peer-to-peer network to equal or exceed the performance of most dedicated server based systems.

WEB® LICENSED TECHNOLOGY

Everything Else You Need

Complete Network has everything else you need to set up your network: cable, connectors, terminators, and even a cable stripping tool.

Complete Network is a trademark of Buffalo Products, Inc. Buffalo is a registered trademark of MELCO, Inc. WEB is a registered trademark of WEBCORP. WEBCORP is a trademark of WEBCORP. INTEL is a registered trademark of INTEL Corp. Other brands and product names are trademarks or registered trademarks of their respective owners.



Toll-Free Complete Technical Support

Buffalo provides technical support for all the hardware and software of your Complete Network. You only need to make one contact for support for any part of your network system.

Easy Installation

An easy installation guide helps you quickly and easily set up your Complete Network

Just the Nodes You Need

With the Complete Network you can start with any number of nodes and add any number of nodes to your network at any time. Combine any of these packages, up to 255 nodes, to fit your needs.

CN-2	2 Node Package	$395.00
CN-5	5 Node Package	$995.00
CN-10	10 Node Package	$1,895.00
CN-15	15 Node Package	$2,795.00
CN-30	30 Node Package	$4,995.00
CN-A	Add-A-Node Package	$225.00

45 Day Money-Back Guarantee

US and Canada Toll-Free

1-800- 345-2356

FAX (503) 585-4505

Buffalo Products, Inc.

2805 19th St. SE, Salem, OR 97302-1520

Response Code: 92CN3

France - 01-4827-6736; Germany - 08152-7912-(0)-50, 02241-66071; Italy - 02-261-0051; Belgium - 016-400416; Denmark - 42-95-3888, 38-89-0909; Finland - 0-351-5055, 0-803-6033; Netherlands - 073-440700; Norway - 2-214-050; Hong Kong - 861-2112; Korea - 02-783-5344; Israel - 3-560-3837; International - 81-45-681-5401

Circle 399 on Inquiry Card.

CONVENTIONAL WISDOM HAS IT THAT COMPAQ HAS THE BEST FEATURES, AND ZEOS AND GATEWAY THE LOWEST PRICES.

IT ALSO SAID DISCO AND COMMUNISM WERE HERE TO STAY.

Pardon us while we mess with your reality. But the new Dimension line from Dell® is about to make conventional wisdom look pretty dumb.

Introducing Dimension, a line of high-quality, full-featured PCs. From notebooks to i486 floor-standing systems.

Dimension systems can be up to $500 less than equivalent PCs from Compaq, Gateway or Zeos.** Each Dimension desktop comes with at least three drive bays and four ISA slots, versus two in some competing systems. And with Dimension PCs you don't pay for a load of software you may not need.

We don't skimp on service either. We offer on-site second-business-day service, toll-free help, 24-hour TechFax,℠ and a 30-day money-back guarantee.△ All from a FORTUNE 500® company.

So if you want a great computer at an incredible price, just give us a call. You'll find Dimension is anything but conventional.

DIMENSION™ 486SX/25

$1,799

Lease♦: $67/MO.

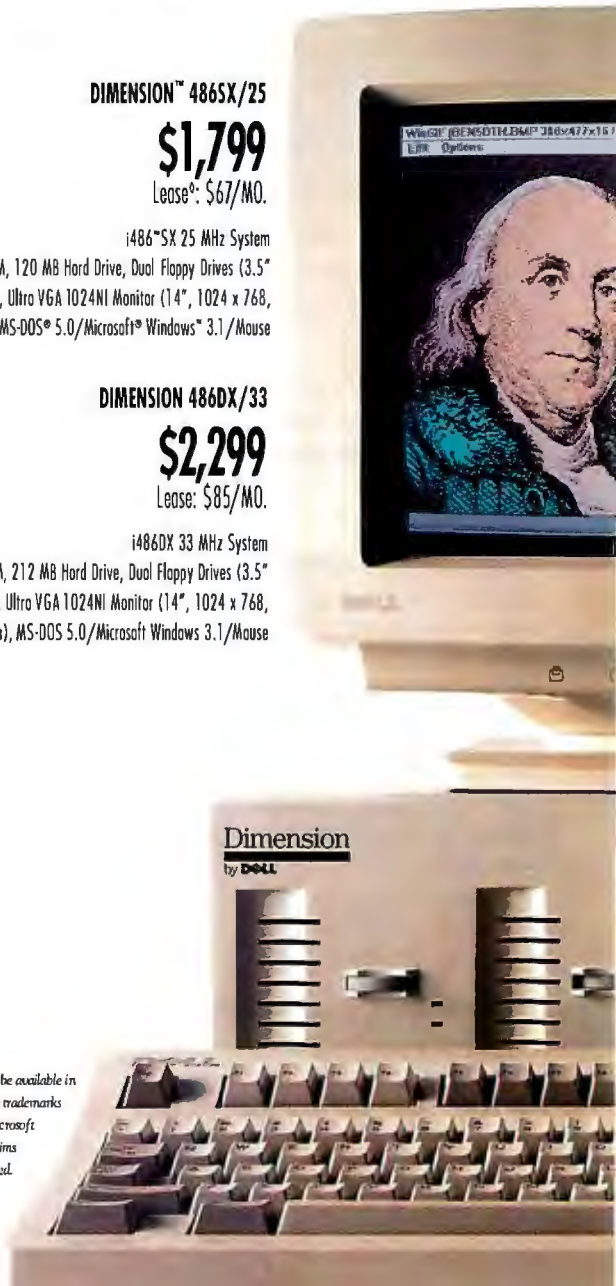
i486™SX 25 MHz System
4 MB RAM, 120 MB Hard Drive, Dual Floppy Drives (3.5" and 5.25"), Ultra VGA 1024NI Monitor (14", 1024 x 768, .28mm), MS-DOS® 5.0/Microsoft® Windows™ 3.1/Mouse

DIMENSION 486DX/33

$2,299

Lease: $85/MO.

i486DX 33 MHz System
4 MB RAM, 212 MB Hard Drive, Dual Floppy Drives (3.5" and 5.25"), Ultra VGA 1024NI Monitor (14", 1024 x 768, .28mm), MS-DOS 5.0/Microsoft Windows 3.1/Mouse



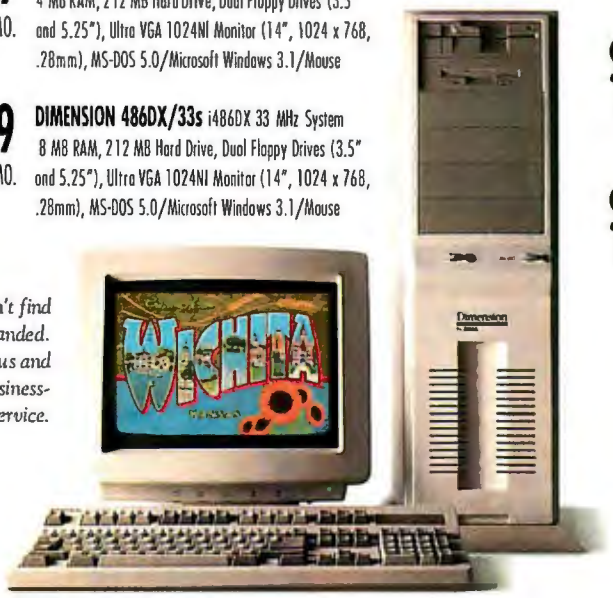
intel inside

Actual dealer prices may vary. △Service provided by BancTec Service Corporation. On-site service may not be available in certain remote locations. ♦Leasing arranged by Leasing Group, Inc. i386, i486 and the Intel Inside Logo are trademarks of Intel Corporation. MS-DOS and Microsoft are registered trademarks and Windows is a trademark of Microsoft Corporation. FORTUNE 500 is a registered trademark of The Time Inc. Magazine Company. Dell disclaims proprietary interest in the marks and names of others. *©1992 Dell Computer Corporation. All rights reserved.*

$2,199 Lease: $81/MO.
DIMENSION 486SX/25s i486SX 25 MHz System
4 MB RAM, 212 MB Hard Drive, Dual Floppy Drives (3.5" and 5.25"), Ultra VGA 1024NI Monitor (14", 1024 x 768, .28mm), MS-DOS 5.0/Microsoft Windows 3.1/Mouse

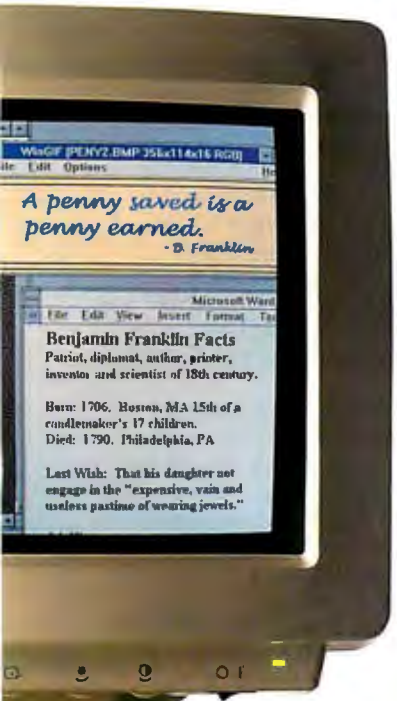
$2,699 Lease: $100/MO.
DIMENSION 486DX/33s i486DX 33 MHz System
8 MB RAM, 212 MB Hard Drive, Dual Floppy Drives (3.5" and 5.25"), Ultra VGA 1024NI Monitor (14", 1024 x 768, .28mm), MS-DOS 5.0/Microsoft Windows 3.1/Mouse

Don't find yourself stranded. Buy from us and get second-business-day on-site service.



$1,499 Lease: $55/MO.
DIMENSION NL20 i386™SL 20 MHz System*
2 MB RAM, 40 MB Hard Drive, Weight: 6.3 lbs. including battery, Minimum battery life: 2.5 hours, Edgelit VGA LCD (8.5" Diagonal, 640 x 480), MS-DOS 5.0/ Microsoft Windows 3.1/Mouse

$1,799 Lease: $67/MO.
DIMENSION NL25
i386SL 25 MHz System*
2 MB RAM, 60 MB Hard Drive, Weight: 6.3 lbs. including battery, Minimum battery life: 2.5 hours, Edgelit VGA LCD (9.5" Diagonal, 640 x 480), MS-DOS 5.0/ Microsoft Windows 3.1/Mouse
*Rapid response service only.



Did we mention that you don't have to go to your typical retail computer store to get one of these computers?

A penny saved is a penny earned? Big deal. A $1000 saved is a hard drive and an Ultra VGA Monitor earned.

Did we mention we're a FORTUNE 500 company?

$1,359 Lease: $50/MO.
DIMENSION 386SX/25 i386SX 25 MHz System
4 MB RAM, 80 MB Hard Drive, Dual Floppy Drives (3.5" and 5.25"), Super VGA 1024I Monitor (14", 1024 x 768, .28mm), MS-DOS 5.0/MicrosoftWindows 3.1/Mouse

$1,549 Lease: $57/MO.
DIMENSION 386DX/33 i386DX 33 MHz System
4 MB RAM, 80 MB Hard Drive, Dual Floppy Drives (3.5" and 5.25"), Super VGA 1024I Monitor (14", 1024 x 768, .28mm), MS-DOS 5.0/Microsoft Windows 3.1/Mouse

Dimension by DELL

1-800-545-3607

HOURS: 7AM-7PM CT MON-FRI, 8AM-4PM CT SAT.

WHEN CALLING, PLEASE REFERENCE #11E78.

Circle 102 on Inquiry Card.

PC Price Wars: Bad Omen for R&D?

Call it a period of retrenchment for PC makers: IBM has forged alliances with former enemies like Hitachi and Apple. Compaq has abandoned the ACE (Advanced Computing Environment) initiative to better shore up its Intel-platform products. Companies such as Zenith Data, CompuAdd, and NCR have announced price cuts across product lines. Dell, too, has increased its cost-cutting campaign to better compete in the current PC price war: Even its top executives have taken a pay cut.

Does the current price war translate into less money for research? No company will own up to cutting R&D funds, but when times are tough, R&D funds often become expendable. At the very least, the current price war is causing companies to refocus R&D toward whatever will most quickly distinguish the company and spoon in more market share. "A prescription for going out of business is cutting your R&D spending," said Andrew J. Neff, managing director of the New York investment research firm Bear, Stearns & Co. "The companies that do will be the ones to go in the shakeout."

Looking at the top microcomputer makers, such as IBM, Compaq, and Apple, it's difficult to see anything amiss. In addition to the Apple/IBM joint ventures Taligent and Kaleida, work at IBM's primary research centers in Yorktown Heights, New York, and Japan has resulted in gee-whiz products such as the ThinkPad pen-based computer and Ultimedia PS/2. Compaq recently announced a new peripherals division, enhancements to its DeskPro/M line as well as new computer lines, and a new triple-bus TriFlex architecture for its Systempro. Apple made a splash with its new PDAs (Personal Digital Assistants).

Even the big guys, however, are finding new revenue sources at the PC low end. For example, Compaq is counting on high-volume sales of its low-end ProLinea line yet is scrambling to produce machines fast enough to keep corporate buyers away from other companies' products. Despite its huge R&D budget, IBM needed Parallan's technology to bring it into the superserver market.

Companies with proportionately smaller R&D budgets must take a wait-and-see attitude. Lee Cannon, director of marketing at Acer America, said he could only speculate on whether the price war would soon result in decreased R&D spending at Acer. "We hope we reduce our costs and still keep our investments up to historical levels," he said.

"Toshiba's investment in technology hasn't slacked off a bit," said Steve Lair, vice president of marketing for Toshiba America's Computer Systems Division, "but we are being extremely careful about the investments we make in that they are targeted directly at customer requirements." And Gene Kunde, chief operating officer of Epson America, notes: "We have tried not to let today's economic reports impact our R&D efforts too much. We've not hit the panic button."

What helps some vendors are sugar-daddy parent companies. For instance, Zenith Data Systems got help in developing its new low-cost PC line from owner Groupe Bull, which has largely phased out its own PC business in Europe. NCR can conceivably get help from AT&T. And U.K. PC maker Apricot—the first company to release a 486 system in 1989—gets heavy R&D investment from Mitsubishi.

Part of the problem in assessing the extent of a company's R&D efforts is in judging the true nature of R&D figures on company balance sheets. "R&D is a flexible number," said Donald Collier, president of the Santa Barbara–based financial analysis firm ProLytix. "By your accounting methods, you can choose to put it as pure R&D or you can lump in engineering, which is more like cost of goods sold."

Marketing, Not Innovation

John Logan, an analyst for the Boston research firm Aberdeen Group, has noticed a shift in R&D funds to individual component makers and components, such as processors, chip sets, and RAM, and away from the vendors charged with building quality price-competitive systems. "Look at computer-magazine benchmark tests of 486 systems, and you'll see the performance differences growing smaller and smaller," he said. In other words, the same group of suppliers is providing components for virtually every system sold.

This leaves vendors with a myriad of options for how best to juggle OEM components into a well-designed system that can sell at a competitive price. It also sends them in two directions: improving service and support and introducing systems for specific niche markets, such as multimedia and network workstations, in an attempt to differentiate their product lines in an increasingly segmented market. ■

—Ed Perratore, with additional reporting by Andy Redfern, Gene Smarte, and Patrick Waurzyniak

NANOBYTES

At the announcement of Unix Systems Laboratories' System V release 4.2, which pundits are now calling the last chance for Unix (see "Is Unix Dead?" on page 134), USL president **Roel Pieper**'s (right) and Open Software Foundation president **David Tory**'s presence together signified a truce in the Unix world. The disarmament between the two companies comes in the form of concessions between USL and OSF. The next release of SVR4 will be made to comply with OSF's AES (Application Environment Specification); OSF's DCE (Distributed Computing Environment) is already compatible with SVR4. Looking further in the future, USL has agreed to support the ANDF (Architecture-Neutral Distribution Format) promulgated by OSF. □

Destiny Technology (Milpitas, CA), developer of ASICs (application-specific ICs) that accelerate and improve the output of laser printers, has extended its patented Edge Enhancement Technology to enhance the quality of all elements on a page, including text, line art, and halftone images. This single-chip solution will let printer manufacturers enhance their printers for less than $20 per unit. Output is good enough in some office applications to eliminate the need for using imagesetters, the company says. EET-X supports PostScript interpreters, PCL (Printer Control Language), and other imaging models and provides a perceived resolution of 2400 dpi for halftone images. When implementing either the ASIC's dual-frame-buffer approach or compression technology, images that would normally require 5 MB or more to be rendered would require as little as 1.5 MB. ■

Once Again, CA-SuperCalc's Numbers Crunched 'Em.

VARBUSINESS
Spreadsheet Report Card 1992

PRODUCT FEATURES	Average Score	Access Tech.	Computer Assoc's	Lotus	Microsoft
Ease of use	7.01	6.70	7.00	6.81	7.52
Memory requirement	6.40	6.82	6.89	5.71	6.18
Ease of programming	6.48	6.33	6.58	6.32	6.89
Ability to manipulate data	7.35	7.00	7.29	7.00	7.82
Sorting capabilities	6.90	7.67	6.94	6.56	6.78
Provision for software security	5.65	5.87	5.87	5.32	6.15
Report writing capabilities	6.34	6.57	6.28	5.99	6.82
Ease of use of interface	6.82	6.75	6.70	6.16	7.63
Software integration capabilities	6.84	6.94	6.82	6.32	7.21
Ease of data retrieval	7.41	7.56	7.82	7.10	7.44
Satisfaction with product profitability	6.21	6.47	6.44	6.01	6.89
Overall quality of product	7.46	7.29	7.72	7.15	7.78
Product features average	6.73	6.80	6.90	6.37	6.94
SUPPORT FEATURES					
Provision for customer support	5.84	5.06	5.97	5.47	6.02
Charges for training time	5.17	4.28	5.20	5.06	5.29
Provision for technical support	5.78	5.20	6.60	5.40	6.26
Provision for marketing support	5.65	5.00	6.40	5.43	5.75
Documentation & product information	6.85	6.25	7.27	6.77	7.13
Frequency of updates & revisions	5.59	6.08	5.95	5.84	6.10
Support features average	5.88	5.33	6.52	5.65	6.02
OVERALL AVERAGE	6.46	6.21	6.71	6.13	6.63

VARBUSINESS
March, 1992

This year's spreadsheet shootout is over. And like last year, the big winner is CA-SuperCalc.®

Coincidence? Hardly. Because once again, the judges were the people who know spreadsheets best – the ones who sell, install and support them for a living. Hundreds of dealers and resellers who know a good program when they see it.

CA-SuperCalc gives them plenty to see: spreadsheet linking, 3-D graphics, beautiful, presentation-quality output...and it runs on just about any PC.

According to the experts, it also outruns Lotus® 1-2-3® and Microsoft® Excel. What's more, Computer Associates' spreadsheet for DEC® users, 20/20, beat 1-2-3 as well, giving us two of the top four programs reviewed by VARBUSINESS.

As you can see, CA-SuperCalc dominated the product support categories, so you can buy it with confidence. And when you factor in the price – just $149 – you can buy it with ease.

Windows™ Version Coming Soon!
Dial 1-800 CALL CAI To Receive A Free DOS Or Windows Demo Disk.

Shouldn't you be using the spreadsheet that beat the big boys? CA-SuperCalc. Number One in number-crunching.

COMPUTER® ASSOCIATES
Software superior by design.

© Computer Associates International, Inc., One Computer Associates Plaza, Islandia, NY 11788-7000. All product names referenced herein are trademarks of their respective companies.

Circle 92 on Inquiry Card.

CorelDRAW 3.0!

The first ALL-IN-ONE business graphics solution!

In the information-packed '90s, good graphics are more important than ever to get your message across quickly and effectively. And now it's easier than ever to use graphics – with CorelDRAW 3.0! Everything you need is in one value-packed box. There is no longer any need to buy separate illustration, charting, painting, and presentation packages now that CorelDRAW 3.0 does it all with unmatched power and ease of use!

And, as an unprecedented bonus, Corel has included a CD-ROM with over 14,000 clipart images and over 250 fonts! You'll get fingertip convenience for software that would otherwise occupy over 500 floppy disks and cost thousands of dollars. It's incredible value for the price – and Corel has made it easy for you to experience the exciting power and effectiveness of super graphics. That's why we put it all in one box!

NEW

CORELDRAW!

The world's #1 illustration package with even more power

- Powerful text handling: includes 250 TrueType fonts
- Creative freedom: live blends, enveloping, 3D extrusions
- Precision and power: unlimited layers, snap-to objects
- Easy to use: online help, exciting interface innovations

NEW

COREL CHART

Powerful and versatile data-driven charting and pictographs

- Great looking charts & pictographs: quickly and easily!
- True 3D charting: with powerful manipulation options
- Wide range of charttypes: from bar to 3D to pictographs
- Powerful data management: DDE links or import from popular packages

NEW

COREL PHOTO-PAINT

Photo retouching and bitmap creation

- Powerful tools: create stunning bitmapped pictures
- Automatic retouching filters: edit scanned or Kodak™ Photo CD pictures
- Color control: work in black & white and 24 bit color
- Easy to use and versatile

NEW

COREL SHOW

The easiest way to create a presentation

- Powerful document integration: bring all your OLE information together
- Easy slide show creation: play animated flicks too!
- Free run-time player: anyone can view your presentations even without CorelDRAW

PLUS CorelMosaic, CorelTrace, Corel Screen Capture, and bonus CD-ROM!

DRAW IT!
CHART IT!
PAINT IT!
SHOW IT!

"CorelDRAW is a phenomenal bargain"
PC/Computing
Michael Burgard
July 1992

ONLY **$595** Suggested list price

IT'S EASY!
CORELDRAW!
3.0

1-800-836-DRAW
FAX:(613)761-9176 • CDNTEL:(613)728-8200
24hr FREE HOTLINE SUPPORT

CorelDRAW is MULTIPLATFORM for corporate standardization: Windows, OS/2, UNIX. And soon available on the MAC and in 21 languages!

COREL

Circle 96 on Inquiry Card.

RICH FRIEDMAN

RUSSIA'S PROGRAMMERS WAIT TO BE DISCOVERED

MOSCOW—Abaci outnumber PCs in the former Soviet Union by a wide margin. Depending on who's counting, there are between 700,000 and 2 million PCs scattered throughout the major cities and university towns of the CIS (Commonwealth of Independent States). High import duties, which run from 40 percent to 80 percent, coupled with a free-falling ruble and a shortage of hard currency (e.g., American dollars) have raised the price of a basic 286-based PC in the CIS to about $1100—what you'd pay for the next-generation 386 PC in America.

If PCs are scarce in the CIS, shrink-wrapped applications from big-name American software developers are even rarer. American companies have been reluctant to sell their programs in the CIS because, until recently, there were no copyright laws (in June, the Russian parliament passed its first software copyright-protection law, which, of course, only applies to Russia) and software piracy is rampant. To date, only 50,000 PC programs have been sold in the CIS, according to several sources. Programming languages from Borland and Lotus 1-2-3 are the best-sellers.

Understandably, because of the rapid political and economic changes sweeping the former Soviet Union, considerable uncertainty and apprehension were expressed by several attendees of the third ICF (International Computer Forum), Moscow's biggest computer show. A cross-section of about 16,000 mostly male academics, government officials, businesspeople, and scientists came to the computer show with a great hunger for any type of PC information. About 50 companies exhibited wares, ranging from an entrepreneurial university student selling a 5¼-inch disk that contained a graphical tour of the Kremlin to the latest Russian version of Borland's Turbo C++.

During the lunches and receptions, some of the attendees' fears and cynicism surfaced. One physicist told me that research projects in the CIS are being funded for periods of no longer than three months. A great deal of cynicism was also expressed regarding how the CIS would spend the billions of dollars of loans requested from the West.

Besides the nascent ICF, the best way for computer-interested folks in the CIS to exchange information is through user's groups. The largest in the CIS is BUGA, the Borland User Group Association, led by 37-year-old president Andrew Zotov. For the past two years, Borland has sponsored a software developer's contest throughout the Soviet Union. This year, 250 developers submitted entries. There is plenty of programming talent in the CIS, but it remains a well-kept secret, largely because of a lack of understanding of what is required to copyright, patent, and market programs abroad.

The winning application in this year's contest was FotoRobot, a program that lets you place and search on digitized photographs or sketches within a database. Yury I. Rassadkin, a lecturer at the Moscow State Technical University, headed the development team.

Masha, a program developed by the Ozero Association in Irkutsk to help English speakers learn Russian, captured second-place honors. Masha zeros in on five grammatical parts of Russian that are especially troublesome for non-native speakers: verbs of motion, verbs with reflexive particles, noun cases, verbs in the perfect and imperfect cases, and participles. The program highlights each grammatical point with multicolored pictures. Animated figures keep the student entertained.

The third-place winner, MACRO_DLL, provides a fully functional scripting language that developers can easily add to their Windows applications. The easy-to-learn language is a subset of Pascal. Once you have developed your application's basic functionality, you can use MACRO_DLL to send events, open dialog boxes, request information from the user of an application, and generally control your application from a set of easily modified scripts. MACRO_DLL was written by Anishenko Evgeny and Sushkov Vitaly from the Radiotechnic Institute of the Russian Academy of Science in Moscow.

These three programs are a fair representation of the many exciting programming ideas waiting to be discovered outside the CIS. With a little luck—and a lot of help—the CIS should begin to make an important contribution to the worldwide PC community. ■

Rich Friedman is an executive editor for BYTE. You can reach him on BIX as "rfriedman."

PHOTOGRAPHY: UNIPHOTO/PICTOR © 1992

Z▪NOTE comes with built-in networking, up

And it's waiting

"Smart designs, like the Z▪NOTE's READYDESK, are making that one-PC goal a reality."
—Jim Seymour
PC Week/May 4 '92

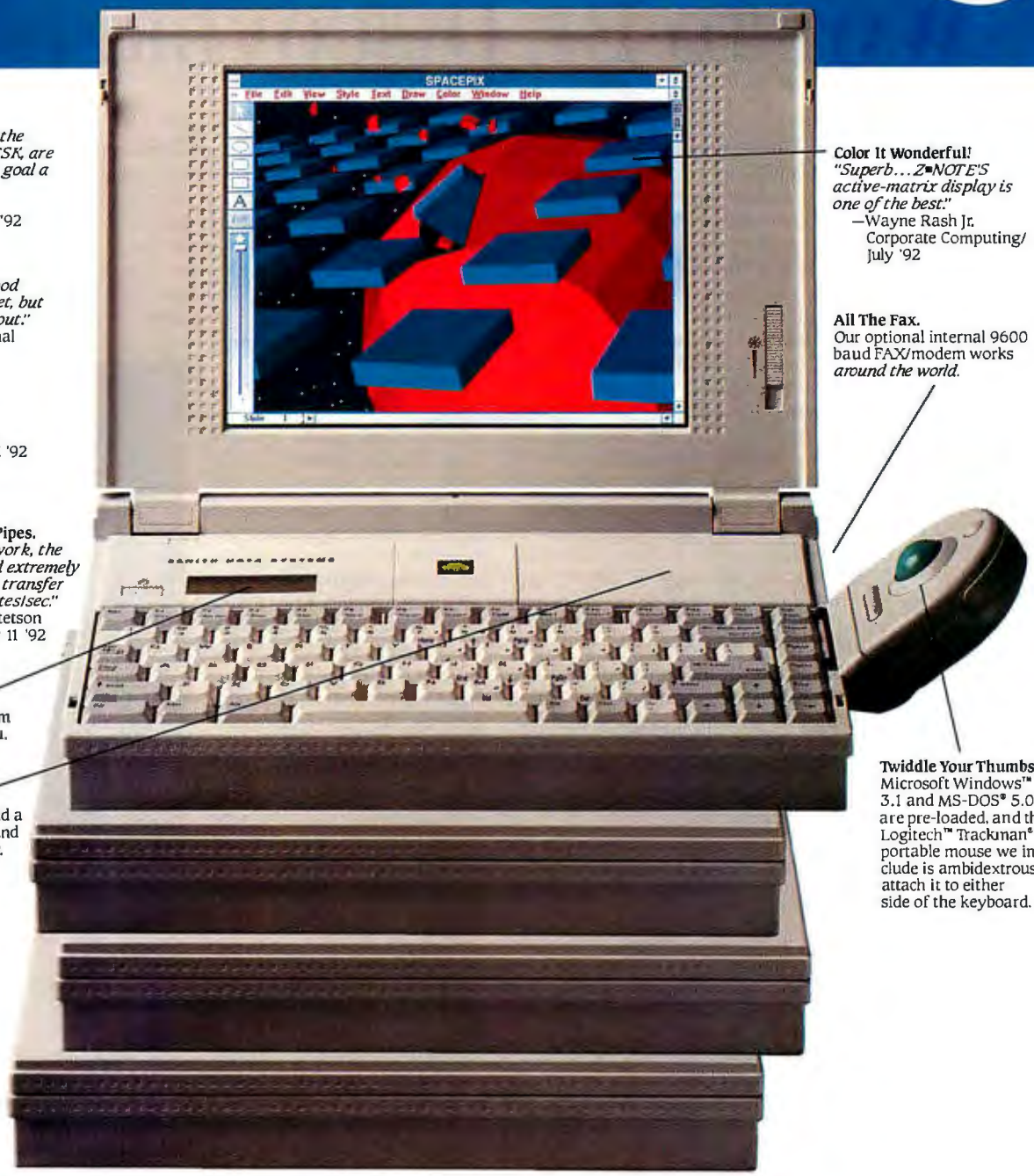
"There are lots of good brands on the market, but the Z▪NOTE stands out."
—Wall Street Journal
May 13 '92

"BEST OF SHOW"
—BYTE Magazine
Spring COMDEX '92

High Speed Communications Pipes.
"Once on the network, the connection proved extremely fast, clocking file transfer rates of 200K bytes/sec."
—Christopher Stetson
PC Week/May 11 '92

What's Up?
A 14-icon LCD System Status Panel tells you.

Do It Yourself.
Pop the panel and add a i387™ co-processor and up to 12 MB memory.



Color It Wonderful!
"Superb...Z▪NOTE'S active-matrix display is one of the best."
—Wayne Rash Jr.
Corporate Computing/
July '92

All The Fax.
Our optional internal 9600 baud FAX/modem works *around the world.*

Twiddle Your Thumbs.
Microsoft Windows™ 3.1 and MS-DOS® 5.0 are pre-loaded, and the Logitech™ Trackman® portable mouse we include is ambidextrous—attach it to either side of the keyboard.

The Z▪NOTE™ series starting at $2399 direct from Zenith Data Systems.

to ten hours of power and upgradeable display.

for you to call.

1-800-237-8721

Generations Ahead.

Z▪NOTE is the third-generation of our groundbreaking 386SL notebook design with a new genius for power management—up to ten hours of useful battery life under Premier System Management.™ And more.

Notebooks Meet Networks.

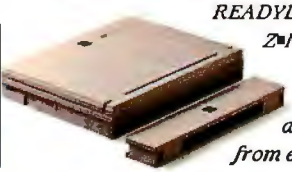
"The Z▪NOTE is the only PC notebook I know of with a built-in connector for computer networks and pre-installed networking software from all three leading companies: Banyan, Microsoft and Novell."

—Walter S. Mossberg
Wall Street Journal/May 13 '92

Do You Dream In Color?

Our high-contrast black-on-white display is upgradeable to brilliant active-matrix color. It's a dream come true.

Beyond The Docking Station.



"You can leave all those desktop peripherals plugged into the READYDESK™—then snap it onto your Z▪NOTE and you're in business. A far smarter approach... also a heck of a lot cheaper than those attache-case-sized docking stations from everyone else."

—Jim Seymour
PC Week/May 4 '92

This Way To The Future.

Upgrade the memory and add a co-processor. Upgrade the HDD, FDD and BIOS. And don't forget the upgradeable display. The future was never brighter.

Z▪NOTE	320L	325L	325Lc
Processor/MHz	i386SL™/20	i386SL/25	i386SL/25
Hard Drive	60MB	85/120MB	120MB
Memory (Std/Max)	2/12MB	4/12MB	4/12MB
Video Display (Viewable)	9.5" VGA black-on-white	9.5" VGA black-on-white	8.4" VGA Active matrix color
NiMH Battery Life*	4-10 hours	4-10 hours	2.5-6.5 hours
Weight	5.9 lbs.	5.9 lbs.	6.5 lbs.
Price	$2399	$2949/$3249	$4999

And The Service Is Great.

Call or fax Zenith Data Systems today. We offer a 30-day money-back guarantee and a 1-year limited warranty. And we'll give you the kind of toll-free factory service and support you just can't get from a third party.

FAX
1-800-472-7211

ZENITH DATA SYSTEMS

A Bull Company

Thinking Ahead.

†Anticipated availability July 1992. All models subject to availability. *Battery life depends on application used, power management features selected and peripherals attached. All prices and specifications are subject to change. Prices are for models shown in U.S. dollars. Shipping, handling and applicable sales taxes not included in the price. Warranty information available upon request. Z▪NOTE, READYDESK and Premier System Management are trademarks of Zenith Data Systems Corporation. Microsoft Windows, MS-DOS and the Ready-To-Run logo are trademarks of Microsoft Corporation. Logitech and TrackMan are trademarks of Logitech, Inc. The Intel Inside logo, i386 and i387 are trademarks of Intel Corporation. Copyright © 1992 Zenith Data Systems Corporation.

ALAN JOCH

A FLIRTATION WITH INNOVATION

TAIPEI—Locals didn't seem to mind that the Canadians won Taipei's Dragon Boat Festival races in June, which this year coincided with Computex, Taiwan's largest computer exhibition and a showcase for foreign computer distributors. For a small country with a growing presence in the world market, placing second in the 2000-year-old race may have been nothing less than graciousness toward its international visitors.

The Dragon Boat Festival honors a poet who drowned himself to protest a corrupt emperor. The poet's friends threw rice dumplings into the water to feed hungry fish who might otherwise devour his remains. In a computer market that's constantly redefining "low-cost," Taiwanese manufacturers at Computex are like those ancient Chinese citizens: They're hurriedly packaging low-cost hardware to feed a demanding world.

At first blush, Computex, with its 150 exhibitors, seems like the computer shows in Las Vegas or New York. The largest and most glittering booths housed the island's leading vendors, such as Acer and Mitac. At an international pavilion, Micropolis erected a faux marble booth with white pebble walkways, and Intel flew large balloons outside the convention center to remind passersby that there was a computer show in town. (It was hardly necessary, however: At a traditional tea house miles away from the show floor, Chinese, Europeans, and Americans spread out computer spec sheets on the low wooden tables as they sipped the local oolong.)

Smaller and, in some cases, more innovative companies had modest booths consisting of little more than products and signs. Digging around these displays was sometimes productive. For example, Visionetics International demonstrated the VIGA+ Videographics card, a Targa-compatible graphics adapter. Sun Joy's multimedia subsystem included a SCSI connector, built-in speakers and microphone, and a CD-ROM drive. Primax showed the ColorMobile-424A, a hand-size color scanner with a motorized mechanism that pulls the unit down a page at the correct speed and without any side-to-side movement.

Unlike at other computer shows, getting basic product information at Computex can be difficult. Vendors resist quoting prices, especially early on in the show. This is because vendors prefer to wait until they find out what sort of prices their competitors are quoting. This elaborate ballet shows the extent to which price remains the main differentiator between Taiwanese products.

Sales figures bear this out. According to International Data Corp., Taiwan accounted for 6 percent of Asia's PC shipments in 1991. However, Taiwan received only 2 percent of the region's $15 billion in sales.

Even more telling are the facts that, in 1991, less than half the Taiwanese-sold PCs carried their own brand names, and the branded market grew by only 5 percent from the previous year. Taiwanese companies are still tied to international distributors that relabel systems.

Nevertheless, Computex vendors gave lip service to backing away from commodity products and clones in favor of technological innovation. New realities in the computer market are pushing Taiwan in this direction. Its PC vendors could survive on 4 percent profit margins when Compaq and other companies charged premiums for brand loyalty. But in the age of low-cost systems from first-tier vendors, Taiwan must find new ways to compete.

Taiwan continues its long journey toward innovation

Last year, Taiwanese computer companies spent only about $11.2 million for R&D. In addition, the government's industrial parks serve as models of how the computer industry might evolve. Three parks near Taipei are devoted to software or hardware development, and companies that build manufacturing operations in the parks are given tax breaks and employee housing.

But the proliferation of less expensive PCs and the fledgling nature of Taiwan's R&D mean the country's manufacturers will continue to compete on price for the time being. Some vendors at Computex said they're building ties to mainland China by establishing manufacturing plants there or sourcing commodity items such as VGA cards. Taiwan's mixed success in the late 1980s and the 1990s means that its low wages don't always provide an economic edge internationally. The challenge now is whether Taiwan can grow at the low end long enough to become a leader in innovative technologies. ■

Alan Joch is a senior editor and director of the BYTE Lab. You can reach him on BIX as "ajoch."

PHOTOGRAPHY: JERRY LEE, TONY STONE WORLDWIDE © 1992

850 CPS & TOUGH AS NAILS!

850 CPS. That's right – 850 characters-per-second!

TOUGH AS NAILS. Why take a chance? Thousands of owners use the 850XL printer from 2 to 18 hours per day. It just keeps on printing, day-in, day-out! And, over 50% of all 850XL printers sold are purchased by existing owners. That alone tells the story for this American-made printer.

FREE 30-DAY TRIAL. We offer a free, 30-day trial to any qualified buyer. No strings attached. What other manufacturer believes this strongly in their product?

Call Us Today! **(800) 468-8788**

GSA Pricing: 800-633-9433
GSA Contract #GS00K-91-AGS-5268

NOW UNDER $2,000!

OTC OUTPUT TECHNOLOGY CORPORATION

Shouldyou needservice,thereare over 400 service locations nationwide toserve you.

2310 N. Fancher Road, Spokane, WA 99212-1381

Circle 138 on Inquiry Card.

AutoCAD Gets a Face-Lift

PATRICK WAURZYNIAK

The best-selling PC CAD software adds a GUI-like interface and speed enhancements

Nearly 175 enhancements and a more intuitive interface breathe new life into the dean of PC CAD programs. Cascading pull-down menus, programmable dialog boxes, and context-sensitive help bring GUI-like functionality to AutoCAD release 12, which remains essentially a DOS-based package. AutoCAD release 12 could help the fortunes of Autodesk, which now ranks as the world's sixth-largest PC software company following the drop in its stock value earlier this year. Autodesk is counting on the new features in release 12, such as support of SQL (Structured Query Language) and PostScript data exchange, to help the company broaden its horizons and open doors to markets outside its formidable strength in desktop CAD.

The new AutoCAD's improvements in terms of ease of use and raw speed became apparent as soon as I loaded the production-shipment version of the software. Installing it is a breeze with Autodesk's installation program. You should be aware, however, that AutoCAD makes significant demands on hardware in terms of memory and disk space, requiring at least 8 MB of RAM and about 25 MB for full installation of all program, help, and tutorial files.

With the newly integrated AVE Render feature's 3-D rendering capabilities, AutoCAD users can more easily create 256-color or full 24-bit, true-color 3-D visualizations of any 3-D drawing while working in AutoCAD release 12. This includes AME solid models.

My test machine was an AST Power Premium 4/50d (see the text box "AST 486 Packs an Expandable Punch" on page 47) with an Intel 486DX2 processor, 10 MB of RAM, and a 210-MB hard drive. Thus, running the new version of AutoCAD was no problem. Although Autodesk says the program will run on low-end 386 systems, my impression is that most users won't run AutoCAD without a reasonably fast 386 processor and the requisite math coprocessor, a generous amount of memory, and lots of free hard disk space.

A Quick Study on Proteus

When talking about the new GUI-like interface, one Autodesk executive likened release 12 to the Greek god Proteus, who was able to take on the characteristics of others yet still kept the same personality underneath. In fact, AutoCAD is supposed to adopt the face of the native environment on which it is running—be it a Mac, Windows, or a SPARC machine. Incidentally, with this program update, Autodesk for the first time simultaneously issued a new AutoCAD release for more than one platform, providing upgrades for both DOS-based PCs and Sun Sparcstations.

I was unable to verify whether the Proteus AutoCAD had such chameleon-like powers, because I ran release 12 only under DOS. Autodesk currently has two ongoing product developments, one for a release 12 running under Windows 3.1 with a Watcom extender product, and a version that will run under Windows NT.

With release 12's new interface, I found myself playing with the program even before bothering to open anything in the 45 pounds' worth of manuals accompanying the program and its companion products, Extension for Windows and AutoShade. Using the mouse, I found release 12 fairly easy to understand even before settling in on the documentation and a short stint with the on-line tutorial.

The release 12 software now greets you with the AutoCAD drawing editor screen, rather than the text-based main menu of previous versions. Most of AutoCAD's major commands can be invoked through clicking on release 12's pull-down menus, which cascade into smaller menus. Pop-up menus can be activated by pressing the Shift key and the right mouse button.

Integrated Rendering

Among the performance highlights, Autodesk says the program offers much faster

AST 486 Packs an Expandable Punch

Following an old strategy recently popularized by a host of competing PC makers, AST Research has once again produced an expandable line of PCs, the Power Premium 486, that is designed to give users virtually painless access to future CPU developments. AST has been manufacturing so-called expandable PCs since the advent of its Cupid-32 architecture almost four years ago.

I tested a top-of-the-line, Intel 486DX2–based AST Power Premium 4/50d, a small-footprint desktop EISA system optimized for Windows graphical environments. Sporting an integrated Western Digital accelerated graphics subsystem on the motherboard with 512 KB of VRAM (video RAM), which is expandable to 1 MB, the Model 213V test machine also came with an optional 210-MB hard drive and optional 14-inch Super VGA-LR monitor (which costs $545).

To run AutoCAD release 12, I had to add RAM to bring the 4/50d up to speed in meeting Autodesk's recommended 8-MB memory requirement. With the Power Premium line, AST touts an easy upgrade and expansion path, something I can indeed attest to: Adding 4 MB of memory to each of two SIMMs was simple. The 4/50d's cover, secured by three hand-tightened screws, popped off easily. Once I got inside, I could easily pull out the processor board, which can be populated with up to 16 MB of memory, from the motherboard to quickly snap in the SIMMs. The whole process took about 15 minutes.

With regard to expandability, the 4/50d's processor board conveniently offers an empty Intel Overdrive socket next to the DX2 processor into which you can later add Intel's clock-doubling chips to speed up older systems in the future. In addition, you can upgrade AST's Power Premium 386SX- and 386DX-based systems to the 486DX2 by inserting an AST Fastboard upgrade.

Aside from being blazingly fast, one of the AST machine's real strengths lies in its ability to quickly perform graphics operations. Using Western Digital's WD90C31 graphics chip with BitBlt and a hardware cursor, the 4/50d accomplishes Windows operations in a fraction of the time they take on 386-class systems. It moves windows without the usual flicker found on such systems with standard VGA graphics.

As for sheer CPU performance, BYTE's low-level DOS benchmarks showed that the 4/50d clearly outdistanced competing systems, such as the Tandon 486/25, while making machines like the Compaq Deskpro 386/25e look a bit long in the tooth. In short, the 4/50d is one system that likes to do Windows fast, while holding the promise of easy upgrades to next-generation processors in the future.

zoom and pan capabilities through the use of 32-bit vector space technology that virtually eliminates regenerations of drawings after you alter them. An enhanced Hide command uses virtual memory and an advanced algorithm to dramatically speed up hidden-line removal in AutoCAD drawings. I found this to be particularly true when doing regenerations on drawings that I had altered through additions or when removing the hidden lines.

One of release 12's nicest features is the integrated AVE (AutoCAD Visualization Extension) Render facility, which replaces the optional AutoShade 2 package as a way of doing basic rendering and shading of 3-D objects within AutoCAD. If you want more complex, photo-realistic 3-D renderings, you can buy the AutoShade 2 with Renderman package. This incorporates technology that Autodesk licensed from Pixar.

With the integrated Render command, I was able to generate 3-D visualizations of AutoCAD sample drawing files, such as a kitchen scene (see the screen), by just calling up a wireframe drawing and clicking on the Render menu at the top right-hand side of the screen. With Render selected, AutoCAD quickly processed 3-D renderings of drawings to a separate screen that can be captured in a frame buffer and saved in one of several formats, including

TGA, TIFF, and GIF. The speed of the rendering process varied between the drawings, but the kitchen scene took slightly over 2 minutes.

The AME (Advanced Modeling Extension) module has been improved. Version 2.1 has a new interface featuring pull-down menus and dialog boxes. The module also adds render support in which AME solid models that are rendered with the AVE Render feature are automatically meshed to produce higher-quality renderings.

With a list price of $3750 (a $250 increase over release 11), AutoCAD release 12 is not exactly an impulse buy. However, engineers requiring a serious full-fledged drafting package along with tools for mechanical modeling and 3-D visualization may find the program worth the hefty expense. ■

Patrick Waurzyniak is a news editor for BYTE in San Francisco. You can reach him on BIX as "patrickw."

THE FACTS

AutoCAD release 12
$3750
Advanced Modeling Extension, $495; AutoShade 2 with Renderman, $1000

System requirements:
A 386-based PC with a math coprocessor, 8 MB of RAM (11 MB is recommended), 11 MB of free hard disk space, DOS 3.3 (DOS 5.0 is recommended), an AutoCAD-supported video display and pointing device, and a plotter or printer-plotter.

Autodesk, Inc.
2320 Marinship Way
Sausalito, CA 94965
(415) 332-2344
fax: (415) 331-8093
Circle 1195 on Inquiry Card.

Power Premium 486
The minimum-configuration Model 3V systems include 4 MB of RAM, 512 KB of VRAM, and a 3½-inch 1.44-MB floppy drive; the Model 83V adds an 80-MB IDE hard drive; and the Model 213V adds a 210-MB hard drive. In the base Model 3V configurations, prices for the 50-MHz 486DX2-based Power Premium 4/50d begin at $3295; 4/50d Model 213V, $4095; 486DX/33-based 4/33d, $2995 and up; 386DX/33-based 3/33d, $2595 and up.

AST Research, Inc.
16215 Alton Pkwy.
Irvine, CA 92713
(714) 727-4141
fax: (714) 727-9355
Circle 1196 on Inquiry Card.

DATA COMPRESSION LIBRARIES™

PKWARE's® Data Compression Libraries™ allow software developers to add data compression technology to software applications. The application program controls all the input and output of data allowing data to be compressed or extracted to or from any device or area of memory.

- All Purpose Data Compression Algorithm Compresses Ascii or Binary Data Quickly with similar compression achieved by the popular PKZIP software, however the format used by the compression routine is completely generic and not specific to the PKZIP file format.
- Application Controlled I/O and memory allocation for extreme flexibility.
- Adjustable Dictionary Size allows software to be fine tuned for Maximum Size or Speed.
- Approximately 35K memory needed for Compression, 12K memory needed for Extraction.
- Compatible with most popular Languages: C, C+ +, Pascal, Assembly, Basic, Clipper, Etc.
- Works with any 80x86 family CPU in real or protected mode. $295.00
- No runtime royalties.

RUNNING OUT OF EXPENSIVE DISK SPACE?

PKZIP can help! PKZIP compresses your files to free up disk space and reduce modem transfer time. You can compress a single file or entire directory structures with a single command. Compressed files can be quickly returned to their normal size with PKUNZIP.

Software developers can reduce the number of diskettes needed to distribute their product by using PKZIP. Call for Distribution License information.

The included PKZIP utility lets you store compressed files as a single self-extracting .EXE files that automatically uncompresses when run. Only $47.00

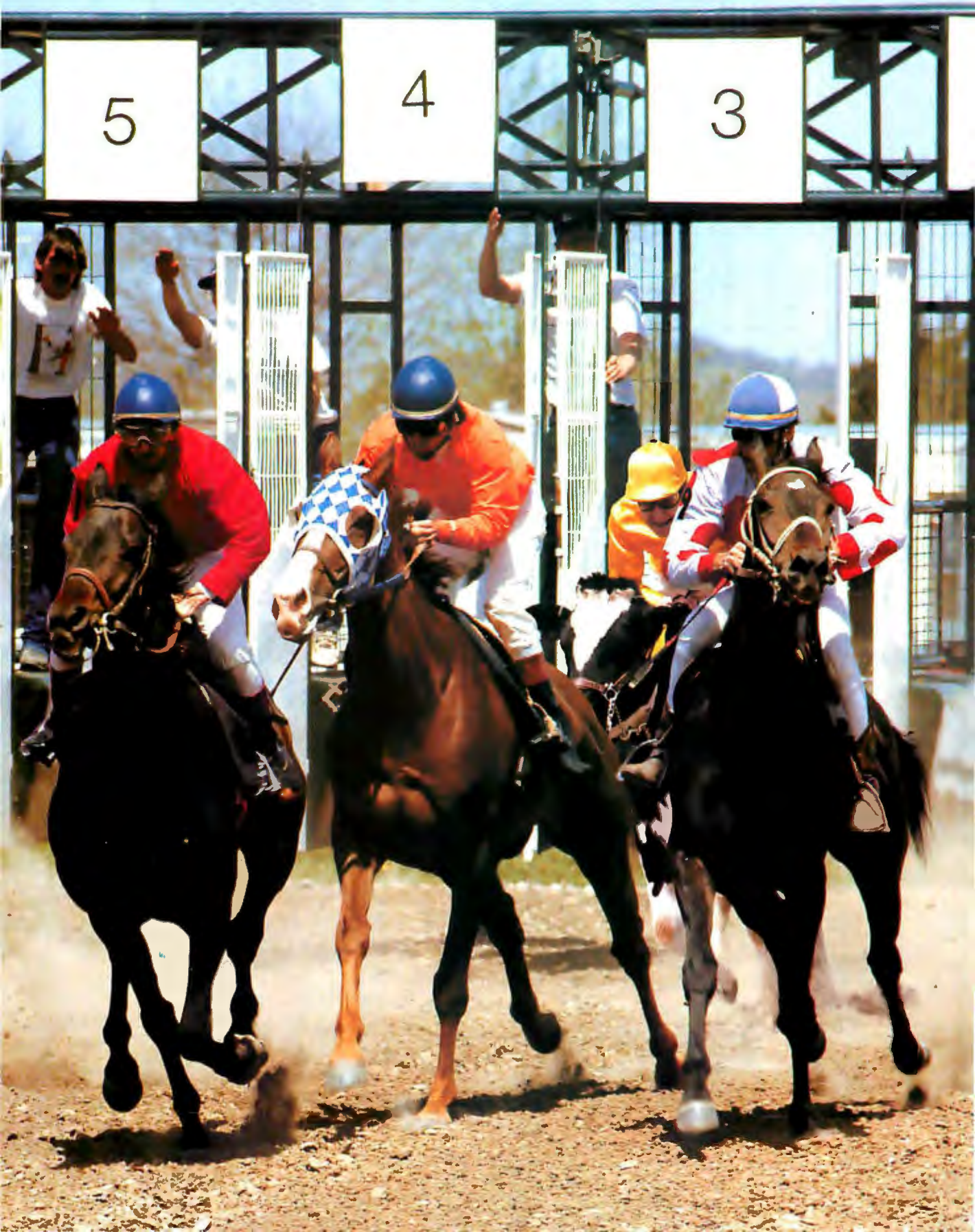
PKWARE® INC.
THE DATA COMPRESSION EXPERTS®

9025 N. Deerwood Dr.
Brown Deer, WI 53223
(414) 354-8699
Fax (414) 354-8559

BY992

Circle 148 on Inquiry Card.

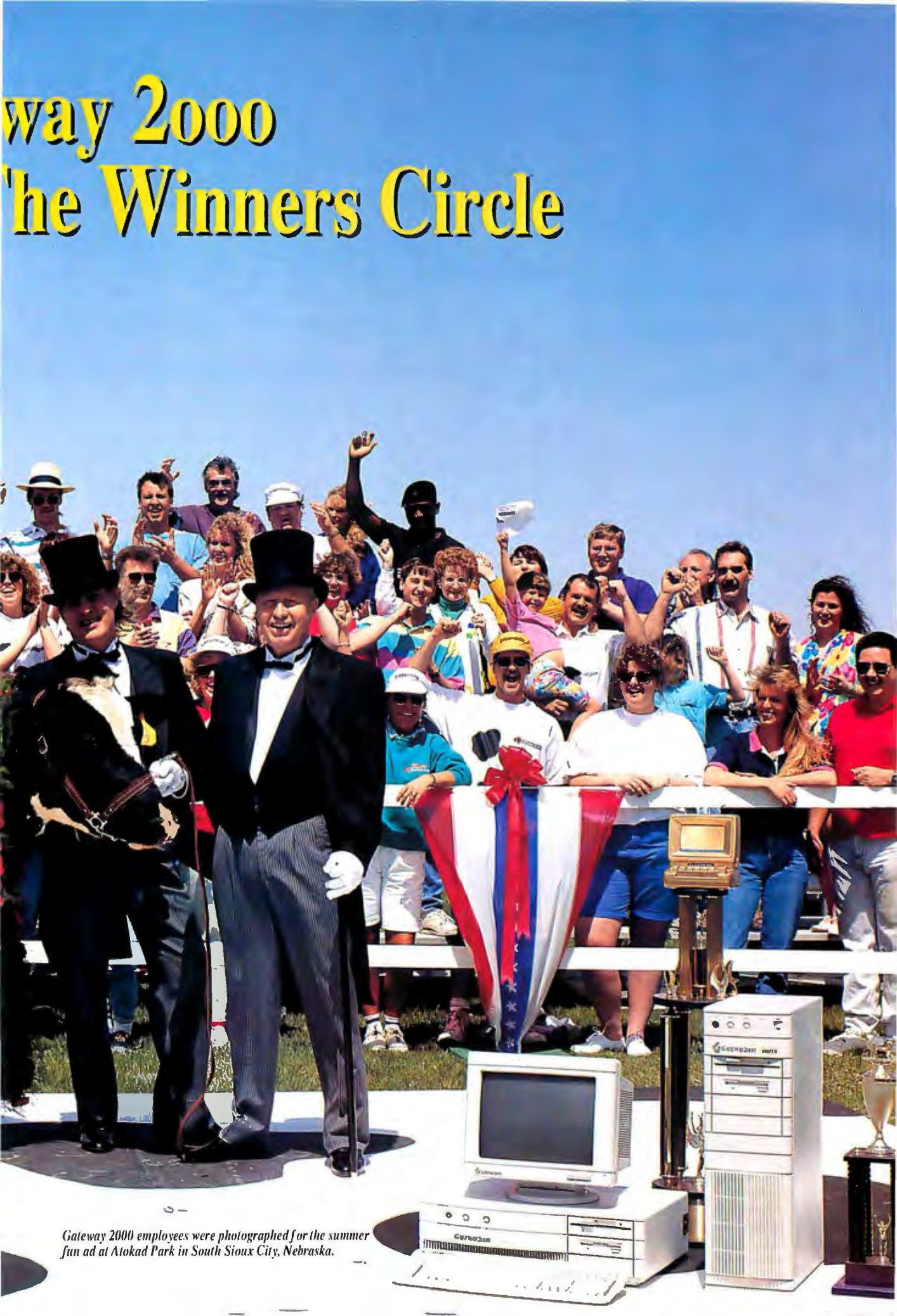
Can You Spot The Winner?



The Choice Is
Black & White!
ATOKAD PARK

It's Gate
That Puts You In T

way 2000
'he Winners Circle



Gateway 2000 employees were photographed for the summer fun ad at Atokad Park in South Sioux City, Nebraska.

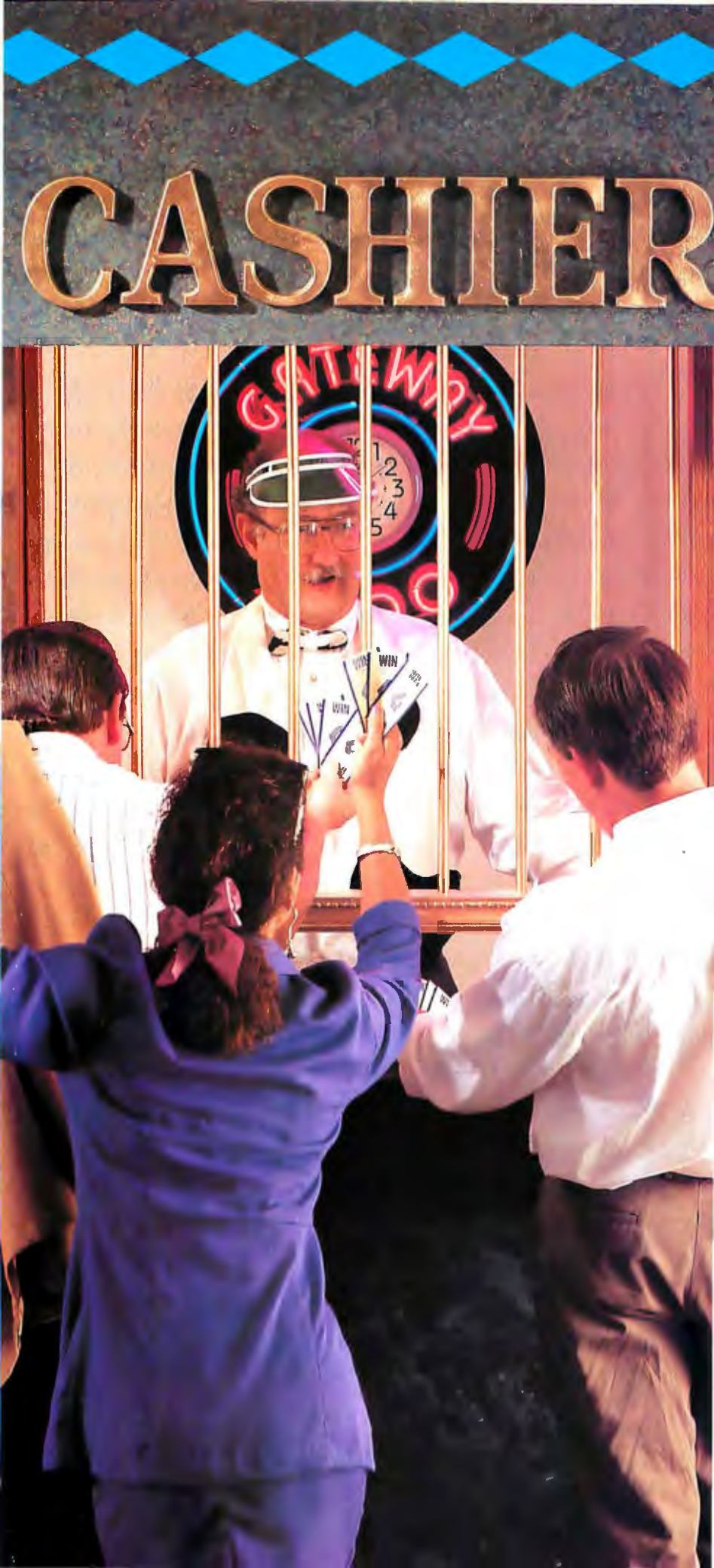
The results are final — all those thoroughbred "favorites" outdistanced by a simple, determined, black-and-white cow! And once again, Gateway 2000 leads the pack to bring you new technology at down-on-the-farm prices.

We've incorporated Intel's new 66MHz DX2 clock-doubler chip, the fastest processor available today, in a reliable ISA machine with racing video and disk performance!

It's just one more big winner in our lineup of value-packed, high-performance systems. So give us a call and get in the Gateway 2000 Winner's Circle!

GATEWAY2000

"You've got a friend in the business."


CASHIER
GATEWAY
WIN

HERE'S A HOT TIP: GATEWAY 2000 IS A SURE THING!

VALUE

Before you put your money down, study the statistics on the contenders. The current trend in the PC industry is to cut prices by stripping down systems and replacing quality components with inferior parts. Even companies with long-standing traditions of quality are doing it. At Gateway, we've never lowered our prices in response to market pressures. We've never needed to. And we'll never sacrifice features or quality to make prices look better. Our race strategy has always been to offer the best price, quality and service in the market.

Price

Gateway's price advantage is simple business economics. We have huge volume buying power. The little guys don't. We have low overhead. You don't pay for glass palaces with us. And we operate on conservative margins. While we've grown big and strong on these rations, our margins are a starvation diet for some of our competitors. We lower prices whenever we can. And we've been quietly doing this since day one.

Quality

When surveyed recently by *PC Magazine*, Gateway customers gave their systems the **highest reliability rating** among 35 of the nation's top PC manufacturers. That's certainly an indication that our great prices aren't a trade-off for quality or performance. Gateway systems are loaded with top-of-the-line components and performance features. We know you don't want a cheap computer. You want a great computer at a great price. You want a Gateway!

Service

We know how important service is to you. That's why we're constantly working to provide the best in the business. Service is one of the reasons we received the **highest customer satisfaction rating** in *PC Magazine's* service survey. Gateway scored "significantly better than any other manufacturer" when PC users were asked, "Would you buy again from the same manufacturer?"

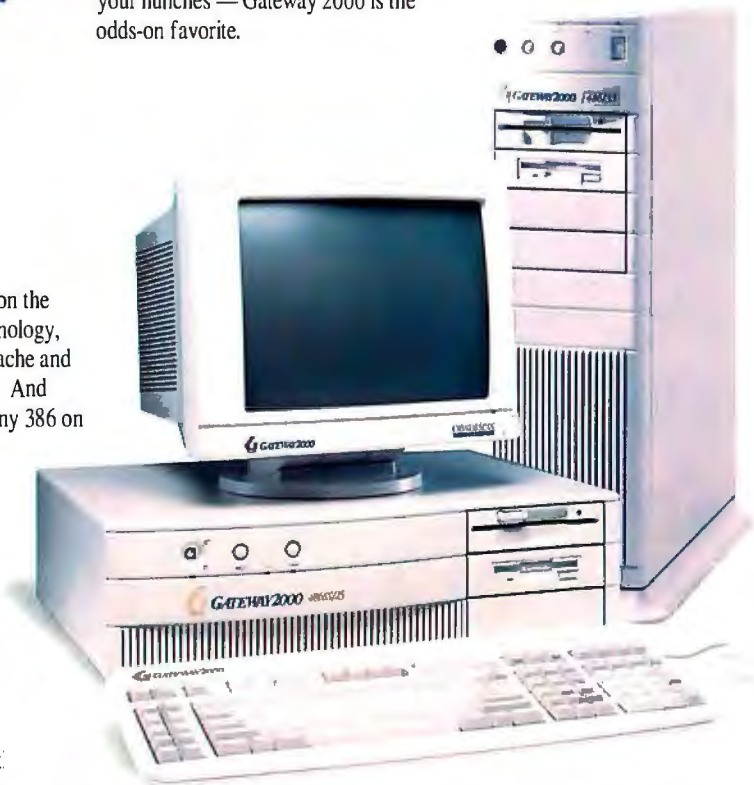
Price. Quality. Service. This simple formula still equals the best value in the industry. Add Gateway's ability to bring you the latest technology at the best prices, and you have a triple-crown winner. So put your money on a sure thing. With Gateway 2000, you're guaranteed to come out a winner!

GATEWAY2000

"You've got a friend in the business."

Gain The Winning Edge With 486 Performance

Gateway's powerful 486 models give you the winning margin! And when you recap our new price reductions and compare us feature-for-feature against other runners, you'll find you won't even have to play your hunches — Gateway 2000 is the odds-on favorite.



25MHz 486SX

■ **$1895**

This is the hottest value on the market! You get 486 technology, including an 8K internal cache and burst mode, at a 386 price. And besides being faster than any 386 on the market, the 486SX/25 is upgradeable to 50MHz if you need increased performance in the future.

33MHz 486DX

■ **$2395**

We recently increased performance and lowered t price of our best-selling, award-winning 486DX/33 by adding an ATI™ Graphics Ultra video card and a faster, 200MB Western Digital hard drive with 13ms access time. At $2,395, the price/performance ratio on this machine is hard to beat. Plus, you can upgrade this system to 66MHz.

50MHz 486DX2
■ **$2695**

Gateway 2000's new 486DX2/50 systems, ISA and EISA, incorporate Intel's speed-doubler technology. The internal core of the DX2 processor executes at 50MHz while communicating with the external memory bus at 25MHz. Our benchmarks show a 35% increase in performance over a 33MHz 486DX.

This system also has the new, faster Western Digital 200MB hard drive and the high-performance ATI Graphics Ultra video card.

50MHz 486DX2 EISA
■ **$3695**

Our EISA system comes standard in a floor-standing tower model, and includes a large, fast SCSI drive and an EISA SCSI controller as standard equipment. RAM cache is expandable to 256K.

66MH 486DX2
■ Call for details.

Gateway 2000 systems come fully configured with all the performance features you want, including two floppy drives, a programmable 124-key AnyKey™ keyboard, a Microsoft® mouse, MS-DOS® 5.0, Windows™ 3.1 and your choice of one application software option. See the back pages of this ad for complete configurations and information about software options, upgrades and peripherals.

Gatorade

GATEWAY 2000 NOTEBOOKS PUT YOU IN RACING FORM

The Nomad Series

Our small, lightweight Nomad notebook computers let you take desktop computer performance anywhere you go. Nomad models come with VGA graphics, a FieldMouse™ (portable pointing device), built-in floppy drive, and an 80 or 120MB hard drive, depending on the model. A patented power-management system gives you hard-to-beat battery life benchmarks — over six hours of operation from a single battery on the 25MHz 486DX system!

The Nomads have a bright, crisp, backlit, 10-inch triple supertwist VGA screen — resolution is 640 x 480, 64 gray scale, on the LCD. With simultaneous video, you can also display on an external monitor.

All these features ... and the Nomads are made in the U.S.A.!

Nomad 325SXL ■ $1995

25MHz, 386SXL processor
■ 4MB RAM ■ 80MB hard drive

Nomad 420SXL ■ $2695

20MHz, Intel® 486SXLP processor
■ 4MB RAM ■ 80MB hard drive

Nomad 425DXL ■ $3495

25MHz, Intel 486DXLP processor
■ 4MB RAM ■ 120MB hard drive

For The Power User On The Go

Nomad Combo ■ $3995

Since the Nomad 425DXL has all the power of a 486DX desktop system, it's the ideal portable/desktop combination system! Save with this combo package!

Combo Highlights: Nomad 425DXL ■ 15" CrystalScan 1572FS color monitor ■ programmable 124-key AnyKey™ keyboard

The HandBook™

If you like to travel light, you can't go wrong with the HandBook. It weighs only 2.75 pounds and measures roughly 6 x 9 inches — smaller than this magazine! Yet it has 286-class performance and real PC features including a bright, backlit screen, a bonafide 40MB hard drive and a comfortable keyboard (no chiclet keys). Downloading information from your HandBook to your office computer is easy with the serial cable and file transfer software provided.

HandBook ■ $1295

For The Executive On The Go

HandBook Combo ■ $3995

Combine the portability of our HandBook with the power of our 33MHz 486 desktop system with communication capabilities — and you have a terrific combo, Gateway value-priced!

Combo Highlights: HandBook with 2,400 bps external modem and communication software ■ 33MHz 486DX system with 120MB IDE hard drive ■ TelePath™ fax/modem package

GATEWAY2000
"You've got a friend in the business."

GATEWAY 2000 ADDS A FREE SOFTWARE BONUS

Choose Your Free Software Option

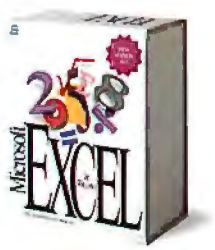
With the purchase of any Gateway 2000 mini desktop, desktop or tower computer system, you receive your choice of one application software option at no additional cost. We'll install your software on your hard drive, optimally configured for your system and Windows, and provide master diskettes and manuals. You may also purchase a second application software option, pre-installed, at extremely competitive prices.

Installation and setup errors are responsible for over one-third of all software problems. You can eliminate that possible source of problems by purchasing your system from Gateway with software pre-installed, tested, and ready to run the moment your system arrives. Add that advantage to the hard-to-beat prices, and Gateway is the only logical choice for PCs and software!

Choose one of the following application software options:

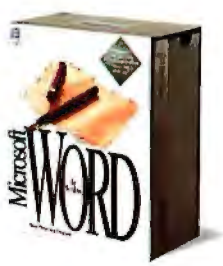
Option #1-*Microsoft Excel for Windows™ 4.0*

■ New version of this powerful spreadsheet, includes online help for *Lotus 1-2-3®* users



Option #2-*Microsoft Word for Windows™ 2.0*

■ Best-selling word processor for Windows. New version 2.0 adds online help for *WordPerfect®* users



Option #3-*Microsoft PowerPoint for Windows™ 3.0*

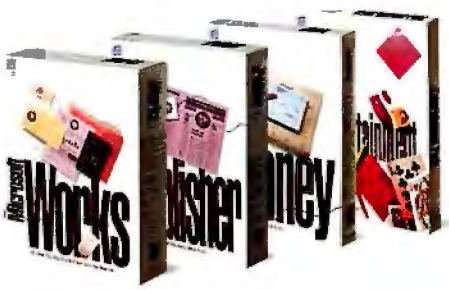
■ Easy-to-use desktop presentations program creates high-quality overheads and 35mm slides

Option #4-*Borland® Paradox® 4.0*

■ The award-winning database from Borland

Option #5-*The Entrepreneur Pack*

■ Includes the latest Windows versions of *Microsoft Works*™, integrating word processing, spreadsheet, and database in one easy-to-use program; *Microsoft Publisher*,™ for creating page layouts; *Microsoft Money*,™ to help you write checks, set budgets, track expenses; PLUS an *Entertainment Pack* with eight games, including *Tetris®*



Option #6- *The Windows Programmer Pack*

■ Includes everything you need to create programs for Windows: *Microsoft QuickC for Windows*,™ *Windows Control Development Kit*,™ *Windows Help Compiler*™ and *Windows Programmers' Online Reference*.™

Option #7-*Microsoft Project for Windows*™ *3.0*

■ Flexible and easy project management program

NOTE: If you would rather replace an option with *Microsoft Office*,™ it is available for $175. This package includes *Word for Windows, Excel* and *PowerPoint.*

More Software At A Great Price!

The following applications are only available with the purchase of a system, pre-installed, or to Gateway customers.

Central Point® Anti-Virus 1.2 For Windows ■ $75

Central Point Backup™ 7.2 for Windows ■ $75

The Norton Desktop™ 2.0 and Prisma Your Way 2.0 For Windows ■ $95

These offers include the identical applications contained in retail packages but will not include the retail box. You get all master diskettes and manuals, shrink-wrapped and packaged in a Gateway 2000 box.

Peripherals

The 15-Inch CrystalScan 1572FS

You'll enjoy your new Gateway 2000 computer even more if you choose the new 15-inch CrystalScan color monitor option. The CrytalScan 1572FS has a flat, square, non-glare screen to reduce distortion around the corners and provide edge-to-edge display area. The CrystalScan 1572FS is an upgrade option only with the purchase of a 386DX or 486 system for an additional $195.

The Gateway 2000 TelePath™ Fax/Modem

The Gateway 2000 TelePath is a 14,400 bps mode, V .32bis, with 9,600 bps fax capability. The TelePath comes with WinFax Pro,™ Crosstalk™ for Windows, Qmodem™ and a free 30-day basic services CompuServe® membership — all for only $195!

■ Fax mode: V.17, V.29 and V.27ter

■ Data mode: V.32bis, V.32, V.22bis, V.22, V.21, Bell 212A and 103, V.42 and MNP 2-4 error correction, V.42 bis/MNP 5 data compression

Included With Every System:

■ One-year limited warranty ■ 30-day money-back guarantee ■ Lifetime toll-free technical support ■ Free on-site service to most locations (*factory service only for notebooks*) ■ Free bulletin board technical support ■ C.O.D. terms and major credit cards honored ■ Net 30-day credit terms and leasing options available to qualified commercial customers

Sorry — we sell peripherals only with the purchase of a Gateway 2000 system, or to people who are already Gateway 2000 customers. For fastest service, call our new direct line for the ***Component Add-On Division: 800-252-3333.*** *Please have your customer ID handy when you call.*

GATEWAY2000

"You've got a friend in the business."

GATEWAY 2000 WINNERS CIRCLE

PORTABLES

HANDBOOK™

- 286 Class Performance
- 1MB RAM upgradeable to 3MB
- 40MB Hard Drive
- Backlit 7.6" CGA Screen
- Size 5.9" x 9.75" x 1.4", 2.75 Lbs.
- 4.5-Hr.* NiMH Battery & AC Pack
- 1 Parallel/1 Serial Port
- 78-Key Keyboard
- MS DOS 5.0, File Transfer Software & Serial Download Cable
- Introductory Bonus Pack
- Carrying Case

$1295

NOMAD 325SXL

- 25MHz, 386SXL Processor
- 4MB RAM
- 1.44MB 3.5" Drive
- 80MB IDE Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 256K
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
- 7-Hr.* NiCad Battery & AC Pack
- 1 Parallel/1 Serial Port
- 79-Key Keyboard
- FieldMouse™ Pointing Device
- MS DOS®5.0 and Windows™ 3.1

$1995

NOMAD 420SXL

- 20MHz, Intel® 486SXLP Processor
- 4MB RAM
- 1.44MB 3.5" Drive
- 80MB IDE Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
- 6-Hr.* NiCad Battery & AC Pack
- 1 Parallel/1 Serial Port
- 79-Key Keyboard
- FieldMouse Pointing Device
- MS DOS 5.0 and Windows 3.1

$2695

NOMAD 425DXL

- 25MHz, Intel 486DXLP Processor
- 4MB RAM
- 1.44MB 3.5" Drive
- 120MB IDE Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
- 6-Hr.* NiCad Battery & AC Pack
- 1 Parallel/1 Serial Port
- 79-Key Keyboard
- FieldMouse Pointing Device
- MS DOS 5.0 and Windows 3.1

$3495

DESKTOPS

25MHz 386SX

- Intel 386SX Processor
- 4MB RAM
- 1.2MB & 1.44MB Drives
- 80MB 17ms IDE Cache Drive
- 16-Bit SVGA with 512K
- 14" CrystalScan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey™ Keyboard
- Microsoft® Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software

$1495

33MHz 486SX

- Intel 486SX Processor
- 4MB RAM
- 1.2MB & 1.44MB Drives
- 120MB 15ms IDE** Cache Drive
- ATI™ Graphics Ultra Video
- 14" CrystalScan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software

$1895

33MHz 486DX

- Intel 486DX Processor
- 64K Cache RAM
- 4MB RAM
- 1.2MB & 1.44MB Drives
- 200MB 13ms IDE** Cache Drive
- ATI Graphics Ultra Video
- 14" CrystalScan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software

$2395

50MHz 486DX2

- Intel 486DX2 Processor
- 64K Cache RAM
- 8MB RAM
- 1.2MB & 1.44MB Drives
- 200MB 13ms IDE** Cache Drive
- ATI Graphics Ultra Video
- 14" CrystalScan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software

$2695

***Enhanced IDE with RIDE (Rapid Integrated Drive Electronics)*

50MHz 486DX2 EISA

- Intel 486DX2 Processor
- 128K Cache RAM
- 8MB RAM
- 1.2MB & 1.44MB Drives
- 340MB 15ms SCSI Cache Drive
- 32-Bit EISA SCSI Controller
- 16-Bit SVGA with 1MB
- 14" CrystalScan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software
- Tower Model is Standard

$3695

66MHz 486DX2

- Call for details

** Battery life was measured using PC Magazine's Battery Rundown Test with power management enabled. Actual results may vary depending on configuration and applications.*

All prices and configurations are subject to change without notice. Prices do not include shipping. Components, peripherals and software are sold only with the purchase of a system, or to customers who already own Gateway 2000 systems. Some limitations apply.

Printed on recycled paper

GATEWAY2000

"You've got a friend in the business."

GLOBAL REFOREST

8 0 0 - 5 2 3 - 2 0 0 0

610 Gateway Drive • P.O.Box 2000 • North Sioux City, SD 57049-2000 • 605-232-2000 • Fax 605-232-2023

Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CDT)

©1992 Gateway 2000, Inc. AnyKey, HandBook, FieldMouse and TelePath are trademarks of Gateway 2000, Inc. Intel is a trademark of Intel Corporation. All other brands and product names are trademarks or registered trademarks of their respective companies.

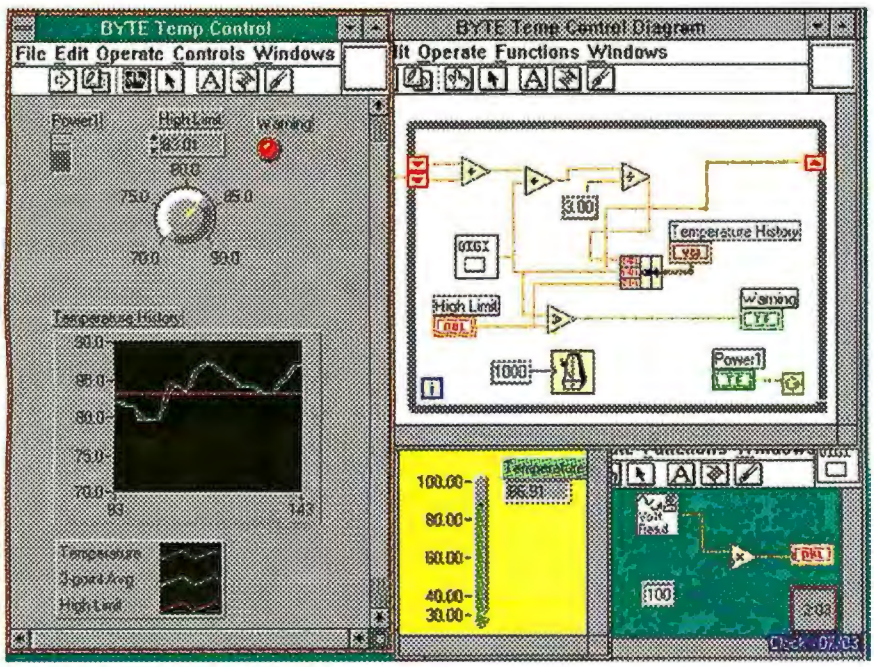
Acquiring Data Through Windows

ANDY REINHARDT

LabView for Windows uses advanced visual programming, but the learning curve is steep

Data acquisition has come a long way since the days of the DEC MINC. The arrival of add-in cards for the Apple II and IBM PC in the early 1980s heralded a lower-cost, more personal approach to collecting and analyzing laboratory data. Ever since then, microcomputer-based data acquisition systems have gotten more sophisticated—although not necessarily much easier to program.

The new LabView for Windows from National Instruments marks yet another turning point for data acquisition: The software not only is incredibly powerful within its niche, but is also a leading example of the industrywide trend toward visual programming. This package lets you design complex real-time data collection and analysis routines using only icons, without typing a single line of code. Although it's not the only such software for data acquisition, LabView may be the first that does not sacrifice flexibility and configurability in the name of ease of use.



LabView uses a CAD-like technique that lets you draw your data acquisition application. In this example, the instrument panel on the left is driven by the diagram on the right. The Digi icon encapsulates the display and diagram at the bottom right.

As with other nonprocedural visual programming tools, however, there is a price to be paid for LabView's approach: The learning curve is steep to create even a simple procedure, such as reading a voltage and displaying it on a graphical strip-chart recorder. And when your procedure gets very sophisticated, structuring and debugging the application can become fiendishly difficult.

Getting the Data

Applications for data acquisition range from biological research in university labs to materials testing at auto makers. Because these uses vary so widely, the hardware and software tools to automate data acquisition must be general, yet specific enough to obviate custom programming.

The typical data acquisition setup includes transducers that measure real-world phenomena (e.g., temperature, pressure, and light) and convert them to voltage. The sensors are wired to A/D conversion hardware, either a stand-alone instrument that outputs formatted digital signals—RS-232 or GPIB (general-purpose interface bus)—or a card installed in the backplane of a PC, Mac, or workstation. Many applications also include TTL-level digital inputs. Data acquisition software packages need to support these basic I/O functions with precise timing control.

Once acquired, digital data is usually stored in stored in RAM and/or saved to disk, displayed on the screen, and analyzed in real time or off-line. The software must create data arrays, support rich graphics, and include mathematical and statistical functions for data analysis. In some automated research applications, the computer also controls actuators that open and shut valves, start and stop motors, or turn on lights.

LabView for Windows is designed to work with the wide array of A/D and D/A hardware sold by National Instruments, as well as with serial and GPIB instruments from companies like Hewlett-Packard and Fluke. It does not directly support third-party boards. The minimum computer necessary to run LabView is a fast 386 PC with a math coprocessor, 5 MB of RAM, 15 MB of free disk space, Windows 3.1, and a mouse. A color display and a printer are desirable.

Because Windows is not a real-time operating system, National Instruments

includes with LabView virtual drivers for DMA and interrupt service that replace those supplied with Windows 3.1. These alone won't make Windows a preemptive multitasker, but assuming that the acquisition hardware samples data at precise intervals and stores it in a buffer, LabView's drivers ensure that data gets routed to the system before it is overwritten.

The Virtual Instrument

LabView for Windows is designed around the notion of the *virtual instrument*, which is a pictorial representation of an instrument's front panel. The power of LabView is that you can create a data acquisition application largely by designing what you want it to look like. Implicit in this approach is an object orientation, because the screen icons represent functions whose inputs and outputs you also specify graphically and that, once defined, can be reused.

When you load LabView, you start with a blank page onto which you drag icons that symbolize controls (e.g., knobs, slider bars, and user input fields) and readouts (e.g., numerical LEDs, bar charts, and alarm indicators). As each component is added to the display screen, a schematic of it is simultaneously added to a matching diagram that parallels the virtual instrument. To create the relationships between the components of the display, you link them (or *wire* them) on the diagram.

For example, you could start by selecting a graph display icon for the virtual instrument. On the diagram, this graph will show up as an output. You must then specify the source of the data that will be pumped into the graph by selecting the actual instrument (i.e., card location and port or device and channel). When these two icons are connected using the wire tool, the software connection is made as well. If you want to amplify the voltage by 100 before delivering it to the graph, you drop in a multiplication icon and a constant and rewire the drawing.

In more complex displays, you can select from hundreds of icons for numeric values, Boolean readouts and switches, strings, arrays, graphs, and decorative elements. On the diagram, you can select constants, math functions (e.g., arithmetic, trig, and log), comparators, programming constructs (e.g., FOR loops), strings, arrays, data-conversion routines, and specialized analytical tools (e.g., signal processing, linear and nonlinear filtering, and regression). The diagram menus also give access to file and data I/O functions.

Setting up applications in LabView involves creating layers of displays and diagrams, which can be encapsulated into icons. This is where the object orientation comes into play. The display you see when running an application is only the top layer. Below that is the diagram, which can contain icons that are themselves defined in other display/diagram pairs. Once a sequence is defined, you can design an icon for it and add it to the library. For example, in the screen, the diagram in the bottom right-hand corner belongs to the display

Multimedia at its Best!

BEST OF Taipei Computer Show BYTE

BEST OF Taipei Computer Show BYTE

Best of the Best

VIGA™ +

Targa+ Compatible !

VIGA Window motion-video card

- video in a window
- stereo audio control
- composite output

and a series of videographics adapters, NTSC & PAL available

In the U.S.& Canada
CALL (310)316-7940
Fax:(310)316-7457

Outside the U.S.& Canada
Tel : 886 35 772-176
Fax:886 35 772-170

VISIONETICS INTERNATIONAL

The Videographics Company

* Targa + is a registered trademark of Truevision Inc.

 Circle 183 on Inquiry Card (RESELLERS: 184).

BEFORE PROTECTING YOUR SOFTWARE...

SEE US AT COMDEX/Fall '92

...against piracy and unauthorized use, make sure that your protection system has all the following qualities:

A GOOD HARDWARE KEY

Hardware-based software protection systems are now the standard worldwide. However, not all keys are the same. A good key should have all the following features:

✔ Compatibility and transparency. The key should work without any problem on your customers' computers. The user should be able to forget the key after connecting it.

✔ Unbreakable electronics. A customized ASIC (Application Specific Integrated Circuit) component should be integrated in the key. This prevents reverse engineering and makes cracking virtually impossible.

✔ A unique and inaccessible software developer's code burnt into the ASIC. (This code should not be held in the key's memory, where it can be read and altered.)

✔ A Read/Write Memory inside the key should be available on demand. The memory should be writable in the field, on any PC, without any special programming equipment.

✔ Very low power consumption, enabling the key to work even under the worst power conditions, on PCs and laptops, with or without a printer.

POWERFUL SOFTWARE

Since it's practically impossible to crack or duplicate a key having all the features mentioned above, a pirate will usually go for the software linking the protected program to the key. Therefore, check that your protection software has all of the following:

✔ A Linkable Protection Module with which calls can be made to the key from any point in the protected program.

✔ An "Envelope" installation program. Such programs enhance security while making it possible to protect a software even without its source code.

✔ Sophisticated antidebugging and encryption mechanisms.

HASP®, THE PROFESSIONAL SOFTWARE PROTECTION SYSTEM, OFFERS YOU ALL THESE FEATURES AND MORE:

HASP was designed by a team of computer experts, professional cryptologists, and electrical engineers. As a result, HASP keys are supported by what is probably the best software in the market, and the HASP system has worked on every computer it has been tried on. In addition to all the features mentioned above, HASP provides:

✔ A Full Authorization System for protecting dozens of programs using only one key.

✔ A Pattern Code Security System (PCS) enabling parallel processing of multiple calls by the Linkable Protection Module.

✔ A Virus Detection option that can be incorporated in the protected program to check whether it has been infected by a virus or tampered with in any way.

✔ Several HASP keys can be daisy-chained.

NETHASP, SOFTWARE PROTECTION FOR NETWORKS

✔ Only **one** NetHASP key is needed to run a protected program from many stations in a network. NetHASP provides full support for protecting DOS and WINDOWS software under network environments, including Novell dedicated & non- dedicated servers, Lan Manager, Lantastic, Banyan, DLink, and NET-BIOS based LANs.

IN A TEST CARRIED OUT BY AN INDEPENDENT LAB, HASP WAS THE ONLY KEY WHICH ✔ WAS NOT BROKEN*.

OPERATING ENVIRONMENTS

✔ **PC:** DOS, WINDOWS, OS/2, SCO UNIX, SCO XENIX, AIX, AUTOCAD, DOS EXTENDERS

✔ **MAC (ADB Port):** System 6.0.5 and up

✔ **NEC (Serial Port):** DOS, WINDOWS

AND THE BOTTOM LINE:

We offer some of the most competitive prices in the market.

Since 1984, HASP has enabled thousands of software producers in more than 40 countries, including several Fortune 500 companies, to protect their software.

To learn more about why so many professionals have chosen HASP, please contact:

ALADDIN KNOWLEDGE SYSTEMS LTD.

15 Beit Oved St., Tel-Aviv, Israe
P.O.Box:11141 Tel-Aviv 61110
Tel: 972-3-5375795
Fax: 972-3-5375796

In North America:

ALADDIN
SOFTWARE SECURITY

200 Broadhollow Rd., Suite #207
Melville, NY 11747, USA
☎ **800-223 4277**, 516-424 5100
Fax: 516-424 8300

- **Australia** Conlab Pty. Ltd., Tel: 3 8985685
- **Belgium** Akkermans bvba, Tel: 3 2338826
- **CSFR** ATLAS Ltd., Tel+Fax: 2 766085
- **Chile** Micrologica S.A., Tel: 562 222 1388
- **Denmark** SC Metric a/s, Tel: 42 804200
- **France** Logidata Intl., Tel: 50707375
- **Germany** CSS GmbH, Tel: 201 749860
- **Greece** Unibrain SA, Tel: 1 6856320
- **Holland** Akkermans BV, Tel: 45 241444
- **Italy** Partner Data S.r.l., Tel: 2 33101709
- **Korea** Hanil System Inc., Tel: 2 5639161
- **New Zealand** Training Solutions, Tel: 4 5666014
- **Poland** Systherm Tel: 061 45065
- **Portugal** Futurmatica Lda., Tel: 1 4116269
- **South Africa** D Le Roux, Tel: 11 886 4704
- **Spain** PC Hardware, Tel: 3 4493193
- **Switzerland** Opag AG, Tel: 61 7112245
- **Taiwan** Teco Ltd., Tel: 2-5219676
- **Turkey** Mikrobeta Ltd., Tel: 4-4677504

* CT Magazine, May 1990.

© Aladdin Knowledge Systems Ltd. 1985-1992

Design Ran Peer

Circle 75 on Inquiry Card.

next to it, which, in turn, defines the Digi icon in the active window.

If all this sounds a little overwhelming, it is. National Instruments has made the job of getting started with LabView a bit easier by providing examples, a good tutorial walk-through, and canned icons for basic activities (e.g., reading a voltage). But the fact remains that it is probably more difficult to set up a simple application using LabView than with procedural code. As with any program, some of the learning curve is semantic and syntactic, but much of it has to do with the *inherent invisibility* of the layers of diagrams and the nonprocedural flow of the program.

Making even a simple change to a diagram diagram (e.g., adding a second plot to a graph) involves complex steps, such as including a shift register in the program loop and a bundle icon to group multiple inputs into a single graph. Some diagrams involve dozens of icons, and each may have been separately defined. To change them requires drilling down through many layers to find the right diagram. Also, the user interface was at times inconsistent.

On the other hand, LabView is remarkably powerful and complete. Although an API is available for accessing external code modules, few applications will require this because practically any data acquisition process can be designed graphically. LabView also includes debugging features that make it possible, for example, to find the source of a data value, set breakpoints, step through a block diagram, and highlight the sequence of execution.

Despite having been designed specifically for data acquisition and control, LabView for Windows is a shining example of visual programming. Setting up a data acquisition procedure is not much different than writing any event-driven program, and the model employed by LabView allows for reusability and freedom from coding, as well as a high degree of complexity. This package deserves to be considered by anybody involved in data acquisition—as well as by anybody eager to study a sophisticated example of state-of-the-art visual programming tools. ■

Andy Reinhardt is BYTE's West Coast bureau chief. He can be reached on BIX as "areinhardt."

THE FACTS

LabView for Windows
$1995

National Instruments
6504 Bridge Point Pkwy.
Austin, TX 78730
(800) 433-3488
(512) 794-0100
fax: (512) 794-8411
Circle 1197 on Inquiry Card.

AITech

*Pro*PC/TV COMPUTER TO TV CONVERTER DEVICE

AMAZING!

Aitech International... the innovative leader in multimedia and desktop video has gone and done it again!

ProPC/TV is the world's finest and most cost effective external device used to take computer text, graphics and games and allows you to show them on your TV screen.

THE BETTER SOLUTION

Every notebook or portable computer user knows the disadvantages of using their monochrome display. Aitech's ProPC/TV provides a better solution to the high cost of large screen monitors.

EFFORTLESS INSTALLATION

ProPC/TV is about the size of a cassette tape case, weighing just a few ounces. It installs quickly and easily, and comes with all required cables.

Call an Aitech sales representative today for more information about the ProPC/TV.

AITech *Vision for Multimedia*

830 HILLVIEW COURT, SUITE 145, MILPITAS, CA 95035 1-800-882-8184

Circle 76 on Inquiry Card.

Programmer's Paradise®

WATCOM SQL Developer's Edition

Complete client/server development tool allows you to develop and deploy single-user standalone applications, and to develop applications for use with the Network Server Edition (sold separately). Includes: Single-user database server (both 16 and 32-bit versions); ACME application development system; Embedded SQL/C preprocessor; SQL libraries for WATCOM C, C/386, MS C/C++ and BC/C++.

List: $795 ***Call for special introductory price!***
FAX*cetera*#: 1683-0010

CPU Monitor

SPECIAL!

Powerful performance and analysis tool for the OS/2 user. CPU Utilization for individual processes or threads, OS/2 process relationships, and more, all graphically displayed in REAL-TIME! Dynamically configure and tune your OS/2 applications. Select PM applications and dynamically change thread priorities; suspend individual threads. Stop runaway, hidden and background processes. Much more. Now available for OS/2 1.2, 1.3, and 2.0!

List: $149 **Ours: $115**
FAX*cetera*#: 1003-3401

GUARANTEED BEST PRICES*

Should you see one of these products listed at a lower price in another ad in this magazine, CALL US! We'll match the price, and still offer our same quality service and support!

Terms of offer:

- Offer good through September 30, 1992
- Applicable to pricing on current versions of software listed.
- September issue prices only.
- Offer does not apply towards obvious errors in competitors' ads.
- **Subject to same terms and conditions**

C Library for Btrieve

New 1.5 version comes complete with Novell's Btrieve, and includes source code and utilities for Btrieve development. This lean and mean C Library will simplify any Btrieve project. Create, read, and write to Btrieve files in single or multi-user environments. 100% Btrieve support including: record locking, file and index creation, and Novell Netware TTS. Supports compilers from Microsoft, Borland, and others.

List: $395 **Ours: $319**
FAX*cetera*#: 1002-3801

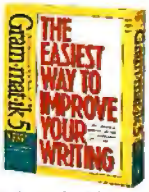
Clarion Prof. Developer

SPECIAL!

A fully equipped development system for producing PC applications. Includes an application generator for creating screens, windows, tables, menus, and reports. Also contains Report Writer, a powerful ad-hoc query utility. Speed, flexibility and ease-of-use give you the power to create much richer programs, in a fraction of the time.

List: $845 **Ours: ~~$625~~ NOW $475**
FAX*cetera*#: 1862-0002

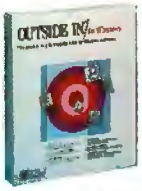
Grammatik 5



Grammatik 5 proofreads documents for hundreds of thousands of errors in grammar, style, spelling, punctuation, and usage. Grammatik 5 works inside all major Windows word processors, and proofreads text from any Windows application. Grammatik also works inside all major DOS word processors, and can proofread files created in every other text-based application. It's the easiest way to improve your grammar.

List: $99 **Ours: $69**
FAX*cetera*#: 0222-0001

Outside In for Windows



Outside In for Windows is a file viewing and data import utility. Use it to copy data from 90 word processing, database and spreadsheet formats to the Clipboard with formatting intact. It also prints files and launches applications. Use it as a standalone utility or as part of Norton Desktop, Windows 3.1 or the major word processors. Outside In supports DOS, Windows and Macintosh files.

List: $89 **Ours: $69**
FAX*cetera*#: 1001-2001

Microsoft C/C++ 7.0

The complete solution for creating Windows applications. Microsoft Foundation Classes help you make a smooth transition to the increased productivity of object-oriented programming, while you generate fast, tight code. Microsoft C/C++ is a complete implementation of the AT&T® C++ version 2.1 specification, allowing you to integrate C++ classes into your existing C applications.

List: $495 **Ours: $299**
Competitive Upg. List: $139 **Ours: $134**
FAX*cetera*#: 1269-0014

Instant-C 5.0

The Instant-C professional programming environment integrates the edit-compile-link-test cycle in one powerful, high performance tool. It combines an incremental compiler and linker with automatic static and runtime error detection (e.g., use of uninitialized pointers, source level debugging, interactive C expression evaluation, and support of programs up to 16MB.)

List: $495 **Ours: ~~$449~~ NOW: $325**
FAX*cetera*#: 1067-0001

800-445-7899

Call Programmer's Paradise Today!

And mention this ad when placing your order!

1-800-445-7899
Corporate: **800-422-6507**
(CORSOFT Division)

Programmer's
The Software Sour

Developers, we're here to serve you. Programmer's Paradise offers the world's largest selection of software development tools and utilities at guaranteed low prices. If you don't see what you want, call us! And don't forget to ask for our free comprehensive catalog.

METAWARE HIGH C/C++

MetaWare Inc. announces its newest product. The 32-bit High C/C++ compiler version 3.0 is a true compiler, not a C to C++ translator. "Incremental Strengths" lets you specify the level of C++ compilation, allowing you to migrate from C to C++ one C++ block at a time. Included in this package is a C++-tailored source-level debugger and a 32-bit Application Development Kit for Windows. MetaWare offers a full line of multi-language, multi-platform compilers for professional software developers.

List: $795 **Ours: $669**
FAX*cetera* **#1590-0008**

386/486 Development

Intel 386/486 C Code Builder	575
Lahey EM/32 5.0	1015
MetaWare High C/C++	669
Phar Lap 386I DOS-Extender	445
Prof. Pascal Ext. DOS	749
WATCOM C9.0/386	719
Zortech C++ Devel. 3.0	445

Basic

dB/Lib Professional	179
GFA Basic for Windows	235
MS Basic PDS	349
ProBas 5.0	169
Q+E Database/VB	CALL
Realizer	319
Visual Basic	129
Visual Basic Comp. Upgd.	95
Visual Basic Pro. Tlkt *SPECIAL!*	99
Visual Basic & Tlkt Bundle	228

C/C++ Compilers

Borland C++	325
Borland C++ w/Appl. Frameworks	549
High C/C++	CALL
Microsoft C/C++ 7.0 Competitive Upgrade	299 134
MS QuickC for Windows	139
Turbo C++ for Windows	69 105

C-Application Generators

CASE:W Corporate	839
dANALYST GOLD	99
PRO-C	99
WindowsMAKER Prof.	795

Dan Bricklin's Demo II

Experience for yourself why 30,000 people have made Demo II 3.0 the leading tool for producing program prototypes, demonstrations, and tutorials. Demonstrate commercial software to potential customers without shipping live software. Produce effective tutorials that interactively teach products. Create Computer Based Training for a fraction of the cost of dedicated CBT authoring software.

List: $249 **Ours: $215**
FAX*cetera* **#0233-0003**

C Communications

BreakOut II	189
C Asynch Manager	165
C Comm Toolkit	139
Essential Comm	259
Greenleaf CommLib	339
Greenleaf ViewComm	319
QuickComm	119
SilverComm C Async	195

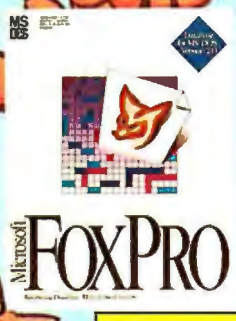
C Screens

C-scape	38
C Windows Toolkit 386	17
Greenleaf Data Windows	33
Instant Windows	41
Island Pro Pak	48
QuickWindows Advanced	11
VC Screen	12
Vitamin C	33

dBFast Windows

The complete stand-alone dBASE/xBASE development language for MS Windows. dBFast lets you create fast, powerful, easy-to-use graphical applications. Design multiple windows, pull-down menus, check boxes, list boxes, radio buttons, bit-map pictures and more. Over 200 extensions to the dBASE III plus language as well as an interactive editor, compiler, and linker.

List: $550 **Ours: $395**
FAX*cetera* **#1004-0003**



PRODUCT OF THE MONTH:
Microsoft FoxPro 2.0 Compet. Upgrade!

Microsoft FoxPro delivers unparalleled performance. Easy to learn, use, and develop, FoxPro 2.0 offers a sophisticated programming environment and cross-platform data and language compatibility with Macintosh and UNIX systems. Now users of competing xBASE products, FoxBASE+ for DOS, and FoxPro 1.X can upgrade to FoxPro 2.0. Included in this offer is a free upgrade to FoxPro 2.5 for either DOS or Windows when the product ships.
List: $199 **Ours: CALL**
FAX*cetera* **#1506-0001**

C- Additional Products

C-Doc	17
C-Doc Professional	26
MKS LEX & YACC	19
PC Lint	10
Phar Lap 286IDOS-Extender	44

C++ Libraries/Utilities

C++Views	41
Codebase 4.5	29
Greenleaf Comm++	16
object-Menu	26
Object Professional for C++	19
Poet	36
Rogue Wave Math.h++	26
Rogue Wave Tools.h++	26
Style	19
Win++	18
Zinc 3.0	39
Zinc Competitive Upgrade	**20**

800-445-7899

International: **908-389-9228** Canada: **800-445-7899**
Customer Service: **908-389-9229** Fax: **908-389-9227**

CALL US

Paradise®

ce for Developers!

CALL 800-445-7899

Database Development

Clarion Prof. *SPECIAL!*	449
Clipper	521
DataBoss 3.5	549
dBASE IV	529
FoxPro	489
FoxPro Competitive Upg.	CALL
FoxPro Distribution Kit	CALL
Paradox 3.5	529
Q+E Database Library	279
R&R Code Generator	179
R&R Report Writer	219
Say What!	45
SilverClip/Fox SPCS	239

Pascal

Topaz	89
Turbo Pascal for Windows	175
Turbo Pascal Professional	209
Turbo Professional	99

Prototyping

Dan Bricklin's Demo II	215
Show Partner F/X	355

Version Control

MKSRCS	CALL
PVCS Config. Builder	209
PVCS Version Mgr (DOS & OS/2)	479
TLIB	109

Utilities

386MAX	65
After Dark	29
Bar Code Library	319
Blue MAX	81
Dr. Switch-ASE	149
DVT (Data Vis. Tool)	CALL
HIJAAK	139
Hold Everything	159
Iconic/Query	219
INSTALIT	135
Label Master	399
MKS Toolkit	199
Norton Anti-Virus	99
Norton Commander	99
Norton Utilities 6.0	129
Opt-Tech Sort/Merge	119
PC Tools Deluxe 7.0	129
QEMM 386	65
SpinRite II *SPECIAL!*	59
UpShot	139

MicroEdge SlickEdit

Programmer's editor with REXX-like macro language, undo/redo 32K steps, multiple windows, 450K help, multiple clipboards, compiler error message processing, procedure tagging, programmable file manager. Multiple files to 1 gig. Brief & Epsilon emulation on all platforms. Now for DOS, OS/2, Windows NT, Unix, Xenix, AIX RS6000, Sun, Silicon Graphics, DG Aviion, HP9000.

List: $195 **Ours: $149**

FAX*cetera* #1997-0001

WATCOM C 9.0/386

Develop and debug 32-bit applications for extended DOS, Windows, and OS/2 2.0 with the most complete 32-bit C development package available. Includes the royalty-free DOS/4GW DOS extender by Rational Systems, components from MS Windows SDK, compiler, linker, debugger, profiler, plus numerous development tools. Supports other industry standard 32-bit DOS extenders. Create ADS Applications for AutoCAD or embedded systems development.

List: $895 **Ours: $719**

FAX*cetera* #1683-0001

GUARANTEED BEST PRICES*

Should you see one of these products listed at a lower price in another ad in this magazine, CALL US! We'll match the price, and still offer our same quality service and support!

Terms of offer:

- Offer good through September 30, 1992*
- Applicable to pricing on current versions of software listed.
- September issue prices only.
- Offer does not apply towards obvious errors in competitors' ads.
- *Subject to same terms and conditions

Editors

Brief	169
ED *NEW!*	CALL
Multi Edit	89
Multi Edit Professional	139
SlickEdit	149
Vadit Plus	149

FORTRAN

Lahey F77-EM/32 5.0	1015
Lahey F77L	535
MS FORTRAN	315
WATCOM FORTRAN 77 9.0	449

Graphic Libraries

Baby Driver II	235
BLACKHAWK dGT	259
Essential Graphics GUI	105
Essential Graphics Kernal	149
Graf/Drive Plus Dev.	269
graphics-MENU	189
GX Effects 2.0	159
GX Graphics	199
GX Text 2.0	125
HALO Professional	315
ICON-TOOLS	135
ImageMan	359
Menuet	279
PGL	149
TGL 2D, 3D	CALL
Victor Image Library	179

Linkers/Profilers

RTLink/Plus *SPECIAL! 1/2 OFF!*	247
Blinker - *NEW VERSION!*	269
Plink86 +	335

Windows Development

CODEPAD for Windows *SPECIAL!*	59
dBFast Windows	395
InstallSHIELD	369
Magic Fields	CALL
MS Test	279
Norton Desktop 2.0 f/ Windows	CALL
ObjectVision	105
RoboHelp	449
Realizer	319
Smalltalk V/Windows	395
SQA: Robot	449
ToolBook	329
WindowsMAKER Prof.	795
Windows Teach	105
zApp	165

WindowsMAKER Professional 4.0

NEW VERSION! Next generation of industry standard C/C++ development tool for Windows. The easiest, fastest way to create Windows apps, just point and click. New architecture uses Switch-It™ Code Generation Modules for generating ANSI C, MFC C++ or OWL C++ code, among others. Award-winning Visual Prototyper lets you test the look & feel and make changes on the fly. TrueCode technology ensures that user code is preserved during code regeneration. Generates Windows .EXE w/fully commented C or C++ source. CUA & SAA compliant.

List: $995 **Ours: $795**

FAX*cetera* # 2602-0003

Phone Orders
Mon-Fri 8:30 AM-8PM EST, Sat 9:30-2:30 EST. We accept MC, Visa, AMEX. Domestic shipments, please add $6 per item for shipping/handling. Items which weigh fifteen pounds or more will be charged at actual UPS ground rates. Domestic COD shipments, please add $4. Rush service available.

Mail or FAX/International Orders/Domestic Purchase Orders Phone number required.

Returns Subject to $25 processing charge per product.

FAX*cetera* (908) 389-8173 Call from your FAX telephone and follow the instructions to receive more information on the products featured above!

Corporate Accounts Call CORSOFT, our corporate sales division. Ask about volume purchase agreements.

*** All prices subject to change without notice.**

TODAY!

800-445-7899

CORPORATE (CORSOFT): 800 422-6507

Circle 125 on Inquiry Card.

The Olivetti Quaderno: A New Voice In Portable Computing

LONDON—Perhaps the most interesting aspect of the **Olivetti Quaderno** is the integration of a DSP (digital signal processor) into the basic design, providing some limited support for speech. The 8086-based subnotebook is a 2¼-pound DOS-compatible machine with a 20-MB hard drive. The machine is packaged in a stylish case, and its proportions are similar to those of a hardback book; it is approximately 8 inches wide, 5 inches deep, and just over 1 inch high.

The top of the case has a cutout for a small LCD screen that shows the time and some system status features. Six buttons (i.e., stop, pause, play, record, fast forward, and rewind) control the speech module while the Quaderno is still closed. This lets you create speech memos in those situations where you have insufficient time to open the machine and type the information in.

Along the right side of the case are a number of connectors and controls, including serial, parallel, and headphone connectors; a reset switch; and a speaker volume control. The serial and parallel ports are of the mini-DIN-8 variety, but the manufacturer does include a cable converter. The only other external feature is a PCMCIA 1.0–compatible slot.

Opening the clamshell-style machine reveals an unusual keyboard and a mediocre 7-inch screen with support for eight levels of gray. The screen isn't backlit, and, although it supports Olivetti's 640- by 400-pixel super CGA mode, I found that it was difficult to read in all but the best light.

The 93-key keyboard layout is similar to the standard Toshiba layout except that the up-arrow key is located between the Slash and Shift keys. This was done to leave the arrow keys in the familiar inverted T shape. But by moving the Shift key, Olivetti has made the keyboard difficult to use. Using both this keyboard and a normal keyboard regularly could be confusing. Above the main keyboard is a useful soft-key numeric keypad. The on/off switch is located to the left of the numeric keypad and has a raised ridge around it to prevent accidental activation.

Internally, the machine is designed around the 16-MHz NEC V30HL 8086-compatible processor. It has 1 MB of RAM, of which 384 KB is configured as expanded memory. The DSP is provided by Analog Devices, and future Olivetti machines may well provide additional functionality through the DSP. Currently, only a speech module is provided, which creates speech files compatible with a number of other vendors who use the Analog Devices DSP. The files are not compatible with Sound Blaster files, and no conversion utility is available yet.

The Quaderno's power comes from a rechargeable nickel-cadmium battery pack, although six standard AA batteries can be used if needed. Battery life varied depending on the processor speed selected and whether the serial port was used, but around 10 hours seems to be the average.

The Quaderno ships with DOS 5.0 installed and includes a configurable suite of utilities written by Olivetti. The software includes a notepad, calculator, schedule, phone book, file manager, voice memo manager, and configuration program. The facilities are basic, and I found that I used only the voice memo manager and the configuration program with any regularity.

The voice software is a good but rudimentary first attempt. It simply lists recorded messages in order, with timings noted in seconds. Individual memos can be selected and played back. I'm looking forward to future machines that use the Analog Devices DSP a bit more fully.

Upon installing a copy of Quarterdeck's Desqview, I found some problems with Olivetti's keyboard driver. The Desqview pop-up key did not operate, and Desqview's useful Ctrl-Alt-Del trapping mechanism failed, too. This left Desqview severely crippled.

Testing this machine revealed some interesting problems with Microsoft's notebook power management software. Running an identical Quattro Pro spreadsheet recalculation on the Quaderno and a slower Toshiba T1000XE revealed that the recalculation took eight times longer on the Olivetti machine.

After some investigation, I discovered that the power saver's processor pause period interfered with the background processing that the recalculation routine used. To remedy the situation, I had to disable the power saver, reducing the potential battery time.

The Quaderno has many virtues, including size, weight, and performance. However, I was left feeling that the software for the system was a rough cut and that future versions of the Quaderno and other additions to Olivetti's subnotebook range would provide refinements to the seemingly rushed software.

—Andy Redfern

THE FACTS

Olivetti Quaderno
about $1300 (£680)

Olivetti Italy
Ing.C. Olivetti and C., S.p.A.
20121 Milano
Vicolo S. Giovani Sul Muro, 1
Italy
39-2-8836-2213
fax: 39-2-861109

Olivetti Advanced Tech
20300 Stevens Creek Blvd.
Cupertino, CA 95014
(408) 996-3867
fax: (408) 996-3053
Circle 1198 on Inquiry Card.

The new TI TravelMate™ 4000 family. Your windows to the future.

MICROSOFT WINDOWS READY TO RUN

Now you can step up to 486™ power with integrated Windows™ 3.1 and DOS* 5.0. Introducing the TI TravelMate 4000 notebook computers — ready for today's applications and those of tomorrow.

Choose from three models to meet your needs. They all feature an enhanced 10" diagonal VGA display, plenty of memory and storage, and four to five hours of typical battery life. Plus the new TM4000 notebooks measure only 8.5 x 11 x 1.8" and weigh in at under 5.6 lbs. (including battery). All this at a surprisingly affordable price and with ample performance to take you well into the future.

For more information and the name of a dealer near you, call 1-800-527-3500.

TM4000 WinSX™/16	
486SX™ 16MHz*	Pre-installed
4MB-8MB RAM	Windows 3.1 and DOS 5.0
80MB HDD	TravelPoint™ pointing device
TM4000 WinSX/25	
486SX 25MHz	Pre-installed
4MB-20MB RAM	Windows 3.1 and DOS 5.0
120MB HDD	TravelPoint pointing device
TM4000 WinDX™/25	
486DX 25MHz	Pre-installed
4MB-20MB RAM	Windows 3.1 and DOS 5.0
120MB HDD	TravelPoint pointing device

*Twice the performance of a 25MHz 386SL™ processor.

TEXAS INSTRUMENTS

TravelMate, TravelPoint, WinSX and WinDX are trademarks of Texas Instruments Incorporated. DOS is a registered trademark, and Windows and the Microsoft Windows Ready To Run logo are trademarks of Microsoft Corporation. 486, 486SX, 386SL and the Intel Inside logo are trademarks of Intel Corporation.
©1992 TI 76504

Circle 174 on Inquiry Card.

A4 Notebook Reveals Acorn Is ARMed and Ready

LONDON—When U.K. system manufacturer Acorn developed a machine based on a processor it had designed itself, few gave the company much chance of surviving. Acorn, an Olivetti subsidiary, developed the 32-bit ARM (Advanced RISC machine) processor to replace the 6502 used in its previous machines. Now that Apple has announced its intention to use the ARM processor in its Newton products, ARM-based systems are taking on new appeal.

Acorn Computers' latest machine is an ARM-based notebook to complement its desktop Archimedes line. The new notebook, called the **Acorn A4**, comes in two variations. The entry-level system has 2 MB of RAM and a 2-MB floppy drive; the high-end model has 4 MB of RAM and a 60-MB hard drive. Both machines run version 3.0 of Acorn's proprietary RISC OS graphical operating system, but they can also run DOS programs by software emulation.

The A4 has an edgelit LCD screen with VGA resolution of 640 by 480 pixels and 16 levels of gray. The system features an 83-key U.K.-style keyboard, and there are connectors for an external analog RGB monitor and an AT keyboard. A serial port and a bidirectional parallel printer port are fitted, but for unknown reasons, the latter will not support LapLink. The A4 weighs 6¾ pounds, a quarter of which is due to the massive rechargeable nickel-cadmium battery pack. Despite the size of this pack and the use of power-saving design techniques, it provides a disappointingly average 2½ to 3½ hours of use.

The system comes with a three-button conventional mouse, although in cramped spaces you can emulate a mouse by using the special Fn modifier key with the *Q*, *W*, *E*, and cursor arrow keys. There's a neat LCD fuel gauge–type battery indicator below the keyboard. The separate AC power unit trickle-charges the batteries during normal use and can handle any nation's supply voltage.

Driven by a 12-MHz ARM3 RISC processor capable of 12 MIPS, the machine is roughly the equivalent of a fast 486 PC or a high-end Mac in terms of computing power. The 2 or 4 MB of RAM is contiguously addressable and is managed by Acorn's sophisticated MMU (memory management unit) chip, which lets you allocate more memory to applications or to system resources interactively at run time.

The RISC OS operating system is held in 2 MB of ROM, with a windowing GUI and a set of core applications; bit-map, vector graphics, and font editors; and a powerful, structured BASIC. Long before Microsoft Windows 3.0 or Apple's System 7.0 appeared, RISC OS featured a fully multitasking, windowing interface with support for data types such as antialiased outline fonts and stereo sounds in a more integrated way than either competitor.

The A4 is a formidable portable-computing platform when running RISC OS applications like the excellent Impression desktop publishing system. It outstrips the PowerBook 170 in terms of raw CPU speed and video and graphics performance, but the choice of software is limited. My only serious criticism is that the mouse cursor was far less visible on the gray-scale LCD screen than on the color screens to which I'm accustomed, and it tended to get lost when moving rapidly. However, you can use RISC OS's global palette control to improve matters somewhat by assigning the cursor full-intensity white while dimming your applications' backgrounds to a light gray.

The optional Acorn PC Emulator program creates what appears to be an ordinary DOS 3.3 session within a RISC OS window, and its fidelity is good enough nowadays to run Flight Simulator, Lotus 1-2-3, Sidekick Plus, and even Microsoft Windows. The snag is that even the nippy ARM processor takes a big hit when software-emulating an 8086. Thus, DOS performance is at the level of a slow 286.

However, you can run text-based DOS applications like word processors very well, and there are good cut-and-paste facilities between DOS and RISC OS; you can cut screens as either text or bit maps and paste them straight into RISC OS without the need to store an intermediate disk file. RISC OS can read and write DOS-format floppy disks.

The A4 will appeal mainly to existing Archimedes users. It's reasonably priced for its power when running RISC OS, but it would not be a sensible purchase merely to run DOS. However, Apple's support of the ARM processor may make Acorn a company to watch.

—Dick Pountain

THE FACTS

Acorn A4
with 2 MB of RAM and a 2-MB floppy drive, about $2675 (£1399); with 4 MB of RAM, a 2-MB floppy drive, and a 60-MB hard drive, about $3225 (£1699)

Acorn Computers
Fulbourn Rd.
Cherry Hinton
Cambridge CB1 4JN
U.K.
44-223-245200
fax: 44-223-214382

Acorn Computers Canada, Inc.
2851 John St., Suite 2000
Markham, Ontario,
Canada L3R 5R7
(416) 946-9461
fax: (416) 946-9462
Circle 1199 on Inquiry Card.

NOW JUST $495*
(Suggested retail price)

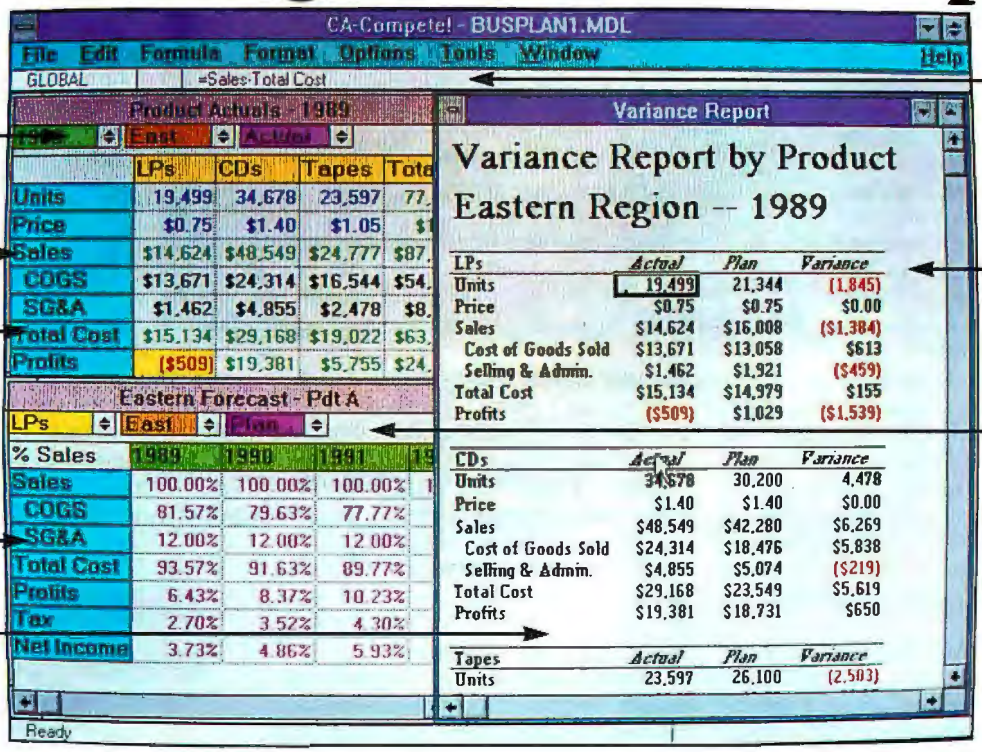
What Comes After Spreadsheets? Introducing New CA-Compete!

Up to 12 different dimensions you can navigate through with the click of a mouse.

Use simple English—no column or row references needed.

Name and save multiple views. Look at up to 12 at a time.

Extra sheets available for custom reports and additional calculations.



Global formulas you can apply to a range of cells.

Presentation-quality output with fonts, borders, and shades.

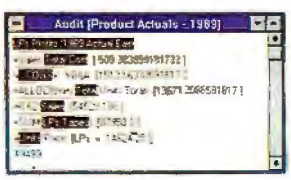
Looks like a spreadsheet with standard commands you know, like cut, paste, copy, and annotate.

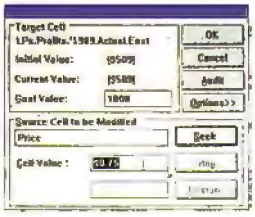
*Chosen "Best of 1990" by PC Magazine.**

Welcome to the world of multi-dimensional modeling & viewing.

1992 W 100 WINDOWS MAGAZINE ANNUAL WIN AWARD

Unlike two-dimensional spreadsheets, CA-Compete! lets you model up to 12 different dimensions and navigate between them instantly with the click of a mouse. And CA-Compete!™ speaks English too, so you can use recognizable names you define, like Sales, Units, Costs and Profit instead of cryptic column and row references. For smarter decision-making there's a broad range of powerful tools like Goal Seek, Allocate, and Forecast, so you can perform extensive "what-is" and "what-if" analyses.





You can also trace the origin of any value with a quick, graphical Audit Trail Tool.

CA-Compete! reads and writes Lotus® 1-2-3,® Excel, dBase,® ASCII and Script Files so you can work with all of your current files.

MICROSOFT® WINDOWS™

And with Windows' Dynamic Data Exchange, you can link your data dynamically with any other Windows program.

Call 1-800-CALL CAI today to get a CA-Compete! Working Model.

It's your chance to get a free glimpse of the future.

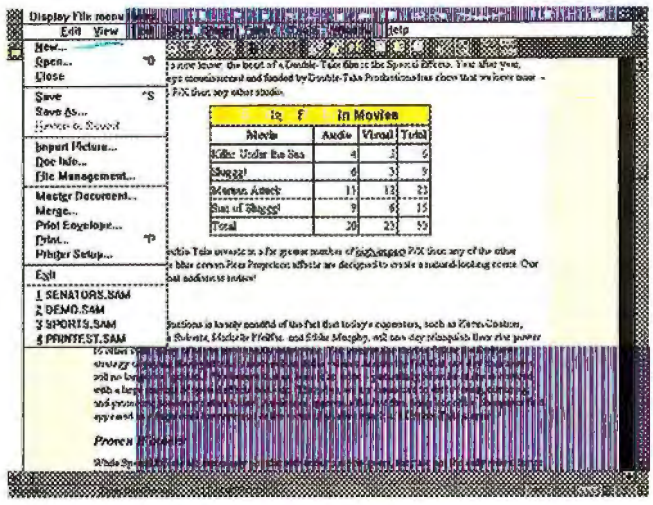
COMPUTER® ASSOCIATES
Software superior by design.

© Computer Associates International, Inc., One Computer Associates Plaza, Islandia, NY 11788-7000. All product names referenced herein are trademarks of their respective companies.

Circle 93 on Inquiry Card.

Ami Pro 3.0 Sets a New Standard

I'm dating myself when I say that I remember when computer word processing meant putting plain ASCII text on the screen. To put it mildly, things have changed. **Ami Pro 3.0,** the latest entry in the explosive battle of Windows high-end word processing packages, ups the ante in the fight among the Big Three: Ami Pro, Microsoft Word for Windows 2.0, and WordPerfect for Windows.



The line between word processing and desktop publishing is fast becoming more and more blurry. Features in Ami Pro 3.0 are considerably more advanced than those found in true desktop publishing packages just a year or so ago.

Ami Pro 3.0 is certainly a major upgrade to version 2.0, which was introduced about a year ago. Some of the features (e.g., drag-and-drop text editing) are obviously reactions to the capabilities of Word for Windows 2.0. But Ami Pro goes beyond reactive design. It's full of clever features that make your work easier and faster.

My reaction to Ami Pro 3.0's fast format ability was, "Why didn't anyone think of this before?" Like many writers, I start by putting all the words down on the screen. I go back and worry about the look and feel later. With other packages, changing text attributes (e.g., bold and italic) or fonts is a multistep process of marking the text and using multiple menus or icons to choose the look and feel. With fast format, all I need to do is point to some text and click on a key. Ami Pro "remembers" the format. I can then go anywhere else in the document, mark text, and instantly change it to match that earlier style. (It's a lot faster to do than to explain.)

One of the things I like best about Ami Pro 3.0 is that it comes preconfigured with loads of useful items. There are 55 style sheets, with predefined styles for everything from business letters to faxes to newsletters. Graphics haven't been forgotten, either: There are over 100 pieces of predefined clip art that you can integrate into your documents. (You can, of course, import any graphical images.)

It would take thousands of words to cover all the features in Ami Pro 3.0. There are the usual bells and whistles you'd expect in a high-end package, such as automatic envelope and label printing, checking the grammar and spelling, and an elegant and easy-to-use mail merge. Unique features include SmartClick, which uses the often-ignored right mouse button for quick descriptions and quick changes. There's also Clean Screen, a nod toward WordPerfect users who like the minimum amount of distracting elements on the screen.

Last but not least, I have to mention SmartIcons, the customizable icon sets that are available in all of Lotus's Windows packages. The concept has been extended in Ami Pro 3.0 with seven sets of icons that you can mix, match, and edit to your heart's content. It's a useful way to make your work go faster and smoother.

Ami Pro 3.0 is a large program. Like Word for Windows 2.0, it requires about 15 MB of hard disk space. There's also a laptop installation option that loads the minimum features in 3.5 MB.

Choosing among high-end Windows word processors is not easy. The competing packages all have a core of similar features coupled with individual personalities. It's like choosing among a Ford, a Chevy, and perhaps a Toyota. At the bottom line, Ami Pro 3.0 sets a new standard that the competitors will rush to match.

—Stan Miastkowski

THE FACTS

Ami Pro 3.0
$495

Lotus Development Corp.
Word Processing Division
1000 Abernathy Rd. NE
Building 400, Suite 1700
Atlanta, GA 30328
(800) 831-9679
(404) 391-0011
fax: (404) 698-7653
Circle 1200 on Inquiry Card.

New Gigabyte Drive Is Portable but Pricey

The old bromide that "programs expand to occupy existing storage" still holds true. For MacFolk working with digital video, 24-bit-deep high-resolution scanned images, complex artwork, or color desktop publishing, the huge files created by these applications easily overwhelm hard drives that hold several hundred megabytes. Worse, in many cases you can't back up these files, even though you may need to transport them to a prepress house to create output.

Storage Dimensions offers an elegant solution. Its new **MacinStor MACB** transportable SCSI hard drives provide high-capacity storage of 235 MB, 500 MB, and 1 GB in a small, lightweight package. A 3½-inch SCSI drive, power supply, cooling fan, SCSI ID selector switch, and dual SCSI connectors are packed into a svelte 3¼- by 5¼- by 8-inch housing that tips the scales at 4½ pounds. The company uses a high-performance DEC SCSI drive that has a 10-millisecond seek time, a 512-KB read/write cache, and platters that spin at 5400 rpm to reduce latency.

A version of these drives (called 2Fast) implements a complete SCSI-2 interface that achieves data transfer rates of up to 10 MBps. Due to interface differences, the

Optiquest 2000D

15" Monitor

TAKING THE LEAD

The 15-inch Optiquest 2000D has taken the lead and blown the competition right out of the water!

With 1,024 x 768 resolution at 72Hz refresh this flicker-free monitor, according to Byte Magazine, is "The performance leader" The award-winning 2000D has a 15-inch flat square screen with an edge-to-edge display. This results in 36-percent more viewing area.

Along with the fine 0.28mm dot pitch, the 2000D boasts of Invar Shadow Mask technology. Now you can increase the brilliance and crispness of the image about 20 percent. Packed with features, the Optiquest 2000D even has micro-processor-based digital controls with built-in memory for 124 custom and preset adjustments.

When you think of high performance monitors, think of Optiquest. We offer a full line of 14, 15 and 17-inch non-interlaced monitors at competitive prices.

We're taking the lead. Go to an authorized Optiquest reseller TODAY and you'll see what we mean.

OPTIQUEST, INC.
9830 Alburtis Ave.,
Santa Fe Springs, CA 90670
Tel: (310) 948-1185 (800) 843-6784
Fax: (310) 949-2231

The Optiquest 2000D meets Swedish MPR-II standards for ELF and VLF low radiation emissions.

All products and brand names are brand names of their respective companies.

Circle 136 on Inquiry Card (RESELLERS: 137).

"... Optiquest 2000D is the overall performance leader."
Byte Magazine: May 1992

OPTIQUEST
The Non-interlaced Company

2Fast drives won't work with the PowerBook.

I received a shipping version of the MacinStor 1-GB transportable drive (the MACB-1000F) for evaluation. The drive comes with a SCSI cable, a disk format and partition application, a Control Panel for mounting and working with disk partitions, two manuals, and a copy of Central Point Software's MacTools Deluxe disk utility software.

How do you test a disk drive? You make it do all the things you demand of a drive. I started by installing A/UX 3.0 from a Mac IIci onto the MACB-1000F. The drive's manual explains how to do this, but I let the A/UX Installer application handle the job because it now supports third-party drives. The process went without a hitch, and although Installer used a default A/UX partition size of 160 MB, A/UX ran perfectly.

Next, I reformatted the drive and used it as a shared volume on the IIci. I was able to set access rights without problems, and the drive immediately became the holding tank for huge scan files created by BYTE staff projects. The drive was then put into temporary duty as an AppleShare volume on our AppleShare file server. No problems were encountered here, either, because AppleShare 3.0 relies on much of System 7.0's features to function.

I finally connected the MACB-1000F to a PowerBook 170 with the appropriate SCSI cable and was able to use files on the drive. Because the drive runs off external power, you'll need to be near an outlet to use it this way.

The MacinStor's one fault is its $5059 price tag. Comparable 5¼-inch SCSI drives can be purchased for under $3000. However, its small size and weight make it attractive to graphics professionals who need to carry megabytes of drawings, images, or magazine pages to a prepress shop for output on a color typesetter. If transporting huge amounts of data is a big issue with you, the MacinStor 1-GB transportable drive is worth it.

—Tom Thompson

THE FACTS

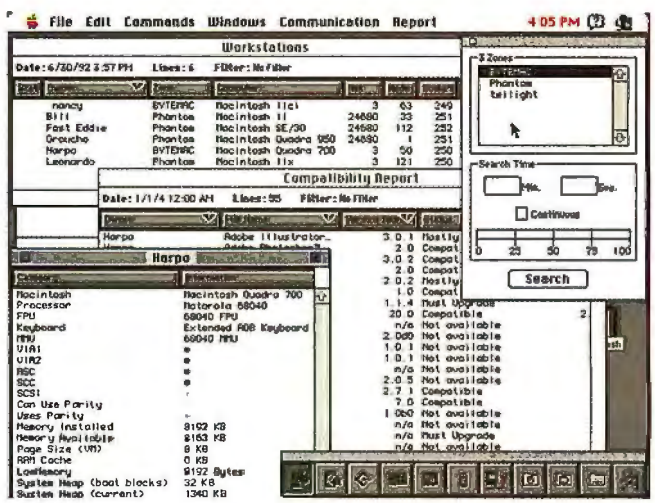
MacinStor
MACB-235F, $1679; MACB-500F, $3129; MACB-1000F, $5059

Storage Dimensions
1656 McCarthy Blvd.
Milpitas, CA 95035
(408) 954-0710
fax: (408) 944-1200
Circle 1201 on Inquiry Card.

NetOctopus 1.1 Manages Mac Network Resources and Software

Here's a network management product whose strange name accurately describes its function. **NetOctopus 1.1** is a network resource manager that lets a network administrator reach across an AppleTalk network (both LocalTalk and Ethernet) to manage the hardware and software resources of networked Macs. NetOctopus comprises a single management application and an InfoReporter Control Panel module that's installed on every Mac.

A network administrator uses the NetOctopus application to query a selected InfoReporter, which reports back the host Mac's hardware and software configuration. You can gather file information (e.g., names, creator, type, and version number) across the network and save it in a database for future reference. For example, you can query a zone of Macs about their CPU type, disk space, and memory to decide whether to install System 7.0 on your network and how much additional hardware you must budget for if you do.



New to version 1.1 of the software is support for System 7.0; a number of Apple events have been defined, so NetOctopus can be driven by other applications (e.g., UserLand Software's Frontier). NetOctopus now supports Apple Installer scripts. Thus, software like drivers or System software (e.g., Tune-Up) can be installed across the network. You can remotely change the Mac's printer selection, its owner name, or other user settings. NetOctopus is compatible with AppleTalk Remote Access, so a network administrator can manage company networks across the country.

Finally, you can perform software auditing with NetOctopus. You can specify

New! 286|DOS-Extender Version 2.5

Microsoft C/C++ 7.0 and Borland C++ 3.1 compatible!

Phar Lap DOS-Extenders

When your reputation's at stake...

We know how much work you put into building your product. Why use inferior tools that often create more problems than they solve? With a Phar Lap DOS-Extender, you know you're getting industry-leading, market-tested tools that have worked reliably for thousands of developers. Other DOS extenders simply can't measure up. Let Phar Lap show you what a DOS extender should be.

Phar Lap Software: Chosen 10 to 1 over all other DOS extenders. Here's why:

	Phar Lap DOS-Extender	Vendor A	Vendor B
Maturity	Over 5 years and 1000 applications	Less than a year	Brand new
Memory Model	Safe	Dangerous	Dangerous
Compatibility	INT 15, XMS, VCPI, DPMI	XMS, DPMI	XMS, VCPI
Library Support	Extensive list of 32-bit libraries	Limited library support	Limited library support
Documentation	Extensive and detailed	Limited	Less than 50 pages

Shatter the 640K barrier and build multi-megabyte DOS applications.

No more suffering with overlays or EMS.

Other DOS extenders can let common programming errors cause system crashes.

Build multi-megabyte DOS programs with Phar Lap's DOS-Extenders!

286|DOS-Extender™ — it's never been so easy! With our 286|DOS-Extender and your Microsoft C/C++, Borland C++ or Microsoft Fortran compiler, you've got all the tools you'll need to quickly and easily build multi-megabyte protected-mode applications — often by simply relinking without making source code changes. Now you can build protected mode applications that access up to 16 megabytes of memory on any DOS-based 80286, 386, 386SX, or i486 PC — without changing development tools! 286|DOS-Extender is also compatible with both Borland's Turbo Debugger and Microsoft's linker and CodeView debugger.

386|DOS-Extender™ — the ultimate in 32-bit power. 386|DOS-Extender turns DOS into a true 32-bit operating system with a flat, 32-bit address space. Your program can access all the memory available in the machine — up to 4 gigabytes! 386|DOS-Extender runs on any DOS-based 80386, 386SX, or i486 PC, and has been used in over 800 applications, including AutoCAD 386 and IBM's Interleaf Publisher. It is backed by a full complement of 32-bit languages, including C, C++, Fortran, Pascal, Ada and Assembler. With true 32-bit performance, you can finally build workstation-class applications for the PC.

Phar Lap Software, Inc
60 Aberdeen Avenue
Cambridge, MA 02138
617-661-1510
FAX 617-876-2972

Trademark holders: 286|DOS-Extender™, 386|DOS-Extender™ - Phar Lap Software, Inc.; Interleaf Publisher™ - Interleaf, Inc.; Windows™ - Microsoft Corp.; DESQview™ - Quarterdeck Office Systems. Registered trademark holders: Phar Lap® - Phar Lap Software, Inc.; AutoCAD® - Autodesk, Inc.; Borland®, Turbo Debugger® - Borland International, Inc.; IBM® - IBM Corporation; CodeView®, Microsoft®, MS-DOS® - Microsoft Corp.

1990 BYTE AWARD OF EXCELLENCE

1991 BYTE AWARD OF DISTINCTION

COMPUTER LANGUAGE PRODUCTIVITY AWARD 1991

Circle 146 on Inquiry Card.

The Colormate

At NEC we make a full line of advanced monitors ideally suited to the Colormate family. The MultiSync® 4FG,™ 5FG™ and 6FG™ all deliver exceptional clarity and they all feature our amazing AccuColor™ Control System.

The more presentations you have to make, the more you need the NEC Colormate™ PS printer. Because the Colormate pays for itself in no time. Legally. For as little as 49¢ a page. Imagine color on paper or transparencies at only a tenth of the cost of sending work out. And what's more, at just $4,799 (MSRP), it's the lowest priced PostScript™ language printer on the market.

The colors are as dazzling as the figures. Everything from soft pastels to brilliant primaries. And all Pantone®* approved. 300 dpi graphics means sharp, clear output. The Colormate PS integrates readily with any network, PC or Mac®. Plus, it's compatible with all popular graphics software.

Imagine all the freedom and control creating presentations in house will give you. Last-minute changes can be made in minutes. Just think, for a few dollars you can have output that looks like a million bucks.

C&C Computers and Communications

PS pays for itself.

For information, dial 1-800-NEC-INFO (in Canada, 1-800-343-4418). Or via fax, call NEC FastFacts™ at 1-800-366-0476 and request # CMPS (2677). NEC GSA # GS00K91AGS5241.

Because ⬆ is the way you want to go.

NEC

Circle 134 on Inquiry Card.

how many legitimate copies of an application the company owns and let NetOctopus perform a tally of the actual copies present on the network. You can load a listing file that contains the names and number of copies of all the company's registered software before beginning an audit. If bogus copies are present, a network administrator can either delete the offending files (if this operation is allowed by the user's InfoReporter settings) or send the user a message to clean up his or her act.

I examined a beta release of NetOctopus 1.1 on BYTE's Mac network. This network is composed of both Ethernet and LocalTalk cabling, two bridges, and several zones. You scan a zone and then select a Mac to examine by clicking on its name in the Workstations window. Double-clicking on the Mac's name brings up a toolbar that lets you examine the system's hardware, System software, SCSI peripherals, NuBus boards, parameter RAM, and more.

The Apple script feature is a delight; I popped the System 7.0 Tune-Up 1.1.1 floppy disk into my Mac IIci, picked two new Macs on the network, and selected the Installer Scripts command. The floppy disk whirred and a log window appeared, informing me which files were removed or updated. I issued a remote Restart command to the two Macs, and the job was done.

Some of NetOctopus's file operations seem awkward; first you command a file search, and then you open a report window. The reason for this order of events is that you often scan numerous Macs simultaneously when gathering information for a software audit. Then you make a report from the collected data. This minor detail should be explained in Balloon Help, but it isn't. However, once you get the hang of this, NetOctopus becomes a capable tool for software inventory and control. Network administrators who must manage both the Macs and the software they run should check out NetOctopus.

—Tom Thompson

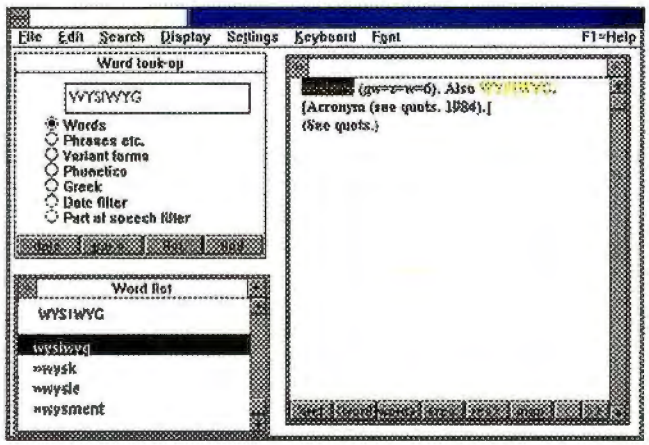
THE FACTS

NetOctopus 1.1
$645 for 10 users; site licenses available; free upgrade to version 1.0 owners

MacVonk USA
313 Iona Ave.
Narbeth, PA 19072
(215) 660-0606
fax: (215) 668-4360
Circle 1202 on Inquiry Card.

The Oxford English Dictionary Second Edition on CD-ROM

LONDON—The *Oxford English Dictionary* is the definitive reference guide to the English language. Unfortunately, the 20 huge volumes occupy over four feet of shelf space. Also, the set costs $3000. In 1987, Oxford University Press (OUP) released a CD-ROM version of the OED, but it was based on the 12-volume 1929 version. Thus, any words, quotes, or derivations that came after that date were not included. Nevertheless, BYTE found that version of the OED so useful that we presented it with a 1989 Award of Distinction (see the January 1990 BYTE).



The **OED Second Edition on CD-ROM** runs under Windows and is based on the second edition of the paper-based OED that was launched in 1989. Having said that, the CD-ROM actually contains the most up-to-date information available on OUP's computer system, which in this case means late 1991. So the OED on CD-ROM is even more timely than the paper edition.

The OED is a treasure of information about the English language. The actual word you are considering is only a small part of the information provided. A single word (called the *head word*) will usually have a pronunciation, a part of speech, a list of variant forms, an etymology, a definition, a list of related head words, some phrases that use the word, and a vast number of quotations showing how the word has been used through the decades. This means that the entry for a single word can be very large. For example, the word *set* has a 750-KB entry that runs to some 60 pages in the paper edition.

Before you even install the software, I suggest you read *A User's Guide to the Oxford English Dictionary*, which explains in detail how each entry in the paper version is constructed. This short book is supplied with the OED on CD-ROM in addition to the CD itself and a software user's manual. A Macintosh version of the CD-ROM is expected in early 1993. The amount of data and indexes crammed on the disc is now close to the absolute maximum at 640 MB.

The beta version of the OED I tested still had no installation routine, and I simply copied the files from the floppy disk onto my hard disk. After loading Microsoft's CD extension, you load Windows and launch the OED application. You are presented with a blank window with the usual array of menu titles across the top. The most obvious place to start is with a search, which gives you five alternatives: word, text, etymology, definition, and quotation.

Selecting any of the searches presents a dialog box and a scrolling window containing all the entries for that data type in the dictionary. You can enter a word or phrase in the dialog box or jump to the scrolling window and interactively search the list by typing the first few letters of the word you want. I found the latter much more satisfying, because I could see when

Pick up the number one real-time operating system.

And run with it.

In today's competitive market, it's important to run with the best. And when it comes to real time, the iRMX® operating system is the clear favorite.

You see, iRMX has a 13-year track record for proven reliability. In fact, only DOS runs on more X86 systems. Now, iRMX for Windows provides the first real-time operating system with guaranteed response time that runs DOS and standard-mode Windows on the i386™ and i486™ architecture. That's right, true real time on a PC.†

iRMX for Windows brings more than just affordable hardware to real time. It also gives you a head start on development with access to the huge installed base of DOS applications and tools. In fact, you even have the option to run Windows†† (including Windows 3.1).

So take the first step, call (800) GET-iRMX (800-438-4769)* and ask for Lit. Pack. #2A. And start running real time with your favorite DOS and Windows software.

intel®

*Outside the U.S.A and Canada, FAX (503) 696-4633. © 1992 Intel Corporation. iRMX is a registered trademark and i386 and i486 are trademarks of Intel Corporation.
†iRMX runs on IBM and Compaq compatible i386 and i486 based PCs. ††All other products shown or mentioned are trademarks or registered trademarks of their respective owners.

an entry wasn't listed rather than having the unhelpful "No entries found" message returned.

The results of any search are displayed as a scrolling list box, and you can select and view individual entries. There is a maximum of 8000 entries in a list box. If a search returns more than 8000 hits, it lists the first 8000 entries. You can paste search results into another Windows application or save them to disk.

There are some 600,000 individual references to words on the CD-ROM, but the most fascinating feature is the database of 2.5 million quotations. These quotations are included to show the usage of a particular word. The first quotation in any list can be considered the first published usage of the word. For example, looking up *WYSIWYG* reveals that BYTE has the first recorded usage of this acronym on page 264 of the April 1982 issue. What follows is a list of subsequent uses in magazines and newspapers.

The speed of a search is impressive when you consider the volume of data stored on the disk. Although timings are not final because this was a beta version, a search on the word *paper* returned 8157 entries in 12 seconds; a failed search takes just 3.5 seconds to report that no entries were found. Multiple word searches take longer. Because optimization is used, however, the least common word is searched for first, and subsequent words are searched only through the current hit list. For example, the phrase *Library of Congress* took 30 seconds to return a handful of entries, with *Congress* being used as the first search word.

Using the dictionary interactively is good for ad hoc queries, but for a serious language researcher, the process of accessing the information is just as important as the search results. Such users will want to take advantage of a query language that uses a SELECT statement to construct requests for information. The statements are easy to create, but for most people there is little point in doing this, because you can achieve most of what the query language does interactively.

My only reservation about this product is that it is addictive. While looking at it, I would quickly get sidetracked on an interesting reference. If you're self-disciplined, this isn't a problem. However, if you've got time on your hands, the OED on CD-ROM provides excellent entertainment. Now, did I mention that Jimi Hendrix and Pink Floyd get only one entry each in the dictionary? Well, actually this leads to...

—Andy Redfern

THE FACTS

Oxford English Dictionary Second Edition on CD-ROM
$850 (£495)

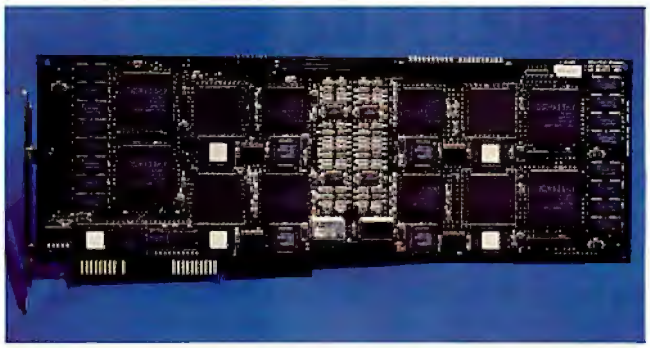
System requirements:
A 386 with 4 MB of RAM, Windows 3.0, and a CD-ROM drive with the Microsoft CD-ROM extension software (version 2.0 or higher).

Electronic Publishing
Oxford University Press
Walton St.
Oxford
Oxfordshire OX2 6DP
U.K.
44-865-267979
fax: 44-865-56646

Electronic Publishing
Oxford University Press
200 Madison Ave.
New York, NY 10016
(212) 679-7300
fax: (212) 725-2972
Circle 1203 on Inquiry Card.

GammaFax MLCP-4/AEB: High-End Fax, Long-Range Potential

It's the latest in cutting-edge fax technology. Using your fax machine's phone, you dial a number and hear "Welcome to XYZ Company's fax information service. For information on widgets, press 1. For..." The automated system leads you through a menu and instructs you to press "start" on your fax or hangs up to call back your device.



Such services are not new. What is relatively new is GammaLink's **GammaFax MLCP-4/AEB** board. When coupled with a Dialogic multiline voice communications system, it lets systems integrators create voice/fax response applications for multiple-line, simultaneous access from a single PC slot. The MLCP-4 lists for $3995, but OEM volume discounts will be available.

The voice-synthesis board I used was Dialogic's $1150 Dialog/41D, which includes a DOS development kit. This board supports up to four channels for dial-up or—for heavy-demand services using an additional adapter like Dialogic's $2300 DTI/124—a digital T1 line. (Heavy fax broadcasting applications without voice synthesis require a direct connection from the MLCP-4 to the T1 board.) Dialogic also offers a 12-channel version, and multiple GammaLink and Dialogic boards can be installed in a single system for as many as 24 channels.

GammaLink was the first company to introduce fax hardware and software for the PC. It has now left behind the market's commodity-based low end to concentrate on high-end products like the MLCP-4. This product combines the features of the GammaFax CP network fax board with the AEB (Analog Expansion Bus) connection required for voice telephony.

Each fax channel on the MLCP-4 has its own dedicated 16-MHz 80C188 processor and 512 KB of DRAM, which eliminates the need to use interrupts or DMA. (All Dialog/41D boards that you install will share an interrupt.) The host system

VALUE

Omron's portable fax/modem weighs only 4.2 oz.

PACKED.

Runs up to 12 hours on batteries.

When you decide to buy a portable fax/modem, you may be surprised by everything else you need to buy. To get the fax/modem to actually work, you have to shop for additional expensive software. Why doesn't someone put everything you need in a single box? They have. The new ergonomically designed Impala™ fax/modem from Omron gives you three top rated Windows and DOS software packages from Delrina and Bit. An AC adapter. Cables. Absolutely everything you need. In a single box. So why shop around when you can get over $300 of extra value *free* with Impala!

OMRON®

FREE COMPUSERVE OFFER FROM OMRON. CALL FOR DETAILS.

CALL 1-800-362-4411 FOR THE DEALER NEAREST YOU.

© 1992 OMRON OFFICE AUTOMATION PRODUCTS, INC. IMPALA IS A TRADEMARK OF OMRON, INC. OTHER PRODUCTS ARE TRADEMARKS OF THEIR RESPECTIVE HOLDERS.

Circle 200 on Inquiry Card.

recognizes the channels as I/O ports whose I/O-base addresses are set via four switches on the board.

The 16-bit board itself offers no direct telephone interface; rather, it relies on the separately sold voice-synthesis board (or a T1 adapter) to handle calls. A P3 20-pin ribbon cable connects the MLCP-4 with the voice-synthesis board through their respective AEB connectors, and you must give the cable a twist to properly align the pins. Beyond this, the MLCP-4's reference material and diagnostic programs (as well as those of the Dialogic board) prove sufficient to get the system up and running.

One necessary feature of the MLCP-4 is the CCITT Group 3 ECM (error-correction mode), which guarantees error-free fax transmission when the recipient's device supports it. If your application uses callback, however, your fax-connect time per call (and the resulting phone bill) will be even higher because of all the error correcting going on.

As with the standard GammaFax CP boards, you can use standard GammaFax applications like FAXM.EXE (the menu program) or the command-line GammaFax Command Language from DOS. You can run these from Windows 3.1 as well, and an OS/2 version should be available by the time you read this. But to develop applications where a board like Dialogic's will make fax requests to the MLCP-4- or for automated fax broadcasting—the $995 GammaFax Programmer's Interface is the ticket. Included as part of this DOS or OS/2 C-language GPI is a library whose four basic commands directly correspond with Dialogic's own API for control of the dispatcher, queue file, image handling, and real-time voice/fax processing.

GammaLink's GammaFax MLCP-4/AEB is a worthy entry into the market of shared and commercial fax applications, particularly in conjunction with a voice-synthesis board or a T1 board. Combined with the GPI, the potential for custom development is already putting a new spin on information retrieval. ■

—Ed Perratore

THE FACTS

GammaFax MLCP-4/AEB
$3995 ($995 extra for GPI)

System requirements:
MS-DOS 3.3 or 5.0 (not 4.x), 640 KB of RAM, and 2.5 MB of free hard disk space.

GammaLink
1314 Chesapeake Ter.
Sunnyvale, CA 94089
(408) 744-1400
fax: (408) 744-1900
Circle 1204 on Inquiry Card.

PC users are finally getting the whole picture. With PC/TCP Plus® you can connect to just about every operating system, from mini-computers and mainframes. PC/TCP Plus simplifies networking so that you can grab game files from underground R&D hosts and check a mainframe-based company-wide calendar from your home PC. You're able to print new documentation on the accounting department's high-speed laser printer, back up quarterly spreadsheets to a Unix box and even notify employees of an upcoming softball game.

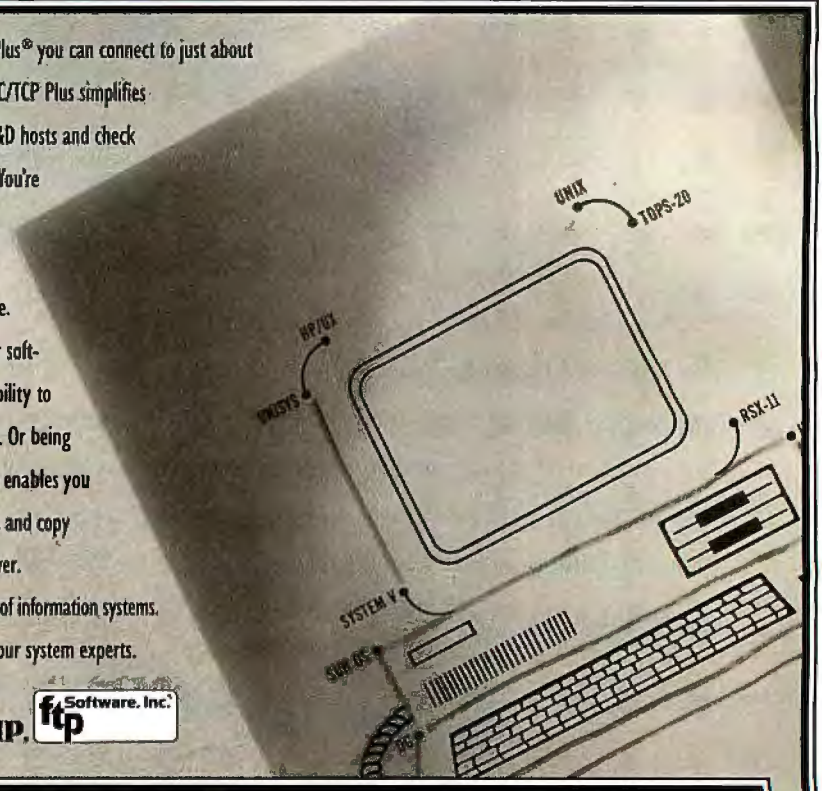
PC/TCP Plus gives you unprecedented compatibility with other software products. For frustrated PC users, that means gaining the ability to query marketing and accounting databases from within Windows. Or being able to use X-Windows to create CAD drawings. PC/TCP Plus even enables you to access graphic Computer Integrated Manufacturing applications and copy graphics files directly from your VAX to your NetWare or VINES server.

Learn how PC/TCP Plus can help your PC draw on a vast number of information systems. Call 617-246-0900 for a free telephone consultation with one of our system experts.

FTP Software, Inc., 26 Princess St., Wakefield, MA 01880-3004.

The performance standard in TCP/IP.

ftp Software, Inc.



We Connect Your PC To All Your Operating Systems.

PC/TCP is a registered trademark of FTP Software, Inc. VINES is a trademark of Banyan Systems, Inc. NetWare is a trademark of Novell, Inc. NFS is a trademark of Sun Microsystems, Inc.

Circle 106 on Inquiry Card (RESELLERS: 107).

release 3.1 shipping

CSS:STATISTICA

CSS/3™ Complete Statistical System with over 1,000 presentation-quality graphs fully integrated with all procedures and on-screen graph customization ■ The largest selection of statistics in a single system; in-depth, comprehensive implementations of: *Exploratory techniques; multi-way tables with banners; nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; logit/probit analysis; general ANCOVA/MANCOVA; stepwise discriminant analysis; log-linear analysis; factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; survival analysis; time series modeling; forecasting; lags analysis; quality control; process analysis; experimental design (with Taguchi);* and much more ■ Manuals with comprehensive introductions to each procedure and examples ■ Integrated Stats Advisor expert system ■ Extensive data management facilities (powerful spreadsheet with formulas; relational merge; data verification; flexible programming language) ■ Optimized (plain English menus/mouse) user interface: even complex analyses require just few self-explanatory selections (CSS can be run without manual; Quick Start booklet explains all basic conventions) ■ Macros, batch/commands also supported ■ All output displayed in Scrollsheets™ (dynamic tables with pop-up windows and instant graphs) ■ Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000) ■ Unlimited size of files; extended precision; unmatched speed (Assembler, C) ■ Exchanges data (and graphics) with many applications (incl. Excel®, Lotus 3®, dBASE IV®, SPSS®) ■ Highest resolution output on practically all printers (incl. HP, Postscript), plotters, recorders, typesetters ■ IBM compatibles, 640k or more ■ Price: **$595.**

Quick CSS™ Subset of CSS/3: all basic statistical modules (incl. data management) and the full, presentation-quality graphics capabilities of CSS/3 ■ Price: **$295.**

CSS:GRAPHICS™ A comprehensive graphics/charting system with data management ■ All graphics capabilities of CSS/3 and, in addition, extended on-screen drawing, 19 scalable fonts, special effects, icons, maps, multi-graphics management ■ Hundreds of types of graphs ■ Interactive rotation and interactive cross-sections of 3D graphs ■ Extensive selection of tools for graphical exploration of data; fitting; smoothing; spectral planes; overlaying; layered compressions; marked subsets ■ Unique multivariate (e.g., 4D) graphs ■ Facilities to custom-design new graphs and add them permanently to menu ■ Import/export of graphs and data, 15 formats ■ Optimized (menu/mouse) user interface; even complex graphs require few keystrokes: all graphs on this page can be produced from raw data in less than 20 minutes ■ Macros, batch/commands also supported ■ Unlimited size of files ■ Highest resolution output on all hardware (see CSS/3) ■ IBM compatibles, 640k or more ■ CSS:GRAPHICS is included in CSS:STATISTICA (available separately for **$495).**

Megafile Manager™ Comprehensive analytic data base management system ■ Unlimited size of files (up to 32,000 fields or 8 MB per record) ■ Megafile Manager is included in CSS/3 and CSS:STATISTICA (separately: **$295).**

CSS:STATISTICA™ A fully integrated system that combines all the capabilities of CSS/3 and CSS:GRAPHICS into a single extremely comprehensive data analysis system ■ Price: **$795.**

Domestic sh/h $7 per product; 14-day money back guarantee.

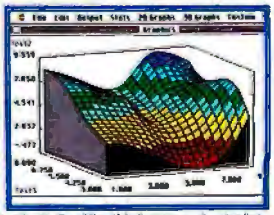
Circle 165 for DOS. Circle 166 for MAC.

StatSoft™

2325 E. 13th St. • Tulsa, OK 74104 • (918) 583-4149
Fax: (918) 583-4376

STATISTICA/Mac™ A CSS-compatible, comprehensive data analysis and graphics system designed for the Macintosh ■ Large selection of statistical methods fully integrated with presentation-quality graphics (incl. EDA, multiplots, a wide selection of interactively rotatable 3D graphs; MacDraw-style tools) ■ Unlimited size of files ■ Exchanges data with Excel and other applications ■ Price: **$595.**

Quick CSS/Mac™ A subset of STATISTICA/Mac: all basic statistical modules and the full, presentation-quality graphics capabilities of STATISTICA/Mac ■ Price: **$295.**



Overseas Offices: Statsoft of Europe (Hamburg, FRG), ph: 040/4200347, fax: 040/4911310; **StatSoft UK** (London, UK), ph: 0462/482822, fax: 0462/482855; **StatSoft Pacific** (Melbourne, Australia), ph: (03) 663 6580, fax: (03) 663 6117; **StatSoft Canada-CCO** (Ontario), ph: 416-849-0737, fax: 416-849-0918; Available From: CORPORATE SOFTWARE and other Authorized Representatives Worldwide: Holland: MAB Julsing, 071-230410; France: Version US (1) 40590913; Sweden: AkademiData 018-240035; Hungary; P&D Soft KFT 185-6868; Belgium: TEXMA 10 61 16 28; South Africa: Osiris 12 663-4500; Japan: SOFEL Co. 03-3251 1195.

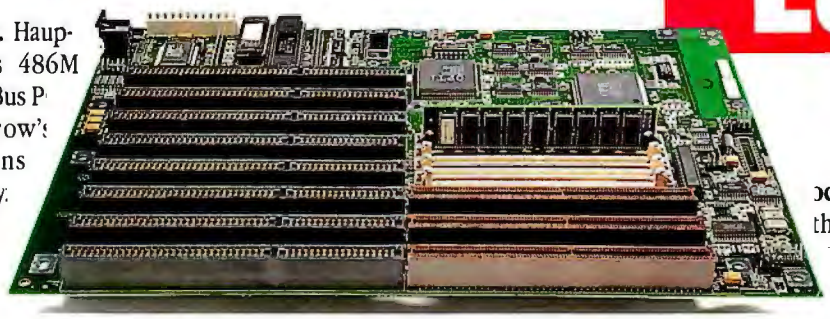
CSS, CSS:3, CSS:GRAPHICS, Megafile Manager, Quick CSS, STATISTICA, StatSoft, dBase IV, Excel, Lotus, MacDraw, Macintosh, Postscript are trademarks of their respective companies; SPSS is a registered trademark of SPSS, Inc.

Hauppauge announces an end

Modular Local Bus PC's from Hauppauge Computer Works

duced at a rapid pace. Hauppauge's LocalBus PC's are designed to be upgraded in three ways: CPU upgrade, Module upgrade and Module addition.

Local



Bust the bottleneck. Hauppauge introduces its 486M series: Modular, LocalBus P designed for tomorrow's Windows applications ...yet affordable today. The 486M PC's bust the 8-MHz I/O bottleneck by using a local bus with a direct connection from the Intel 486 CPU chip to the graphics processor. There's also up to 1 MByte of CPU cache RAM and lots of system memory (from 4MB to 64MBytes). Features you can afford today. Features you'll appreciate in the years ahead.

ɔcal bus graphics. For the absolute highest in Windows graphics performance, we've put our GUIacc (Graphical User Interface accelerator) right on the LocalBus. It includes the S3 graphics accelerator plus 1MByte of high speed Video RAM and a HiColor DAC. The GUIacc runs at the CPU speed, giving you the highest performance graphics combination available anywhere! Run your favorite true-color paint or drawing program with super performance.

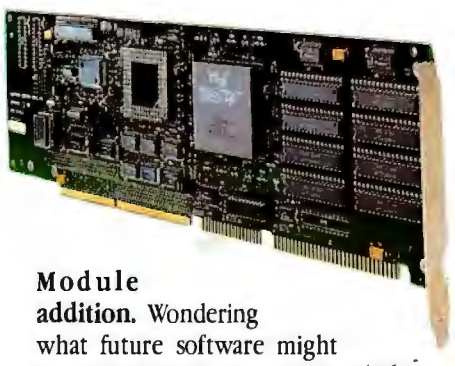
Avoid future shock with Hauppauge CPU modules

CPU upgrade. Hauppauge 486M PC's are designed to accept any 486 CPU chip. Simply remove the old 486 from its LIF socket and replace it with a newer, faster CPU and you're off and running with the latest 486 processor power.

Module upgrade. As new generations of CPU chips come to market, CPU upgrade will not always be possible. The Hauppauge LocalBus is designed as a 64-bit bus to allow upgrades to future CPU generations with maximum performance.

Full throttle graphics. Designed by our engineers and built here in the U.S.A., our 486M PC's are for Windows users who need more performance at an affordable price. And for users who have seen the dizzying change in technology and don't want to buy a new computer every two years. We know you don't want to replace your computer every time a new trend develops.

Fly non-stop. New generations of CPU's and software are being intro-



Module addition. Wondering what future software might require of your hardware? Our 486M PC's have a LocalBus slot for hardware accelerators that can solve long-term software problems.

- Microsoft DOS 5.0
- Microsoft Windows 3.1
- Norton Desktop for Windows 2.0
- Factory installed, ready to run software on hard disk with floppy disk backups
- 30-day satisfaction guarantee
- One year warranty
- Unlimited technical support

MICROSOFT® WINDOWS™ COMPATIBLE

THE NORTON DESKTOP™ FOR WINDOWS

Trademarks: Windows, DOS: Microsoft Corp.; Auto CAD: Autodesk; Intel Inside, i486: Intel Corp.; Norton Desktop: Symantec Corp.; i860, Win TV, GUI acc: Hauppauge Computer Works; IBM PC: IBM Corp.; 53-53 In.

to the Windows graphics jam:

Bus!!

Intel 486DX-33 CPU module
128K cache, expandable to 1MB
4MB RAM, expandable to 64MB
130MB <16msec cached IDE hard disk drive
Local bus GUIacc with 1MB VRAM and Hi-color DAC
14" Super VGA monitor
1.2MB, 1.44MB floppy disk drives
2 serial, 1 parallel
Maxiswitch 101 keyboard

Intel 486SX-20 CPU module
128K cache, expandable to 1MB
4MB RAM, expandable to 64MB
130MB <16msec cached IDE hard disk drive
Local bus GUIacc with 1MB VRAM and Hi-color DAC
14" Super VGA monitor
1.2MB, 1.44MB floppy disk drives
2 serial, 1 parallel
Maxiswitch 101 keyboard

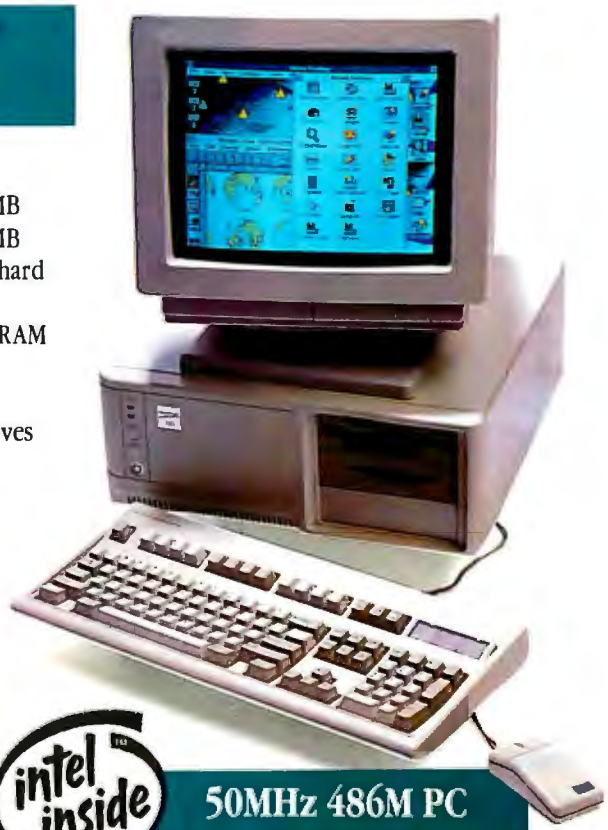
4860 CADstation

Our dual processor 4860 CADstation is designed for specific, heavy-duty AutoCAD applications. We've packed it with both a 33MHz 486 processor for fast overall performance and an Intel i860 RISC accelerator to speed up AutoCAD and Autoshade. And you'll get our 1152x900 24-bit per pixel local bus frame buffer for photo-realistic drawings. Dual monitor support plus the Hauppauge GUIacc top off feature list to make the 4860 CADstation the world's best PC for CAD!

Hauppauge's specially designed ADI/860 driver takes advantage of the i860 graphics capability for the best performance CAD system available. The ADI/860 is compatible with:

- AutoCAD rel. 11 and rel. 12
- Autoshade ver 2
- 3D-Studio version 1 and 2

Prices start at $6995.



intel inside

50MHz 486M PC $2895

Full speed Intel 486DX-50 CPU module
128K cache, expandable to 1MB
4MB RAM, expandable to 64MB
130MB <16msec cached IDE hard disk drive
Local bus GUIacc with 1MB VRAM and Hi-color DAC
14" Super VGA monitor
1.2MB, 1.44MB floppy disk drives
2 serial, 1 parallel
Maxiswitch 101 keyboard

Hauppauge!

Hauppauge Direct
91 Cabot Court
Hauppauge, New York 11788-3706

800-443-6284
In New York: 516-434-1600
Fax: 516-434-3198

Circle 112 on Inquiry Card.

An Integrated System

The Austin Executive Package includes an Austin 486/50 ISA system, a 210-MB hard drive, and 8 MB of RAM. It also has an NEC 4FG 15-inch noninterlaced flat-screen monitor, a Diamond Stealth VGA card with an S3 chip, and a Lexmark keyboard. The Austin Executive is preloaded with DOS 5.0 and Windows 3.1. An upgrade package for most Austin computers includes the monitor, the keyboard, and the VGA card.
Price: Austin Executive Package, $3890; upgrade package, $1290.
Contact: Austin Computer Systems, 10300 Metric Blvd., Austin, TX 78758, (512) 339-3500; fax (512) 454-1357.
Circle 1271 on Inquiry Card.

Austin Computer Systems' Executive Package integrates high-performance components for number-crunching and graphics applications.

Notebook Travels with 486 Power

The Model T50 486NoteBook, based on the 486-DX2 microprocessor, has 4 MB of RAM, 2.5 MB of which is 25-ns, 32-bit CMOS RAM. Total RAM is expandable to 10 MB. The 10-inch-diagonal, black-on-white, triple-supertwist VGA LCD has a resolution of 640 by 480 pixels with 16 gray scales. The Model T50 includes an 80- or 120-MB 2½-inch hard drive and an internal battery. The 5-pound notebook is 1⅛ inches thick. Options include a battery pack and an internal 2400-bps data/send fax modem. Standard software on the machine is DOS 5.0, LapLink Pro, and Battery Watch.
Price: With an 80-MB hard drive, $5599; with a 120-MB hard drive, $5899.
Contact: NoteBook Computer Co., 13100 Northwest Frwy., Suite 100, Houston, TX 77040, (713) 939-0486; fax (713) 939-1486.
Circle 1272 on Inquiry Card.

The 50-MHz Model T50 has an optional internal adapter for an external CRT monitor.

Ethernet for Everyone

A 386SX Ethernet workstation, the Lanco 320se runs at 20 MHz and has 2 MB of RAM (expandable to 8 MB). The unit includes an integrated 512-KB silicon RAM disk (expandable to 1.44 MB). Video consists of an ultra-VGA video interface that will support 1280- by 1024-pixel 16-color resolution or 1024- by 768-pixel 256-color resolution, and 512 KB of video RAM, expandable to 1 MB on the motherboard. The machine also has an analog and TTL monitor interface. All circuitry in the 6-pound machine is loaded on a single surface-mounted CPU board.

The 320se has Ethernet 10Base-2, 10Base-5, and 10Base-T connectivity; a bidirectional parallel printer port; and dual asynchronous serial I/O ports. Its user-selectable remote or local boot capability lets the network administrator make immediate system upgrades and control changes from the server. Software drivers are included for all disk or network operating systems.
Price: $1495.
Contact: Lanco, Inc., 800 West Airport Frwy., Suite 1100, Irving, TX 75062, (214) 438-4955; fax (214) 438-1571.
Circle 1273 on Inquiry Card.

Versatility at the High End

The full-size Dasher II-486/33LE EISA PC can be a NetWare LAN server or run Unix as a multiuser system. Connected to an Aviion server, the unit becomes a workstation; it also works as a single-user system.

Expandable to a 50-MHz unit via an exchange of motherboards, the system's basic configuration consists of a 33-MHz CPU, 4 MB of RAM (expandable to 28 MB via SIMMs and to 60 MB via a board), a 1.44-MB or 1.2-MB floppy drive, and a Super VGA card with 1 MB of video RAM that supports up to 1024- by 768-pixel resolution in 256 colors. The machine is designed to support Intel's 33-/66-MHz microprocessor when it becomes available.

The Dasher II-486/33LE includes five available 32-bit EISA bus-mastering slots and four half-height drive bays. You can configure three of the drive bays with a second floppy drive and as many as three hard drives, for a maximum of 1.5 GB of storage. The unit ships with DOS 5.0 and Windows 3.1. Optional 128-KB direct-mapped cache memory is available.
Price: $4095.
Contact: Data General Corp., 3400 Computer Dr., Westborough, MA 01590, (800) 328-2436 or (508) 366-8911.
Circle 1274 on Inquiry Card.

3 GB of Optical Storage

The HyperSpace Shuttle for SGI, based on the HyperSpace rewritable optical drive, is a plug-and-play desktop library for Silicon Graphics workstations. Able to handle up to five 600-MB cartridges in its magazine, the Shuttle's on-line storage capacity is 3 GB.

The 3600-rpm HyperSpace drive in the Shuttle has a 1-MBps sustained data transfer rate, an average access time of 37 ms, and an average seek time of 28 ms. The optical cartridges are compatible with other ISO-standard optical-drive products. The HyperSpace Shuttle is targeted at data-intensive graphics environments, such as CAD/CAM, animation, and imaging.

Price: $9990.

Contact: Ricoh File Products Division, Ricoh Corp., 3001 Orchard Pkwy., San Jose, CA 95134, (408) 432-8800; fax (408) 943-9364.

Circle 1275 on Inquiry Card.

PostScript Color Printing

Occupying less desk space than a laser printer, the Personal ColorPoint PS thermal printer offers a resolution of 300 dpi with 16.7 million colors. The printer lets you produce three- or four-color and monochrome images on paper or film.

The Personal ColorPoint PS provides full PostScript compatibility, supports HPGL (Hewlett-Packard Graphics Language) 7475A emulation, and provides 39-font Apple LaserWriter II emulation with bit-map smoothing.

Standard interfaces include serial, parallel, and AppleTalk. An optional video interface allows high-speed image capture, and you can store additional fonts on an external hard drive via an optional SCSI connector. The printer lets you increase the buffer memory size from the standard 6 MB to 22 MB.

The Personal ColorPoint PS also features linear Pantone color matching. Software drivers are included for Windows 3.0 and Mac OS environments.

Price: About $7622 (£3995).

Contact: Ambitron Ltd., 13 The Paddock, Hambridge Rd., Newbury, Berkshire RG15 5TQ, U.K., 44-635-36555; fax 44-635-32055.

Circle 1276 on Inquiry Card.

The HyperSpace Shuttle for SGI allows data access across heterogeneous Unix networks.

Projections in Color

ColorWorks LCD projection panels from Proxima use color-stripe filters with a passive-array LCD for high-quality color and light weight. The color-stripe filter technology, which permits all three color filters to be placed on one panel, enables the panels to project up to 24,389 colors with a contrast ratio of 20 to 1 and a resolution of 640 by 480 pixels.

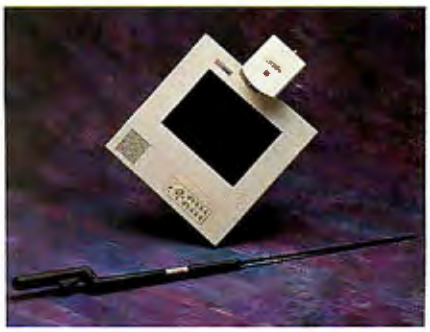
With ColorWorks panels, you can add brilliant saturated color to charts, graphics, spreadsheets, and text. As a dynamic medium, ColorWorks lets you incorporate special effects and limited animation in your work.

The entry-level 9-inch-diagonal A502C and 11-inch-diagonal A522C ColorWorks panels are compatible with PCs, Macs, and Apple IIs. The panels have a full-duplex serial port and come with wireless remote control and cabling needed for high-impact VGA and Mac II presentations. The A522C includes presentation utility software and additional cabling. Both panels are compatible with Proxima's Cyclops interactive pointer system.

Price: A502C, $3995; A522C, $4995.

Contact: Proxima Corp., 6610 Nancy Ridge Dr., San Diego, CA 92121, (619) 457-5500; fax (619) 457-9647.

Circle 1277 on Inquiry Card.



The ColorWorks panel projects true color economically.

Portable Floptical Drive

FloptiPak 21, a 3½-inch 21-MB floptical drive, weighs less than 2 pounds for easy transportability. The SCSI device, which measures 1 by 9 by 5 inches, accesses its power through the floppy drive port of your Mac. The FloptiPak 21 uses optical servo track positioning and magnetic read/write technologies to achieve a density of 1245 tracks per inch. The drive reads and writes to standard 1.44-MB floppy disks for Macs and PCs and to 720-KB floppy disks for PCs.

Price: $699; media, $49.

Contact: Mass Microsystems, Inc., 810 West Maude Ave., Sunnyvale, CA 94086, (408) 522-1200; fax (408) 733-5499.

Circle 1278 on Inquiry Card.

Computer-to-TV Link

TV Link connects any VGA-equipped computer to a TV, TV monitor, or video projector. Able to display at resolutions of up to 640 by 480 pixels, the 3-pound unit has NTSC composite and S-Video outputs.

Price: $1165.

Contact: KDI Corp., 3975 McMann Rd., Cincinnati, OH 45245, (513) 943-2000.

Circle 1314 on Inquiry Card.

Desktop Video Publishing

VideoVision brings video publishing to your desktop. The interface card contains built-in video input, video output, 24-bit graphics display capabilities, comprehensive software controls, and an external connector panel for video and audio connections. The integration of these capabilities lets you implement an idea in a number of different ways, such as in interactive on-screen demonstrations and as slides. The Mac-compatible card also allows you to input and output analog and digital video.

A built-in encoder provides flicker-free images directly to videotape and has on-board international-standards-conversion capabilities. Instantaneous variable window resizing without loss of resolution lets you display video at resolutions of up to 768 by 576 pixels. The card is bundled with Diva's VideoShop and MacroMedia's Action.

Price: $2399.

Contact: Radius, Inc., 1710 Fortune Dr., San Jose, CA 95131, (408) 434-1010; fax (408) 434-0770.

Circle 1279 on Inquiry Card.

VideoVision integrates video with sound and display.

Graphics Fly in True Color

Two boards follow different paths to fast graphics in true color.

A 32-bit graphics coprocessor board, Number Nine Computer's #9GXiTC supports the display of 16.7 million colors at resolutions as high as 1024 by 768 pixels. The board also creates a virtual workspace that supports 65,000 colors at resolutions of 1152 by 870 pixels and 1280 by 1024 pixels. In the virtual area, you can open multiple applications at the same time.

The card's HawkEye Feature Set offers unique capabilities. HawkEye Zoom lets you instantly magnify your entire screen by two, four, eight, or 16 times by pressing a hot key or a mouse button. HawkEye Chameleon Cursor lets you change the color of the cursor by clicking on an icon and selecting a color from a pop-up menu. HawkEye Resolution Exchange lets you click on an icon to select the desired resolution and number of colors you want to display; the Resolution Exchange changes the resolution, reboots your computer, and returns you to Windows.

Price: $2295.

Contact: Number Nine Computer Corp., 18 Hartwell Ave., Lexington, MA 02173, (617) 674-0009; fax (617) 674-2919.

Circle 1280 on Inquiry Card.

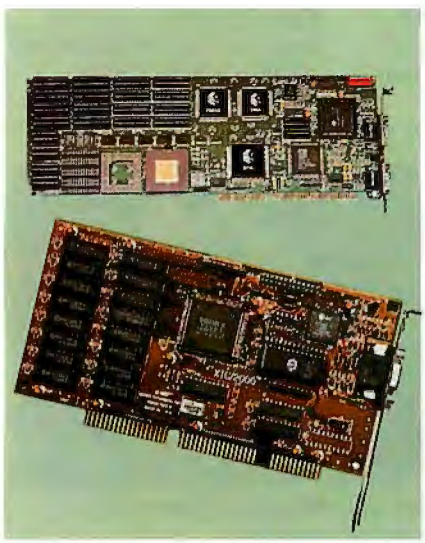
Video Dynamics' XTC/2000 24-bit graphics display adapter for PCs supports 2 MB of VRAM (video RAM), allowing displays of up to 256 colors at 1280- by 1024-pixel resolution. The board supports up to 65,536 colors at 800- by 600-pixel resolution, and up to 16.7 million colors at 640- by 480-pixel resolution.

The XTC/2000's hardware-accelerated graphics coprocessor speeds up critical graphics functions to more than 10 times the speed of standard Super VGA, according to Video Dynamics. Drivers on the board include support for AutoCAD, Windows 3.1, GEM, X Window System X11.5, Lotus 1-2-3, Ventura Publisher, and WordPerfect.

Price: With 1 MB of VRAM, $399; with 2 MB of VRAM, $499.

Contact: Video Dynamics, Inc., 1550 Bryant St., San Francisco, CA 94103, (800) 243-3527 or (415) 863-3023; fax (415) 863-2979.

Circle 1281 on Inquiry Card.



The #9GXiTC (top) and the XTC/2000 (bottom) offer two approaches to colorize high-resolution displays.

Upgradable CPU Cartridges

The i486DX/50 and 386DX/40 upgradable CPU cartridges from Positive can be used in any of Positive's CPU-upgradable systems. The 486DX/50 is based on the 486DX microprocessor for high speed and power. The 386DX/40 has a math coprocessor and a built-in RAM cache.

Price: 486DX/50, $1499.99; 386DX/40, $599.

Contact: Positive Corp., 405 Science Dr., Moorpark, CA 93021, (805) 523-0340.

Circle 1282 on Inquiry Card.

Boost Your IBM AT

Based on AT&T's DSP32C digital-signal-processing CPU, the DSP32C board provides your IBM AT with 25 MFLOPS of computing power. The board combines a 50-MHz version of the 32-bit DSP with 640 KB of 35-ns wait-state static RAM and a 32-bit bidirectional parallel port, which runs at full processor speed. The AT's bus can make memory transfers while the DSP32C is executing.

Price: About $2862 (£1500).

Contact: Neural Computer Sciences, Unit 3, Lulworth Business Centre, Nutwood Way, Totton, Southampton SO4 3WW, U.K., 44-703-667775; fax 44-703-663730.

Circle 1315 on Inquiry Card.

Try stuffing these into a laptop.

Laptops have their place, but for mission-critical applications requiring serious expansion, workstation power, CRT-quality screens or toolbox ruggedness, get a P.A.C.™ (Portable Add-In Computer). ■ **MASSIVE EXPANSION.** Nobody gives you more expansion possibilities then Dolch. In an 18 pound package a Dolch P.A.C. has room for up to five full-size EISA/ISA add-in cards. You can add up to 32 MB RAM, 1 GB HDD, and any combination of drives, CD-ROM, removable HD, streaming tape, and more. ■ **EXTREME POWER.** Dolch P.A.C. systems have been rated "the fastest portables on the market" since 1987, and have won more Editor's Choice awards then any other product in its category. *Computer Reseller News* calls the 486-50E "a dream machine . . . one of the most powerful PCs of any kind." P.A.C. systems are based on 386SX and DX, and 486 CPUs up to 50MHz, delivering as much as 22 MIPs. ■ **DAZZLING DISPLAYS.** "Breathtaking . . . Dolch's heart-stopping TFT Color Display produces vibrant colors and sharp images virtually on par with those seen on desktop VGA monitors," reports *PC Computing*. ■ **MIL RUGGEDNESS.** Every P.A.C. is as tough as it is powerful. Certified under MIL Std. 810C Dolch provides true mission critical reliability. ". . . it simply outclasses its competitors and it is sturdy and solid . . ." says *PC Magazine*. ■ **GET THE FULL STORY.**

intel inside

Dolch.

POWER PORTABLE ADD·VANTAGE

DOLCH COMPUTER SYSTEMS · 372 TURQUOISE STREET · MILPITAS · CALIFORNIA 95035 · USA

Circle 104 on Inquiry Card.

1989 1989 1990 1990 1991 1991 1992

Bidirectional Data Mover

Designed around Trantor's P3C ASIC chip, the T348 MiniSCSI Plus parallel-to-SCSI host adapter enables you to move full 8-bit data blocks in both directions between the host computer and SCSI devices connected to the parallel port without losing the use of your printer. Transfer speed is similiar in both directions.

The portion of the adapter that contains the active circuitry is adjacent to the SCSI device, eliminating the need for a separate SCSI cable. The adapter is particularly suitable for use with CD-ROMs, according to Trantor.
Price: $229.
Contact: Trantor Systems, Ltd., 5415 Randall Place, Fremont, CA 94538, (510) 770-1400; fax (510) 770-9910.
Circle 1283 on Inquiry Card.

Sonic Digitizer

With the GP-10 Sonic Digitizer, you can digitize blueprints, drawings, maps, x-rays, film, and projected images without using a tablet. The single-piece unit lets you choose from eight output formats or program it for your own output; it has an on-screen menu for format selection via a one-time initialization. The digitizer is compatible with PCs and Macs, as well as with major software packages.
Price: $1775.
Contact: Science Accessories Corp., 200 Watson Blvd., Stratford, CT 06497, (203) 386-9978; fax (203) 381-9270.
Circle 1284 on Inquiry Card.

The MiniSCSI Plus connects CD-ROM and SCSI devices to laptops.

Keep Your CPU Cool

A commercial heat sink and miniature fan combination, the CPU Kooler complies with Intel's temperature specification for housing its 486 processors, providing an internal environment of from 32° to 185°F measured at the top center of the ceramic pin-grid array. Available in several heights to fit different cabinets, the CPU Kooler comes with a 12-V motor that connects to a floppy drive cable.
Price: $39.95.
Contact: PCubid Computer Technology, 6705 Silverthorne Cir., Sacramento, CA 95842, (916) 338-1338.
Circle 1285 on Inquiry Card.

Fast Printing

Kansai's high-speed printer buffers feature a DMA architecture on all I/O ports, achieving buffering throughput of up to 300 KBps. The EDB-30 (three ports), EDB-40 (four ports), and EDB-50 (five ports) buffers allow printers to receive data as fast as CPUs and bus architectures can transmit it. The buffers are available with 1, 2, 4, 8, or 12 MB of SIMM memory installed. You can daisy-chain multiple buffers, which don't require special software or drivers, the company says.
Price: $599 and up.
Contact: Kansai Electric USA, 2005 Hamilton Ave., Suite 220, San Jose, CA 95125, (800) 733-3374 or (408) 377-7062; fax (408) 377-7085.
Circle 1287 on Inquiry Card.

Virus Hunter

Version 2.0 of the PC Rx Antivirus uses a binary searching method that scans two to three times faster than the previous version in DOS and Windows to detect more than 1650 viruses. The program's pattern-independent TSR virus filter monitors suspicious programs for nine virus behaviors.

In Windows, PC Rx 2.0 lets you continue working while it scans in the background. This scanning reduces the PC Rx scanning meter to an on-screen icon, letting you view the progress. If PC Rx finds a virus, a scrollable Virus Found List pops up that gives you the option of clicking on one or a group of infected files and instructing the program to delete or rename the files or clean the virus.
Price: $69.
Contact: Trend Micro Devices, Inc., 2421 West 205th St., Suite D-100, Torrance, CA 90501, (800) 228-5651 or (310) 782-8190; fax (310) 328-5892.
Circle 1286 on Inquiry Card.

Power Protector

A computer and modem surge-protector strip, the EG556TC from Intermatic continuously monitors the incoming power line for a surge or spike. The unit responds within a nanosecond to absorb any overload while allowing normal voltage to continue to pass through the line. After the power returns to normal, the surge strip automatically resets to monitoring mode.
Price: $36.95.
Contact: Intermatic, Inc., Intermatic Plaza, Spring Grove, IL 60081, (815) 675-2321.
Circle 1317 on Inquiry Card.

Font Card for Okidata Printers

The TurboCard font card from UDP Data Products expands the usefulness of the Okidata 400/800 series of LED printers. The card provides Swiss and Dutch equivalent fonts, as well as the company's interpretation of typefaces such as Dom Casual, Copperplate, Old English, Brush, and Copper Black. Compatible with Windows 3.1, the TurboCard includes drivers for popular word processing packages.
Price: $249.
Contact: UDP Data Products, 2908 Oregon Court, Building I-2, Torrance, CA 90503, (800) 888-4413 or (310) 782-9800.
Circle 1316 on Inquiry Card.

The Monitor for Windows

The ViewSonic 7 was the original, "Big Screen for Windows" monitor. Here's what some editors said about it:

Byte (May 1992) *"... The ViewSonic 7 gets our vote as the best overall monitor".*

Windows Magazine (May 1992) "... The ViewSonic 7 is the best value in the test".

Infoworld (Sept 1991) "The ViewSonic 7 captured the top spot in our tests".

Introducing the NEW 14" ViewSonic 5E and 15" ViewSonic 6FS.

The best of all worlds ... ideal Windows' monitors to fit the size and budget requirements of every customer.

Now you have a choice.

These three great non-interlaced monitors have a lot in common, including minimum resolution of 1,024 x 768 at 72Hz refresh up to 1,280 x 1,024 non-interlaced. That's flicker-free! Plus they're multi-frequency and have a non-glare screen.

The two larger monitors both have a flat square screen and microprocessor-based memory with programmable preset modes for screen adjustments. And, for a safer environment, they are MPR-II certified for low radiation.

If you're particular about which monitor is best for Windows, make it a ViewSonic. You get a choice ... of size and price range along with the excellent ViewSonic quality and reputation.

ViewSonic®
20480 E. Business Parkway
Walnut, CA 91789
(714) 869-7976 (800) 888-8583
FAX (714) 869-7958

All products and brand names are trademarks of their respective companies.

Circle 181 on Inquiry Card (RESELLERS: 182).

There Are 174 In AutoCAD

3. Phenomenal 3D rendering. Capabilities that used to come only with AutoShade® are now built into AutoCAD® Release 12. And hidden line removal is up to 100 times faster.

4. AutoCAD SQL Extension (ASE) allows you to access data in standard database management systems via SQL. ASE provides commands for manipulating external nongraphic data and linking it to graphic entities in AutoCAD drawings.

5. Region Modeler creates intelligent 2D models. Allows you to quickly create 2D shapes with holes and complex boundaries. Automatically finds area, perimeter and inertial properties of a region.

6. Automatic timed save at user-selected intervals.

7. Now you can use PostScript® typefaces in AutoCAD drawings.

8. You can also import PostScript files into AutoCAD, and plot them.

9. New boundary polygon command surrounds an area with a closed polyline automatically.

10. New Fence or Polygon window crossing selection feature speeds selection of entities in dense and complex areas of drawings.

11. No Main Menu! You now enter directly into the AutoCAD drawing editor, where you can perform standard file handling and configuration operations, as well as work on your drawing.

12. Dramatically improved entity selection speed in large drawings.

13. Nested entity dimensioning. Entities within blocks or external references are now easily dimensioned.

14. Locked layers feature prevents accidental modification of drawing data.

15. PostScript output feature lets you enhance AutoCAD drawings by using PostScript-compatible imaging programs.

16. Release 12 and Release 11 drawings are forward and backward compatible.

17. Support for 255 individual pen widths for laser and electrostatic plotters.

18. You can plot without leaving the drawing editor. (And without losing the UNDO file.)

19. Now you can import TIFF, GIF and PCX raster images into your drawing.

20. GripEdit feature allows interactive editing of selected entities without running a command.

21. PickFirst feature lets you select entities prior to executing a command.

22. Improved external references. You can attach, reload or bind Xref files while the "master" is being edited.

23. Enhanced hatching. Automatically hatch bounded areas with a single pick.

24. New continuous polyline linetypes facilitate contour mapping and other applications.

25. Programmable dialog boxes can be customized for your particular working environment or by third-party application developers.

26. AutoCAD's new integrated calculator performs calculations based on existing geometry and includes extensive algebraic and geometric functions.

27. New ALIGN command lets you move and rotate entities in 2D or 3D.

28. 3D ROTATE command rotates entities about an arbitrary 3D axis.

29. 3D MIRROR command mirrors entities on an arbitrary 3D plane.

30. CHANGE command enhancements simplify entity property modifications, such as elevation, color, layer, linetype and thickness.

31. Advanced, multipoint tablet calibration allows compensation for map projections or stretched drawings.

32. Platform-independent menus and dialog boxes that follow operating system standards. So AutoCAD works like other programs on your computer.

33. An improved graphical interface makes the power of AutoCAD more accessible to everyone.

34. Cascading pull-down menus that put more power at your fingertips.

35. Pop-up menus at the cursor location for often-used items.

36. Screen menu is automatically updated to reflect the currently running command.

37. Shift and Control key combinations allow you to invoke more commands with your mouse and digitizer buttons.

38. Single mouse click-and-release action for selecting pull-down menus.

39. Automatic Drawing Conversion. Full support for any drawing created by any version of AutoCAD.

40. Enhanced CONFIG command allows for configuring AutoCAD from the drawing editor.

41. New dialog boxes give you control of dimension variables and styles.

42. Dimension dragging feature provides visual feedback while creating dimensions.

43. RECTANGLE command now allows you to create a rectangle with just two screen picks.

44. Enhanced Write Block command helps developers maintain "smart" drawings (entity handles).

45. Enhanced command transparency lets more commands be used inside other commands.

46. Transparent "Object Filters" dialog box allows more flexible definition of selection sets.

47. ZOOM Window is now the default.

48. DXFIX utility reads R12 DXF™ files and translates them into R10 files.

49. New COMPILE command compiles shape files, font files and Type 1 PostScript fonts.

50. Now you can fill closed polylines with PostScript patterns for extremely high-quality output.

51. Network users can view and plot AutoCAD drawings without using server authorization.

52. Database-specific drivers link AutoCAD and external nongraphic databases, such as dBase,® Paradox,® Oracle® and others.

53. Create New Drawing command now allows you to start with an unnamed

Now All Upgrades To AutoCAD Release 12 Are Only $500.

Offer Expires October 31, 1992.

Depending on what version of AutoCAD® you're using, the normal price of upgrading to new AutoCAD Release 12 could be as much as $3000. Act now and you can upgrade for only $500.*

☐ Yes, I want to upgrade now. Please have an Authorized AutoCAD Dealer call me.

☐ I'm interested. Please send me more information on AutoCAD Release 12.

Are you a current AutoCAD user? ☐ Yes ☐ No, but I'd like to be. If yes, what Release? _____

What platform? ☐ DOS ☐ Sun™ ☐ Other? _____ Current Serial # _____

Name _____ Company _____

Title _____ Address _____

City _____ State ____ Zip _____ Phone _____

Please complete this reply card. Or call 1-800-964-6432, ext. 770. AUTODESK

*Upgrade price valid in U.S. and Canada only. AutoCAD Release 12 is now available on DOS 386 and Sun platforms. Other versions will be available soon.

©1992 Autodesk, Inc. AutoCAD, Autodesk and the Autodesk logo are registered trademarks of Autodesk, Inc. Sun is a trademark of Sun Microsystems, Inc.

NO POSTAGE
NECESSARY
IF MAILED
IN THE UNITED
STATES

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 76475 SEATTLE, WA

POSTAGE WILL BE PAID BY ADDRESSEE

AUTODESK, INC.
PO BOX 84883
SEATTLE WA 98124-9763

New Features Release 12.

drawing or specify a prototype drawing.

54. OPEN command presents "Open File" dialog box to simplify loading of existing drawings.

55. SAVE AS command now changes the current drawing name to new name specified.

56. END and QUIT commands prompt you for a file name when exiting an unnamed drawing, to prevent you from losing data.

57. Several AutoLISP® enhancements, including much faster loading of LISP routines.

58. A wide range of new and enhanced system variables, especially created for the power user.

59. DD Modify command allows for interactive editing of entity parameters.

60. New Units Control dialog box shows all units, angles and direction values on-screen as well as precision settings.

61. New special context-sensitive help dialog boxes allow you to browse through available help files.

62. New View Control dialog box allows selecting with a pick instead of typing in view name.

63. You can plot AutoCAD drawings as bit map files in PCF, TIFF, TGA and GIF formats. You can even automatically FAX your drawings to a subcontractor or client.

64. 24-bit, true color rendering is supported by appropriate hardware.

65. PostScript files can be brought in as outlines or fully rendered images.

66. Modify Entity dialog box enables you to edit an entity's properties directly.

67. Mirrored blocks can now be exploded.

68. List and load standard AutoCAD SHX fonts as well as Adobe Type 1 PostScript fonts from dialog box.

But Either One Of These Alone Makes It Worth The Price.

1. Something every AutoCAD® user has been waiting for: new technology that virtually eliminates regens. A new built-in 32-bit display list permits pans and zooms without regens. So you can spend your time editing your drawing, instead of waiting for regens.

2. The plot quickens. Now you get WYSIWYG plot preview, on-the-fly plot device selection and the ability to save plot configurations.

69. New option allows a box to be drawn around dimension text automatically.

70. Insert a text string before or after dimension text automatically.

71. Configuring for ADI® drivers has never been easier, with the new feature that displays all drivers in the appropriate menu when configuring AutoCAD.

72. HP LaserJet legal-size paper output is now supported by a new, improved device driver.

73. ADS applications can now be compiled by inexpensive "real mode" compilers; no need for costly development tools.

74. AutoLISP and ADS can now be used to drive the PLOT command.

75. Linetype scaling adjusts to view scale in Paper Space.

76–174. Unfortunately, we're out of space. But you get the idea. Release 12 is the most significant enhancement of AutoCAD ever. Its improved performance will pay off for every AutoCAD user. So the cost of an upgrade can pay for itself in a couple of weeks.

If you're still not convinced, call your Authorized AutoCAD Dealer. Your dealer can give you an even more complete list of the new features. And tell you what you need to do to upgrade. If you need more information or the number of your nearest dealer, call

1-800-964-6432, ext. 770.

Outside the U.S. and Canada fax 415-491-8303.

AUTODESK®

©1992 Autodesk, Inc. Autodesk, the Autodesk logo, AutoCAD, AutoLISP, ADI and AutoShade are registered trademarks of Autodesk, Inc. AutoCAD Development System (ADS) and DXF are trademarks of Autodesk, Inc. All other product names are trademarks of their respective holders.

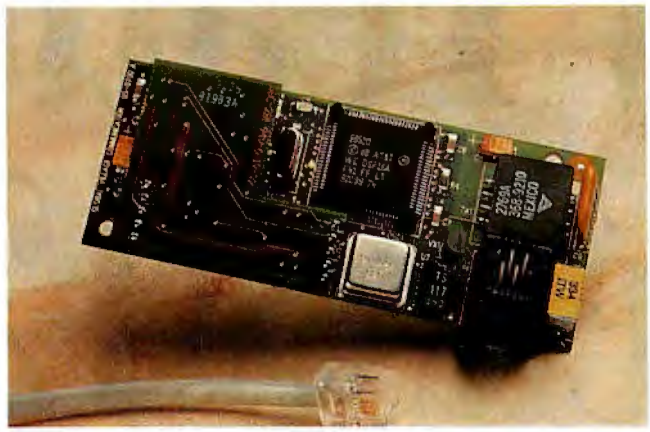
Circle 82 on Inquiry Card.

Internal Modems for the PowerBook

High-speed data access and faxing come to the PowerBook with Global Village Communication's PowerPort Gold internal fax/data modem. A V.32bis modem with V.42bis error correction and data compression the PowerPort Gold provides error-free transmissions at a speed of 14,400 bps; faxes are transmitted at 9600 bps. The board also lets you connect transparently to AppleTalk networks at speeds similiar to those of desktop access.

Also new are the PowerPort Silver and the PowerPort Bronze. Designed for moderate users of on-line services, the PowerPort Silver includes data access and has 9600-bps fax send and receive speeds. The PowerPort Bronze, geared for heavy users of fax services who sometimes need to communicate on-line, has 2400-bps data-access, 9600-bps fax-send, and 4800-bps fax-receive speeds.

Each modem works with any PowerBook. GlobalFax software wakes up a PowerBook to receive a fax and then returns it to sleep mode.
Price: PowerPort Gold, $795; PowerPort Silver, $595; PowerPort Bronze, $295.
Contact: Global Village Communication, 1204 O'Brien Dr., Menlo Park, CA 94025, (415) 329-0700; fax (415) 329-0767.
Circle 1288 on Inquiry Card.



PowerPort Gold makes location-independent computing a reality with your Mac PowerBook.

Integrate Voice, Fax, and Network Traffic

Micom Communications' remote Ethernet bridge, NetRunner, integrates voice, fax, and data traffic with LAN traffic over low-speed leased lines. With NetRunner, you can transmit synchronous and aysnchronous data, voice, and fax over the same line.

The company uses its Rapid Relay technology with NetRunner to squeeze voice and data traffic together with bridged LAN traffic. Data compression provides an average 100 percent increase in capacity of the leased-line bandwidth. Speech compression lets you combine speech with bridged LAN trafffic without slowing down the performance of your LAN.

NetRunner supports all LAN protocols and traffic. It has integrated modem and CSU/DSU (channel service unit/digital service unit) board options and built-in management functions. You can integrate up to six voice/fax channels with your LAN traffic.
Price: Starts at $3500.
Contact: Micom Communications Corp., 4100 Los Angeles Ave., Simi Valley, CA 93063, (805) 583-8600; fax (805) 583-1997.
Circle 1289 on Inquiry Card.

NetRunner integrates data, voice, and fax on leased lines.

Instant Serial Ports

QwikSwitch is a serial-port expander/data switch that increases the number of serial ports on your PC or laptop to five. You can direct data to any of five connected devices after you have selected the device from your keyboard. If you have a device that you use more frequently than others, QwikSwitch will default to that port.

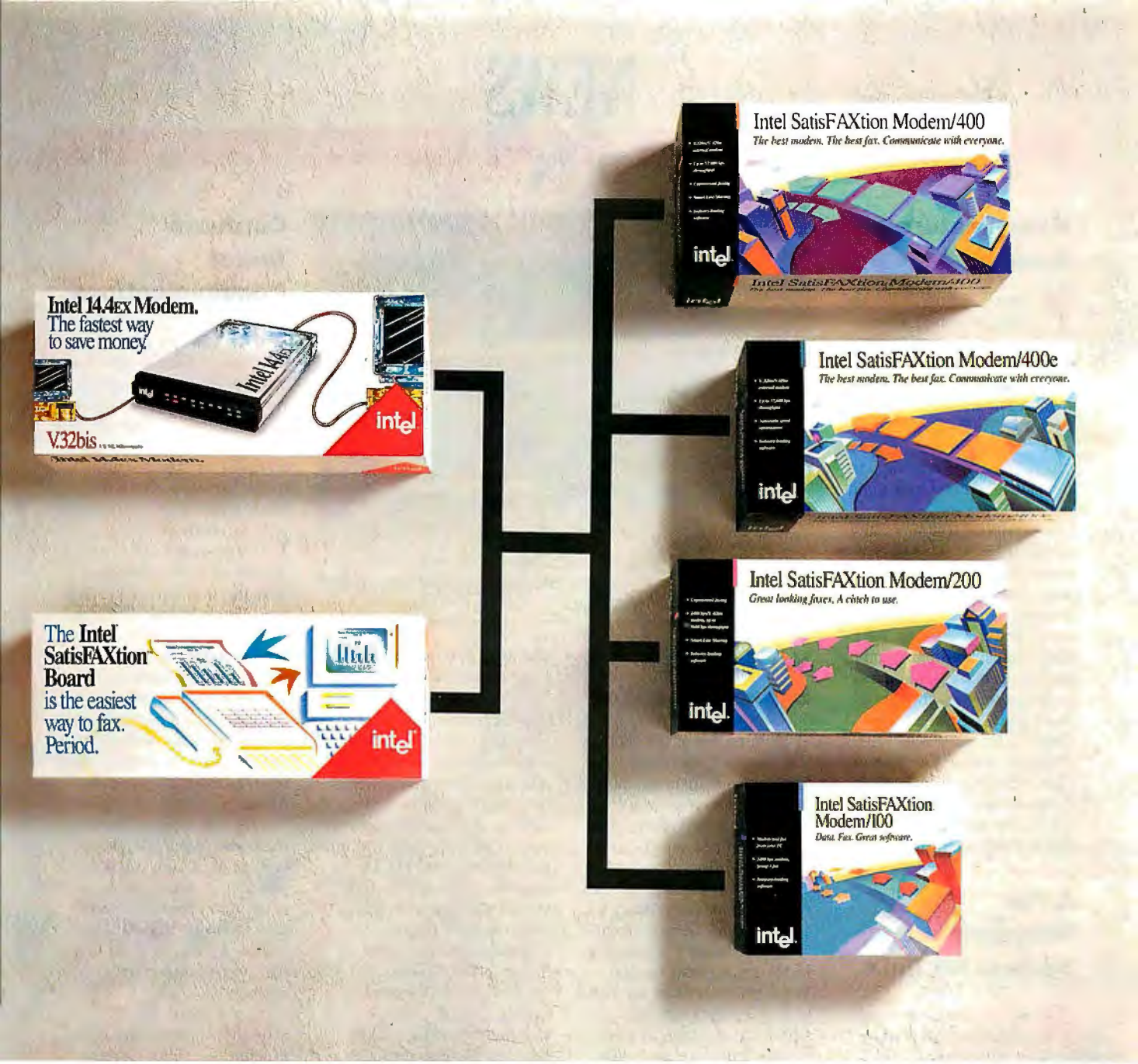
With any-to-any port connections, QwikSwitch lets any PC access any other PC or device. A PC accelerator permits data transfer rates as high as 115,000 bps. The 1- by 4- by 7-inch unit connects to your PC's existing COM port.
Price: $175.
Contact: Western Telematic, Inc., 5 Sterling, Irvine, CA 92718, (800) 854-7226 or (714) 586-9950; fax (714) 583-9514.
Circle 1290 on Inquiry Card.

TSR Reboots Network Stations Automatically

A TSR program that brings back to life a NetWare network's print servers and gateways after a file server has crashed or been shut down, Lazarus periodically polls network integrity. When a network error or power outage occurs, Lazarus becomes active and continuously checks the network for activity. When the network is restored, the utility automatically reboots the stations on which it is installed and restores related services.
Price: Single copy, $74.99; server license, $299; site license, $2999.
Contact: Software Marketing Group, Inc., 108 Third St., Suite 202, Des Moines, IA 50309, (800) 395-0209 or (515) 284-0209; fax (515) 284-5147.
Circle 1291 on Inquiry Card.

LAN Snooper

The Snooper, a source code toolkit, helps developers build custom protocol analyzers for additional protocols used by applications software. Able to run on any PC, the analyzer captures live traffic on Ethernet networks. It then saves the captured packets for analysis through summary, hexadecimal, or decoded protocol displays.
Price: $350.
Contact: General Software, Inc., P.O. Box 2571, Redmond, WA 98073, (206) 391-4285; fax (206) 746-4655.
Circle 1318 on Inquiry Card.



Married. With children.

The traditional modem is a dying breed. And in its place comes a new generation of products.

Introducing the Intel family of faxmodems—a combination of our award-winning modem technology and SatisFAXtion® Board that brings you a no-compromise modem and fax in one. All for about the price of a data modem alone.

Our top-of-the-line product, the SatisFAXtion® Modem/400, is 50 percent faster than a traditional 9600bps modem. Plus it features unequalled fax capabilities. The Model 400e is the powerful external brother to the Model 400. And Models 200 and 100 are excellent values if you have less need for speed.

So don't settle for just a modem. For the ultimate performance, features and compatibility only Intel can give you, tie the faxmodem knot now.

Experience our no-obligation, 14-day Test Drive program. For the Intel Test Drive dealer nearest you, call 1-800-538-3373, ext. 63.

WE MAKE COMPUTERS WORK HARDER.
Find out more. Ask for ext. 63
1-800-538-3373

intel®

©1992 Intel Corporation. SatisFAXtion is a registered trademark of Intel Corporation. For information faxed directly to you, call 1-800-525-3019 and ask for document 9990. For international inquiries, call 1-503-629-7354. In Europe, +44-793-431155.

Many-Featured Modem

Patton Electronics' Model 1080 Universal Short Range Modem operates in synchronous and asynchronous RS-232 environments. The modem works over a 13-mile distance and at data rates of from 1200 to 19,200 bps. The unit supports point-to-point and multipoint communications.

The Model 1080 operates at full or half duplex over two unconditioned twisted-pair wires and at half duplex over a single pair of wires. Additional features include V.54 diagnostics, automatic equalization, transformer isolation, surge protection, and six front-panel LEDs.

Price: $295.

Contact: Patton Electronics Co., 7958 Cessna Ave., Gaithersburg, MD 20879, (301) 975-1000.

Circle 1292 on Inquiry Card.

A Fax Management System for Unix

Replix, a Unix-based fax management software system, lets you send, receive, route, view, and manage faxes from your desktop system. Incorporating an advanced GUI with a full feature set, Replix can be fully integrated with other software products and is based on a client/server architecture. The system automatically notifies you of incoming faxes and the status of outgoing faxes. It supports PostScript and is scalable, letting you add multiple clients, servers, and fax modems.

Price: $2395 and up.

Contact: Samsung Software America, 1 Corporate Dr., Andover, MA 01810, (800) 899-7724 or (508) 685-7200; fax (508) 685-4940.

Circle 1293 on Inquiry Card.

The Model 1080 Universal Short Range Modem operates at distances of up to 13 miles and can pass two hardware-control signals—one in each direction.

Version 3.0 Expands the Web

Version 3.0 of the Web network operating system consists of six loadable modules that you can install separately based on the individual requirements of each network station. You load each module into upper memory blocks, leaving intact the conventional memory area.

Web, which fully supports NetWare, replaces the NetWare client software on workstations, giving each station simultaneous status as a NetWare client and a Web peer. Web's emulation of NCP (NetWare's Core Protocol) enables the seamless sharing of files with an unlimited number of NetWare servers without a designated machine for bridging functions.

A new proprietary burst-mode technology in version 3.0 supports burst mode for up to 127 packets per transaction. The company's dynamic data compression increases data throughput by as much as 1400 percent in all topologies, according to Webcorp. The system now supports large packet sizes of up to 16,384 bytes.

Able to freely mix peers, clients, and servers on the same network, Web 3.0 can also mix Web peers, clients, and servers with Novell servers. An independent setup program provides a single-user interface for local or remote modification of all station configuration and optimization options.

Price: Single-user, $99; 5-user, $449; 10-user, $765; 15-user, $975; 30-user, $1495.

Contact: Webcorp, 3000 Bridgeway, Sausalito, CA 94965, (415) 331-1449; fax (415) 331-0911.

Circle 1294 on Inquiry Card.

Standby UPS

A 600-VA UPS (uninterruptible power supply) with a built-in LAN port, the BC 600LAN is compatible with such diverse network operating systems as LANtastic and AppleShare. The unit features four spike and noise-filtered AC outlets.

Price: $377.

Contact: TrippLite, 500 North Orleans, Chicago, IL 60610, (312) 329-1777; fax (312) 644-6505.

Circle 1319 on Inquiry Card.

Cordless Serial Communications

Now you can communicate via serial interfaces without cables at distances ranging from 7 to 70 meters. The Infralink 818 provides an enhanced infrared transmitter/receiver unit that allows quick cableless data exchange between PCs and modems or between computers.

During serial operation, the device provides a net data transmission rate of 115,200 bps. The Infralink 818 uses full-duplex communication with invisible, modulated infrared light on eight switchable channels, enabling any number of PCs or peripherals to communicate with eight other units. Computer/printer recognition is always automatic.

The unit displays the address and target address, as well as the status. An independent microprocessor-supported protocol assures data integrity, and the Infralink 818 uses a 9-bit identification code for error correction.

The Infralink 818 is available as an external unit or a built-in version that is suitable for laptops, notebooks, and notepads. Separate optical transmission/receiver unit accessories are also available for range optimization.

Price: About $299 (about DM 450).

Contact: Infralink GmbH, Am Fuchsberg 8, D-4040 Neuss-Uedescheim, Germany, 49-2101-3-50-53; fax 49-2101-3-27-91.

Circle 1295 on Inquiry Card.

WITH S-3 WINDOWS ACCELERATOR

Announcing Idek's Resolution Revolution

Now You Can Get True 1280 x 1024 Non-Interlaced Color at VGA Prices

IDEK MF-5317 with HELIO TC-1280-256 $1495.00

IDEK MF-5221A with HELIO TC-1280-256 $2495.00

Idek MF-5317 Features:
- 17" FST
- VGA - 1280 x 1024
- .28 mm dot pitch CRT
- 30-65 kHz
- MPR II

Helio TC 1280-256 Features:
- 1280 x 1024 non-interlaced
- S3 accelerator
- 256 colors at 1280 x 1024

Idek MF-5221 Features:
- 21" FST
- VGA - 1280 x 1024
- .31 mm dot pitch CRT
- 30-80 kHz
- MPR II

Idek and Helio Computer have joined forces to offer you Idek's advanced 17" and 21" flat screen monitors with Helio's high resolution 1280 x 1024 non-interlaced graphics board ... giving you unmatched true colors and resolution at VGA prices

There's a revolution going on in flat screen monitor performance! Two of the industry's pioneers are breaking all the rules ... by offering you "true" 1280 x 1024 non-interlaced performance at VGA level prices!

With either of these Idek 17" or 21" monitors, you'll enjoy state-of-the-art flat screen monitor technology combined with automatic frequency scanning. Add to this the performance-boosting power of Helio's high resolution graphics board, and you've got an unbeatable monitor at an unbelievable price.

The offer won't last forever, so now's the time to act! Take advantage of these revolutionary package prices ... and get the kind of color performance and resolution you've always wanted!

Iiyama North America Inc., 650 Louis Drive, Suite 120, Warminster, PA 18974 U.S.A. Tel: (215) 957-6543. Fax: (215) 957-6551.

IDEK Iiyama

Call 215-957-6543* for the name of the distributor/dealer nearest you.

* Offer valid in North America

Circle 119 on Inquiry Card.

IF IT HAS ADOBE* SCALABLE FONTS, COLOR, AND QUIET TECHNOLOGY,
IT CAN ONLY BE FROM PANASONIC.
Multi-Mode Printer
Panasonic
Quiet KX-P2124 Printing
24 PIN
The KX-P2124, a 24-pin with ATM* and color option.

A few dot-matrix printers offer you scalable fonts.

A few, color. But no other printer offers you scalable fonts...color...and Panasonic® Quiet Technology.

Put our KX-P2124 and 2123 to work and you'll get the flexibility of Adobe Type Manager® and scalable fonts...you'll add drama to your documents with our optional color kit...and you'll hear very little, indeed.

Put any of our other Quiet Technology printers to COLOR OPTION work and you can accomplish whatever your needs.

From our 2123, a budget-minded 24-pin with Adobe Type Manager* and optional color...to our 2624 wide-carriage business printer with ATM*,...to our 9-pin 2180 with 6 near letter quality fonts and optional color.

All with the kind of features that made Panasonic printers the leaders of the industry. Such as multiple paper paths, EZ™ Set control panels, and a two-year limited warranty on parts and labor†.

The Panasonic 2000 Series Quiet Technology Printers.

Call us for more information: 1-800-742-8086. Or visit your Panasonic dealer.

†See your dealer for warranty details.

*ATM and Adobe Type Manager are registered trademarks of Adobe. Adobe ATM for use with Microsoft® Windows™ 3.0 or higher. Available on selected printers only.

Panasonic Office Automation OA

ONCE YOU'VE TRIED OUR QUIET TECHNOLOGY PRINTERS, YOU'LL NEVER SETTLE FOR ANYTHING LESS.

The KX-P2123, a 24-pin with ATM and color option.*

The KX-P2180, a 9-pin with color option. ATM not available.*

The KX-P2624, a 24-pin with ATM. Color option not available.*

PQ9-BY

Circle 139 on Inquiry Card.

Customize Your Visual Basic Image Displays

The Dazzle/VB add-on control library for Visual Basic lets you customize your VB programs with a variety of graphics effects. Dazzle/VB's custom control and DLL routines let you display images in up to 256 colors, add more than 30 fade and wipe screen-transition effects, and adjust colors within your images.

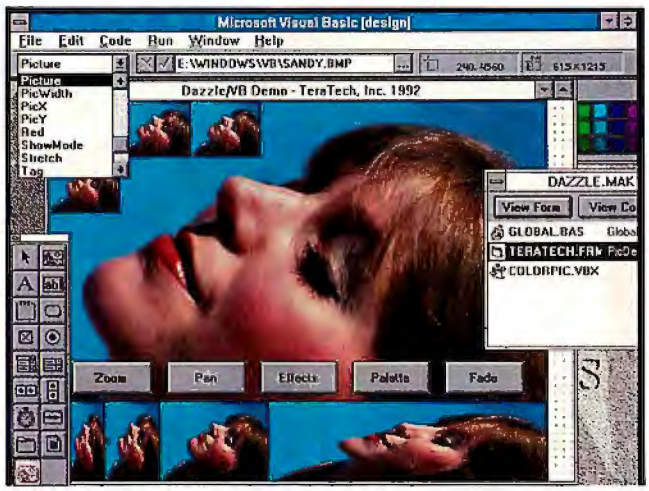
The Dazzle/VB DLL lets you use its partial image block copy routines to create your own wipe effects. To access and set Dazzle/VB properties, you simply click on the appropriate function, as listed on the VB properties menu, and it's set.

A more advanced version, Dazzle Professional, offers all the features of Dazzle/VB but adds tools for gray-scale and full-color negative image display, utilities to compress and decompress BMP files, color image enhancement, and palette control.

Price: Dazzle/VB, $299; Dazzle Professional, $499.

Contact: TeraTech, 3 Choke Cherry Rd., Suite 360, Rockville, MD 20850, (800) 447-9120 or (301) 330-6764; fax (301) 963-0436.

Circle 1296 on Inquiry Card.



TeraTech says that Dazzle/VB is the only true image controller currently available for Visual Basic.

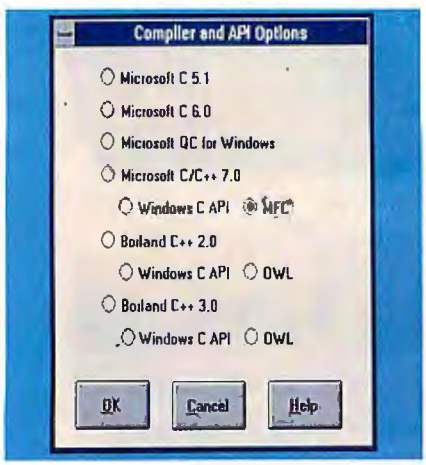
Generate Code for Windows APIs

Now you can automatically produce code for your MFC (Microsoft Foundation Class)–based Windows APIs. According to its developer, Case:W 4.0 is the only code generator for the MFC library for C/C++. The product also supports the other two most popular Windows interface builders, the Windows C API and Borland's ObjectWindows. Case:W's modular structure lets you port code among the three environments by generating code for one environment, "snapping on" a knowledge base of implementation details, and generating again to create the same interface in a different class library.

Price: Case:W with one knowledge base, $995; additional knowledge bases, $395 each.

Contact: Caseworks, Inc., 1 Dunwoody Park, Suite 130, Atlanta, GA 30338, (404) 399-6236; fax (404) 399-9516.

Circle 1298 on Inquiry Card.



With Caseworks' snap-on knowledge bases, you can generate code for the Windows C API, as well as for MFC and ObjectWindows class libraries.

Peek into Windows

DeMystifiers lets Windows programmers see how their applications interact with the internal components of the Windows operating system. Five independent tools capture information on memory management, message processing, graphic device interface display and device capabilities, systemwide environment settings, and screen image detail. The Voyeur component analyzes events occurring to windows and provides information on window characteristics (e.g., parentage, dimensions, class, and location). Colonel looks at the Windows kernel and shows you how memory is distributed within it. Mechanic looks at your hardware devices and drivers and lets you see related fonts and font characteristics. Ecologist gives you information on the Windows environment, including your current mode, Windows and DOS versions, your directories, cursor position, and more. Finally, the BlowUp module magnifies a region on your screen to help with window alignment, icon dithering, and other tasks.

Price: $129.

Contact: MicroQuill Software Publishing, Inc., 4900 25th Ave. NE, Suite 206, Seattle, WA 98105, (206) 525-8218; fax (206) 525-8309.

Circle 1297 on Inquiry Card.

DOS and Windows Compiler Support

The version 3.0 upgrade of Zinc Software's multiplatform application framework for C++ provides compiler independence and single-source compatibility to developers of DOS and Windows software. Zinc Interface Library 3.0 features push-button access to windows objects such as check boxes, scroll bars, and radio buttons.

Developed first under Windows, the DOS version features a Windows-like look with push-button access to tools. You can work in either text-to-graphics or graphics-to-text mode. The Zinc application framework provides support for Borland, Microsoft, and Symantec (Zortech) C++ compilers.

Price: $399.95; $499.95 with source code.

Contact: Zinc Software, Inc., 405 South 100 East, Second Floor, Pleasant Grove, UT 84062, (801) 785-8900; fax (801) 785-8996.

Circle 1299 on Inquiry Card.

Raima Database Engine Captures Fortune 500 With Record Speed

Accelerated Database Performance

Compared to conventional relational databases, retrieval of records can be 10—20—even 50 times faster with Raima Data Manager from Raima Corporation.

Propelling The Biggest Names In Business

Companies like General Motors, Hewlett-Packard, IBM, Eastman Kodak, Rockwell and others are using Raima Data Manager in their competitive environments. Today's most critical, most demanding applications demand the high performance of Raima Data Manager.

Powerfully Efficient Leading-Edge Technology

Raima's combined technology merges the flexibility of relational databases with the lightning speed and efficient storage of the network model. With the program written entirely in C, you can "fine-tune" the Raima Data Manager engine for optimum performance in any application.

Put Yourself In Fast Company

Give yourself the competitive edge of Raima Data Manager:

- Speed—faster access to data
- Portability—supports most environments
- Royalty-free—increase your profits
- Source code availability—total programming flexibility
- Full Raima support services—including training

Whether you're writing a stand-alone DOS application, or one for UNIX accessing thousands of records, Raima Data Manager will put your application on the fast track. Race to the phone and call for more information!

Raima Data Manager™
The High Performance DBMS

In the U.S. or Canada, call: 1-800-DB-RAIMA
In Washington state or international, call: **(206)747-5570**

Specifications Relational B-tree indexing. Network data model. Relational SQL query and report writer. Single & multi-user. Automatic recovery. Built-in referential integrity. **Supports:** VMS, QNX, ULTRIX, UNIX System V, Berkeley 4.2, AIX, SunOS, SCO, MS DOS, MS Windows, and OS/2. **Most C Compilers and LANs supported.**

Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA **(206)747-5570 Fax: (206)747-1991**
International Distributors: Australia: 61 2 419 7177 **Belgium:** 32 2 734 9818 **Estonia:** 7 142 328 287 **Finland:** 358 080405350 **France:** 33 1 46 09 27 84 **Germany:** 49 7022 34077; 49 214 91051 **Italy:** 39 49 829 1285 **Japan:** 81 33 865 2140 **Mexico:** 52 83 49 53 00 **The Netherlands:** 31 2159 46814 **Norway:** 47 2 38 48 88 **Russia:** 7 812 292 7210 **Singapore:** 65 334 0061 **Sweden:** 46 13 111 588 **Switzerland:** 41 64 517475 **Taiwan:** 886 2 552 3277 **Turkey:** 90 1 152 05 16 **United Kingdom:** 44 992 500919
Copyright ©1992 Raima Corporation, All rights reserved. Photo: Dale LaFollette

BY92RC

Circle 154 on Inquiry Card.

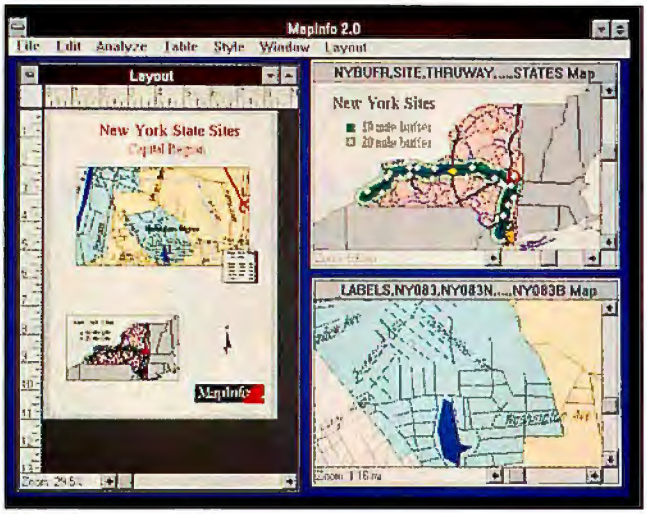
Build Your Own MapInfo Programs

MapInfo 2.0 for Windows uses a built-in SQL (Structured Query Language) relational database management system to let you access and display data geographically from databases, spreadsheets, and delimited ASCII files. You can overlap these data files to compare their contents. By displaying data such as a ZIP code or city name in relation to its location, you can see patterns, relationships, and trends that might otherwise go unnoticed.

New features include buffering, which lets you search around lines or areas by creating a specific border or corridor around them; support for object, line, and other query searches; SQL queries for "within," "contains," or "intersects" limits; 18 projection methods; and support for hundreds of coordinate systems. Enhanced presentation options include a page-layout window, improved graphics tools, and support for Windows 3.1 TrueType fonts and label text rotation.

MapBasic, designed for use with MapInfo 2.0 for Windows, lets you use a BASIC-like language to create your own MapInfo applications. Besides standard tools, such as an interface builder and program debugger, MapBasic lets you perform complex database queries using Standard SQL. You can also add graphical geographic objects to your maps, create buffers, and find perimeters and distances.

According to the company, all MapInfo files and applications developed in MapBasic are portable across Windows, Macintosh, Sun, and Hewlett-Packard platforms.



In MapInfo's upper right window, a buffer search around the New York State Thruway shows all the user-specified hits within a 20-mile drive.

Price: MapInfo 2.0 for Windows, $995; MapBasic, $795.
Contact: MapInfo Corp., 200 Broadway, Troy, NY 12180, (518) 274-6000; fax (518) 274-0510.
Circle 1300 on Inquiry Card.

Manage Complete Fills the Small-Business Bill

Manage Complete 2.0 for DOS offers a variety of business-oriented tools within a single program. At the heart of Manage lies a complete accounting program, geared toward small-business owners, that provides tools for accounts receivable, accounts payable, general ledger, checkbook, invoicing, sales order entry, bids and proposals, payroll, and inventory management. You can import data in 17 file formats. In addition to the accounting functions, Manage includes contact management, report writing, text editing, personnel files, applicant tracking, and other tools.

Manage is based on a FoxPro 2.0 database engine, which allows for real-time access to all your records. All Manage modules share a single set of data files, so you don't have to do updates across the system. Manage's network version shows you who is working on a record at any given time, and system administrators can limit access to certain tools.
Price: $299.95; $499.95 for unlimited nodes.
Contact: Management Information Software, Inc., 3301 Gandy Blvd., Tampa, FL 33611, (800) 825-5647 or (813) 832-3449; fax (813) 1311.
Circle 1301 on Inquiry Card.

ManagePro Takes Over Your Goals

MP (ManagePro) relies on a combination of scheduling, database, reporting, and expert system tools to provide goal management and people management tools in one program. MP for Windows outlines goals in a timeline format, displays your final goal as a composite of related tasks, and monitors the progress of those tasks.

The people-oriented tools in MP let you track and report on performance expectations and achievements, compensation, relationships between people and goals, and coaching of employees. The Management Advisor provides on-line access to professional advice. Password protection secures personnel data when you use the program over a network.
Price: $395.
Contact: Avantos Performance Systems, 5900 Hollis St., Suite C, Emeryville, CA 94608, (510) 654-4600; fax (510) 654-1276.
Circle 1302 on Inquiry Card.

Let Your PC Play the Stock Market

With AIQ TE (TradingExpert), your PC can track market indexes and equities and make trading recommendations. The program's expert system analysis of stock price, volume, and market indexes lets you monitor your picks using sector and group analysis, live trend lines, and weekly charting. TE makes recommendations based on updates of price and volume data. Its tracking capacity is limited only by your disk space, although AIQ Systems says that most users of the system monitor between 500 and 1500 equities.

TE users have the option of electronically accessing current and historical pricing on all equities for a monthly flat rate. Dial Data and Interactive Data provide this service to TE customers.
Price: $1499; on-line stock pricing data fee, $25 to $60 per month.
Contact: AIQ Systems, Inc., P.O. Box 7530, Incline Village, NV 89452, (800) 332-2999 or (702) 831-2999; fax (702) 831-6784.
Circle 1303 on Inquiry Card.

The only Windows™ statistics package you'll ever need.

NEW
SYSTAT® for WINDOWS

#1 for DOS and Windows

Rated "the best general-purpose statistics program" for the PC by *Software Digest*®, SYSTAT for DOS is now joined by SYSTAT for Windows. This addition to the SYSTAT family takes full advantage of Windows, with pull down menus, dialog boxes, sizable windows, and the ease of use you expect in a Windows package.

SYSTAT for Windows runs in standard and 386 enhanced modes and can take advantage of Windows advanced memory management. No matter how large or complex your analysis is, you can use SYSTAT.

SYSTAT delivers a balance of power and simplicity. It lets you analyze and manipulate data with a comprehensive range of advanced statistical procedures, and present your results with stunning graphics.

Just point and click

SYSTAT is a full-fledged Windows application. Just point and click. SYSTAT's QuickStat™ buttons give you simple, single-click shortcuts to common statistical analyses.

More statistics, from the basic to the most sophisticated

A full range of univariate and multivariate statistics–from *t* tests to multidimensional scaling. With a few clicks you can turn most statistics into graphs and perform:

- multiway crosstabs with log linear modeling
- nonparametric statistics
- principal components and factor analysis
- cluster analysis
- time series
- nonlinear estimation
- correlation matrices
- means, effect, and dummy models
- post hoc tests

SYSTAT offers the most advanced multivariate general linear model available for Windows.

The most graphics

No other statistical or graphics package can produce all the scientific and technical graphs that SYSTAT can–nor surpass its ease of use. Graphics capabilities include:

- histograms
- single, multiple, stacked, and range bar graphs
- single and grouped box plots
- stem-and-leaf diagrams
- pie charts
- scatterplot matrices
- 3-D data and function plots
- contour plots
- control charts
- maps with geographic projections
- Chernoff faces
- complete color spectrum
- log and power scales
- confidence intervals and ellipses
- linear, quadratic, step, spline, polynomial, LOWESS, exponential, and log smoothing

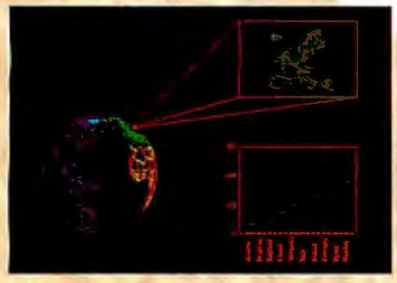
A compatible family of products

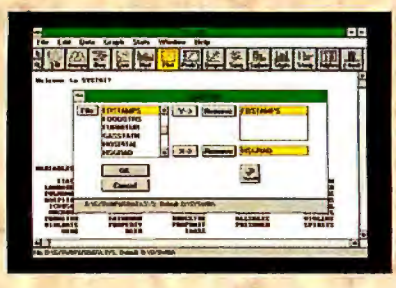
Whichever you choose–SYSTAT for Windows, SYSTAT for DOS or both–you'll enjoy the most powerful statistics and scientific graphics software available for the PC.

For more information, special offers for current users, and demo disks, call:

708-864-5670

For Windows circle 171,
For IBM/DOS circle 172.





For more information call or write: **SYSTAT, Inc.**, 1800 Sherman Avenue, Evanston, Illinois 60201-3793. Tel: 708.864.5670, Fax: 708.492.3567

Australia: Hearne Marketing 61.3.8661766, **Austria:** CSM 43.1.5053695, **BeNeLux Countries:** Oasis 31.3402.66336, **Canada:** Multi-Health 416.424.1700, **Denmark:** Agrolab 45.64.406575, **Finland:** Mikro Martti 358.0.6923800, **France:** Statilogie 33.1.40935000, **Germany:** STATCON 49.55.4272075, **Italy:** PiSoft 39.587.213640, **Japan:** HuLinks 81.33.5902311, **Malaysia:** Dagang Teknik 603.719.8299, **New Zealand:** Hoare & Assoc. 64.78.562675, **Norway:** polysoft 47.3.892240, **Spain:** Add Link 34.3.4590722, **Sweden:** Technology Transfer 46.76076207, **Switzerland:** Fritschy & Partner 41.31.215151, **SYSTAT UK:** 44.81.6921562

SYSTAT®

© 1992 SYSTAT®, Inc. *Software Digest Ratings Report/8.5*, May, 1991. Software Digest is a registered trademark of NSTL, Inc.

Now! Northgate® Provides Novell®

How do you know the computer you get is really Novell certified? Typically, if you specify even the slightest deviation from the original certification, Novell no longer recognizes the system as certified.

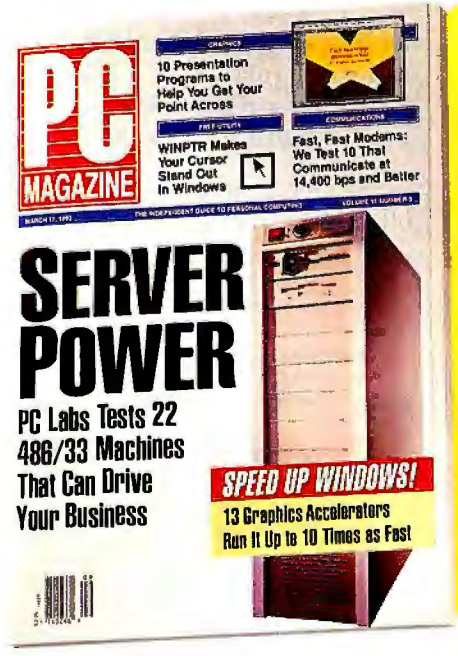
Northgate knows the importance of Novell certification. That's why we have qualified to self-certify our network servers and workstations.

Northgate can assure you we'll ship your custom-configured, Novell-certified system in as few as four weeks, rather than the several months it takes to be certified at Novell. And, because we do all the lab work, your certified system will very likely cost less.

Novell Labs Tested & Approved™

Self-certification capability is just one more reason why corporations coast-to-coast now rely on Northgate for all their networking needs. Northgate has your solution, too!

Powerful File Servers and Workstations! Select from 386 and 486 file servers, as well as a variety of workstations featuring our popular 386SX/25 systems. All are FCC Class B certified.



PC MAGAZINE EDITORS' CHOICE
March 17, 1992
Northgate Elegance 433e

Make the Editors' Choice Elegance™ 486/33e The Heart Of Your LAN!

"The Northgate Elegance 433e is a turnkey NetWare® computer with a laudable price..."

"...Northgate gives network administrators everything they need – a turnkey system with hard disks optimized for NetWare, excellent expansion capability and good performance..."

"The Northgate Elegance 433e, with its well-rounded and sensible configuration has it all; a performance/features score that's better than average and a dynamite price which together create a higher-than-average Bang for the Buck score. The server is even Novell certified."

Certification For Most Configurations!

LAN solutions from the company ranked #1 in customer satisfaction for technical support by *PC Magazine* readers.* Services include technical support 24 hours a day, seven days a week, comprehensive hardware warranties and more. Plus, our technicians are backed by Certified NetWare Engineers. This is your assurance of the best support possible.

Choice of Topologies and Operating Software! Select from ARCNET™, ETHERNET Thin Net, ETHERNET 10BASE-T, **Token Ring** or wireless LANs. Plus, NetWare® 3.11, 2.2, NetWare Lite® and LANtastic®.

486 EISA Speed And Upgradability At Our Lowest Price Ever! Northgate's 486 ZXP EISA workstation is upgradable across the entire range of Intel processors including: 486SX/20, SX/25 DX/33, DX2/50 – even the new DX2/66! Features up to 128 MB RAM, 32-bit EISA controller, EISA bus and more. Call for specs and pricing!

Get up to 4GB of fault-tolerant disk storage with the OmniArray parallel disk array. Northgate RAID technology uses four drives plus a fifth parity drive giving you true high disk fault tolerance and high data availability. Novell certified.

Call for complete custom configuration information.
800-345-8709

Major corporations, volume purchasers and government agencies call National Business Accounts: 800-545-6059
GSA# GS00K91AGS5193 PS01

Charge it to your VISA, MasterCard, Discover, American Express and Northgate Big 'N' Card. 12-60 month leasing plans also available.

NORTHGATE COMPUTER SYSTEMS, INC.

"When it has to work right"™

7075 Flying Cloud Drive, Eden Prairie, MN 55343

©Copyright Northgate Computer Systems, Inc. 1992. All rights reserved. Northgate, Elegance, and the Northgate 'N' logo are U.S. trademarks or registered U.S. trademarks of Northgate Computer Systems. All other products and brand names are U.S. trademarks and registered U.S. trademarks of their respective companies. We support the ethical use of software. To report software copyright violations, call the Software Publishers Association's Anti-Piracy Hotline at 1-800-388-PIR8. *May 26, 1992.

CODE B4309

A Scientific Swiss Army Knife Program

With the HiQ computational program for the Macintosh, you can create, solve, and present scientific and engineering problems in a single environment. HiQ's object-oriented architecture lets you manipulate your data with more than 600 built-in functions, interactive 2-D and 3-D graphics, and its own 4GL (fourth-generation language).

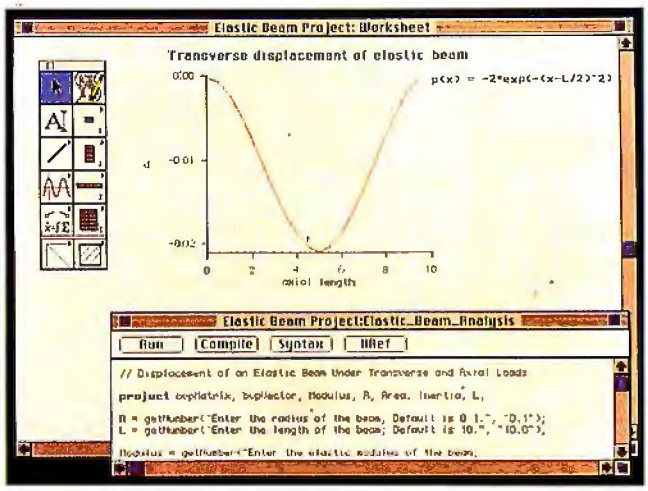
From within the system's mathematical solution interfaces, you enter functions, parameters, and other data. HiQ tabulates the results and plots the information as a 2-D or 3-D graph. As the system solves your equation, it simultaneously generates code written in its own programming language. You can use this code to create a larger, customized program for solving more sophisticated or specialized programs. Once you accumulate your desired graphs, notes, and other data, you can organize them into a single document.

According to its developer, HiQ lets users who specialize in different disciplines share tools and information without having to understand the intricacies of one another's work.

Price: $695.

Contact: Bimillennium Corp., 101 Albright Way, Los Gatos, CA 95030, (408) 866-2010; fax (408) 866-2305.

Circle 1304 on Inquiry Card.



HiQ's Project Worksheets let you group all your related data into a single document. From here you can click on an editor to change the Worksheet content.

Filter Program Tests DSP Data

Running under DOS, Adaptive Filters 2.5 lets you analyze your DSP (digital signal processor)–based data's adaptations as the data is affected by filter conditions that you create. Using several styles of least mean squared, fast recursive least squares, and other algorithms, you can design filters with single-or multidimensional input signals. Adaptive Filters supports transversal, lattice-ladder, and QR-rotation architectures. You can also design all filters within floating-point or fixed-point arithmetic and implement tests of real-world or simulated conditions.

Price: $399.

Contact: The Athena Group, 3424 Northwest 31st St., Gainesville, FL 32605, (800) 741-7440 or (904) 371-2567; fax (904) 373-5182.

Circle 1305 on Inquiry Card.

New Tools for Unix Element Analysis

The latest release of the LUSAS finite-element-analysis program combines new analysis elements with an updated menu- and form-driven interface. Unix-based LUSAS 11.0 runs under Motif and provides elements designed to examine linear and nonlinear stresses and vibration, and dynamic and thermal properties.

LUSAS uses an eight-node solid element, which its developer claims is faster than 20-node solid elements in the analysis of 3-D structures. New algorithms provide information on impact problems involving sliding friction between two or more surfaces, and a new creep facility lets you model time-dependent data. The super-element structure provided in version 11.0 lets you make changes to part of a model without having to rerun the entire problem.

Price: About $4800 to $18,240 (£2500 to £9500), depending on configuration.

Contact: FEA Limited, Forge House, 66 High St., Kingston upon Thames, Surrey KT1 1HN, U.K., 44-81-541-1999.

Circle 1306 on Inquiry Card.

Molecular Modeling for Novices

An introduction to molecular modeling is provided in a low-cost program from Oxford Molecular. Nemesis Sampler is an interactive modeling system that lets you build molecules of up to 50 atoms, modify existing molecules, and rotate and scale your structures in 3-D. You can also calculate partial atomic charges and dipole moments and optimize overall molecule energy. Nemesis Sampler, based on the high-end Nemesis program, runs on both PCs and Macs.

Price: About $55.50 (£29).

Contact: Oxford Molecular, Ltd., Magdalen Centre, Oxford Science Park, Oxford OX4 4GA, U.K., 44-865-784600.

Circle 1307 on Inquiry Card.

Windows Data Acquisition in Real Time

What its developer claims to be the first real-time data acquisition and display software for Windows is available now from Labtech. The Notebook and Notebook/XE programs let you collect data, display it in real time, and simultaneously log it to a disk at processing rates of up to 1 kHz. A configurable buffer lets you collect data while performing other system tasks. Notebook provides 58 data-analysis functions, or you can add your own functions. Notebook/XE's advanced functionality offers such features as remote instrument support and support for multiple screens with up to 25 windows per screen. Notebook requires Windows 3.1 and supports DLLs and DDE.

Price: Notebook, $1495; Notebook/XE, $2495.

Contact: Labtech, 400 Research Dr., Wilmington, MA 01887, (508) 657-5400; fax (508) 658-9972.

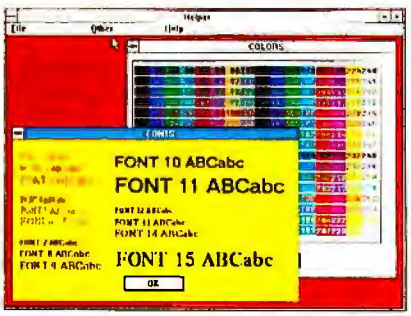
Circle 1308 on Inquiry Card.

Attention All dBASE Users: Your Windows Have Arrived.

Introducing new dBFast.™ The first and only dBASE™ compatible database and dBASE/X-Base language for Windows. It's the fastest, smartest and easiest way for millions of users and developers to join the Windows revolution.

1992 W 100 WINDOWS MAGAZINE ANNUAL WIN AWARD

Graphical, colorful dBFast will bring new life to all of your existing dBASE programs.

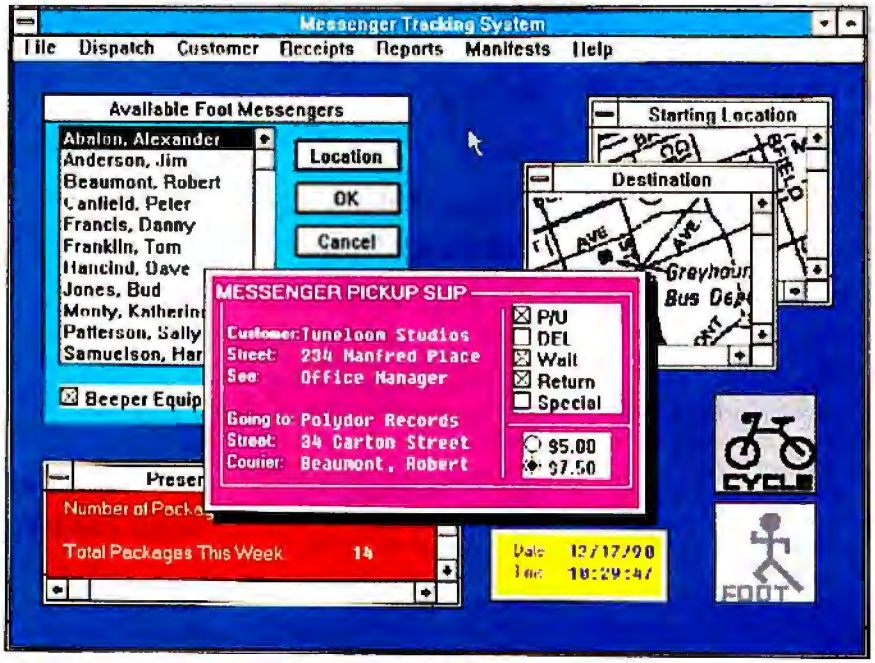


Your applications will really come to life with multiple colors and fonts.

Liven them up with multiple, movable windows, pull-down menus, check boxes, dialog boxes, radio buttons, push buttons and bitmap pictures.

dBFast also helps you create new dBASE programs quickly and easily.

MICROSOFT® WINDOWS™



dBFast helps you create powerful, graphical database applications quickly and easily with pull-down menus, check boxes, radio buttons and even bitmap images.

Unlike other Windows development systems that force you to learn a new language, dBFast allows dBASE, Fox and Clipper developers to use the language they already know with more than 200 extensions and an interactive editor, compiler and linker.

Free Demo Disk

And full industry standard DDE and DLL protocols allow your programs to communicate with other Windows applications.

So call 1-800-CALL CAI and we'll rush you a free Demo Disk.

Call right now.

After all, haven't you waited long enough?

COMPUTER® ASSOCIATES
Software superior by design.

dBFast™

© Computer Associates International, Inc., 1 Computer Associates Plaza, Islandia NY 11788-7000. All trade names referenced herein are trademarks of their respective companies. dBASE is a registered trademark of Ashton-Tate Corporation.

Circle 94 on Inquiry Card.

TypeReader Provides True OCR for the Mac

Using ExperVision's MLFA (Machine-Learned Fragment Analysis) technology, TypeReader for the Macintosh lets you scan clear, fuzzy, colored, and faded documents while retaining page-formatting characteristics. The software also recognizes thousands of typefaces, type sizes, word spacing, and paragraph returns. The program includes Adobe Type Manager and TrueType.

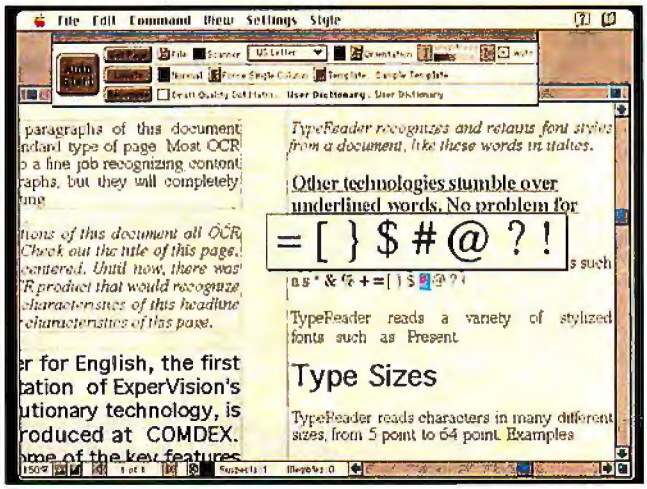
The program uses recognition dictionaries to reduce errors from suspicious characters. The context-sensitive postprocessing capabilities check for accurate use of similar characters. The On-Screen Verifier highlights suspect characters and lets you make changes on the fly. TypeReader includes three levels of verification, specialized spelling checkers, multiple file processing, double-sided-page scanning, and portrait or landscape orientation capabilities.

Developers of Windows applications now have the option of incorporating TypeReader's OCR capabilities into their own programs. RTK (for optical character recognition ToolKit) is available as a Windows DLL. The toolkit lets you specify what parts of an image to recognize when scanning. Your scanned data can then prompt such actions as message routing and updating a database. You can specify multiple areas to scan in each document.

Price: TypeReader, $695; RTK, $2500 recoverable licensing fee plus volume-based royalties.

Contact: ExperVision, Inc., 3590 North First St., San Jose, CA 95134, (800) 732-3897 or (408) 428-9988; fax (408) 456-0823.

Circle 1309 on Inquiry Card.



TypeReader provides mirrorlike recognition of margins, text wrapping, columns, tables, and other page formatting.

XTree Makes Its Windows Debut

An MDI (multiple document interface) lets the XTW (XTree for Windows) hard drive management utility list every drive to which you're connected and all the corresponding directory trees, file lists, documents, and ZIP archives. You can use XTW to display all these drive branches on a single customizable screen and then copy, delete, move, rename, and view files from this screen.

According to its developer, XTW offers more file viewers (over 50) than any comparable utility. In addition to viewing database, word processing, spreadsheet, and other files, the program lets you view ZIP-compressed files without extracting them. Other XTW features include application launching, a command toolbar, support for DOS-based networks, and background processing.

Price: $49.95 until the end of October, $99 thereafter.

Contact: XTree Co., 4330 Santa Fe Rd., San Luis Obispo, CA 93401, (805) 541-0604; fax (805) 541-8053.

Circle 1311 on Inquiry Card.

Task Switcher Adds Functionality

Version 6.0 of Software Carousel adds a screen saver and a personal reminder tool to the task-switching utility from SoftLogic Solutions. The DOS utility gives you hot-key access to up to 12 programs and lets you customize your task-switching methods.

Carousel's new personal reminder system lets you make note of time commitments (with or without an alarm) on a repeating or one-time basis. For an indefinite period of time, shipments of Carousel will include a copy of the Memory Miser 386 memory management utility.

Price: $89.95.

Contact: SoftLogic Solutions, Inc., 1 Perimeter Rd., Manchester, NH 03103, (800) 272-9900 or (603) 627-9900; fax (603) 627-9610.

Circle 1312 on Inquiry Card.

ZyIndex Gears Up for Windows

ZyIndex 5.0 for Windows encompasses several modules, which offer index-building, index-searching, and application-building capabilities. The index builder, ZyBuild, lets you create an index of documents that reside anywhere on your hard drive or network.

New searching techniques and tools include display of search hits in context, logging of searches, application launching, simultaneous searching of multiple indexes, a viewer for embedded graphics files, support for dBase files and other database file formats, document archiving, and support for Windows 3.1. You can perform various types of searches, including phrase, Boolean, user-defined concept, and wild-card.

The program's InfoApps function lets you create and manage groups of related documents. These groups act as customization tools for your searching and organization processes. InfoApps let you add hyperlinks, annotated self-stick notes, bookmarks, compression, and other features.

Price: $395 for a single-user version; $995 for a network bundle of three concurrent licenses.

Contact: ZyLab, 100 Lexington Dr., Buffalo Grove, IL 60089, (800) 544-6339 or (708) 459-8000; fax (708) 459-8054.

Circle 1310 on Inquiry Card.

SPREAD THE WORD

Please address new product information to New Products Editors, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Better yet, use your modem and mail new product information to the microbytes.hw or microbytes.sw conferences on BIX. Please send the product description, price, ship date, and an address and telephone number where readers can get more information.

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

Yes, I want FREE ollowing products!

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

Fill out this coupon carefully. ***Please Print.***

_____

_____

_____

_____

_____

_____

A. What is your primary job function/principal area of responsibility? (Check one)

1 ❑ MIS/DP
2 ❑ Programmer/Systems Analyst
3 ❑ Adminstration/Management
4 ❑ Sales/Marketing
5 ❑ Engineer/Scientist
6 ❑ Other

B. What is your level of management responsibility?

7 ❑ Senior-level
8 ❑ Middle-level
9 ❑ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ❑ Yes
11 ❑ No

D. What operating systems are you currently using? (Check all that apply)

12 ❑ PC/MS-DOS
13 ❑ DOS+ Windows
14 ❑ OS/2
15 ❑ Unix
16 ❑ MacOS
17 ❑ VAX/VMS

E. For how many people do you influence the purchase of hardware or software?

18 ❑ 1-25
19 ❑ 26-50
20 ❑ 51-99
21 ❑ 100 or more

❑ **Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.**

September 1992 89 98

Product Category Information

Circle the numbers below for information on the entire category of products you're interested in.

Hardware

Accessories/Supplies	1
Add-in Boards	2
Bar Coding	3
Communications/Networking	4
Computer Systems	5
Data Acquisition	6
Disks & Optical Drives	7
Diskettes/Duplicators	8
Fax Boards/Machines	9
Graphics Tablets/Mice/ Pen Input	10
Keyboards	11
LAN Hardware	12
Laptops & Notebooks	13
Mail Order	14
Memory/Chips/Upgrades	15
Miscellaneous Hardware	16
Modems/Multiplexors	17
Monitors & Terminals	18
Multimedia	19
Printers/Plotters	20
Programmable Hardware	21
Scanners/OCR/Digitizers	22
Tape Drives	23
UPS	24

Software

Business	25
CAD/CAM	26
Communications/Networking	27
Data Acquisition	28
Database	29
Educational	30
Engineering/Scientific	31
Entertainment	32
Graphics	33
Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Miscellaneous Software	37
On-Line Services	38
Operating Systems	39
Programming Languages/ Tools	40
Security	41
Shareware	42
Software Duplication	43
Spreadsheets	44
Unix	45
Utilities	46
Windows	47
Word Processing	48

General

Books/Publications	49
Recruitment	50
Miscellaneous	51

52	78	104	130	156	182	208
53	79	105	131	157	183	209
54	80	106	132	158	184	210
55	81	107	133	159	185	211
56	82	108	134	160	186	212
57	83	109	135	161	187	213
58	84	110	136	162	188	214
59	85	111	137	163	189	215
60	86	112	138	164	190	216
61	87	113	139	165	191	217
62	88	114	140	166	192	218
63	89	115	141	167	193	219
64	90	116	142	168	194	220
65	91	117	143	169	195	221
66	92	118	144	170	196	222
67	93	119	145	171	197	223
68	94	120	146	172	198	224
69	95	121	147	173	199	225
70	96	122	148	174	200	226
71	97	123	149	175	201	227
72	98	124	150	176	202	228
73	99	125	151	177	203	229
74	100	126	152	178	204	230
75	101	127	153	179	205	231
76	102	128	154	180	206	232
77	103	129	155	181	207	233

409	435	461	487	513	539	565
410	436	462	488	514	540	566
411	437	463	489	515	541	567
412	438	464	490	516	542	568
413	439	465	491	517	543	569
414	440	466	492	518	544	570
415	441	467	493	519	545	571
416	442	468	494	520	546	572
417	443	469	495	521	547	573
418	444	470	496	522	548	574
419	445	471	497	523	549	575
420	446	472	498	524	550	576
421	447	473	499	525	551	577
422	448	474	500	526	552	578
423	449	475	501	527	553	579
424	450	476	502	528	554	580
425	451	477	503	529	555	581
426	452	478	504	530	556	582
427	453	479	505	531	557	583
428	454	480	506	532	558	584
429	455	481	507	533	559	585
430	456	482	508	534	560	586
431	457	483	509	535	561	587
432	458	484	510	536	562	588
433	459	485	511	537	563	589
434	460	486	512	538	564	590

766	792	818	844	870	896	922
767	793	819	845	871	897	923
768	794	820	846	872	898	924
769	795	821	847	873	899	925
770	796	822	848	874	900	926
771	797	823	849	875	901	927
772	798	824	850	876	902	928
773	799	825	851	877	903	929
774	800	826	852	878	904	930
775	801	827	853	879	905	931
776	802	828	854	880	906	932
777	803	829	855	881	907	933
778	804	830	856	882	908	934
779	805	831	857	883	909	935
780	806	832	858	884	910	936
781	807	833	859	885	911	937
782	808	834	860	886	912	938
783	809	835	861	887	913	939
784	810	836	862	888	914	940
785	811	837	863	889	915	941
786	812	838	864	890	916	942
787	813	839	865	891	917	943
788	814	840	866	892	918	944
789	815	841	867	893	919	945
790	816	842	868	894	920	946
791	817	843	869	895	921	947

1123	1149	1175	1201	1227	1253	1279
1124	1150	1176	1202	1228	1254	1280
1125	1151	1177	1203	1229	1255	1281
1126	1152	1178	1204	1230	1256	1282
1127	1153	1179	1205	1231	1257	1283
1128	1154	1180	1206	1232	1258	1284
1129	1155	1181	1207	1233	1259	1285
1130	1156	1182	1208	1234	1260	1286
1131	1157	1183	1209	1235	1261	1287
1132	1158	1184	1210	1236	1262	1288
1133	1159	1185	1211	1237	1263	1289
1134	1160	1186	1212	1238	1264	1290
1135	1161	1187	1213	1239	1265	1291
1136	1162	1188	1214	1240	1266	1292
1137	1163	1189	1215	1241	1267	1293
1138	1164	1190	1216	1242	1268	1294
1139	1165	1191	1217	1243	1269	1295
1140	1166	1192	1218	1244	1270	1296
1141	1167	1193	1219	1245	1271	1297
1142	1168	1194	1220	1246	1272	1298
1143	1169	1195	1221	1247	1273	1299
1144	1170	1196	1222	1248	1274	1300
1145	1171	1197	1223	1249	1275	1301
1146	1172	1198	1224	1250	1276	1302
1147	1173	1199	1225	1251	1277	1303
1148	1174	1200	1226	1252	1278	1304

234	259	284	309	334	359	384
235	260	285	310	335	360	385
236	261	286	311	336	361	386
237	262	287	312	337	362	387
238	263	288	313	338	363	388
239	264	289	314	339	364	389
240	265	290	315	340	365	390
241	266	291	316	341	366	391
242	267	292	317	342	367	392
243	268	293	318	343	368	393
244	269	294	319	344	369	394
245	270	295	320	345	370	395
246	271	296	321	346	371	396
247	272	297	322	347	372	397
248	273	298	323	348	373	398
249	274	299	324	349	374	399
250	275	300	325	350	375	400
251	276	301	326	351	376	401
252	277	302	327	352	377	402
253	278	303	328	353	378	403
254	279	304	329	354	379	404
255	280	305	330	355	380	405
256	281	306	331	356	381	406
257	282	307	332	357	382	407
258	283	308	333	358	383	408

591	616	641	666	691	716	74.
592	617	642	667	692	717	742
593	618	643	668	693	718	743
594	619	644	669	694	719	744
595	620	645	670	695	720	745
596	621	646	671	696	721	746
597	622	647	672	697	722	747
598	623	648	673	698	723	748
599	624	649	674	699	724	749
600	625	650	675	700	725	750
601	626	651	676	701	726	751
602	627	652	677	702	727	752
603	628	653	678	703	728	753
604	629	654	679	704	729	754
605	630	655	680	705	730	755
606	631	656	681	706	731	756
607	632	657	682	707	732	757
608	633	658	683	708	733	758
609	634	659	684	709	734	759
610	635	660	685	710	735	760
611	636	661	686	711	736	761
612	637	662	687	712	737	762
613	638	663	688	713	738	763
614	639	664	689	714	739	764
615	640	665	690	715	740	765

948	973	998	1023	1048	1073	1098
949	974	999	1024	1049	1074	1099
950	975	1000	1025	1050	1075	1100
951	976	1001	1026	1051	1076	1101
952	977	1002	1027	1052	1077	1102
953	978	1003	1028	1053	1078	1103
954	979	1004	1029	1054	1079	1104
955	980	1005	1030	1055	1080	1105
956	981	1006	1031	1056	1081	1106
957	982	1007	1032	1057	1082	1107
958	983	1008	1033	1058	1083	1108
959	984	1009	1034	1059	1084	1109
960	985	1010	1035	1060	1085	1110
961	986	1011	1036	1061	1086	1111
962	987	1012	1037	1062	1087	1112
963	988	1013	1038	1063	1088	1113
964	989	1014	1039	1064	1089	1114
965	990	1015	1040	1065	1090	1115
966	991	1016	1041	1066	1091	1116
967	992	1017	1042	1067	1092	1117
968	993	1018	1043	1068	1093	1118
969	994	1019	1044	1069	1094	1119
970	995	1020	1045	1070	1095	1120
971	996	1021	1046	1071	1096	1121
972	997	1022	1047	1072	1097	1122

1305	1330	1355	1380	1405	1430	1455
1306	1331	1356	1381	1406	1431	1456
1307	1332	1357	1382	1407	1432	1457
1308	1333	1358	1383	1408	1433	1458
1309	1334	1359	1384	1409	1434	1459
1310	1335	1360	1385	1410	1435	1460
1311	1336	1361	1386	1411	1436	1461
1312	1337	1362	1387	1412	1437	1462
1313	1338	1363	1388	1413	1438	1463
1314	1339	1364	1389	1414	1439	1464
1315	1340	1365	1390	1415	1440	1465
1316	1341	1366	1391	1416	1441	1466
1317	1342	1367	1392	1417	1442	1467
1318	1343	1368	1393	1418	1443	1468
1319	1344	1369	1394	1419	1444	1469
1320	1345	1370	1395	1420	1445	1470
1321	1346	1371	1396	1421	1446	1471
1322	1347	1372	1397	1422	1447	1472
1323	1348	1373	1398	1423	1448	1473
1324	1349	1374	1399	1424	1449	1474
1325	1350	1375	1400	1425	1450	1475
1326	1351	1376	1401	1426	1451	1476
1327	1352	1377	1402	1427	1452	1477
1328	1353	1378	1403	1428	1453	1478
1329	1354	1379	1404	1429	1454	1479

BYTE

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

See reverse side for card.

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

BYTE

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 176 PITTSFIELD, MA

POSTAGE WILL BE PAID BY ADDRESSEE

BYTE

READER SERVICE

P.O. BOX 5110

Pittsfield, MA 01203-9926

USA

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BYTE

JERRY POURNELLE

THE AMIGA REVISITED

I suppose I could start by saying it has been another hectic month, but then every month seems to warrant that. Of course, this is Chaos Manor.

I had hoped to get to OS/2 this month. It's not all my fault. OS/2 installs only from the A drive. Like most real-world systems, my machines take a 5¼-inch disk on the A drive and a 3½-inch disk on the B drive. For months IBM never sent me any copy of OS/2; now I have no fewer than 14 copies—and every single one is for 3½-inch drives. Now the solution is to open the Gateway 2000 486/50, swap cables for the drives, run Setup, and inform the computer of the change.

Alas, about the time I was ready to swap cables, I heard new rumors that IBM is coming out with a bug-fixed version of OS/2. I've got enough reports of known bugs that it makes sense to wait. In fairness: I also have reports from highly enthusiastic readers who say that OS/2 runs many DOS sessions in true multitasking; that it runs most important Windows applications flawlessly; that it was easy to set up, and there wasn't any messing about with a PIF (program information file) and the like; and that they have had few to no problems.

Anyway, next month, OS/2 for sure. IBM says they have a fix that lets you install OS/2 from the B drive, and they're sending that as well as 5¼-inch disks.

Laptops

We went down to the beach house this month. The theory is that Larry Niven and I can pop down there away from the phone and do fiction without distractions. That works surprisingly well. Roberta and I also go there when I'm working on my own books; and, of course, it's an excellent place to experiment with concepts of computer portability. This time I may have gone a bit far.

I had with me Moby Brick, which is a 486 computer smaller than a box of Microsoft Windows software; an older 386 Brick; the ancient Zenith Supersport SX; the new Zenith Mastersport; an older Texas Instruments TravelMate 3000 WinSX; a Gateway notebook, the Nomad 420SXL, which appears to be identical to the WinSX except that it has a Gateway label and 2 MB less memory; the newest AT&T/NCR Safari; and probably a couple of others I lost track of. We had enough computing power to run the city of San Diego. I also had bags and bags of software. Our beach house looked like an electronics shop.

I hadn't really lost my mind. Much of my on-the-road software was scattered across several computers, and I hadn't had time to consolidate it preparatory to passing a couple of those machines along to local schools. There was also a lot of uninstalled software. I got all that straightened out and took the opportunity to do a bit of comparison.

Ergo Computing's Moby Brick has been my main machine when I'm at the beach, and it still is. It's not something to carry on the road: we're about to take off for San Francisco and Silicon Valley, and I won't take it along. The advantage of Moby Brick is that when I get it connected up to a good color monitor, keyboard, and mouse, I can't really tell the difference between it and my main machine; or I couldn't until recently, anyway. I keep a power supply, a Microsoft "Dove bar" mouse, and a Northgate Omni-Key Plus "Pournelle-configuration" keyboard at the beach house, so all I have to carry back and forth is Moby Brick itself.

Jerry looks at transportable and notebook computers and takes a closer look at the Amiga 3000T

Ergo furnishes a heavy-duty padded case for transporting Moby Brick, but I confess I don't bother. My Moby Brick resides in an old Wingz shoulder bag, and there's room in there for the computer, telephone cables, a notebook, a pile of floppy disks, and some pencils. Obviously I don't throw it across the room, but I'm not all that careful with it; and so far it has survived many trips, as has its predecessor, the 386 Brick.

I also keep a "Niven-configuration" keyboard: my partner for some unaccountable reason likes old AT-style keyboards with the function keys across the top, and the Control key down by the Shift key, where Satan wants it. Having both keyboards makes it easy to set Moby Brick up for Larry.

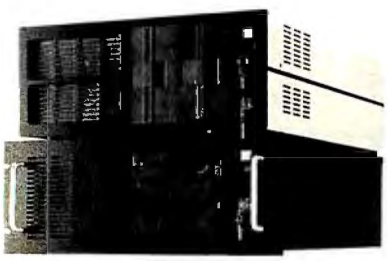
Larry's not yet into Windows, so he gets a setup that, except for the smaller 15-inch Princeton monitor (as opposed to the 20-inch Nanao Flexscan he favors), is identical to his home operating environment, which is

ILLUSTRATION: STEVE TURK © 1992

Circle 120 on Inquiry Card

Rack & Desk Chassis FOR XT/AT/286/386/486

Integrand's unique packaging design uses modular construction. We have 3 basic models for ISA/EISA bus computers. Over 90 interchangable modules allow you to customize them to nearly any requirement. We make drive enclosures and rackmount keyboards too. Integrand offers high quality, advanced design hardware and strong support. Why settle for less?



Rack & Desk Models
Accepts Most Motherboards and Passive Backplanes
Doesn't Look Like IBM
Rugged, Modular Construction
Excellent Air Flow & Cooling
Designed to meet FCC
204 Watt Supply, UL Recognized
200 & 300 Watt Supplies, UL, CSA, TUV
Reasonably Priced

NOW AVAILABLE Rackmount Keyboards

Three Models: Drawer, Shelf, and Panel
Reasonably Priced

Call or write for descriptive brochures, prices or applications assistance:

INTEGRAND RESEARCH CORP

8620 Roosevelt Ave. • Visalia, CA 93291

209/651-1203

FAX 209/651-1353

We accept VISA and MasterCard

IBM/XT/AT TM IBM • 286/386/486 TM INTEL. Drives and computer boards not included.

Desqview. That's what I used until recently.

The first thing I did when I got things set up at the beach house was to install Windows 3.1, updating the previous Windows 3.0 installation that came with Moby Brick. That worked just fine. However, when I tried to convert the screen from 640 by 480 pixels to my usual 1024 by 768 pixels, I couldn't do it. I suspect I don't have the right drivers for Windows 3.1. I'm not complaining: on a 15-inch screen, 640 by 480 pixels is actually good enough. It's all I get on a laptop, and indeed about half the Windows-using computers in Chaos Manor are set to 640 by 480 pixels.

On the other hand, I didn't have much problem with a CD-ROM device for Moby Brick. I used one of the little Trantor devices that converts your printer port to a SCSI port, and it worked OK. Actually, I did that only for a test, but now that Microsoft has integrated Word for Windows and Bookshelf—more on that later—I'll want CD-ROM capability on trips as well as at home.

One of the main advantages of Moby Brick over a laptop is its single half-card slot, which can hold, say, a SCSI controller or a Sound Blaster; but technology is catching up here. Not only does Trantor have a parallel port–to–SCSI device, but Zircom has an Ethernet connector that can hook your portable into your main system. Most laptops have VGA output, so if you have a monitor, you can get color.

Supra has a neat little 14,400-bps fax modem, so you don't need a fax card on the road. The Supra modem also has error-correcting capabilities, which will let you work through noisy hotel phone-line systems that overwhelm the built-in modem in most laptops. The Supra modem is small enough to stuff into the computer carrying case if you're not checking luggage. Of course, it does use a serial port, so if your portable doesn't have a second serial port or separate mouse port, you can't use a mouse and an external modem at the same time.

Moby Brick remains an excellent tool for going from one fixed location to another; but I'd hate to have to carry the monitor and keyboards along on every trip. What with new tiny hard drives, small high-capacity external hard drives, and new improvements in chip technology, laptops are catching up with portables in capability.

Laptop Wars

When we went up to San Francisco, we winnowed things down to two laptops. One was my Mastersport. I love Zenith laptops. Last week we had to repair the ancient Z-183 laptop I gave our church. It cost $83.50, the first repair it has needed in five years of hard use.

Roberta chose the Nomad 420SXL. It's preferable to TI's WinSX even though it has less memory, because the WinSX has taken lately to locking up at unexpected intervals. It does that only when it's doing a big modem download, so there's screen action but no keyboard activity. We don't know if the problem is connected to the WinSX's screen blanker/disk drive manager software, or if there's a heat problem, or if a chip got loose. Otherwise, the machine works just fine, and while we're off up north, I'll have Alex take it to a good repair shop. The main point here is that Roberta, having had a chance at half a dozen laptops, is very fond of the WinSX, and since the Nomad is identical to it except for memory, she's quite happy to take the Nomad.

Gateway furnishes better documentation with their machine than TI did. The external power pack is much smaller and puts out a lot less heat. The Nomad comes with different memory configurations. The documentation says that installing more memory is tedious and requires removing the keyboard. I think the machine needs the full 4 MB—Windows machines really do need a lot of memory—so if you're not mechanically inclined, your best bet is to get one with the full 4 MB in the first place.

The Nomad comes with the same "sort of mouse" that came with the WinSX. It's a tiny little thumb-ball device, and it's no good; at least I can't use it well. Fortunately, we have a Logitech TrackMan Portable. That's so neat you may want to use it on your desktop machine, and it works just fine on the Nomad. The Nomad comes with Windows 3.1 installed. I'm not happy with the Microsoft memory managers, so I installed QEMM-386, as I routinely do with new machines.

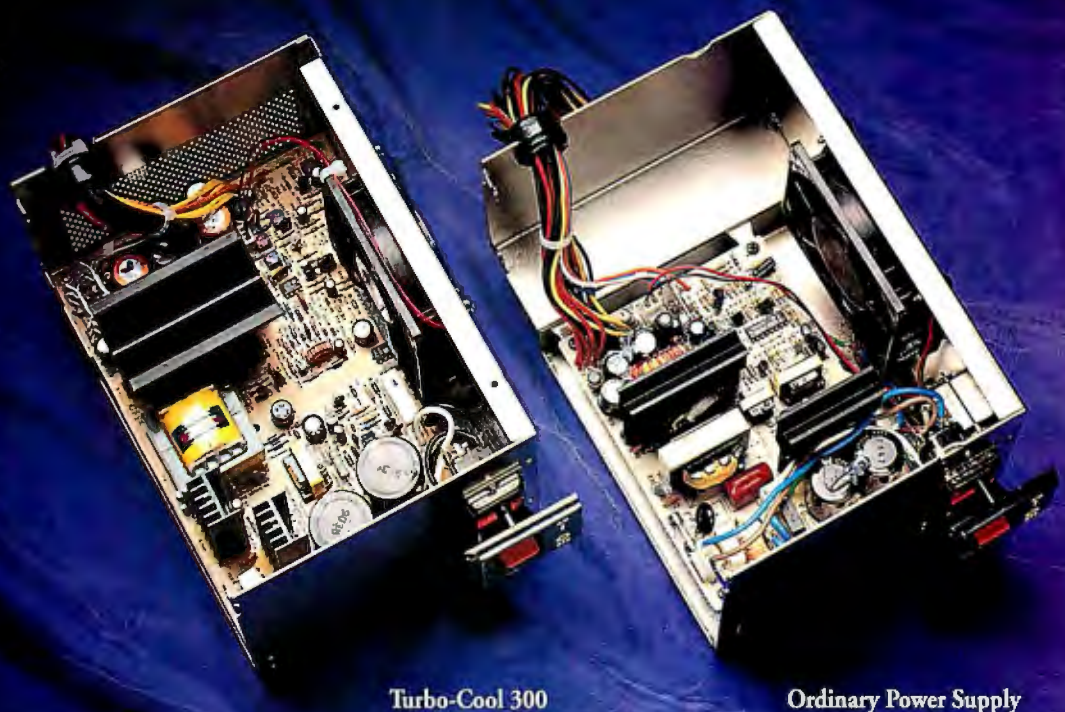
Like Niven, Roberta is still using Desqview rather than Windows, and QEMM-386 works with both. You do want to boot without the DOS=HIGH statement in CONFIG.SYS if you're running Desqview, and you may want some other customizations. The easy way to do this is to have a couple of batch files: MAKEWIN.BAT copies CONFIG.WIN and AUTOEXEC.WIN to be CONFIG.SYS and AUTOEXEC.BAT; MAKEDV.BAT does the same for CONFIG.DV and AUTOEXEC.DV.

Help!

One other thing the WinSX had was an on-line menuing system and help file manager called Lap Manager. I never used it

AN ORDINARY POWER SUPPLY JUST ISN'T ENOUGH.

What power supply is inside your computer? If you are like most people, you don't know, and frankly, don't care. But, because your computer's power supply is a critical system component, what you don't know, may hurt you. An inferior power supply can cause interference, rebooting, hard drive errors, and other nasty hard-to-track problems. So why take chances? Call the power supply specialists at PC Power and Cooling today.



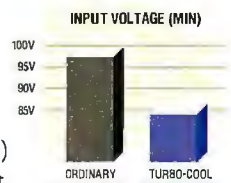
HERE ARE TEN GREAT REASONS TO SELECT THE INDUSTRY'S BEST, THE TURBO-COOL™ 300 AND TURBO-COOL™ 450.

1. 50% TO 100% MORE POWER

The more power, the better! Our high-capacity units start drive motors with ease, run cooler, last longer, and allow for future expansion.

2. BUILT-IN LINE CONDITIONING

Turbo-Cool power supplies won't skip a beat when the line voltage sags. Their wide input range (85-135V, 170-270V) and heavy-duty input components protect your PC and its data from sags, surges and spikes.



3. FCC-B AND VDE-B LINE FILTER

A dual-stage EMI filter keeps electrical noise well below agency standards.

4. INDEPENDENT REGULATION

Turbo-Cool's superior independent-regulation design keeps output voltage tolerances 20 times tighter than that of an ordinary power supply. This exceptional stability improves hard drive reliability during critical access periods.

5. ULTRA-CLEAN DC OUTPUT

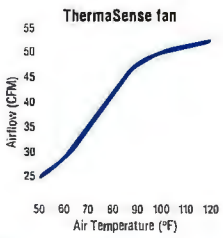
A dual-stage output filter ensures that sensitive computer chips receive pure, low-ripple power.

6. PROTECTION CIRCUITRY

Our units offer the most complete protection from dangerous overvoltage, overcurrent, and short circuit conditions.

7. THERMASENSE™ COOLING FAN

The Turbo-Cool 300 features ThermaSense, our high-capacity, thermostatically-controlled, variable-speed fan. It's ideal! High-performance systems operate up to 35° cooler while standard ones run as much as 75% quieter.



8. UL/CSA/TUV APPROVALS

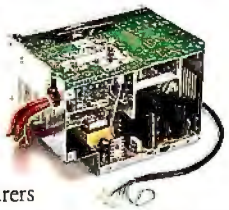
Our high-capacity units are safety approved by not only UL, but also by Canada's CSA and Germany's strict TUV.

9. TWO-YEAR WARRANTY

Turbo-Cools are designed and tested for MTBFs of over 100,000 hours. They come with a no-hassle 2-year warranty and a 30-day money-back guarantee.

10. GREAT VALUE

Loaded with premium features, a Turbo-Cool power supply will upgrade the performance of your PC or LAN file server at a retail cost of only 55¢ to 80¢ per watt. You'll be powered by a unit that is popular with award-winning PC manufacturers and recommended by experts such as the PC Magazine Advisor!


Turbo-Cool 450

PC POWER & COOLING, INC.

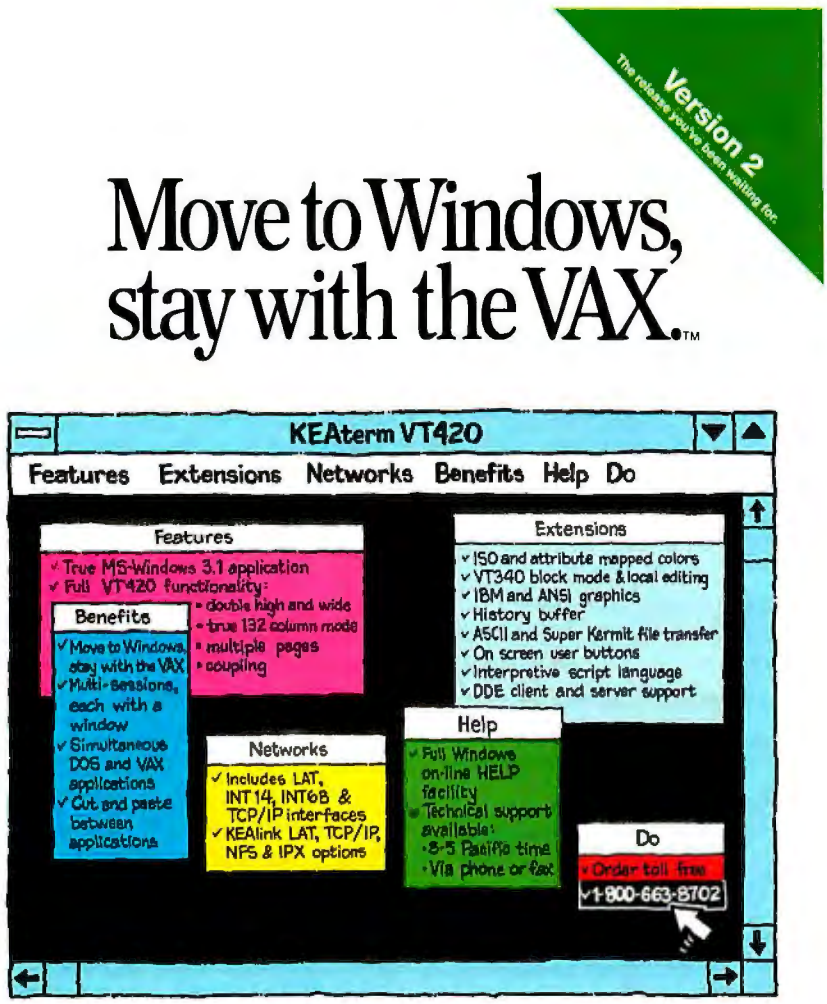
5995 Avenida Encinas, Carlsbad, CA 92008 • (619) 931-5700 • (800) 722-6555 • Fax (619) 931-6988

Circle 142 on Inquiry Card (RESELLERS: 143).

much, but Roberta liked it. I don't mind remembering that you type `mpower -on` to turn on the WinSX (on the Mastersport, it's `machine modem on`), but Roberta isn't much interested in memorizing details of machine operation. I wrote her a series of batch files for her older Zenith laptop. They'd turn on the modem, log onto the right directory, and invoke the proper communications program for BIX or GEnie. I didn't get around to that with the WinSX, because it had Lap Manager.

I'll have to do it for the Nomad, unless I find a way to install Lap Manager on it. While I'm at it, I'll jigger the AUTOEXEC.BAT file to give my name and fax number when the machine turns on. I'd done that on the Zenith laptop before it was stolen, and that's how the San Diego police knew to call me when they recovered the machine.

Roberta thinks all laptop machines ought to come with good on-line help systems describing the machine and any preinstalled software. Many outfits put up readme files, but they tend to be too long and unindexed. What Roberta wants is hypertext on-line help files. She also points out that USRobotics prints the essential information from their manual right on the bottom of the modem. There's a lot of blank space on laptop bottoms....



RoboHelp

If you have an application that can benefit from hypertext help systems for Windows, you need RoboHelp from Blue Sky Software. This really works to take the sting out of building help systems. The author of RoboHelp—who, curiously, is unnamed—says in the preface to the manual that "the day of the ASCII read-me file is over." With luck, this is true.

RoboHelp requires Microsoft Word for Windows, Microsoft Windows 3.x, and the Microsoft Help Compiler 3.x. Given those, you can build hypertext help systems for just about every Windows application.

Using RoboHelp is straightforward. You'll need to know a bit about Windows and Word for Windows and how to use the Microsoft Help Compiler; otherwise, it's all explained simply enough. Do understand, this is a professional tool, but anyone who can use Word for Windows can use it. That certainly includes teachers.

I strongly recommend that anyone distributing a Windows product, or hardware with Windows installed, build real help files to include with the product. You'll make your customers much happier and end a lot of reviewer frustrations. RoboHelp looks to be the simplest way to do that; this makes Blue Sky a public benefactor and more than justifies a User's Choice Award.

Cursorific Pro

I'm still writing this in Q&A Write, but I'm now used to Windows and Microsoft Word; enough so that I've taken to running Windows on the Mastersport. The only problem I had with that was that I sometimes had trouble locating the Windows cursor on the desktop.

That was just about fixed by Cursorific Pro from Aapex Software. This installs simply, ending up as a resource in your Windows Main program group. Invoke it and choose cursors for different conditions. You get a lot of cursor sizes, patterns, and shapes to choose from. One of them will be visible in almost any light condition.

This is one of those programs that does one thing, does it well, and causes no problems. If you have any trouble at all seeing your Windows cursor—or if you're just

Circle 123 on Inquiry Card.

GO

START OVER

Imported EISA board has no tech support

GO BACK 1 SPACE

Discount board has compatibility problems

50 MHz Now Available

START HERE

Cheap board fails in UNIX system

Select Dependable AMI EISA motherboards

No AMI EISA BIOS

Discount boards not worth the savings

Imported board proves unreliable

GO BACK 1 SPACE

Use AMI EISA for reliable network file server

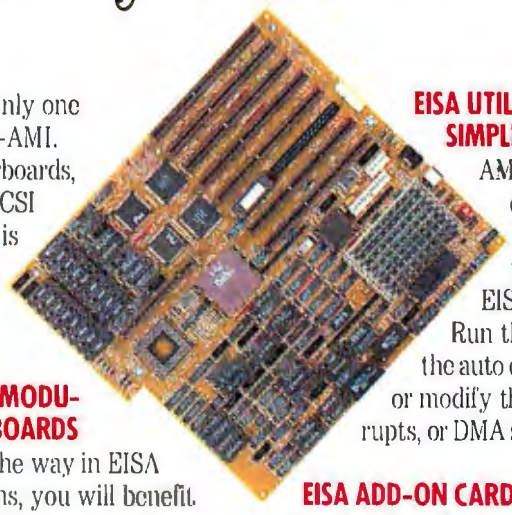
MOVE AHEAD 2 SPACES

Slow SCSI interface ruins reputation

GO BACK 3 SPACES

AMI EISA

The Only Game In Town



For EISA, there is only one player to consider—AMI. Whether it's motherboards, BIOS, utilities, or SCSI host adapters, AMI is the single source for advanced EISA technology.

ADVANCED EISA & MODULAR CPU MOTHERBOARDS

With AMI leading the way in EISA motherboard designs, you will benefit from bulletproof performance and proven reliability.

- EZ-Flex—A new modular CPU design offering easy upgrades to future technology.
- Enterprise II—A proven EISA performer, popular for critical applications.

EISA UTILITIES MAKE THE JOB SIMPLE

AMI designed and developed the EISA Configuration Utility to make configuring EISA products a snap. Run the ECU and select the auto configuration option, or modify the I/O ports, interrupts, or DMA settings as you desire.

EISA ADD-ON CARDS

The Fast Disk EISA SCSI Host Adapter, with a combination of 16 MB cache, and intelligent 386SX I/O management, is the fastest SCSI host adapter on the market today. Look to AMI for other EISA cards in the near future.

THE LEADING EISA BIOS

AMI is the worldwide standard for BIOS. AMI's EISA BIOS provides the reliability, compatibility, and features you desire. Plus, it's compatible with AMI's BIOS Configuration Utility, providing on-site customization for the Integrator or OEM.

THE AMI DIFFERENCE

AMI's expertise covers the entire EISA environment. With research, engineering and support functions under one roof, AMI is unmatched in knowledge and support. Call AMI, and you will understand why AMI's "monopoly" on EISA makes it the only game in town.

AMI

SINGLE SOURCE TECHNOLOGY

Circle 78 on Inquiry Card (RESELLERS: 79).

AMERICAN MEGATRENDS, INC.
800-U-BUY-AMI or 800-828-9264, 404-263-8181, fax 404-263-9381

Discount EISA boards have high failure rate

GO BACK 3 SPACES

Discount board has slow video speed

LOSE TURN

Use highly compatible AMI EISA BIOS

PROFITABLE PARKING

GO TO BANKRUPTCY

bored with your cursor—this is the program to get. It sure saved me some eyestrain. Recommended, and the winner of a User's Choice Award.

K-U-I

If you don't care for trackballs and you have to run Windows on a portable, Softac's K-U-I—Keyboard User Interface—may be just what you need. This lets you set up a bunch of hot keys to launch applications, simulate a mouse, and do command-line control in a pop-up window. K-U-I also includes user-selectable cursors.

I find I don't at all mind either the Microsoft Ballpoint or the Logitech TrackMan Portable, so this isn't as useful to me as I thought it would be when I got it; but if you're tired of mousing around, this may be the remedy.

The Amiga 3000T

This is a report, not a review. I don't have the time or space to go into all the features of the Amiga 3000T and the new Amiga 2.0 operating system. What I can do is give you some impressions and tell you why you might want to buy one.

The Amiga was the first personal computer with a practical multitasking operating system. It also had stunning visuals integrated with a good sound system, so it was the first practical low-cost multimedia machine as well. As a result, it attracted quite a few users. Most were hobbyists. Some dropped along the wayside, but a few, like my colorful friend Leo Schwab, became real fanatics who thought themselves Keepers of the Sacred Flame. They went around denouncing IBM, which may or may not have helped get others to take the Amiga seriously.

Others, like David Joiner and Joanne Dow—you can find them on-line in the Amiga conference on BIX—were willing to overlook the machine's many and very real defects: weird documentation—many of its best features weren't documented at all, and they were passed along as folklore; a slow and insanely dumb disk drive system; hokey error messages; a start-up system that was just plain odd, involving a "Kickstart" and an icon-operated "Workbench," except that power users could use a command system called a CLI (command-line interface); mysterious terminology; and so forth. Of course, some of these were strengths rather than defects, but the early Amiga was so poorly documented that many features were as confusing as bugs.

There were a number of revisions, and promises of more, but over the years the Amiga lost several chances to move up to real rivalry with the Mac. On the other hand, it's still here, with about a million units in the U.S. and perhaps 3 million worldwide; and while sales aren't exactly leaping along, they're not all that slow either. The Amiga has found a definite niche; and those who like it, like it a lot.

Moreover, the new version of the operating system that is incorporated into the 3000T fixes most of the problems described above. The floppy drive system is still a bit weird, but it's no longer intolerably slow. The hokey "Guru Meditation" messages you got if there was a system crash are gone, and, even better, so are the system crashes. The new operating system boots up from ROM and comes up when you turn on the machine: no more two-stage Kickstart-Workbench bootup. The operating system has many features you won't find in DOS systems, too.

For instance, quite good sound rendering is built in: no sound board is needed to

Rub lamp and say:
"I want vivid color from an affordable printer."
"I want vivid color from an affordable printer."
"I want vivid color from an affordable printer."
If that doesn't work call 1-800-835-6100, Dept. 22J.

The Phaser™ II PXe color printer produces 16.7 million of the world's brightest, most vivid colors. It prints at 300 dpi onto transparencies or paper using PostScript Language-Level 2. It works with PC or Mac applications, it's fast, it's networkable and at $4995, unexpectedly affordable. Rub for awhile, then call.

Tektronix

Circle 173 on Inquiry Card.

get multimedia. The ProWrite word processor (it's much like MacWrite in use) will have the Amiga read the screen to you. It does a surprisingly good job, too.

Arexx, the Amiga version of the Rexx command programming language, is built into the Amiga operating system. Rexx is a very powerful language that lets you build highly complex and useful software robots to handle such things as communications and backup unattended; experienced Amiga users can do astonishing things with it.

About the time you read this, there will be a new addition to the Amiga 3000T operating system: the ability to read DOS files directly. That is already installed on my system. It makes text and source code transfers very easy. The 3000T I have has a high-density 3½-inch drive; that's at present an undocumented feature, but I presume Commodore will document and support it soon.

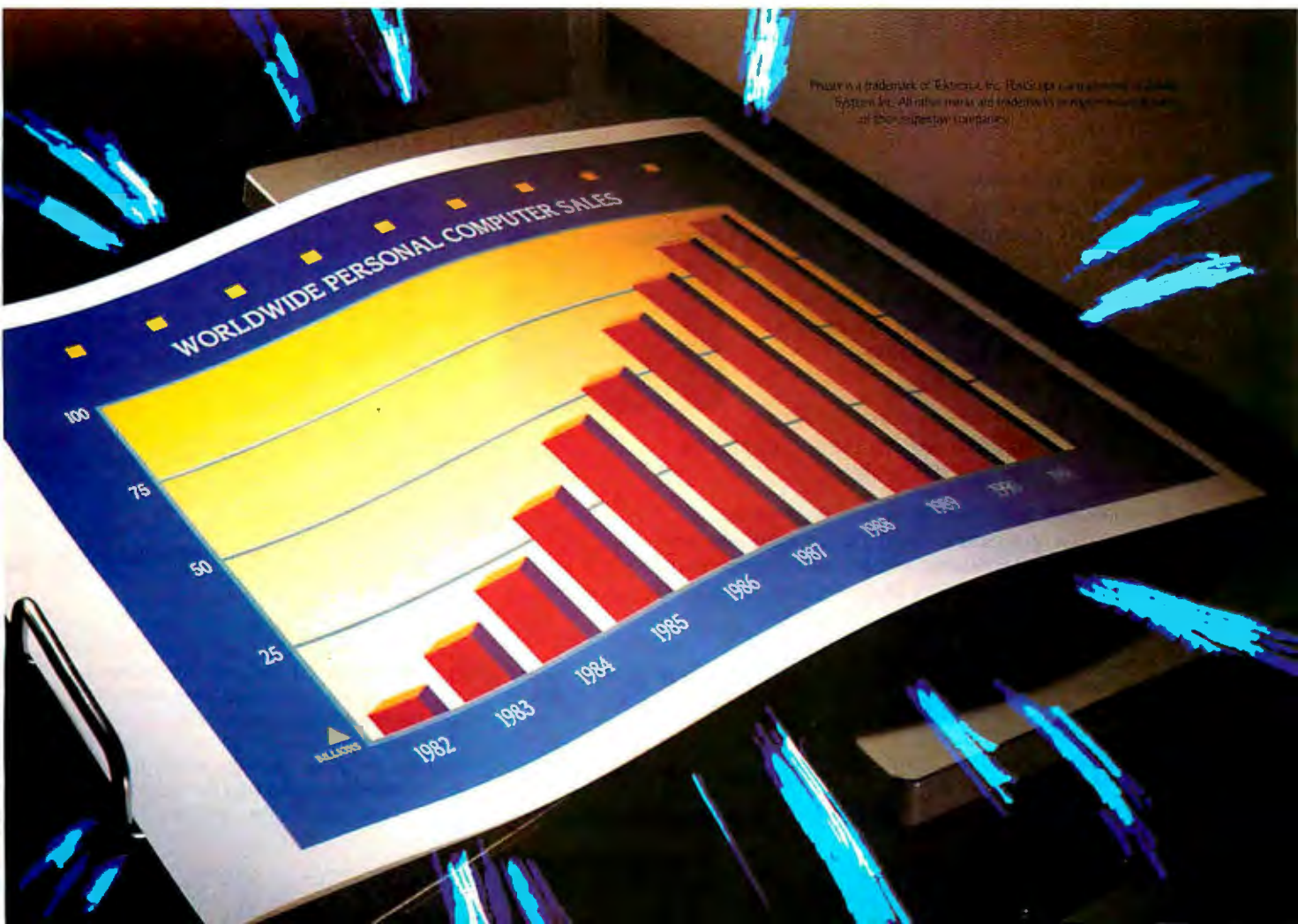
The Amiga 3000T has full SCSI capability. Attach any true SCSI device, including a hard drive, and it ought to work just fine; no controller card is needed. We tested the Amiga's SCSI capability by connecting up the Palindrome DAT (digital audiotape) drive that normally runs off a Future Domain controller card. There was nothing to it: just connect it up, put in a blank tape, and bring up the backup program.

The current version of the backup program isn't very sophisticated.

The current version of the backup program isn't very sophisticated: it will do only incremental backups to a new tape, otherwise only full backups on a previously used tape. On the other hand, it works just fine, and it's fast (at least with DAT), so I can't complain. It will restore single files or *drawers* (which is what directories are called on the Amiga). We erased some games and restored them from tape, and they ran as well as they ever did. I am told that any SCSI tape drive, such as those from Colorado Memory Systems, will work with the Amiga.

The next test was CD-ROM drives. First we tried a Denon drive (manufactured by Sony), which is supposed to be true Mac-compatible SCSI. It didn't work. Then we tried the Toshiba CD-ROM drive that came with the Corel Blockbuster package. That worked first crack. The Denon drive is older, but it works with most SCSI devices; I don't know why the Amiga 3000T didn't like it. The Toshiba is easily the fastest CD-ROM drive I have; it works just fine. So does the Pioneer read/write optical drive. An Amiga doesn't know about WORM files, so you can't run a WORM drive. All SCSI devices are not equal. I don't have any advice on how to tell which will work with the Amiga and which won't.

SCSI devices appear to the Amiga operating system as just another drive. The CD-ROM retrieval software I know about is all written for DOS or Mac operating



systems; I'm not aware of any for the Amiga. We were able to read DOS directory and filenames all right, and text files; but we couldn't run any of the retrieval software. We were able to view some CD-ROM screen images.

Art Department Professional is a wonderful program that converts just about any screen image format to something the Amiga can display, and we were able to look at, for instance, NASA GIF files just fine. The VGA quality is excellent, but then you expect that from the Amiga.

Indeed, desktop video is the Amiga's strongest point. It's easier to make a good desktop presentation integrating visuals, animations, and sound with the Amiga than with any other system I know; certainly than with any PC-type system. Moreover, Amiga stuff can be output to tape and then played on any VCR: I recall a spectacular presentation by Klaus Heiss at Doug Trumball's studio in the Berkshires. It was a series of solar-sail spacecraft, drawn and animated by Georgetown University students using an Amiga 2000.

I'm supposed to do another space presentation at the White House, and I think I'll work up something on the Amiga. I've got some scanned images of my ships, there are plenty of space images for background, and Disney makes an excellent animation program; and there are several programs that will build presentations. Stay tuned.

I wouldn't recommend the Amiga as the only computer for a small business. You can manage: There are reasonable word processors, databases, and spreadsheet programs for the Amiga; but you will be out of step with everyone else. I'd hate to do my income taxes without Taxview or MacInTax, and there are many small businesses using Quicken or Access to Platinum for accounting; neither of these has an Amiga version. My artist friend Kelly Freas likes the Amiga because of the graphics, but his wife finds the business software is driving her nuts. Of course, they haven't bought any new software in years. Still, in my judgment they'd do better to get a PClone for the business and leave the Amiga for graphics and games.

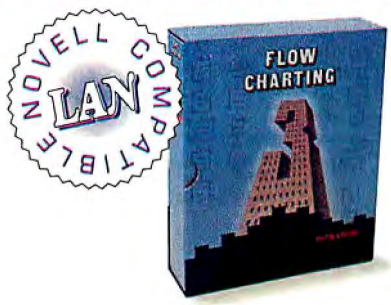
The Amiga is used as a solo business machine in Europe, and knowing the Amiga and its European software base may be an edge for those wanting to do business over there. There's also a simple program that will change the Amiga video output from U.S. NTSC to the European PAL standard (which has more scan lines).

The Amiga fares better as a solo machine for students, provided that the student is curious about the machine's potential. Amiga users will get a very good grounding in both basics and slick tricks of computer use; Windows or the Mac should be a snap for an experienced Amiga user. College students may need software, such as dynamic simulation programs, that just aren't available on an Amiga; on the other hand, while I haven't seen it, Dr. Marvin Weinstein, an Amiga enthusiast at the Stanford Linear Accelerator Center, says that Amiga DOS Maple is as good as Mathcad or Mathematica. Most of the big CD-ROM databases don't have any Amiga access software. It might be possible to write an Arexx script that would do much of that, but I'd hate to try it.

Actually, it might be fun to try that, provided that you didn't have a fortune riding on the results. I don't recommend the Amiga as your only business machine, but I can recommend it as a second machine for people who just like to play with computers; I'd guess that about half the BYTE readership would find the machine worth having just for fun, and many of those

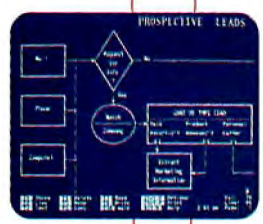
ARE YOU SPENDING TOO MUCH TIME DRAWING FLOWCHARTS?

YOU NEED FLOW CHARTING™ 3.



Every day, professionals worldwide save time and money using Flow Charting 3. It's fast, efficient, easy to use, and always produces presentation-perfect charts and diagrams.

With Flow Charting 3's built-in flexibility, you can create customized charts using a variety of shapes, lines, and text—placed where you want them.



Plus, Flow Charting 3 is now available in a LAN version. Making it easy to share files and set up work groups for specific projects.

And it's backed with free technical support and a 90-day no-risk guarantee. So if you're spending too much time drawing charts, call for a free demo and see for yourself what makes Flow Charting 3 the best-selling flowcharting software.

See your dealer today! Or for a free interactive demo disk,call 1-800-525-0082, ext. 112

International: 408-778-6557, ext. 112

Novell is a registered trademark of Novell, Inc.

PATTON & PATTON Software Corporation

Excellence in charting the flow of ideas!

Patton & Patton Software Corp. 485 Cochrane Circle, Morgan Hill, CA 95037

Circle 141 on Inquiry Card.

MINUTEMAN TAKES CHARGE IN OVER 1000 JCPENNEY STORES.

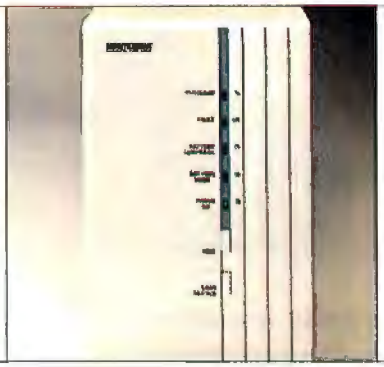
Every time JCPenney sells a pair of jeans, a toaster or a bottle of perfume, MINUTEMAN takes charge. That's because more than one thousand JCPenney stores rely on MINUTEMAN UPS systems to back up power to their point-of-sale systems.

Every day your company relies on its voice and data communications equipment to stay productive. Unfortunately, the electricity that powers these vital systems is not reliable.

Blackouts, brownouts, spikes, surges and even lightning strikes are common in most business environments. And the high cost of losing vital information and productivity due to power outages and surges calls for preventive measures.

Power requirements can be confusing. And your company has unique needs that often require custom solutions.

MINUTEMAN's Intelligent Power Master Series:
- **PM600 - $579**
- **PM1250 - $1049**
- **The intelligent power boost feature allows for normal input to the computer during extended brownouts of up to -12% without draining the batteries**
- **True sinewave**
- **Continuous protection from surges and spikes**



- **Auto frequency selection - 50Hz or 60Hz**
- **LEDs and alarms indicate overload, even in AC mode**
- **Lightweight and small footprint**
- **LEDs and alarms for low, weak or bad battery and LEDs of remaining operation time**
- **Auto self diognostic of all system functions**
- **Test button**

MINUTEMAN PRODUCTS:
- On-line and standby UPS 300VA to 10KVA
- Shutdown software for every available operating system
- Automatic voltage regulators
- Surge suppressors
- Global Socket Series - compatible with all major plug patterns
- Two year warranty

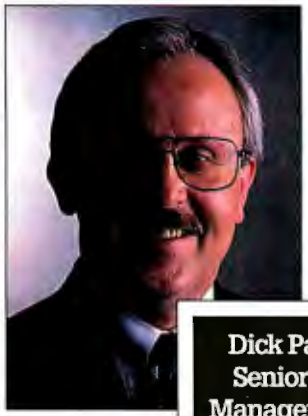
Call our toll-free POWER HOTLINE now for your free Power Protection Guide.

(800) 238-7272

MINUTEMAN®
UNINTERRUPTIBLE POWER SUPPLIES

Reduced prices up to 36%

Call for complete price list.

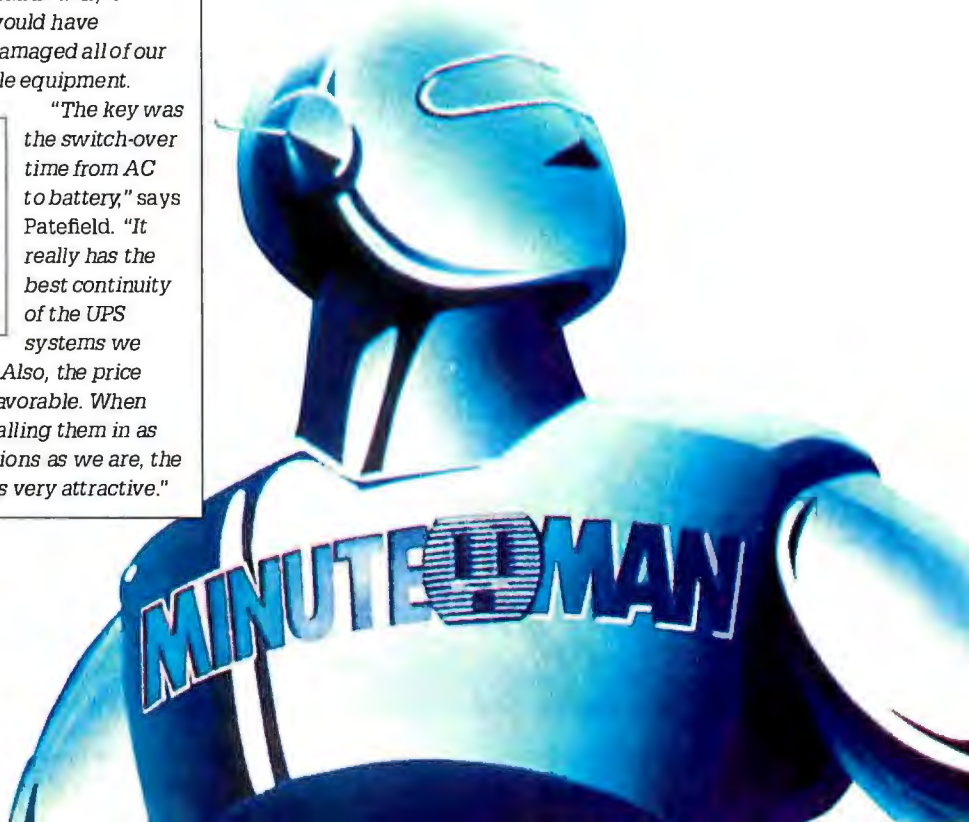


Dick Patefield, Senior Project Manager for Store Systems Support, JCPenney

Recently JCPenney Co., Inc. changed its operations from the old POS systems to the new PC-based technology, relying on PC platforms for point-of-sale and in-store support. And they back each one up with help from MINUTEMAN.

"There was a violent surge in one of our stores," says Patefield. *"If we didn't have the MINUTEMAN unit, it probably would have seriously damaged all of our point-of-sale equipment.*

"The key was the switch-over time from AC to battery," says Patefield. *"It really has the best continuity of the UPS systems we evaluated. Also, the price was very favorable. When you're installing them in as many locations as we are, the pricing was very attractive."*



Circle 140 on Inquiry Card.

© 1992 Para Systems, Inc., 1455 LeMay Drive, Carrollton, Texas 75007 (214) 446-7363 (214) 446-9011 fax

Just Add Code.

NEW Version 5.0 Includes Phar-Lap 386|DOS-Extender

32-bit protected-mode Fortran

Your Fortran code is important. Trust it to the company that has been writing award-winning Fortran language systems for 25 years.

(800) 548-4778

Lahey
Computer Systems, Inc.

Fortran is our forte

(702) 831-2500 ■ Fax: (702) 831-8123 ■ P.O. Box 6091 ■ Incline Village NV 89450

would see some business potential in the desktop video capabilities of the machine. I could have made the same statement about the Amiga 2000, but that machine was much harder to use, so many would have given up before they got started. The 3000T, with its new operating system and better documentation, is much less dependent on folklore workarounds.

On that score: the folklore is available for those who want it. The Amiga users groups on GEnie and BIX are about the largest machine-specific conferences going, and the Amiga community enthusiastically tries to help anyone with a problem. If this column makes you curious about the Amiga and you want to know more, my advice is to get on BIX and talk to Joanne Dow (BIX name "jdow").

The Amiga is also said to be the best games machine around. Alas, so far I have been unable to get many of my older Amiga games to work with it. Pirates, from Microprose, for example. The game begins spectacularly, much better color and animation than the Mac version; but within 5 minutes it locks up and has to be reset. (I'm told there is a hacked version that does run with the 3000T, but I haven't seen it.) Firepower, a wonderful two-player tank-simulation game, won't run at all, and MicroIllusions, the company that produced it, is out of business. Many other older games defeat themselves: the 3000T can't handle the copy-protection schemes. Some game designers wrote directly to the 2000's hardware and ROMs, and while Commodore tried to make the 3000T ROMs compatible with the more common programmer tricks, they weren't always successful.

On the other hand, some programs will degrade the 3000T to slow games down—Populous I is spectacular on the Amiga, but it runs far too fast on a 3000T—and other programs will hack out the older copy-protection schemes and let you install the games on your hard disk.

It used to be that, because of the Amiga's spectacular graphics and sound integration, there were more games for the Amiga than for any other machine. Now that the Mac has color and VGA is fairly standard on the PC, developers tend to write for the larger market and then port back to the Amiga. This often fails to take advantage of many Amiga features, so the Amiga versions of games are no longer necessarily much better than the PC versions; and some major games never are ported to the Amiga.

For all that, the Amiga has a real niche, and while sales aren't spectacular, it's here to stay. If you need desktop video, you may be able to justify getting one for that;

Why do they call it a dongle?

He wasn't famous. He didn't drive a fancy car, but dressed in his favorite Comdex T-shirt and faded blue jeans, he set out to change the course of the computer software industry. Quite a task for a lonely software developer.

Sitting in front of his computer, drinking pots of coffee and smoking cartons of cigarettes, he'd write pages of code.

It took time. Years in fact. But he did it. He wrote the most powerful computer program in the world. Now came the hard part. Selling it.

The Most Powerful Program in the World

Determined to make those long years pay off, he called on every distributor, VAR and dealer in the world. He drove from Beantown to San Diego. Flew from Dublin to Borneo. Everyone loved the program.

So he sold a few. Only a few.

Back in Boston he waited. After a long year with only 13 orders he set out to see what happened. As he drove across the country and flew around the world he discovered everyone knew about his program. Everyone had it too.

The Global Marketplace

From Paris to Prague, his program was everywhere in Europe. When he got off the plane in Hong Kong he found his program stacked to the ceiling in every computer store. Amazed in disbelief, he bought a hundred cartons of cigarettes and a hundred pounds of Indonesia coffee and flew back to Boston.

Beaten, battered and bruised he went back to the drawing board. This time he would really change the face of the software industr He would develop a device that would prevent unauthorized distribution of software programs.

Call It What You Like

He developed a hardware key. His peers applauded his efforts. Finally, a solid solution for revenue protection.

But he didn't know what to call it. He thought of naming it after an exotic place he visited in his travels. Madagascar was a bit too long, though.

"Name it after you, Don!", urged his peers. So he did. Soon everyone was calling the key a dongle, after Don Gall — the lonely software developer who did what he had to do.

You've Come A Long Way, Baby

Today, dongles are different. Fact is, they've come a long way. Leading the industry with security solutions, Rainbow Technologies has changed the face of hardware keys. They work with multiple applications, are programmable and network versions control concurrent usage. And they're always transparent to the end-user.

Sentinel Family from Rainbow

Truth is, more and more developers are using keys. And the Sentinel Family is the most widely used in the world. In fact, over 6,000 developers use Sentinel from Rainbow. Why? They are simply the most effective, reliable and easy to implement keys on the market.

Learn more about securing your software and how keys provide developers with extra value. Call for a free copy of **"The Sentinel Guide to Securing Software."** And see just how easy it is to install a hardware key into your application in just minutes. Try it with our low cost Sentinel Evaluation Kit. Order one for your DOS, OS/2, Windows, Macintosh or UNIX based application.

And remember, when you need a dongle, you need Sentinel — the only dongle Don Gall would use.

CALL
800/ 852-8569
FOR YOUR FREE GUIDE
TO SECURING SOFTWARE

SENTINEL
Securing the future of software

Some call it a dongle. Those who know, call it Sentinel.

RAINBOW TECHNOLOGIES

9292 JERONIMO ROAD, IRVINE, CALIFORNIA 92718 ▪ 714/ 454-2100 ▪ fax 714/ 454-8557
International offices are located in the United Kingdom, Germany and France.

Circle 155 on Inquiry Card (RESELLERS: 156).

but you may find yourself using it because it's just plain fun.

Word for Windows

The adventure continues. I've just got a copy of the CD-ROM version of Word for Windows; it's integrated with Microsoft Bookshelf. Provided that you have a CD-ROM drive, it's neat, what with integrated thesaurus, dictionary, Columbia desktop encyclopedia, and other stuff, all built into your text editor. They've also put the entire Word for Windows manual on-line: the CD-ROM is completely filled, 600 MB of program and information.

I haven't had my copy long, but I've already told Larry Niven to order one. More next month, but I think this is my word processor for the future.

CD-ROM Interim Report

Everyone needs a CD-ROM drive, and they're now down to a price that anyone can afford; I've seen drives with a stack of CD-ROMs in the DAK mail-order catalog for under $200. Of course, the cheaper drives are very slow. You'd do better to spend another hundred for a faster drive. A slow CD-ROM is still better than no CD-ROM at all, but you can use it only for text retrieval, not multimedia.

I think I was the first columnist to predict a big future for CD-ROM; that future is here, and in a couple of years you'll no more have computers without a CD-ROM drive than you'd have one without a hard drive.

One painless way to install CD-ROM is to purchase the Multi-Media Kit from Creative Labs. This package consists of a Sound Blaster Pro board with a SCSI controller, an internal half-height CD-ROM drive, and the software upgrades needed for multimedia operation with Windows 3.1. The result is a good, solid, fast CD-ROM drive.

A second way is to contact the Bureau of Electronic Publishing (141 New Rd., Parsippany, NJ 07054, (800) 828-4766 or (201) 808-2700; fax (201) 808-2676) for their catalog and decide what to do from there.

I've also had excellent results with any SCSI drive and Corel's SCSI controller board and software. Corel has the added advantage that it works well with the Pioneer Minichanger, which is coming into its own. In the future, I will want one CD-ROM drive just for the Microsoft Word/Bookshelf integrated package; I can foresee when I will want several CD-ROMs on-line at all times and still need a drive for CD-ROMs used occasionally. The Minichanger is the obvious solution to that; indeed, my own setup now has a very fast Toshiba CD-ROM drive in a daisy chain with the Minichanger.

However you do it, you will soon find you can't do without CD-ROM.

WinJet and LaserMaster

I've mentioned LaserMaster before. Their products come in two flavors: WinJet 800 and LaserMaster TrueTech 1000/4, which is a big laser printer. WinJet 800 converts your LaserJet II, IID, III, or IIID into an extremely fast PostScript printer with 300- or 800-dot-per-inch resolution.

The TrueTech 1000/4 is about the same speed, but it has 1000-dpi resolution. Alex and George Jumper installed the TrueTech 1000/4 on a Novell network system, and aside from a couple of glitches having to do with sequencing—the software must be installed before the hardware board is put into your PC, and the print output has to be directed to the proper queue before

GREAT THINGS COME IN SMALL PACKAGES

This powerful print server can tackle your biggest network printing problems

- Connects any parallel printer directly to your Ethernet LAN
- Fully Novell Netware 286 and 386 compatible
- Can attach to 8 file servers simultaneously
- Fast and easy to install
- Combines high-speed printing and exceptional printer control
- Supports encrypted passwords, forms, notify, cancel, and others
- Full one-year warranty and unlimited free technical support
- Made in the U.S.A.

Make the Rose Connection

ROSE ELECTRONICS

10850 Wilcrest Drive • Houston, Texas 77099 • Phone (713) 933-7673 • Fax (713) 933-0044

1-800-333-9343

Circle 157 on Inquiry Card.

Dynamite Comes in a Small Package...

Never before has so much power & technology been packed into a SupraFAXModem! The SupraFAXModem V.32bis combines a *potent* mix of fax and data features — for *explosive* results! Maximum fax potential is achieved with Group 3 fax machine compatibility at up to 14,400 bps and Class 1 & 2 software compatibility. With raw data speeds from 300 to 14,400 bps, and up to 57,600 bps with V.42bis compression, it *blasts* data over telephone lines. Plus its revolutionary display gives you 25 different status reports! For just a little more, you can add caller ID and voice capabilities later this year. All this for the *dynamite* price of $399.95! In addition to the standalone version (without software) SupraFAXModems are available in Windows™, DOS™, and Macintosh™ packages.

SUPRA FAX MODEM V.32bis

9600 bps Version $299.95

Circle 196 on Inquiry Card.

Supra Corporation

1-800-727-8647

NOW SHIPPING

* Low-cost, user-installable Voice & Caller ID upgrades available Q3 '92 • All trademarks belong to their respective companies.

7101 Supra Drive SW, Albany, OR 97321 USA • Fax: 503-967-2401 • 503-967-2410

entering Windows—they had no problems.

Their report concludes: "It becomes obvious why the LaserMaster people include the acid-free high-quality bond with their machine. The test sheets look so great you hate to throw them away. All in all, quite impressive."

They've since installed LaserMaster printers at a couple of client installations, and everyone is happy. My publisher, Jim Baen, has typeset several books, including one of mine, in-house with a PostScript printer; I've recommended that he purchase a TrueTech 1000/4 and do all of my

ITEMS DISCUSSED

Amiga DOS Maple.....$450
Waterloo Maple Software
160 Columbia St. W
Waterloo, Ontario,
Canada N2L 3L3
(519) 747-2373
fax: (519) 747-5284
Circle 1146 on Inquiry Card.

Amiga 3000T.....$4499
Commodore Business Machines, Inc.
1200 Wilson Dr.
West Chester, PA 19380
(800) 662-6442
(215) 431-9100
fax: (215) 431-9156
Circle 1147 on Inquiry Card.

Art Department Professional.....$299
ASDG, Inc.
925 Stewart St.
Madison, WI 53713
(608) 273-6585
fax: (608) 271-1988
Circle 1148 on Inquiry Card.

Cursorific Pro.....$69.95
Aapex Software
P.O. Box 13379
Reno, NV 89507
(800) 728-7650
(702) 324-4580
fax: (702) 324-4578
Circle 1149 on Inquiry Card.

DRM-600 CD-ROM Minichanger.....$1295
Pioneer Communications of America, Inc.
3255-1 Scott Blvd., Suite 103
Santa Clara, CA 95054
(800) 527-3766
(408) 988-1702
fax: (408) 988-1848
Circle 1150 on Inquiry Card.

K-U-I.....$79.95
Softac Corp.
23 Sunset Rd.
Winchester, MA 01890
(617) 721-1010
fax: (617) 721-2590
Circle 1151 on Inquiry Card.

LaserMaster TrueTech 1000/4.....$4495
WinJet 800.....$795
LaserMaster
6900 Shady Oak Rd.
Eden Prairie, MN 55344
(800) 365-4646
(612) 944-9330
fax: (612) 944-0522
Circle 1152 on Inquiry Card.

Microsoft Word for Windows and Bookshelf Multimedia CD-ROM.....$595
Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 883-8101
Circle 1153 on Inquiry Card.

Moby Brick 486/33.....$3995
Ergo Computing, Inc.
1 Intercontinental Way
Peabody, MA 01960
(800) 633-1925
(508) 535-7510
fax: (800) 843-2742
Circle 1154 on Inquiry Card.

Multi-Media Kit.....$849.95
Creative Labs, Inc.
1901 McCarthy Blvd.
Milpitas, CA 95035
(800) 998-5227
(408) 428-6600
fax: (408) 428-6611
Circle 1155 on Inquiry Card.

Nomad 420SXL.....$2795
Gateway 2000, Inc.
610 Gateway Dr.
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
fax: (605) 232-2023
Circle 1156 on Inquiry Card.

ProWrite for Amiga 3.2.....$99.95
New Horizons Software, Inc.
206 Wild Basin Rd., Suite 109
Austin, TX 78746
(512) 328-6650
fax: (512) 328-1925
Circle 1157 on Inquiry Card.

RoboHelp.....$495
Blue Sky Software Corp.
7486 La Jolla Blvd., Suite 3
La Jolla, CA 92037
(800) 677-4946
(619) 459-6365
fax: (619) 459-6366
Circle 1158 on Inquiry Card.

Supersport SX.....$5499
Zenith Data Systems
2150 East Lake Cook Rd.
Buffalo Grove, IL 60089
(800) 553-0331
(708) 808-5000
fax: (708) 808-4434
Circle 1159 on Inquiry Card.

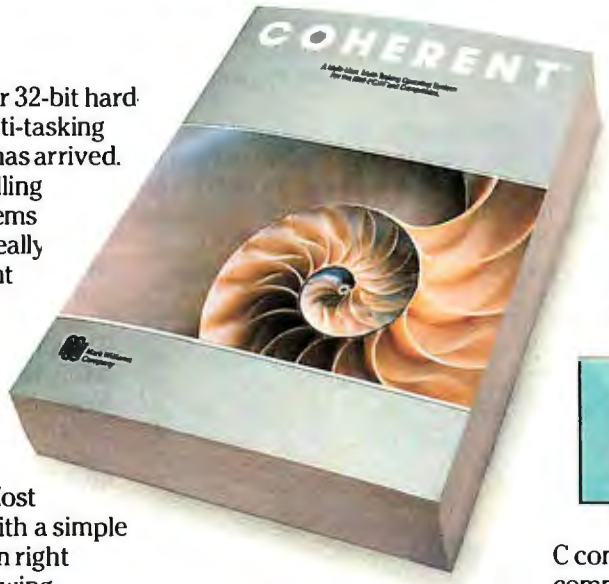
Supra Fax Modem V.32bis....$399.95
Supra Corp.
7101 Supra Dr. SW
Albany, OR 97321
(800) 727-8772
(503) 967-2440
fax: (503) 967-2401
Circle 1160 on Inquiry Card.

Windowcraft.....$295
Windowcraft Corp.
6 New England Executive Park
Burlington, MA 01803
(800) 828-2268
(617) 272-0999
fax: (617) 273-0749
Circle 1161 on Inquiry Card.

The World's Best Selling UNIX Clone Just Got Better.

Now with full 32-bit implementation!

If you want to ignite your 32-bit hardware with the multi-user, multi-tasking power of UNIX, Coherent 4.0 has arrived. And if you're operating or selling small business network systems with dozens of users, that's really good news. Because Coherent 4.0 is what you want in UNIX at a price that's hard to believe.



Run UNIX applications today!

Coherent is now binary compatible with UNIX. Most UNIX PC applications port with a simple recompile and many now run right out of the box. The list is growing everyday, so call for details.

Yes, It's For Real!

How can it be? First of all, Coherent was independently developed by the Mark Williams Company, so you don't pay for UNIX licensing fees. You don't pay any mark-up or reseller costs either. Coherent is only sold directly to you.

Coherent.™ Still $99.95.

six disk installation is a breeze compared to their 25. You'll also learn it faster and increase overall performance. All because Coherent is smaller, faster... and better.

Small, But So Complete.

Make no mistake, Coherent is a wholly professional development system. You get a complete C compiler, assembler and over 200 UNIX commands including full sets of functions for development, administration, maintenance and text processing.

Coherent also comes with UUCP capabilities that connect you to a world-wide network of free software, news and millions of UNIX users. And it's all clearly documented in Coherent's highly praised 1200 page manual.

"...(Coherent) may be the best thing that has happened to UNIX yet."
–William Zachmann, PC Week

In fact, over 40,000 copies of Coherent have already been sold. And, like the ones we quote here, virtually every critic who's reviewed Coherent has raved about it.

	MWC COHERENT Version 4.0	SCO UNIX/386 Version 3.2V2
No. of Manuals	1	14
No. of Disks	6	25
Kernel Size	100 K	375 K
Install Time	40 min.	3-4 hours
Suggested Disk Space	10 meg	60 meg
Min. Memory Required	1 meg	2-4 meg
Performance*	85.7	31.3
Price	$99.95	$2590

*Byte C Compiler Benchmark: Compiles per minute on 25 MHZ 486.

So Much Less, Yet So Much More.

As a virtual clone of UNIX, Coherent embraces the original UNIX philosophy: Small is beautiful. Small price, yes. But there's more, much more, to Coherent than its amazing price.

Requiring only 10 megabytes of disk space, Coherent can reside with DOS. So you can keep all your DOS applications and move up to Coherent. And it runs with as little as 1 MB of memory versus 4 MB for other UNIX versions.

The World's Only Plug And Play UNIX Clone.

You'll have Coherent up and running with a fraction of the time and effort it takes for other UNIX versions. Our

Experienced, Supported, Guaranteed.

Mark Williams Company has been developing professional programming tools since 1976. Our commitment to our products and users is unsurpassed. Users applaud our popular BBS and the widely acclaimed telephone support they get free from Coherent developers.

Still, we're not asking you to take a chance on Coherent. We've made it foolproof to see for yourself–with a 60-day money-back, no hassles guarantee. So pick up that phone and order Coherent now. And the best way to UNIX will be on its way to you!

800-MARK WMS

(800-627-5967 or 708-291-6700, FAX: 708-291-6750)

60-DAY MONEY BACK GUARANTEE!

Mark Williams Company
60 Revere Drive, Northbrook, IL 60062

Coherent is a trademark of Mark Williams Company. UNIX is a trademark of USL.

Distributors: Australia (07) 266-2270, Chile (02) 2235538, Czechoslovakia 632-62877, Denmark 42-88-72-49, Finland 41-871-201, France (1) 46-72-80-74, Germany (0511) 53-72-95/(030) 313-7015, Norway 211-0950, Sweden (0) 660-192-90, UK (091) 4276430.

forthcoming books with it.

WinJet 800, meanwhile, is plenty good enough for anything but slick paper typesetting. It, too, installs simply. A board goes into your PC, and an interface board goes into your LaserJet. The only problem is that the cable between the two boards is only 10 feet long; my printer and computer are not 10 feet apart, but the cable route is longer than that. WinJet 800 works so well, though, that I'm looking into ways to change the cable route so that I can keep it; which probably says all that needs saying.

WinJet 800 takes all the sting out of Windows printing. It's fast and reliable, and the results are beautiful. A User's Choice Award, and highly recommended.

Windowcraft

I haven't time to do this justice this month, but you'll be hearing about it a lot in the future. This is to Windows what HyperCard is to the Mac: an authoring system for developing Windows applications. It will automatically convert many Mac HyperCard stacks to Windows. It makes objects. It includes a paint program. It has a built-in debugging tool. It's powerful enough that I could use it to do a jazzy Windows version of Roberta's reading program, and that's likely to happen soon.

In a word: Windowcraft is what ToolBook should have been; it's what Windows has been waiting for. A lot more later, but if you're interested in developing Windows applications, you can't afford not to know about this.

Winding Down

Many books this month. Microsoft Press has a stack of Word for Windows books, all with some value, but you're probably better off getting the CD-ROM version of Word for Windows: it has the Word manual on-line, and it's much better indexed than any book index I've seen.

The computer book of the month is by Michael A. Banks, *The Windows Shareware Book* (John Wiley & Sons, 1992, ISBN 0-471-55817-6). I'd be astounded if you didn't find at least one of the shareware programs included worth the price of the book, and Banks does a good survey of the shareware scene.

The book of the month is by James Davidson and William Rees-Mogg, *The Great Reckoning: How the World Will Change in the Depression of the 90's* (Summit Books, 1991, ISBN 0-671-66980). I guarantee you won't agree with it all, but I bet you can't put it down once you start it.

The game of the month is Interstel's Dusk of the Gods. I guarantee the interface will drive you nuts, and you'll curse some of the implementation; but it's based on real Norse mythology, and provided you're interested in the Aesir and Vanir, it will be one of the most *interesting* games you'll ever see.

Next month, a wonderful science adventure game, operations research at Microsoft, new sound boards, and much more. ■

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."

HOW TO EXTEND YOUR CAD POWER

With Generic CADD, you can put the power and productivity of CAD on every desk. From engineering to manufacturing to tooling and more, Generic CADD allows you to view, edit, export and print your valuable AutoCAD* designs, or sketch design concepts. Generic CADD software runs on standard PCs, Macs, and laptops, utilizing existing hardware. At $495, it's the economical way to extend your CAD power. To learn why over 300,000 people are using Generic CADD, call 1-800-228-3601.

Ask for Info Pak #A30.

PC MAGAZINE EDITORS' CHOICE

AUTODESK

WORLD PRODUCT OF THE YEAR 1991

Generic CADD Version 5.0

*Generic CADD 6.0 and Generic CADD for Macintosh 2.0 – load native AutoCAD DWG drawing files directly. Copyright 1992 Autodesk Retail Products. All rights reserved. Generic CADD is a registered trademark of Autodesk Retail Products. AutoCAD, Autodesk, and the Autodesk logo are registered in the U.S. Patent and Trademark Office by Autodesk, Inc. Macintosh is a registered trademark of Apple.

Circle 108 on Inquiry Card (RESELLERS: 109).

Buy FrameMaker® 3.0 for UNIX and receive a FREE Interleaf® filter,* a $995.00† value.

Now you can instantly transfer all your Interleaf documents—text, graphics and formatting into FrameMaker.

[ ] *I am interested in receiving a free Interleaf filter, please contact me immediately.*

[ ] *I am interested in more information. Send me FrameMaker's FREE Guide On Document Publishing.*

For more information about the free filter offer or FrameMaker 3.0 for UNIX call ***1-800-U4FRAME.***

Name _____

Title _____

Phone (____) _____

Company _____

Street _____

City _____

State/Province _____ Zip/Postal Code _____

Number of employees _____

Purchase timeframe (in months)

[ ] 0 - 3 [ ] 4 - 6 [ ] 7 - 12 [ ] more than 12

Please describe your computing environment:
Indicate number of computers:

____ Apollo ____ Macintosh ____ PC UNIX SCO ____ DECstation

____ NeXT ____ PC Windows ____ HP 9000 PC ____ DOS

____ Sun ____ IBM RS/6000 ____ PC OS/2

FRAME TECHNOLOGY 1010 RINCON CIRCLE SAN JOSE, CA 95131-9847

*Offer good thru October 31, 1992.
† The InterLeaf filter is only available as a part of the optional FilterPak for $995.00. Frame offers filters for 12 different UNIX software packages, call for more information.

Byte

NO POSTAGE
NECESSARY IF
MAILED IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 1762 SAN JOSE, CA

POSTAGE WILL BE PAID BY ADDRESSEE

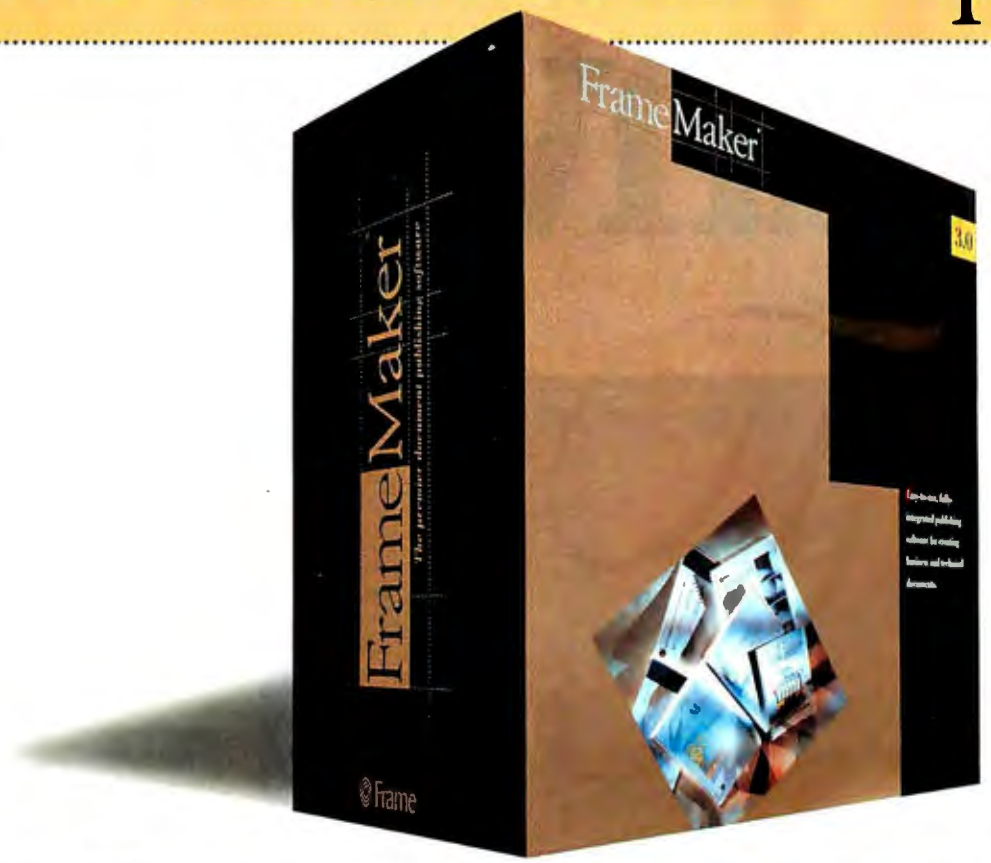
FrameTechnology®
The document publishing company

FRAME TECHNOLOGY
1010 RINCON CIRCLE
SAN JOSE, CA 95131-9847

MULTI-PLATFORM DOCUMENT PUBLISHING

FrameMaker.

The ultimate Interleaf® "upgrade."



Year after year you Interleaf users hoped for a newer, friendlier, better publishing solution—and what you got were promises.

▶ What you ought to get is FrameMaker.®

▶ With FrameMaker you'll get a document publishing program that's powerful, fully featured, and fully integrated—like Interleaf. But not fully frustrating—like Interleaf.

▶ You'll get a familiar, well-behaved user interface that increases your productivity, instead of a proprietary interface that increases your confusion. You'll get accessible, intuitive tools like FrameMaker's Conditional Text, instead of cumbersome, procedure-intensive nightmares like Interleaf's "Effectivity."

▶ You'll finally get files that are truly compatible—across all the major desktops and across future upgrades. Instead of Interleaf version 5 on your Sun™ that can't be handled by Interleaf version 3 on your Macintosh.

▶ You'll get the same compatibility with FrameViewer,™ Frame's leading edge viewing technology that lets you distribute FrameMaker documents—or even converted Interleaf documents—electronically. So everyone in your organization can receive up-to-the-minute, accurate information on-line.

FREE INTERLEAF FILTER

▶ And if you act quickly you'll get an even easier upgrade deal: a ***free*** Interleaf-to-FrameMaker file conversion filter*-a $995 value.** Call **1-800-U4-FRAME Ext. 233** today for more information. And this time upgrade for good.

Frame®

© Copyright 1992 Frame Technology Corporation. All rights reserved. International customers please call (408) 433-3311. Frame, FrameMaker and Frame Technology are registered trademarks of Frame Technology Corporation. The Frame logo and FrameViewer are trademarks of Frame Technology Corporation. Other brand or product names are trademarks or registered trademarks of their respective companies. *With purchase of FrameMaker for UNIX. Offer good thru October 31, 1992. **The Interleaf filter is only available as a part of the optional UNIX FilterPak for $995.

Circle 105 on Inquiry Card.

End PC Envy

A Window on the Network

As you can see, DOS programs run alongside Microsoft Windows programs. You've seen this all before in our DESQview, right? Yes, but now there's more. DESQview/X lets you access and control a wide variety of PCs and workstations through your own PC. This feature is called remote computing.

In the example to the right, Lotus 1-2-3 is running in its own 386SX PC. The window at the top of the screen is a DOS window running on a remote 486 PC under DESQview/X. At the lower left is a FrameMaker program running on a remote IBM RS/ 6000 workstation in another part of the company.

Works the Way You Want

You can change menus, add sub-menus. Add menu items that run remote programs. Change commands. DESQview/X gives you a menu to use for your macros. And if you prefer a graphical desk top instead of a menu, DESQview/X's Application Manager gives you buttons for opening a set of programs used in a project or even for launching remote programs. What's more, you can specify window size and color. And if you are using DOS text programs, you can set them up so that the font changes size as you change the size of the window. We call this feature scalable DOS windows (see the Lotus 1-2-3 window at left).

Brand and Platform Freedom

DESQview/X runs on 386SX PCs and above. And from within windows on those PCs, you can use programs* running on any number of remote DESQview/X PCs if your network supports NetWare or NetBIOS. Add DESQview/X's optional Network Manager for TCP/IP networks and you can also access programs running on IBM RS/6000s to HP 9000s to Sun workstations. And it works the other way, too: these workstations can view and use DOS programs in their displays.

* DOS graphics programs currently run only on your local PC.

Looks the Way Users Want

DESQview/X supports sculptured menus, customizable backgrounds, graphic buttons for launching programs, icons and online context-sensitive help to make computing easy and fun. If you are a DESQview user, you'll find DESQview/X very familiar, with an improved look. But if you prefer a different look and feel, we offer two other interface options: OSF/Motif and OPEN LOOK.

Introducing DESQview/X™ for DOS

DESQview/X gives everyone access to the power of the fastest PC—or workstation—on the network.

Remote Computing is a Reality

Set up and run programs on remote DESQview/X PCs on your network. Instruct and support users. Diagnose problems and solve them from your own PC. DESQview/X provides controlled access to every program on every PC.

Easy to Set Up and Administer

DESQview/X asks three questions: Do you wish to transfer files to and from other computers? Do you wish to use programs on other computers? and Do you wish other people to have access to programs on your computer? That's all it takes for DESQview/X to set itself up. DESQview/X incorporates QEMM-386 to assure maximum memory utilization and Manifest for easy diagnosis and problem-solving.

Here's How You Might Use DESQview/X on Your Network:

Say for instance your company uses a particular database that requires lots of horsepower or lots of memory to run. You can set it up on a 486 PC loaded with memory — then allow appropriate users access as you normally do on the network. The difference is that the database will be running on the remote 486 instead of the local PC. Users can take advantage of the power they need, when they need it. And you'll be able to best assess who actually needs his/her own 486 PC.

Give your PC the key to unlocking and sharing the power of other PCs on the network.

DESQview/X is a graphical multitasking environment for DOS. It is so powerful that it literally turns DOS PCs into graphical workstations. With DESQview/X, you can run DOS and Microsoft Windows programs simultaneously, view them in windows, transfer between them, create DESQview/X-global or program macros and manage your files.

1991 BYTE AWARDS OF EXCELLENCE

DESQview/X makes computing lots easier, more productive, and more fun.

With DESQview/X, you can now run programs and access files on other computers on the network and view them in windows on your own PC. Distribute tasks among computers based on their capabilities and available resources.

Remote diagnosis and support is now a reality. With DESQview/X you can support, instruct; even remotely demonstrate programs right at your user's computer.

If you have X Window workstations, our optional 'DESQview/X to Other X Systems' TCP/IP Network Manager allows you to run workstation programs remotely from PCs.

For all this power, DESQview/X is stunningly easy to set up and use, and can run on any 386 or 486 PC with as little as 4MB RAM and 40MB hard disk.

DESQview/X multiplies the power of networked PCs by erasing the boundaries between computers; between programs and between users. Welcome to the limitless future of enterprise-wide computing.

Yes! Please Send:

Qty	Product	5-1/4	3-1/2	Each	Totals
	DESQview/X			$275.00	
	DESQview/X Network Mgr. (TCP/IP)			$200.00	
	OPEN LOOK interface			$200.00	
	OSF/Motif interface			$250.00	
				Shipping & Handling $10 (Canada & USA only)	
				California Residents add 8.25%	
				Grand Total	

Payment method ☐Visa ☐MasterCard Expires ___/___

Card # _____

Name _____

Addre _____

City _____ State ___ Zip ___

'all (800) 354-3222 ext. 1D1 for fastest service
Please allow 3 weeks for delivery

Registered users of Quarterdeck products are eligible for a special offer. Call (800) 354-3222 7AM-5PM PST.

Quarterdeck

Quarterdeck Office Systems, 150 Pico Boulevard, Santa Monica, CA 90405 (310) 392-9851 Fax (310) 314-4219
Quarterdeck International Ltd., B.I.M. House, Crofton Terrace, Dun Laoghaire Co. Dublin, Ireland Tel.(353) (1) 284-1444 Fax (353) (1) 284-4380

©1992 Quarterdeck Office Systems. Trademarks are property of their respective owners.

Circle 152 on Inquiry Card.

COVER STORY

FEATURE

Is Unix Dead?

As Unix faces the stiffest competition of its long life—Windows NT—can it survive?

TOM YAGER AND BEN SMITH

Among operating systems, Unix is the grand old man. Over its long life, it has garnered respect and ridicule, awe and animosity. Never before has computer code managed to so passionately galvanize and divide, anger and excite otherwise level-headed technologists. Unix stories transcend reality. Wizards and demons abound. Gatherings of the faithful generate the kind of excitement usually reserved for evangelists' tents.

Today, however, Unix's seniority and mystique hold little sway. At least 25 different Unixes exist now, and committees dispassionately choose from among various Unix versions, but six providers dominate: Sun Microsystems, The Santa Cruz Operation, Hewlett-Packard, Unix Software Laboratories, DEC, and IBM. The entry of Next, Univel (the joint venture between USL and Novell), Solaris (from SunSoft, Sun Microsystems' software subsidiary), and other new multiplatform Unix players will, odd as it may seem, help consolidate a confusing field of choices. But in the midst of that consolidation, Unix will face what may be its most powerful adversary to date: Microsoft Windows NT.

At this crossroads, it is appropriate to examine some key aspects of Unix: What makes it unique? How has it changed over the years? What are the threats to its survival, and how might it overcome them? And, most important, will it survive?

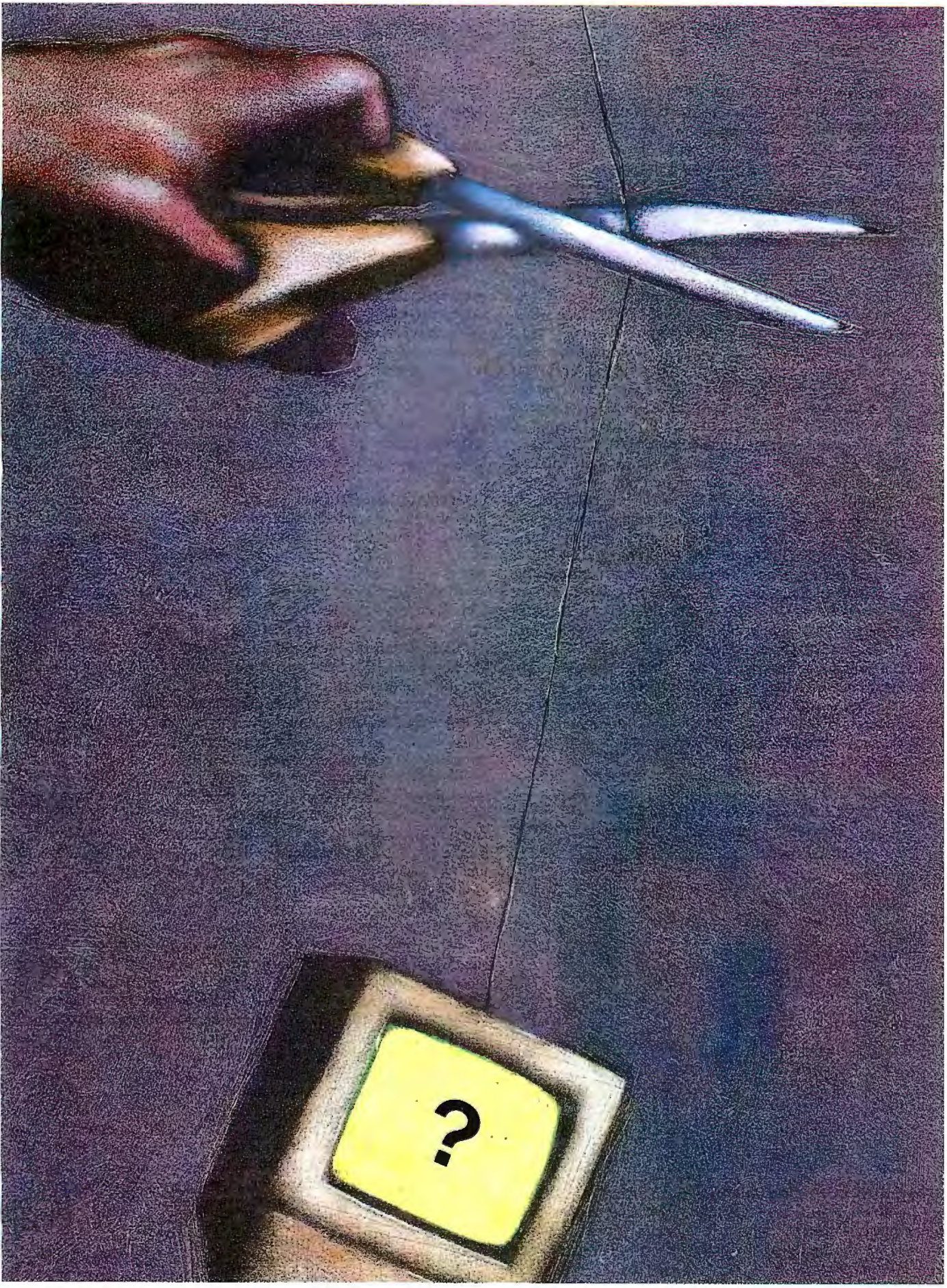
Reports Greatly Exaggerated

Despite its problems, Unix is not dead; in fact, it's surprisingly healthy. Unix remains compelling because it is the only operating system to offer multitasking, graphics, and cross-platform compatibility in one package. Market researcher Dataquest estimates that, for 1991, Unix sales (including both systems and operating systems) totaled 1.2 million units, for $18.2 billion in revenue. Unix revenue will climb to $44.7 billion in 1996 on unit sales of 4.1 million, according to Rikki Kirzner, a senior industry analyst in Dataquest's software group (see figure 1).

Other analysts believe that Windows NT will slow Unix's growth. NT is a legitimate threat to Unix's domination of the workstation market and to its chances for success on the desktop. NT may be the strongest stimulus to date for inducing Unix providers to stop arguing and start cooperating in an endeavor to give software applications developers a standard software base. The Unix industry has answered that call with new versions aimed at the Intel-based desktop: USL's Unix System V release 4.2 (also known as Destiny), Next's NextStep, and SunSoft's Solaris.

continued

ILLUSTRATION: TIM TEEBKEN © 1992



Understanding the Unix Community

There are two distinct branches of the Unix user community. The first group could just as well be running VM, VMS, or any other operating system; it just so happens that its chosen applications run on Unix. These unwitting people may be the fastest-growing segment of Unix users. Participants in many information services—AT&T Easy Link, for instance—are Unix users and not even aware of it. Many retailers run their businesses on Unix. What these users have in common is that some technically knowledgeable person or firm set up and maintains their systems. For this group, Unix is an invisible tool.

The other, better known, Unix community comprises technically adept users, for the most part. They may be using workstations now, but they are the people who were running serial terminals not long ago. In contrast to the first group, these users understand the inner workings of the operating system. This uniquely dedicated group forms the core of the "Unix community," a near-cult with a strict hierarchy based on technical knowledge (see the text box "Unix: A Child of a Thousand Parents" on page 137). The people involved in the creation of Unix built it for people like these. But now that Unix is falling into the hands of the uninitiated, its role—and its shape—are beginning to change.

Those blissfully unaware users of the first group are Unix's future. In fact, they're the future for all multitasking operating systems. Ask today's user what he or she needs, and you'll hear multitasking, graphics, and cross-platform compatibility. These needs are keeping Unix alive, because it's the only operating system that delivers them all.

Unix users have come to take seamless file sharing, network printer services, remote application execution, client/server program support, and multiuser access for granted. MIT's efforts with the X Window System have made graphics part of the mix, providing a network-integrated graphical application environment that's still unmatched by any other popular system. These and other services make Unix a perfect choice for networked applications, and Unix is presently the only operating system that integrates these elements.

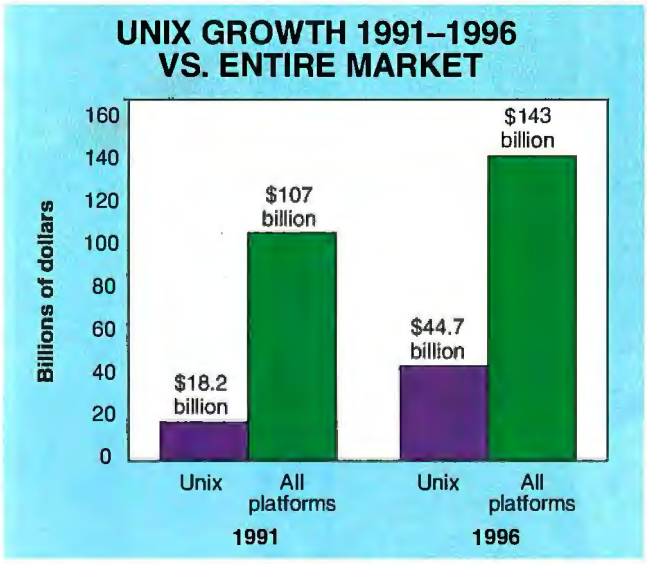


Figure 1: *Unix's growth in dollar sales will actually outpace that of the market as a whole through 1996, according to market research firm Dataquest. The compound annual growth rate for Unix during this period is 27.5 percent, but only 5.9 percent for all platforms.*

Thomas Giammo, assistant commissioner of information systems at the U.S. Department of Commerce's Patent and Trademark Office, agrees: "In the next year or two, there's no other player that can give us what we need," he says.

In spite of that commitment, Giammo echoes the sentiments of both large- and small-scale users who feel stuck with Unix: It solves their short-term problems, but it creates other problems that make it an unlikely long-term solution. Giammo predicts that, as a result, Unix will be effectively wiped out in the mid-1990s; his money's on Windows NT. And he's not alone.

Once Unix became a commercial property, it lost its unity of purpose. In the hands of vendors who knowingly built cross-version incompatibility into their offerings (partly to lock customers into a particular flavor), Unix has generally failed to track user demands adequately. While it meets needs like multitasking and networking well enough, it leaves lesser issues unaddressed. For example, it's still too hard to use and administer, not compatible enough across implementations, and, for the most part, too married to its old character-based, command-line, serial-terminal traditions. "[Unix] is a hacker's version of an operating system that has grown respectable over time," says Giammo.

Overcoming the Problems

Improving Unix is much on the minds of Unix vendors. "If you have an X-based desktop with Mac-like features, the end user won't care that Unix is underneath," says Ken Arnold, an engineer at HP's Distributed Object Computing Program. As base-level machines get more powerful, they can better run the larger Unix operating systems. Then, to the end user, it is simply a matter of what off-the-shelf applications are available.

Avadis Tevanian, director of System Software at Next, agrees. He envisions a GUI that can run productivity applications side-by-side with user-made custom applications. "To get up to millions of units, you have to get rid of [the Unix shell]," he says.

But a GUI has not been an original, fully integrated part of Unix. Instead, it is usually a distinct layer poured over Unix's command line. In contrast, *everything* on the Mac is handled graphically, and the operating system is tuned for it. Even when the system crashes, a graphical dialog box tells you what went wrong. Most Unix systems boot and shut down in full-screen text mode, and when you need to jump into single-user mode for maintenance, you don't get graphical pull-down menus and radio buttons—you get a prompt. For graphics to contribute adequately to ease of use, it must be an integrated part of the system.

The Next machine provides a shining example of Unix with highly integrated graphics. Unless something goes terribly wrong, or unless you request otherwise, you'll always have graphics insulating you from the operating system (see screen a). Even the most experienced users—the programmers—work inside a cozy graphical environment with visual tools that make it easy to develop NextStep applications. There's almost nothing the command line offers that the graphical environment does not.

The Next computer, though not a best-seller, has proved that the concept of invisible Unix is a viable one and that graphical workstations can be safely placed on the desks of general users. Jerry Marger, president of the law firm Marger, Johnson, McCollom & Stolowitz of Portland, Oregon, is a believer. He converted his firm's DOS network to a Next system because of the latter's ease of use and performance. "NextStep is awesome. Operating a Next is like operating a Mac, except that it's got a truck engine instead of a four-banger," Marger says.

PC Unix: Waiting for Standards

Plagued by bugs, incompatibilities (particularly in graphical and networking applications), and a lack of cohesive standards, PC

Unix: A Child of a Thousand Parents

In the view of many, Unix is a living, evolving child with thousands of parents. If some Harvard M.B.A. had seen the plan for Unix in advance, the project never would have got off the ground. But for a time at least, Unix soared, and the concept of development not by committee but by *community* became a model for other large projects.

Not long after a small group of AT&T engineers created the earliest Unix in 1969, the work was taken up by an unaffiliated group: students. The best thing that ever happened to Unix was the handing of its source code to a bunch of kids.

Ken Arnold, now an engineer at Hewlett-Packard's Distributed Object Computing Program, was one of those students. Back in the early 1980s, he was part of the pack at the University of California–Berkeley that created BSD 4.0 Unix. BSD spawned a number of cornerstone technologies and went on to become a foundation for several successful commercial operating systems (including SunOS and NextStep).

"We basically took a lot of people's neat stuff [and] added it to the new things required to make the project go," says Arnold. It was this "neat stuff" that made Unix rich. "Frankly, I suspect most people didn't give a wet ball of lint for its educational value. It was fun, it was central, and we got to do it," Arnold adds.

Networking, the full-screen editor, the fast file system, and countless other necessities were all born at Berkeley. AT&T and its agents rolled pieces of Berkeley's work into its own product, and some vendors (e.g., Sun Microsystems and DEC) opted to use Berkeley's output directly rather than AT&T's adaptation of it. Even though BSD included AT&T code, that code was part of an older, less expensive version of Unix.

Before long, Unix source code found its way to universities all over the world, and, under the banner of "research," commercial Unix took shape. Students and corporate engineers worked (virtually speaking) side-by-side in what remains the largest and most fruitful collective technical project of all time.

As AT&T raised license fees and imposed increasingly restrictive terms, it forced commercial implementers to look for alternatives. That's how the Open Software Foundation was born. The key OSF members, including HP, DEC, and Apollo, intended to get out from under AT&T's thumb by creating a Unix-like operating system that didn't require paying the latest (and most expensive) AT&T license fees.

The OSF's first product, Motif, took on a quick following as the first commercial toolkit for building professional-looking X Window System applications. OSF/1, a mix of Carnegie Mellon University's Mach kernel (as used on the Next) and IBM's AIX, is off to a shaky start, thanks to vendors who got tired of waiting for it. Other planned OSF technologies, like DCE (Distributed Computing Environment) and ANDF (Architecture-Neutral Distribution Format), have a brighter future.

On the operating-system side, the OSF served its purpose, putting the fear of failure into the giant AT&T, whose Unix Software Laboratories subsidiary now has responsibility for selling Unix. Shortly after the OSF was formed, AT&T spun around and completely revamped its licensing policies.

A Tough Act to Follow

Unix's golden age gave way to an era of commercialization. Instead of getting Unix from AT&T or Berkeley, consumers began getting it from third-party packagers like Sun and Microsoft. The earliest Intel-based PCs ran a derivative of Unix called Xenix, made by the same upstart Microsoft that had created PC-DOS. While Sun and others established beachheads in scientific and technical shops, Microsoft turned Xenix into a vertical-market powerhouse. The workstation market grew by emphasizing single-user performance and graphics. Xenix and other early PC Unix derivatives grew by making it possible to give multiple users access to shared programs and data for the cost of cheap terminals and serial cables.

Once it became possible for ordinary people to run Unix on their desktop PCs, companies sprang up to push the idea. The Santa Cruz Operation was born, the contract-programming shop Interactive Systems went public, and Microport carved out the low end. On the face of it, Unix was everywhere. You could run it on workstations, mainframes, minicomputers, and PCs. And now, a number of hungry vendors were adding their value to Unix.

The value each commercial player added increased Unix's girth but also chipped away at its benefits. As the system grew bigger, it got slower, and the sheer volume of code and number of contributors to it fostered bugs and incompatibilities. The flood of new features meant more for users to learn, and making the system easy to use had never been a priority. Stories of Unix's unwieldy and unreliable nature set the stage for vendors of proprietary multitasking operating systems.

That was the first big mistake: If early commercial adopters of Unix had focused more on reliability and ease of use than on heaping features helter-skelter into the environment, proprietary competitors like DEC's VMS and IBM's OS/2 would have had no reason to exist. The openness that generated such excitement in the early days fermented into separatism. Each vendor created its own flavor of Unix, incompatible with all the others. Details were getting overlooked, and things seemed to get out of control.

How out of control? In 1989, DMR Group, a Montreal-based computer software consulting and services company that has done studies for UniForum and X/Open on the Unix and open-systems markets, found about 25 brands as the result of a survey of about 6000 sites. That number was whittled down to six top Unix versions. According to Andrew Toller, a principal at DMR, the top six were SunOS; SCO Xenix and SCO V/386 (combined tally); HP-UX; Ultrix; AT&T System V release 4.0; and IBM's AIX, which was just beginning to make an appearance.

Circle 98 on Inquiry Card (RESELLERS: 99).

Space - Savers

Popular Space-Saver Keyboard
$98.00

First successful alternative to conventional keyboard saves 60% desk space with a foot print of 27.3 x 15.2 cm. Has full travel tactilly responsive keys with standard left-right spacing for easy touch typing. 100 keys, compatible with IBM XT/AT PS/2. Many language versions available.

Stand-Alone LCD Monitor
$995.00

This 10" black on white monitor is easy-to-read, yet compact. Resolution is 640x480 with sharp, flicker-free image. Sharp's high refresh rate, triple supertwist nematic technology with back lighting provides a super bright, low radiation screen with a wide viewing angle. The adjustable monitor base is only 29x14 cm. It lets you mount the LCD monitor on vertical surfaces or fold for transport. Comes with 1.5 m cable and VGA adaptor card. No external power required. IBM AT compatible.

NEW

Diskless LANStation
$1995.00

Combines Space-Saver Keyboard, LCD Monitor and 20 Mhz 386sx CPU w/2 Meg RAM (4 Meg optional) in a single very small footprint (27.4 X 26.0cm). Network ready with 10 Base2, 10 BaseT NE-2000 compatible network adapter built-in. Unit does not fold for portability.

To Order Call Toll Free **1-800-DATALUX**

1 year warranty on all products shown. Order direct from stock with 15 day full return privileges. Visa, MasterCard, AmEx charges and COD accepted. OEM and reseller volume discounts available.

Spec Sheets Sent By Automatic 24 hr. FAX Transmission **1-703-662-1675**

DATALUX

First Choice In Space-Saver Peripherals

2836 Cessna Drive • Winchester, VA 22601
Phone 703 662-1500 • Fax 703 662-1682

MasterCard VISA AMERICAN EXPRESS

IS UNIX DEAD?

Unix never made serious inroads on the desktop. Developers who were once excited about the prospect of a stable multitasking PC operating system quickly discovered the volume of problems to be worked around. Unlike DOS and Windows, which seem to run on every PC, PC Unix was fussy: You had to have the right processor, bus, drive controller, tape drive, and display card. Software developers also found that they had to create a separate version of their applications for each flavor of PC Unix. While one version of a program can run on every SPARC-based system in the world, the same was never true for PC Unix.

Having so many different PC Unixes is hurting the Unix market. The solution, oddly enough, is to fill the market with a new batch of incompatible PC Unixes from the likes of Univel, Next, and SunSoft. There's some hope that, with the new high-profile players, some de facto standards can be struck. They'll be largely proprietary standards, but the success of Apple and Microsoft proves that those are the standards that stick.

Public standards can't easily be enforced. When every Unix provider can alter the source code to suit its individual needs, how do you keep providers from creating incompatible versions? By making binary licenses easier and less expensive to obtain, the keepers of Unix ensure that a broad set of functions known to be stable, including graphics and networking, will be part of most copies of the operating system. USL's deal with Novell, for example, gives USL a distributor it can keep a close eye on. There will, no doubt, be those who feel compelled to tinker with this stable code, but USL hopes they'll be so overwhelmed by competitors doing fully compatible releases that they'll get back in line.

USL spokesperson Ry Schwark says maintaining compatibility is not the only reason to leave the source code alone. "One of the reasons we have driven development down to the binary level is to off-load as much development responsibility as possible from the OEMs," he notes. Those OEMs will have to pass on the cost of customizing Unix to their customers—a painful choice in a market of shrinking margins.

Of the PC Unix players, SCO and Next are in the minority. Most of the others are lining up behind USL's SVR4.2 (see screen b). Unlike its predecessor release 3.2, SVR4.2 makes networking and graphics more or less standard elements of the distribution. Some vendors will probably choose to unbundle portions of it, but graphical applications built for SunSoft's PC Unix should recompile for Univel's version without changes.

It's not important that these vendors will ship different sets of standard applications. What matters is that developers will have a predictable standard software base on which to rest their code. There will be no more rewriting applications to make them run on variants of PC-based SVR4.2, if it lives up to its promise.

Next doesn't mind striking out on its own. It's bringing NextStep, based on Carnegie Mellon University's Mach kernel, to Intel-based systems in an attempt to capitalize more on the fervor over Windows than on any renewed interest in Unix. Obviously, it can't deliver binary application compatibility with its own Motorola-based workstations, but if Next can reduce porting of applications to a simple recompile, it has a chance.

Pencom (Austin, TX) has ported its X server Co-Xist from NextStep 2.1 to NextStep 486 2.1, a version that Next never released as a product. "We probably had more problems than some developers," says Chris Chauvin, product manager and principal developer of Co-Xist. He adds that the difficulties had more to do with the fact that Co-Xist has a dependence on the CPU. Pencom succeeded in doing the port by rewriting specific chunks of code that were optimized for the 68020 microprocessor. The rewritten code was optimized for the 486 within a week; the actual code rewrite took only a couple of days, Chauvin adds.

"Other people were having one- and two-day turnarounds" in

If you need to communicate something clearly, say it more than once,

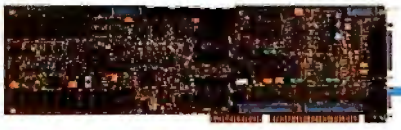
say it more than once,

say it more than once.

Say it with Multimedia. Say it with Bravado.™

Truevision Bravado is the multimedia engine that lets you multiply ideas. Add and control live video and audio. Merge VGA text and graphics. Repeat your message with power. If you're ready for people to get the message, clearly, what you need is Truevision Bravado.

For more information about Truevision and Bravado, CALL 1-800-344-TRUE.



When it comes to video, it comes from Truevision.™

TRUEVISION®

7340 Shadeland Station, Indianapolis, IN 46256
INTERNATIONAL: Brazil 55-192-329-956 Canada 416/940-8727 France 33-1-3-952-6253 Spain 34-1-563-0282
Italy 39-2-242-4551 U.K. 44-628-77-7800 Germany 49-89-612-0010 Other International 617/ 229-6900
© 1992, Truevision, Inc.

Circle 176 on Inquiry Card (RESELLERS: 177).

ATTENTION 386 USERS
RUN SOFTWARE UP TO
3 TIMES FASTER

REAL
CYRIX.
UNREAL
PRICES.

Now get PC Week's "Top Rated"
FasMath™ coprocessor for 386SX
or 386DX PCs at a bargain price.

FASMATH 83S87 MATH CHIP
FOR ALL 386SX PCs
NOW
$79*

Cyrix FasMath has won every
comparative PC publication review ever
held for math coprocessors.
Available at computer dealers
everywhere. Or call 1-800-FAS-MATH.

*83S87 -33 for
386SX33PC; $99

**83D87-40 for
386DX40 PC; $129

Cyrix
Advancing the Standards

TOP RATED
PC WEEK LABS
AUG. 27,1990

BYTE
AWARD OF DISTINCTION

COMPUTER Best Performer SHOPPER

FASMATH 83D87 MATH CHIP
FOR ALL 386DX PCs
NOW
$99**

Cyrix products are proudly made in the USA. Cyrix is a registered trade mark and FasMath is a trademark of Cyrix Corporation.

Circle 385 on Inquiry Card
(RESELLERS: 386).

UNIX VS. WINDOWS NT

Technical issues that are a toss-up between Unix and Windows NT

- Advanced hierarchical file system with long descriptive names
- 32-bit linear memory model
- Preemptive multitasking
- Memory-mapped files
- Shared libraries
- Integral peer networking
- Distributed global naming (assuming LAN Manager NT)

Areas in which NT looks better than Unix

- Threaded SMP (symmetric multiprocessing). Some flavors of Unix (e.g., NextStep) are threaded but lack SMP, while others (e.g., SVR4) are SMP-capable but not threaded. Solaris 2.0 claims threaded SMP.
- Layered device-driver architecture. NT will provide generic disk, display, network, and printer drivers that will allow driver writers to specialize relatively easily to create specific device drivers. Unix drivers are more monolithic and, hence, more difficult to create and maintain.
- Interapplication communication. NT provides well-defined services (e.g., OLE, or Object Linking and Embedding); Unix does not.
- A well-integrated scalable-font subsystem. While SVR4.2 will offer Adobe Type Manager and NextStep has Display PostScript, the dominant Unix GUI, X Window System, still relies heavily on bit-mapped fonts.
- DOS/16-bit Windows support (unproven, but likely to equal or exceed that of OS/2 2.0 and far exceed that of any Unix).
- Source code–compatible applications, with a hugely successful Windows 3.x installed base.

Areas in which Unix looks better than NT

- Multiuser capabilities.
- Distributable GUI (X)—graphical applications are intrinsically client/server.
- Well-standardized basic network services (TCP/IP, sockets, RPC [remote procedure calls]) that work reliably across wildly different hardware platforms and operating-system versions. NT offers a lot of options (named pipes, mail slots, NetBIOS, sockets, RPC, and even, potentially, DDE/OLE, if and when they are made network-aware), but the danger is that there may be no clear path for developers to write distributed NT applications.
- Well-standardized wide-area E-mail.
- Availability for more platforms than are likely, at least in the short term, for NT.

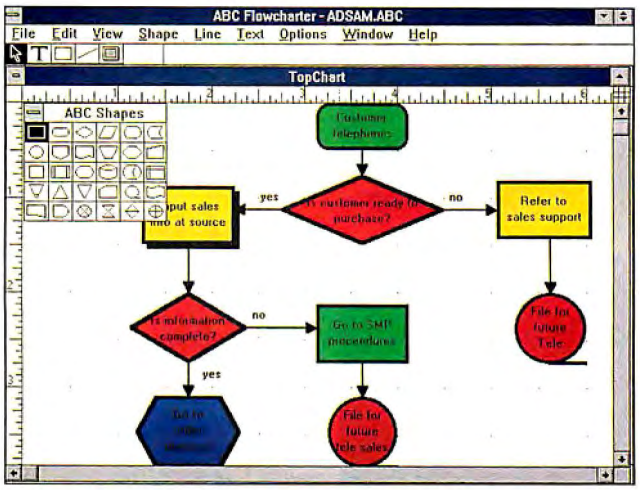
porting Next applications over to the 486 platform, says Chauvin. This lends support to Next's claim of simple recompilation. Pencom will need to port the application again under NextStep 3.0 when Next makes it available in late summer. "Nobody's port will be considered complete until then," Chauvin notes.

Solaris 2.0, a derivative of SVR4, is going to be the acid test for Sun spin-off SunSoft. It remains to be seen whether the software arm of a hardware vendor is truly willing to create a level playing field. Sun is trying to set itself up with a virtual monopoly on SPARC operating systems and, through SunSoft and Solaris 2.0, is planning to extend its reach into the realm of high-end PCs.

The dicey part of this deal is that Sun's hardware side will still be developing its own so tware. Along with countless SPARC and Intel vendors, it will be licensing its own operating system

"I've never liked flowcharting, but ABC Flowcharter has changed my mind."

Kevin Reichard
COMPUTE Magazine, 9/91



Fast, easy ABC Flowcharter is America's #1 Windows flowcharting solution!

Take a complex process, and make it simple. That's the whole idea behind ABC Flowcharter® from Micrografx.

ABC Flowcharter is the choice of everyone from programmers to consultants, accountants to engineers. It helps you easily break the most complex procedures into logical steps. Making you more productive, more consistent, more accurate in everything you do.

> "A Windows-based package that's both powerful and easy to use."
>
> *InfoWorld*
> April 20, 1990
>
> "Turns making flowcharts into child's play."
>
> *DBMS Magazine*
> August 1991

With ABC Flowcharter, you'll be able to quickly update your charts as things change. Something you can't do with manually drawn flowcharts. And unlike other Windows flowcharting packages, ABC Flowcharter lets you link subcharts to your main chart to depict deeper levels of detail.

You can choose from thousands of shapes and symbols – sizing, placing, and linking them easily with your mouse. Then add text as needed. A Windows interface makes it all incredibly simple.

Act now and get Windows OrgChart™ software FREE!

Mail in your ABC Flowcharter registration card plus proof of purchase before October 15th and we'll send you a copy of the #1-rated Windows organization charting software free (a $149.95 value). You pay only our regular $10 shipping and handling charge.

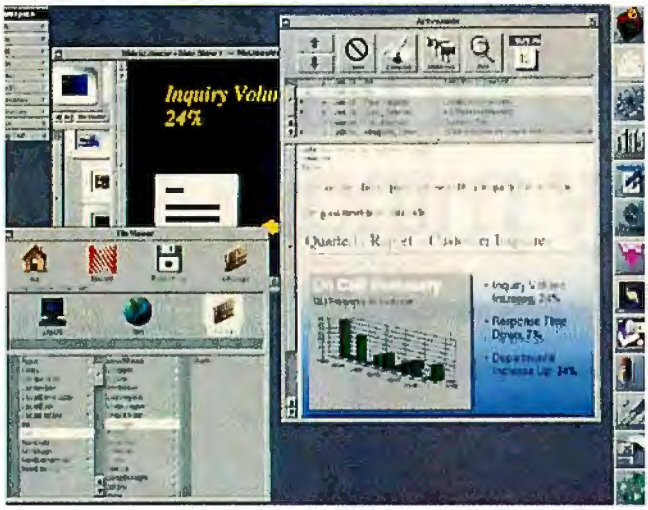
If you're using flowcharts now, ABC Flowcharter will make it a pleasure. And if you're not, ABC Flowcharter is a great reason to start. *Call today for more information!*

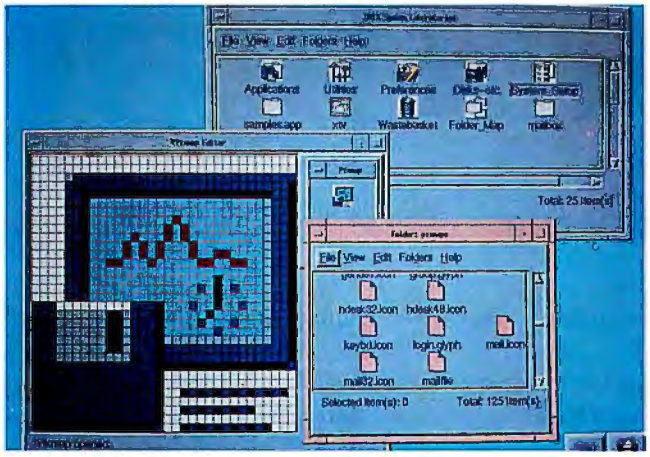
1-800-598-1980

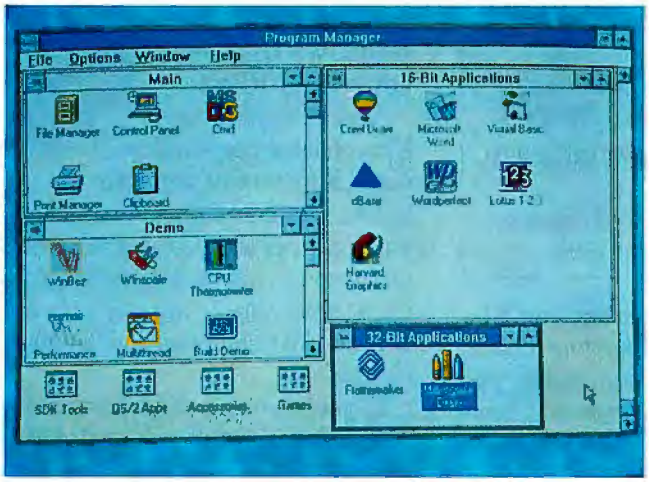
M I C R O G R A F X®

Micrografx, Inc., 1303 Arapaho, Richardson, TX 75081 (214) 234-1769. Micrografx has offices in Toronto, Paris, London, Munich, Milan, Sydney, Copenhagen and Tokyo. Copyright ©1992, Micrografx, Inc. All rights reserved. Micrografx and ABC Flowcharter are registered trademarks of Micrografx, Inc. All other products are trademarks or registered trademarks of their respective owners.

Circle 127 on Inquiry Card.







NextStep (top), SVR4.2 (center), and Windows NT (bottom) all have unique visual traits. NextStep uses heavy shading, floating menus, and animated icons to achieve its glossy twenty-first-century look. SVR4.2's early allegiance was to Open Look, a capable but not popular X interface layer. USL's commercial release will include OSF/Motif as well. Windows NT offers a bridge to Windows users by providing no surprises: It looks, feels, and acts like Windows.

from its own subsidiary, SunSoft. But Sun will have a unique advantage in the added-value department. As new technologies are born, managers at Sun get to choose whether to keep the jewels locked in Sun's safe or share them with the world through SunSoft. In any case, Sun freely confesses its intention of using proprietary enhancements to keep Sun-brand SPARC systems leading the market.

Through all this, SCO is claiming the high ground for its decision to pretty much stay put. Open Desktop 2.0, SCO's flagship Unix bundle, offers little more than previous versions and is still based on SVR3.2. SCO's approach seems to depend on SVR4's failing to catch on. "The conventional wisdom says that Sun, Univel, and so on are going to eat [SCO's] lunch," says Maureen O'Gara, editor of the *Unigram-X* newsletter.

Nina Lytton, president of consulting group Open Systems Advisors (Boston), thinks that developers will be attracted to Open Desktop 2.0 because it is proven and stable. "That strategy sounds like a yawn, but [SCO's] is the low-worry approach for Unix," Lytton says. She also notes that Open Desktop 2.0 will run applications written for SVR4.

The NT Factor

Windows NT is the wild card in Unix's future. Microsoft has a talent for whipping up public support for its products while they're still on the drawing board. The U.S. Patent and Trademark Office, under Giammo's guidance, is pre-sold, but he expects to wait a year or two after NT is available before adopting it, to ensure that it lives up to its promise. He's not interested in Windows: "From what I've seen," he says, "Windows is a kludge. It's even worse than Unix." He blames the "DOS baggage" Windows carries.

Microsoft claims NT will run DOS, Windows, new 32-bit applications, OS/2 applications, and X applications within an NT window (see screen c). Dwayne Walker, Microsoft's director of Windows NT and networking products, says, "If you had to summarize NT, you'd say it is powerful, scalable, easy to use, and compatible. And it offers multitasking and multiprocessing."

In addition, Microsoft says that NT will have built-in networking, including TCP/IP, and C2-level security. NT is portable from 386 and 486 PCs to RISC environments, supporting the Mips R4000 as well as DEC's Alpha RISC chips. Microsoft claims an advantage for developers, too: The 32-bit Intel-based applications they develop for NT will run native under Microsoft's Win32S extension for 16-bit Windows. With all that, Windows NT is clearly targeted at Unix, becoming what Walker calls "a high-end operating system for desktops and servers just as Unix is a high-end operating system for desktops and servers" (see "Unix vs. Windows NT" on page 140).

Microsoft clout alone could make NT a success. Next's Tevanian concedes that Microsoft's market presence is a big advantage, and according to O'Gara, at least one other Unix provider is worried: "Even the street fighters over at Sun are concerned when they look at what's happening with Windows. They see the way the market works: The users are a bunch of sheep, and Billy [Gates, Microsoft CEO] is the shepherd," says O'Gara.

For Giammo and others, Windows NT sounds like a dream come true, solving all compatibility headaches in one swoop. But with the end-user version at least three months away from shipping, NT is still a question mark. O'Gara calls NT "the unhardened operating system. You can't tell me that this thing is going to be ready to run mission-critical applications anytime soon." And the strength of Windows 3.1 on the desktop might not help Microsoft in promoting NT on workstations.

Open Systems Advisors' Lytton says Unix users are not impressed by the quality of Windows 3.1. "People thought that Windows would be the path of least resistance, but now that

WE DIDN'T HAVE TO PUT OUR OPTICAL PRODUCTS ON PEDESTALS. JERRY POURNELLE DID.

"I am pleased to report that I'm sold. **The Pioneeer optical drive... is as solid as a rock.**... Thus, I'm discontinuing testing. Now I'll just use the drive. ...I now rely on the Pioneer erasable optical disks for backup, for primary storage of really big files, and for archive copies of software... you really need something **so easy** to use that you'll routinely use it for backup... **the Pioneer DE-S7001 will do the job very well indeed. Recommended.** *Byte (9/91)*

The Pioneer six-pack CD-ROM Minichanger is great. We've had it in operation for the best part of the year now, on a number of different systems.... **It has always performed flawlessly**... it changes drives a lot faster than you'd expect it to.... **It's really fast**.... Accesses that used to take many seconds are now nearly instantaneous. Accesses that took over a minute now take a few seconds. **I always did like the Minichanger.... Now it's even better.**... Incidentally, the Pioneer Minichanger will work just fine with a Mac. *Byte (10/91)*

The Pioneer DE-S7001 dual-purpose external optical disk drive I've written about before. Log your wordprocessor to that, save early and often, and you'll have it all.... In a word, WORM drives look like **the ultimate in backup storage.** *Byte (12/91)*

Suppose you erase a file? Overwrite one you wanted to keep? And suppose your house burned down? You don't have any off-site backup at all.... **I could remedy that by installing the DE-S7001 on the network server and archiving on that**.... *Byte (11/91)*

JERRY POURNELLE
RENOWNED COMPUTER COLUMNIST

I have the DRM-600 running not only with QEMM386.SYS, but inside DESQview windows, which has the amusing result that I can actually have several CD-ROM windows open at once.... **It's surprising** how fast you can switch back and forth among them.... The Pioneer DRM-600... **it's very convenient** to have a bunch of CD-ROMs available without swapping. *Byte (1/91)*

It's quite intuitive [the Pioneer CD-ROM Minichanger]: no instructions are required.... **Recommended**. *Byte (1/91)*

This technology is coming of age. *Byte (1/91)*"

For more information or for a free VHS videotape "Pioneering The Future," about Pioneer optical disk products, call 1-800-LASER-ON, and find out why Pioneer is the leader in optical disk technology.

PIONEER®

Pioneer DE-S7001, Pioneer DRM-6●●, and Pioneer DD-S5101 are trademarks of Pioneer Communications of America, Inc. QEMM386.SYS and DESQview are trademarks of Quarterdeck Office Systems.

Circle 147 on Inquiry Card.

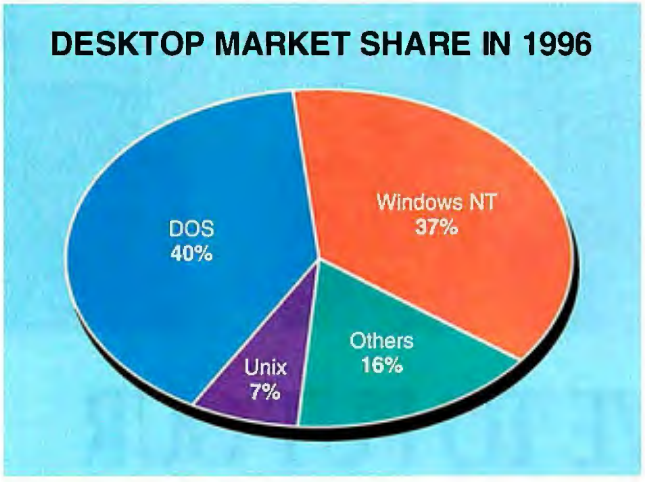


Figure 2: *Although Dataquest expects Unix to have 47 percent of the workstation market by 1996, it will not fare as well in the desktop arena. There, Unix is a distant third at 7 percent, with Windows NT and MS-DOS holding a combined 77 percent market share.*

they've had a chance to really assess 3.1, the vision isn't as rosy as it was," she says.

Dataquest's Kirzner sees a bright future for NT: "We believe Windows NT will be the winner, because you can't stop the power of Microsoft, but Unix will do well," she says. Today, Unix has about 86 percent of the workstation market. By 1996, that figure will drop to 47 percent, due largely to NT. Dataquest projects that NT will claim 37 percent of the desktop market by 1996; DOS will retain 40 percent, and Unix will be a distant third with 7 percent (see figure 2).

Promises, Promises, Promises

While NextStep will be one of the contenders for the high-end multitasking desktop, it appears that the fiercest salvo fired at NT will come from an unlikely alliance: Univel. USL, looking to get serious about marketing and distribution, and Novell, hoping to shed some of its proprietary image in the newly competitive climate, have joined forces to offer a new shrink-wrapped Unix operating system that may be available as early as this fall.

Sold as SVR4.2 by USL and as UnixWare by Univel, it has a list of promises at least as long as NT's. What's surprising is that USL doesn't plan to stake out only the high end Microsoft has targeted for NT: SVR4.2's minimum configuration is a 16-MHz 386SX with 4 MB of memory. USL's literature talks about running the operating system comfortably on systems with 60-MB hard drives and even dares to suggest that SVR4.2 would run nicely on a notebook computer.

For standards, SVR4.2 hits a grand slam. The U.S. government and other large corporate customers will appreciate the Posix, FIPS, X/Open, B1/B2 security, OSF AES (Application Environment Specification), and IBCS (Intel Binary Compatibility Specification) compliance. Users of the Intel port will be able to run SVR3.2 and earlier SVR4 applications without hassle. And non-U.S. users get their share of attention, thanks to multibyte characters, alternative date and time formats, message tables, and an internationalized version of the Curses text-interface library.

Difficulty with hard disk file systems has caused a lot of people to turn away from previous PC Unix implementations. SVR4.2 proposes to solve this by introducing a journaling file system. Journaling protects data by first writing it quickly to a reserved area on disk. Then, when the system has time, the journal is flushed and the real file updating is done. At that time, the various Unix file-system data structures on disk are updated as well. Once it has written the data and updated the structures, the operating system deletes that journal entry and moves to the next one.

In the past, data was transferred from the memory buffers directly to its final destination on disk. If you turned off the power or reset a running system, chances were there would be several files in various states of incompleteness, where either the data or the file-system structure would be out of sync.

Modern Unix file systems write disk information in a predictable order that lets a utility called `fsck` comb through the file system and make sense of it again. But with journaling, that, presumably, won't be necessary. To bring the system up to date, you just play back the entries remaining in the journal. Eliminating the need for frequent file-system cleaning also greatly reduces the time required to reboot a system.

Univel is slimming SVR4.2's size and price by unbundling, breaking with the "everything in one box" tradition. But SVR4.2 is hardly stripped down; both the client and server versions include X and graphical shell support, source-level compatibility with seven common Unix implementations, DOS and Windows support, and networking. USL's role in this is to break with its own tradition of leaving most of the porting job up to licensees. USL will develop targeted binary versions of SVR4.2 (Intel, SPARC, Mips, RISC System/6000, and HP PA RISC versions are promised) and license them to packagers ready-to-run.

Those packagers, with Univel among them, can focus on adding value rather than on doing the basic port. The Intel version will ship from USL with drivers for a variety of display, disk, and SCSI devices. One frequent gripe about X—its dependence on bit-mapped fonts—will be answered by Adobe Type Manager, which will be a standard part of SVR4.2. And SVR4.2's desktop manager will include productivity applications and point-and-click shells for common system administration tasks.

Novell's involvement will get SVR4.2 into the company's authorized dealers, who will provide the added value of NetWare integration. Novell's dealers are an important channel, since it's largely the same one Microsoft is targeting with both LAN Manager and Windows NT. Novell is using SVR4.2 to get its share of the "open systems" pie and keep Microsoft out of Novell's stronghold.

Dataquest's Kirzner believes SVR4.2 will

What USL/Univel Promises with SVR4.2/UnixWare

- Compatibility with seven leading Unix implementations, including SunOS/Solaris, SVR3.2, BSD, and Xenix.
- Inclusion of the X Window System, with both OSF/Motif and Open Look interfaces, and development tools that allow users to switch applications' look-and-feel between them at run time. Adobe Type Manager will provide scalable fonts.
- Inclusion of TCP/IP networking in the base offering. UnixWare will offer NetWare capability as well, delivered by Portable NetWare.
- A minimum configuration of a 16-MHz 386SX with 4 MB of memory and a 60-MB hard drive.
- Graphical tools for common system administration functions, and a group of user productivity applications.

GO FIGURE!

DesignCAD 2D. Like Leonardo da Vinci's concept of a rotary blade aircraft, it is ahead of its time, not only in technology, but also in cost and value.

DesignCAD 2D is only $349, and it has more and better features than the other CAD programs that cost $3,000!

And, if you're ready for a three dimensional CAD program, there is the state-of-the-art DesignCAD 3D . . . for only $499!

So, how come theirs costs several thousand dollars and ours costs a couple hundred? Go figure. (Why do you think the Mona Lisa is smiling like that?)

CAD/CAM Software

PC MAGAZINE EDITORS' CHOICE

PC MAGAZINE EDITORS' CHOICE

BUYERS ASSURANCE SEAL

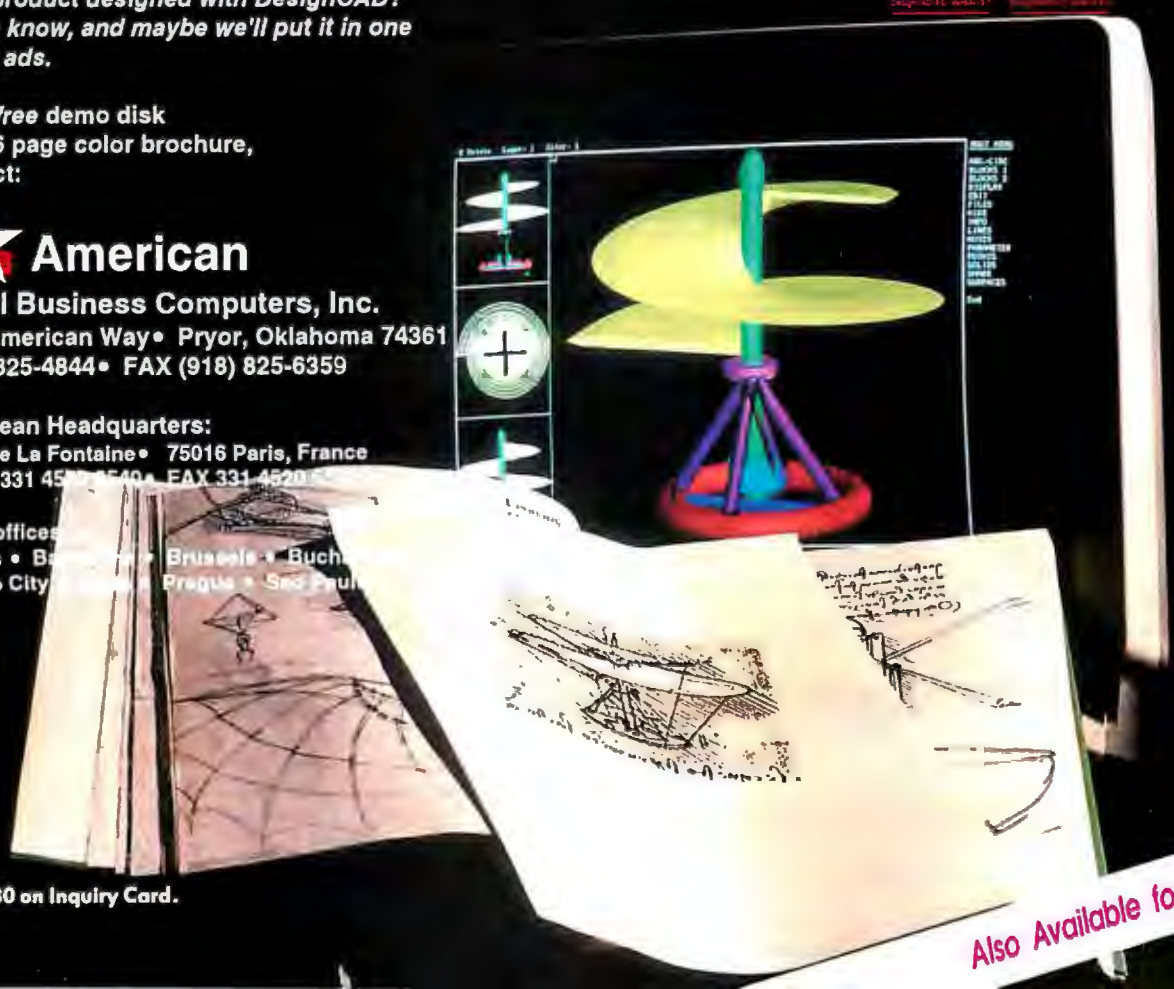
Your product designed with DesignCAD? Let us know, and maybe we'll put it in one of our ads.

For a *free* demo disk and 16 page color brochure, contact:

American
Small Business Computers, Inc.
One American Way• Pryor, Oklahoma 74361
(918) 825-4844• FAX (918) 825-6359

European Headquarters:
102 Rue La Fontaine• 75016 Paris, France
Phone 331 45[illegible] FAX 331 4520[illegible]

Other offices
Athens • B[illegible] • Brussels • Buch[illegible]
Mexico City [illegible] • Prague • Sao Paul[illegible]



Circle 80 on Inquiry Card.

Also Available for Macintosh

allay the fears of some Unix vendors. "It's a pure, unadulterated version of B1-level secure Unix, but for the PC," she says. "You buy as much or as little as you need." Kirzner says SVR4.2 will be priced to compete against Windows and OS/2, ostensibly in the $100-to-$150 range. USL declines to give a price for SVR4.2, preferring to leave it up to its licensees.

Not everyone is convinced that SVR4.2 will be successful on Windows' and MS-DOS's turf. "It would be stupid to put Unix on people's desktops," says Andrew Toller, a principal with DMR Group, a Toronto market research and consulting firm. He notes that DMR consultants usually use Unix as a back-end system fronted by Windows on the desktop in all but the most technical environments, particularly in software development applications.

Open Systems Advisors' Lytton expects a rough beginning for SVR4.2. "[SVR4.2] is having the same honeymoon [as NT] right now with the press," she says. "But any major new release always has problems that need to be worked out." She cites MOOLIT (the Motif/Open Look Interface Toolkit) as an example, claiming that it won't support any application that uses superset features of Motif.

In spite of the doubts, Toller says that many DMR clients have begun asking about SVR4.2. "These are people that until a year ago didn't even know what Unix was," he says.

When SVR4.2 hits the streets, if it's everything that's promised, it will mark a new era in PC Unix. USL's doing the binary work will help ensure cross-platform application compatibility. USL is straddling the Open Look/Motif fence by offering both GUIs, and it's also committing to technologies like ANDF (Architecture-Neutral Distribution Format) and DCE (Distributed Computing Environment). DCE adds functionality to existing networks by allowing you to share applications as well as data. You can transparently allocate CPU power to networked applications, running pieces of a program on several machines at once.

The goal is to develop these and other new technologies at USL and then get them to packagers in a ready-to-run state, complete with documentation. That's a major shift for USL, and one that more closely parallels Microsoft's strategy than the arcane Unix channels of old.

It's Just Starting

Unix isn't dead, but certainly the next few years will mark a period of intense change. Users and developers will be faced with important decisions. As the Unix market consolidates, the query "Which Unix?" may change to a less confusing question: "Unix or NT?"

To answer that question, Unix vendors, previously content to focus purely on technical issues, will have to spend more time solving ease-of-use concerns. And they will have to counter Microsoft's marketing might head-on.

Unix has a rich history. If the new pack of Unix vendors can keep from bickering among themselves, Microsoft will face a strong competitor of NT. ■

Editor's note: *West Coast bureau chief Andy Reinhardt, news editor Patrick Waurzyniak, and senior technical editor at large Jon Udell also contributed to this story.*

Tom Yager is a BYTE technical editor and author of Unix Program Design and Development for IBM PCs *(Addison-Wesley, 1991). Ben Smith is a testing editor in the BYTE Lab and author of* UNIX Step-by-Step *(Howard W. Sams, 1990). You can reach them on BIX as "tyager" and "bensmith," respectively, and on the Internet at tyager@bytepb.byte.com and ben@bytepb.byte.com, respectively.*

Copia International Ltd

AccSys™ for PARADOX

C libraries for joining forces.

- C Libraries to Paradox Tables
- Windows (DDL) and VisualBasic Support
- Multi-Platform/C Source Available
- Twice the Speed & Half the Size of Engine
- Full Network Support

MICROSOFT® WINDOWS™

FOR TECHNICAL DETAILS: 708/924-3030 DOC. NO. 889822

Copia International Ltd.

Wheaton, Illinois 60187 708/682-8898

COMPUTER SECURITY PRODUCTS

COMPLETE LINE OF PROVEN AND EASY TO INSTALL COMPUTER SECURITY PRODUCTS FOR COMPUTERS.

PREVENT COMPUTER THEFT!

Kablit™ Security System

This system allows you to secure all your computer components: CPU, monitor, keyboard, printer. **Internal component security:** Kablit fasteners secure the rear panel of CPU protecting internal boards and hard drives. Fasteners available for all applications. Prices **$34.95** to **$49.95** depending on system.

DISK DRIVE LOCK™

IBM PS-2 DLK-270 Series

Now you can lock a diskette into your disk drive and force the computer to boot from the diskette. Disk Drive Lock models available for PS/2 - 30, 55SX, 50, 70 and 90. Protect your data from viruses or from being copied. Other drive locks to fit most non IBM PS/2 and Macintosh disk drives. List price **$24.95**

Order your free catalog of these and many other security products. Purchase orders accepted. Quantity pricing available. Shipping not included. MC/VISA accepted. Dealer inquiries invited.

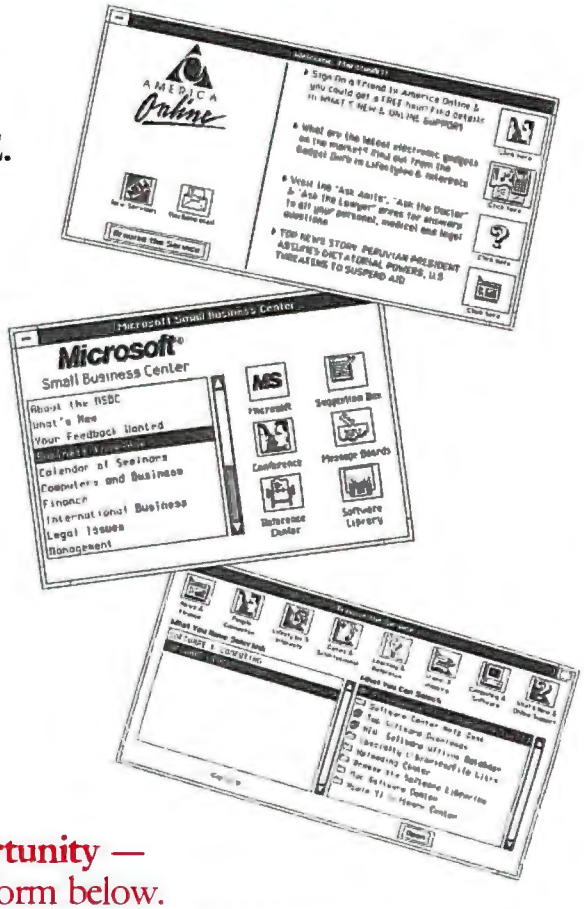
Secure-It, Inc. 18 Maple Court East Longmeadow, MA 01028 1-800-451-7592

Circle 158 on Inquiry Card (RESELLERS: 159).

Own a Modem?

Try America Online for FREE

If you own a computer and a modem, we invite you to take the opportunity to try **the nation's most exciting online service, America Online®, for FREE.**



- Build a software library by downloading selected files from a library of thousands — productivity software, games, and more!
- Get computing support from industry experts at online conferences and through easy-to-use message boards.
- Tap into expert advice on running a small business in the exclusive Microsoft® Small Business Center.
- And much more! Order now and you'll receive FREE software and a FREE trial membership to try America Online.

Join us in this exciting opportunity —
Simply complete and mail the form below.

Detach & Mail Today!

Must respond by 10/1/92

☑ **YES**, I want to try America Online! Send me FREE software and a FREE trial membership to try the service.

Name: _____

Address: _____

City: _____

State: _____ Zip: _____

Home Phone: ( ) _____

Disk Size: ☐ PC 5¼" ☐ PC 3½" ☐ Macintosh

The PC version of America Online requires ☐ a PC/XT or higher; ☐ 512K memory or higher; ☐ a hard drive; ☐ a mouse; ☐ a modem; ☐ Hercules or EGA monitor or above.

AMERICA Online®

Rates higher outside the continental United States. America Online is a registered service mark of America Online, Inc. Microsoft is a registered trademark of Microsoft Corporation.

6220/PC

ATTENTION MODEM OWNERS!

RESPOND BY 10/1/92!

How Many of These America Online Services Could You Use Right Now?

- Stock Quotes and Portfolio Management
- More Than 45,000 Software Files and Programs
- Fast, Easy Downloading
- Searchable Online Encyclopedia
- Powerful Electronic, Fax, and U.S. Mail Capabilities
- Multi-Player Graphic Games
- Microsoft® Small Business Center
- Access to Computer Industry Experts
- Special Interest Groups and Clubs
- Graphic Windowing Interface
- Homework Help and Tutoring Sessions

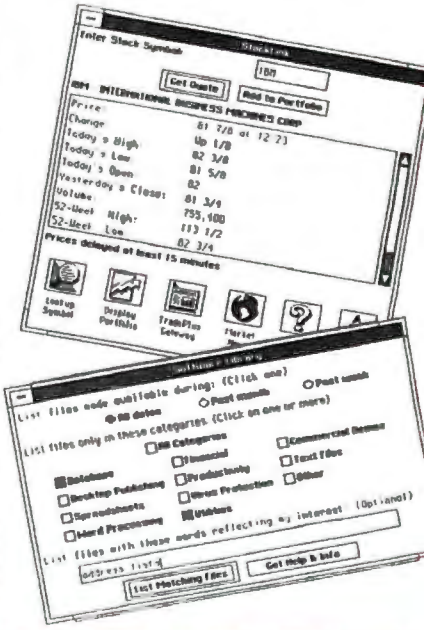
See other side for details about your FREE trial of America Online!

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 9096 VIENNA, VA

POSTAGE WILL BE PAID BY ADDRESSEE

America Online
8619 Westwood Center Drive
Vienna, VA 22182-9806



FEATURE

The Greening of Computers

Both vendors and consumers are finding that environmentally sound computing pays

ANDY REINHARDT, ED PERRATORE, ANDY REDFERN, AND RICH MALLOY

In the computer industry, you never know where idealism leaves off and opportunism kicks in. The trend toward more environmentally sensitive, or *green*, computing offers the rare opportunity to indulge both simultaneously: A new wave of more ecological products and processes now emerging from research labs is making it possible for vendors and users to save money and save the earth.

The pleasant surprise is that for vendors, environmentalism is turning out to be smart business. Companies not only earn brownie points for being good citizens, but many of their new design, manufacturing, packaging, and waste recovery techniques also save money compared with older methods. When you factor in the constant need for vendors to differentiate their products in an overcrowded market, reengineering products and processes to be more ecological becomes too attractive a prospect to ignore. And if that's not enough, tough new laws in places like Germany and Sweden are forcing companies—including multinationals—to rethink how they make and package computer products.

The environmental impact of the computer industry is twofold: The use of computers generates both solid and toxic waste and represents a large portion of energy consumption in developed countries. The consumer typically pays the expense of dealing with the waste via costs that the manufacturer passes on and fees and taxes associated with municipal landfills. Electricity consumption of computers is a major hidden cost that many businesses don't bother to analyze.

Cleaning Up at the Factory

Compared to industries such as petrochemicals, metals, and paper, the computer industry once enjoyed a reputation for being relatively clean. The work of groups such as the Silicon Valley Toxics Coalition shattered this image by demonstrating that computer waste products (especially from semiconductor manufacturing) were polluting the air and contaminating soil and groundwater. According to director Ted Smith, the group is "now much more focused on ways to prevent pollution than on cleaning up what's already there." Companies are revising their processes to eliminate expensive chemicals and disposal charges.

CFCs (chlorofluorocarbons), used as a solvent to wash residue off printed circuit boards, are a main target for elimination. Although CFCs have been implicated in ozone damage for years, companies were slow to switch to alternatives because of the investment they had in using CFCs, and because alternative methods were comparatively more expensive. But in the wake of the 1989 Helsinki Declaration, in which 81

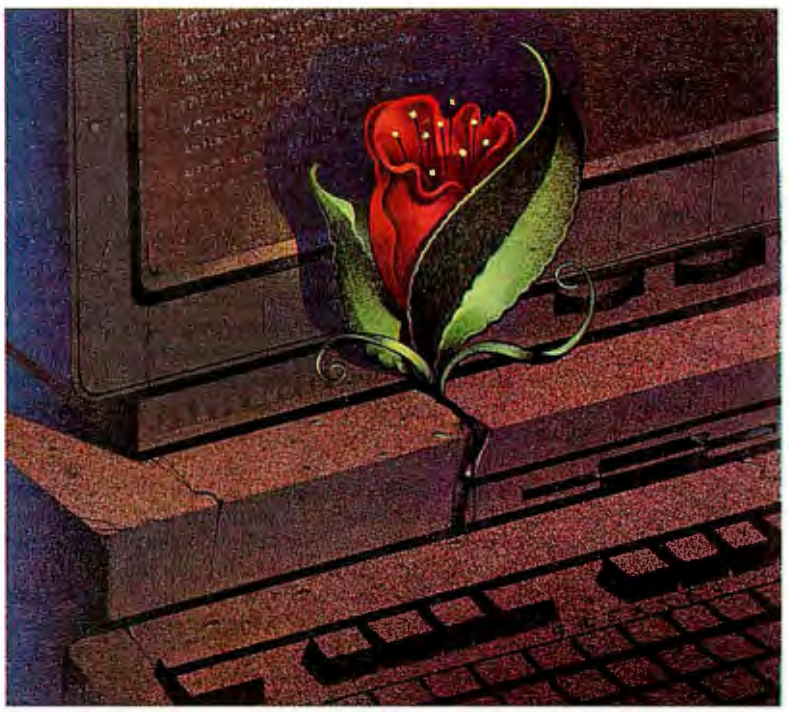


ILLUSTRATION: JOHN BREAKEY © 1992

countries committed to eliminate the use of CFCs by the year 2000, the cost of using CFCs, both politically and economically, has become too high to ignore.

In April 1991, Apple announced that it would use a new process for making boards and assemblies that does not require them to be cleaned. This change will let Apple eliminate all use of CFCs in its Fremont, California; Cork, Ireland; and Singapore plants by the end of this year. In June 1991, Compaq announced the adoption of a similar "no-clean" process, saying it would stop using all CFCs by 1995.

Other companies have dropped CFCs in favor of a remarkably simple cleaner: good old soap and water. At its manufacturing plant in San Jose, California, IBM now sprays its assemblies with soapy water, instead of bathing them in industrial solvents. Intel's systems plant in Oregon has made the same switch. According to Intel's spokesperson Howard High, the cost benefits are substantial: The company expects to save $1 million to $2 million per year on the cost to buy CFCs and an extra $1 million to $2 million per year it paid to dispose of the used chemicals. High says the costs of both raw materials and disposal are rising sharply, which will make the equation even more compelling in the future.

Large Computer Companies Eliminating CFCs

- **Apple**
- **Compaq**
- **DEC**
- **Fujitsu**
- **IBM**
- **Intel**

Ironically, while the substances used to replace CFCs may be benign for the ozone layer, some are dangerous in other ways. For example, U.K. chip manufacturer Inmos will be using IPA (isopropyl alcohol) as a replacement for CFCs. Unfortunately, IPA is highly flammable and would be extremely dangerous if used in the same quantities as CFCs. So, far from using a straight substitution, Inmos has had to find techniques for preventing accidental ignition of IPA and to develop a washing technique that reduces the quantity of fluid used. Fujitsu has developed an ultrasonic water cleaner. Using cold water, steam, and ultrasonic cleaning, Fujitsu says its device can remove 10 times as much dust as CFC washing did.

Another problem Intel and other chip makers confront is the disposal of defective parts. High says that Intel can reclaim precious metals from failed components if they're caught at the wafer stage. But once mounted in plastic or ceramic carriers, defective parts have to be tossed in landfills. High couldn't say how many parts Intel throws away each year but notes that the parts don't contain any hazardous compounds.

Recycling Is In

Computers and peripherals themselves are rarely tossed into landfills, but consumables, such as paper, printer ribbons, disk media, toner cartridges, and batteries, typically are. Such consequent waste from computers makes up a minority of municipal garbage, but its proportion has grown every year since the advent of the personal computer. Finding ways to recycle these materials has become the latest trend in the industry, with companies such as Apple, Hewlett-Packard, and Lexmark International leading the way.

Because environmental regulations vary widely around the world, companies with global operations face a particular challenge. Some have decided to adopt the standards of the country with the strictest laws, since those are often a bellwether for the rest of the world (see the text box "Tough Laws Promote Change" on page 150). Doing so lets companies enjoy economies of scale, since a single model can be sold in any market.

Waste disposal is really two separate problems: volume and toxicity. The amount of garbage directly due to computers is nearly impossible to determine, and awareness of the link is so recent that even the Solid Waste Association of America, an industry group that is part of the Society of Plastics Industry, can't quantify its magnitude. Some of the materials thrown into dumps (e.g., batteries and monitors) contain toxic chemicals that can leach out and poison the soil and groundwater.

Printers and Monitors

In the last year, several companies have announced programs to recycle laser-printer toner cartridges. BIS Strategic Decisions says that 11.75 million toner cartridges were shipped in 1990, projecting that the number will climb to 19 million this year and nearly 28 million in 1995. This is a lot of nonbiodegradable garbage to add to the world's landfills.

Apple's program to recycle toner cartridges began in March 1991. Cartridges bought in the U.S. include a prepaid shipping label that lets you return them when they're spent. For every cartridge you return in the U.S., Apple will donate $1 to one of two environmental organizations. Apple claims that 95 percent of the cartridge is recovered, and some of it is reused as is or recycled. Lexmark International, the IBM spin-off company that sells laser printers and typewriters, introduced a similar program last June. Ken Bissel, a Lexmark spokesperson, couldn't specify exactly how many cartridges were returned under the program but said that the number was relatively small but growing.

A booming business exists for remanufactured toner cartridges. At one time, "recharging" cartridges simply meant drilling a hole and putting new toner in. Now, says William E. Kelley, executive director of the International Cartridge Recyclers Association, cartridge remanufacturers "have learned that they have got to put out quality products." Cartridges are completely disassembled and rebuilt with new components as necessary. Some vendors replace the original drum with a lifelong unit, which can be reused several times. Remanufactured cartridges are less expensive. If a new cartridge cost $100, says Kelley, a remanufactured unit with a lifelong drum would cost about $75. And the vendor might give you a break on the price if you turn in that unit again because of the lifelong drum.

In Japan, Canon has its own recycling program. It is in the process of doubling the capacity of its reprocessing plant in China by the end of 1993. This facility currently recycles 150,000 cartridges per month. Canon expects to be able to reprocess 600,000 units by the end of 1994. The firm says it has been reusing almost 95 percent of the cartridges, which are collected in both Japan and the U.S.

With its new Ecosys printer, Kyocera has probably come up with the best way to deal with printer drums. One of Kyocera's key themes is to emphasize environmentally sound products and processes. To that end, the company has doubled its production capacity of polycrystalline solar cells, expanded the use of environment-friendly ceramics in industrial processes, and focused significant research efforts on thin-film technology. This thin-film technology is a key ingredient in Kyocera's new printer.

Kyocera used its thin-film expertise to create a photosensitive drum that is coated with a hard layer of amorphous silicon. To keep the drum surface clean, Kyocera supplies a ceramic-based toner, which is packaged in a biodegradable container (made from kelp). The result is that the drum will probably last the printer's lifetime, and all disposables are biodegradable. This

4,000,007 reasons to upgrade to System 7.

1. Rave reviews.

MacUser gave System 7 its Editors' Choice Award. Byte, its Award of Excellence. Software Publishers Association named it a Best New Business Software Product of the Year.

2. One-step installation.

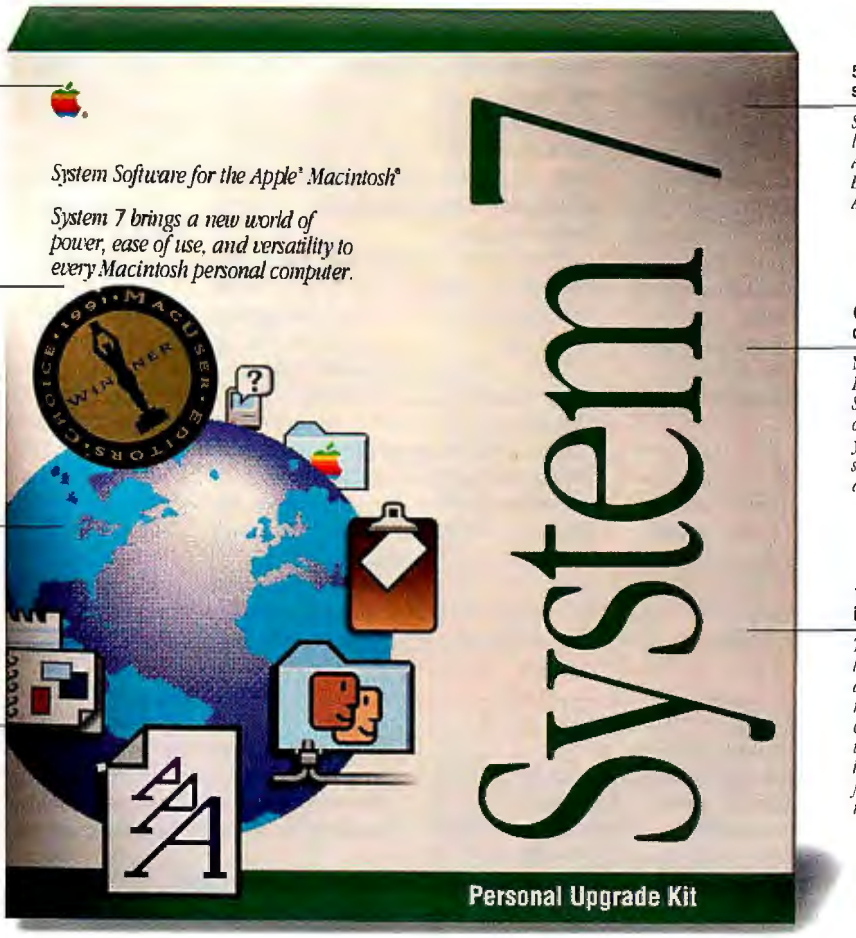
The "Before You Install" disk confirms the compatibility of your software (including INITs). Then, simply click the mouse to install System 7. Any questions? 90 days' toll-free phone assistance included.

3. It's developed quite a following.

Developers have shipped hundreds of applications that take advantage of System 7 power. Microsoft, Claris, Lotus, Aldus, Adobe and many more.

4. Runs on your Macintosh today.

System 7 works on all Macintosh computers. To run multiple programs, four megabytes of memory are recommended. Two megabytes are required.



5. Powerful software utilities.

System 7 will let you run the latest software utilities from Apple, including Macintosh PC Exchange, QuickTime™ and AppleTalk® Remote Access.

6. More power out of the box.

Macworld says, "The new Finder...is worth the cost alone." System 7 improves the way you organize, view and work with your information. Built-in file sharing lets you share files over a network, simply and easily.

7. Keep your investment current.

The best way to keep up with the latest technology is to stay ahead with System 7. You'll need it to take full advantage of today's applications, hardware and software. And it will help you grow with the future as new technology innovations come along.

Macintosh System 7. If the first seven reasons didn't convince you to upgrade, just ask the four million Macintosh® users who have already discovered the power of System 7.™ Call us at **1-800-538-9696, ext. 185.** We'll give you the name of an Apple software reseller near you. And you'll discover the power of System 7. The power to be your best.®

©1992 Apple Computer, Inc. All rights reserved. Apple, the Apple logo, AppleTalk, Macintosh and "The power to be your best" are registered trademarks of Apple Computer, Inc. QuickTime and System 7 are trademarks of Apple Computer, Inc. This ad was created using Macintosh computers.

Tough Laws Promote Change

ANDY REDFERN

The severity of waste disposal and energy conservation problems varies greatly around the world. Some countries, particularly those with high energy costs and relatively few means to discard trash, have taken legislative action to force companies to minimize these problems.

One key area affected is packaging. German law now places some responsibility for the disposal of excess packaging on the retailer. If, for example, you bought 100 floppy disks in 10 boxes of 10 disks each, it would be the responsibility of the retailer to dispose of the packaging that held the 10 boxes of disks together. With this onus on the retailer, retailers are pressuring manufacturers to use product packaging sparingly. For example, Japanese monitor maker Eizo has recently redesigned the four-layer packaging of its video cards so that only one integrated layer of packaging is left.

By the end of the year, this "polluter-pays" attitude is set to be further extended when a wide-ranging German state ordinance on electronic goods takes effect. The detail of the ordinance has still to be ratified, but it places the responsibility to recycle and reuse electronic goods on the manufacturer. So, if you buy a personal computer, once it has reached the end of its working life, you will have the right to return it to the manufacturer via the retailer. The manufacturer will then be legally obliged to recycle or reuse the system.

If this measure is ratified, it will have a major impact on computer design around the world. As has already been seen in the area of monitor emissions, manufacturers design systems to meet the highest legal standard required around the world. For example, Sweden has the toughest rules on monitor emissions, and many monitors not even sold in Sweden already meet the Swedish safety standards.

To meet this proposed ordinance, companies must first work out whether reusing or recycling of their equipment is the most economical. Renovating computer equipment has little appeal for many manufacturers. Product life cycles are so short that by the time companies return their equipment, there is little opportunity to resell it. Some product reuse projects are under way; for example, collecting and refurbishing personal computer equipment and consumables to be sent to charities in developing countries. But the most serious efforts are in the area of recycling.

Manufacturing giant NEC has been investigating the recycling of electronic equipment since 1969. Because of the use of expensive metals (e.g., gold) in high-performance systems, NEC has been reclaiming the precious metals from defunct systems for resale. NEC now has a partly owned subsidiary called Kowa Enterprises based in Kawaski City, Japan, that recycles some 3000 tons of machinery every year. Through a network of 52 branch offices across Japan, Kowa collects 90 percent of its hardware for recycling from other NEC subsidiaries. Kowa is also responsible for the safe management and disposal of industrial waste and hazardous substances from the old NEC machines.

In the early 1970s, IBM established a similar program in the U.K., and in 1991, this program recycled or reused 80 percent of IBM's total obsolete-parts inventory, according to reports published by IBM. IBM's goal is to raise this to 95 percent of all components used on printed circuit boards and in monitors. IBM has also voluntarily extended this recycling program by providing a disposal service for customers who have equipment that has reached its life expectancy.

is in marked contrast to most laser printers.

The catch is that there is no catch. An amazing feature about the Ecosys printer is that its eco-friendly nature is achieved without any disagreeable side effects. The printer is no larger than similar 10-page-per-minute laser printers; in fact, its LED technology allows it to be considerably smaller than most of its competitors. And its price tag of $2395 and claimed cost of operation (less than 1 cent per page) are so low that even people who don't give a hoot about the environment should seriously consider this printer. The *Eco* in Ecosys could well stand for economy, as well as ecology.

Old or broken monitors can be disassembled for scrap, except for the CRT, which has to be disposed of in an expensive hazardous waste dump because of the lead in the glass. Monitors can also be reconditioned for less cost than buying new ones. Video Display (Tucker, GA) specializes in repairing CRTs in computer displays. According to company chairperson Ron Ordway, the most common point of failure in displays is not the tube itself but the electron gun or the electronics that drive it. Video Display can fix these components and preserve the rest of the tube and housing. The result is a refurbished monochrome CRT for about 60 percent of the cost of a new one or a color tube for about 50 percent, Ordway says. Unfortunately, Video Display sells its reconditioned monitors only to service organizations and repair shops; they are not available to the general consumer.

Salvaging Systems

According to Ethan Seidman, a researcher for *Garbage* (an environmentally oriented magazine based in Gloucester, MA), when a computer enters the waste-processing stream, it is usually stripped of all salvageable or recyclable parts, which can include metal or plastic casings, electronic components, wiring, and even nuts and bolts. Virtually nothing is left when the crows are done picking.

Some channels have emerged for disposing of intact but unwanted equipment. The East-West Development Foundation (Cambridge, MA) accepts donations of used systems for export to Russia and eastern Europe. Some companies sell their used equipment to brokers, who recondition it for export to the Third World. And the Solid Waste Association of America's information hotline (see the text box "Guide to Green Computing Groups, Products, and Services" on page 158) advises callers to donate old

We'll show you how to play the media better than Bush, Clinton and Perot put together.

Easy to get rolling.

You don't need extra hardware to start working with QuickTime. Simply drag the QuickTime system extension into your System Folder. Now applications designed to support QuickTime can work with digital video sequences, animation movies, sound files and compressed images.

View and edit QuickTime movies.

Play, pause, fast-forward, rewind and advance frame by frame with the MoviePlayer application. Copy video and animation clips, paste them together, create your own movies.

Compress PICT images.

Shrink them to a fraction of their original file size and save valuable space and transmission time with the Picture Compressor application. (Compressed files can be used automatically in any existing application that supports PICT files.)

Convert existing data into movies.

Convert other file formats (AIFF, PICS, PICT, Scrapbook, DOS image formats) to QuickTime movies with the Movie Converter application. Control frames per second, compression scheme and color depth.

One-button movie recording.

Digitize video and sound easily with the Movie Recorder application. View what you've recorded, save it or toss it out and try again. (Requires a video-capture card and sound digitizer.)

The Starter Kit.

Includes the system extension and Scrapbook, MoviePlayer, Movie Recorder, Movie Converter and Picture Compressor applications. Plus QuickClips,™ a CD-ROM disk with samples of movies and still color images and an electronic catalog of products that support QuickTime.

QuickTime Starter Kit. How well you communicate has never been more important. That's why Apple created QuickTime.™ The ability to paste digital video, animation and sound into your presentations as easily as pasting graphics into text. So if you'd like the name of an Apple software reseller near you, call us at **1-800-538-9696, ext. 175.** They'll tell you more about the QuickTime Starter Kit and show you how to communicate your ideas more powerfully than ever.

QuickTime requires a Macintosh® computer with a 68020, 68030 or 68040 processor. At least 4 megabytes of RAM. An Apple® SuperDrive™ or compatible floppy disk drive. A hard disk drive. System 6 (version 6.07 or later) or System 7™ (version 7.0 or later). You'll also need an Apple CD-ROM drive or compatible CD-ROM drive for accessing the contents of the CD-ROM. ©1992 Apple Computer, Inc. All rights reserved. Apple, the Apple logo and Macintosh are registered trademarks of Apple Computer, Inc. QuickClips, QuickTime, Software and System 7 are trademarks of Apple Computer, Inc. This ad was created using Macintosh computers.

equipment to charities willing to accept it or to contact the manufacturer to see if it wants to reclaim the system for service parts.

The problem of dealing with obsolete equipment has led to changes in system design. Examples are the new expandable PCs from Compaq, AST, Acer, and others: Originally created to address an economical problem—the rapid obsolescence of technology and desire by customers to expand their systems—these PCs are also more environmentally sensitive because they delay the disposal of otherwise functional equipment. Similarly, many vendors are now redesigning their systems for ease of service, which also makes them easier and less expensive for salvagers to disassemble.

Some of the plastic computer cases are impregnated with leaded and cadmium pigments, but so far the evidence of leaching is inconclusive. A report in *Appliance Manufacturer*, May 1992, says that Europe, but not the U.S., has established a timetable for eliminating cadmium from some resins, including those often used in computer casings. HP has already decided to switch to resins that contain no heavy metals.

The disposal of plastics, while much in the public eye, may become less of a problem as new techniques emerge for recycling plastic. This year, a study presented by researchers from Dow Plastics in Midland, Michigan, showed that the plastic (i.e., polycarbonate/acrylonitrile butadiene styrene) most often used in computer casings could be ground up and remolded with little or no degradation in key attributes, such as weight, thermal properties, and flame resistance; however, the color darkened slightly with each successive recycling.

These findings were achieved in a controlled environment using homogeneous plastic samples. The results were not as successful when different grades of plastic, or even similar plastics from different suppliers, were intermixed, suggesting that recycling will only be feasible when plastics are carefully sorted. To help promote that end, the Partnership for Plastics Progress, a group of 26 major resin producers, has recently started a committee called the Computers and Business Equipment Group. The group's charter is to focus on postconsumer issues, especially the disposal and recycling of plastics used in data-processing equipment.

Companies are increasingly trying to ship documentation on CD-ROM.

The Paper Chase

Far from creating the paperless office, the microcomputer industry has contributed to even greater paper use. The American Paper Institute, an industry association, reports that shipments of uncoated, free-sheet paper grew from 6.5 million tons in 1976—the year the Apple II was introduced—to 11.5 million tons in 1990, the latest year for which figures are available. Ron Lamb, a spokesperson for the Council on Plastics and Packaging in the Environment, notes that the rise is due mostly to the advent of high-speed photocopiers, personal copiers, and laser printers.

Some of the surge in consumption is on the production side. For example, the Microsoft Windows 3.0 package, including documentation, consumed more than 2 pounds of virgin paper, which means that the 10 million units sold have alone used at least 21 million pounds of new paper. Microsoft, IBM, Sun, Apple, and other companies are aware of this problem and are increasingly trying to ship documentation on CD-ROM. Doing so not only saves trees but also substantially reduces postage costs and improves ease of use for customers.

A study conducted by Franklin Associates for the U.S. Conference of Mayors' National Office Paper Recycling Project found that in 1990, nearly 11 million tons of waste paper were generated in U.S. offices, of which the lion's share, some 8.1 million tons, is high-grade printing and typing paper. Another 1.2 tons is cardboard. These amounts are expected to climb to 9.2 million and 1.5 million tons, respectively, by 1995.

Only 15 percent of office paper waste was recovered for recycling in 1990, the study found. But with aggressive, coordinated efforts by business and government, the rate of recycling could be nearly tripled, for a total of about 3.4 million tons, according to the study. In addition to supplying the growing demand for recycled paper, this would reduce total office waste to 5.8 million tons, or about 70 percent of current levels.

The value of used paper depends not only on the stock but also on how it was used. In general, mixed paper has the least value and white ledger paper the most. But interestingly, plain paper that has been through an impact printer is four to 10 times more valuable than laser-printed paper waste, says Brian Day of the National Office Paper Recycling Project. This is because paper recyclers can't remove laser ink as easily, but new processes to de-ink the 60 percent of office paper now laser printed are on the horizon.

Battery Blight

The most notorious toxic waste from computers comes from their lowly batteries, which contain heavy metals, such as lead, cadmium, and mercury. Most desktop PCs today use a battery to back up system-setup memory, and nearly all battery-powered portables and notebooks use rechargeable nickel-cadmium batteries for system power.

Researchers from the University of Arizona Garbage Project, who have excavated 11 landfills in the U.S. and Canada to learn what they reveal about waste-disposal patterns, say batteries represent only two-tenths of a percent of the garbage by volume but alone constitute nearly 20 percent of the hazardous waste generated by U.S. households and offices. According to Marge Franklin of Franklin Associates, the main source of toxic cadmium is rechargeable batteries used in electronic devices.

Sometimes a nickel-cadmium battery is not really worn out but simply unable to hold a charge due to poor maintenance. Nickel-cadmium batteries exhibit what is known as the *memory effect*, where premature recharging can reduce battery life. According to Andrew Czernek of The Complete Portable (Prospect Heights, IL), nickel-cadmium batteries are good for 300 to 500 recharges before you must throw them out. For $39, the company will test your battery and restore it to full capacity through a series of deep discharges over a five-day period. If the battery is not recoverable, there is no fee. The Complete Portable disposes of bad batteries through recyclers. Some companies send Czernek hundreds of batteries at a time, saving the companies a considerable amount over the cost of new batteries.

In October 1991, Apple announced a battery recovery program for its PowerBook notebooks. Noting that rechargeable batteries typically expire after two years, Apple said it would accept used batteries at any of its worldwide service providers and pay the full cost of their recycling or proper disposal.

The long-term solution for system makers is to use newer battery types that don't contain cadmium, such as nickel metal hydride or zinc-air. Both of these emerging technologies offer an additional benefit: They have higher power-to-weight ratios than nickel cadmium does, which means you get longer operating life per pound of battery. Nickel-hydride batteries typically allow

Don't Shoot It, Troubleshoot It.

LANDMARK... the widest selection of PC diagnostic software, firmware, and hardware in the world!

PC WON'T BOOT? KICKSTART IT!

Don't replace your motherboard, use **KickStart 2**™. When serious hardware problems occur, nothing gets you up and running as fast. KickStart 2 *measures power within 2.5%* on all four voltages, *shows Power-On Self-Test* (POST) failure codes, and features *on-board ROM-based diagnostics* allowing you to determine and remedy the problem quickly, easily, and inexpensively!

Built-in serial and parallel I/O *allows for testing remote via modem*, or simply logging results to a remote terminal, printer, or laptop. You can configure your own test routines and store them in KickStart 2's battery backed-up CMOS RAM for quick future use. On-board switches, LEDs, and digital displays allow complete control over testing in systems lacking video or disk.

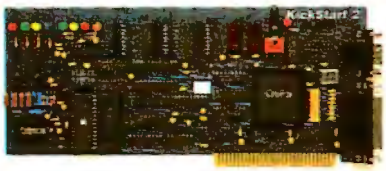
KickStart 2 is the ultimate *SECURITY CARD*, too. With two levels of password protection and pre-O/S activation, you can confidently prevent unauthorized use of your PC.

Includes serial and parallel loopback plugs and the Landmark **JumpStart**™ AT ROM BIOS for testing ATs that don't issue POST codes. KickStart 2 works independent of your operating system. You can use it on DOS or UNIX systems. ***CALL for current pricing.***

THE 5 MINUTE SOLUTION TO FLOPPY DRIVE FAILURE

With **AlignIt**™ you can clean, diagnose, and align your floppy drives in minutes without a scope. Patented technology requires only a screwdriver to perform ANSI-accurate alignments (.3 mils).

AlignIt is ideal for corporate users with multiple PCs. The **GOLD STANDARD** feature allows you to align all your PCs to the same in-house standard, guaranteeing that all your floppies are perfectly interchangeable between PCs! Available in 3.5" or 5.25" for both high and low densities. ***CALL for current pricing.***



*"The number of tests KickStart 2 can perform is mind-boggling... **IF THE KICKSTART 2 CAN'T FIND THE PROBLEM, IT PROBABLY EXISTS IN YOUR HEAD,** not in the hardware."*
Rich Santalesa, Computer Shopper

*"KickStart 2 system diagnostics board helps users check out virtually every aspect of a PC's hardware system... **THE BOARD IS A WORTHY INVESTMENT** for computer maintenance."*
David Claiborne, PC Week

PROFESSIONAL LEVEL PC TROUBLESHOOTING

Landmark **Service Diagnostics**™ is ideal for professionals requiring the most exhaustive diagnostic test capabilities.

Service Diagnostics is not just a single product, but a complete LINE of products. It's comprised of software, hardware, and firmware so you can choose the best "tool" for the job.

PC MAGAZINE EDITORS' CHOICE
August 1990
Service Diagnostics: The Kit

*Overall, Service Diagnostics: The Kit was the best performer you're running a service department. **SERVICE DIAGNOSTICS IS NOT AN OPTION. IT'S A NECESSITY.***
Bill O'Brien, PC Magazine

When your PC won't boot, you'll need **ROM POST** firmware, a plug-in chip that virtually "jumpstarts" the system to determine what's wrong. And, when your printer isn't working, you won't know whether it's the LPT port, cable, or printer without hardware, like our loopback plugs (which together with our software completely test the COM ports).

To provide you a complete troubleshooting resource, Service Diagnostics is offered in single modules or in "kits." Components include; CPU-specific software (PC, XT, AT, 386/486, PS/2), ROM POSTS (PC, XT, AT) and floppy alignment disks (3.5" and 5.25").

All the Service Diagnostics software modules are available in self-booting versions for use with non-DOS operating systems like UNIX.

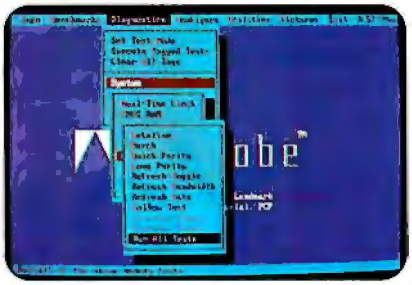
Service Diagnostics is powerful and flexible. Hundreds of tests can be performed on your motherboard, memory, video, COM ports, floppy and hard drives, printer, and more. ***CALL for a customized quote on the kit that's right for you!***

PC DIAGNOSTICS MADE EASY

You don't need to be technical to use **PC Probe**™. With clear, intuitive, pull-down menus and 206 pages of on-line help, troubleshooting your PC is truly MADE EASY!

And, you don't have to be handy with a screwdriver to make PC Probe pay for itself. Just by providing a diagnostic report to your service and repair shop, you'll save money and receive quicker service.

PC Probe runs over 150 tests including; motherboard and CPU, memory, video card and display, keyboard, COM ports, floppy drive and controller, hard drive and controller, and more. Includes **VirusCure**, Landmark **Speed Test**, **AT SetUp** & loopback plugs. ***CALL for current pricing!***



SLASH HARD DISK SET-UP TIME

If you install, upgrade, or maintain hard drives, then you need **DiskBase**™. It'll save you boat-loads of time and money by putting the exact hard disk information you need at your fingertips... whenever you need it.

DiskBase reveals 12 technical specs on over 2500 hard disk drive models and 8 technical specs on over 220 controllers. Once you've located the correct hard disk model, you can instantly bring up a listing of all compatible controllers. ***CALL for current pricing!***

• Toll Free Tech Support
• 90 Day Money Back Guarantee
• Federal Express Shipping

CALL (800) 683-6696

FAX (813) 443-6603 • Int'l (813) 443-1331

LANDMARK
RESEARCH INTERNATIONAL CORPORATION
703 Grand Central Street • Clearwater, FL 34616

Copyright 1992 PC Probe, AlignIt, KickStart, JumpStart, ROM POST, Service Diagnostics, DiskBase, and Speed Test are trademarks of Landmark Research International Corp. All Rights Reserved. Other names are trademarks of their associated owners.

Circle 169 on Inquiry Card (RESELLERS: 170).

notebooks to run about 25 percent longer between charges than would a nickel-cadmium battery of the same weight.

Makers of desktop computers are also addressing the battery disposal problem, while at the same time making their systems more secure and flexible. Both HP and Amkly Systems have eliminated battery-backed-up CMOS RAM for storing system setup information in favor of flash memory. With flash memory, there is no danger that the setup will be lost if the battery dies, and in both companies' PCs, the system BIOS is also stored in flash memory so that you can update it.

Save Power, Save Money

At its office in Munich, Germany, Intel has a guard, who, after hours, twice makes his way into every office and turns off unused PCs. Systems that must remain on (e.g., file servers or computers used for remote log-in) sport a prominent sticker—available from supervisors alone—that tell the guard to keep his distance.

Sound excessive? Expensive? When it comes to paying for power, Intel is like any other company that faces rising utility bills owing to the proliferation of computers and related equipment. Intel has found that the cost savings in power that this practice achieves have more than paid the guard's salary.

Studies on the energy required to run your business have been available for years. Items broken down have typically included things like manufacturing, air conditioning, and lighting. But until recently, studies have relegated the rising costs of computer equipment, as well as the extra cooling of office spaces using it, into the category of "Miscellaneous" or "Other." Steve Blanc, R&D program manager for Pacific Gas and Electric (San Francisco, CA), said, "This is the biggest unregulated load in any building. This load, particularly PCs, has increased on an order of magnitude."

According to nameplate-rating estimates by BR Associates of the power used by electronic office equipment in the Pacific Northwest, PCs alone accounted for 12 percent of the total. This figure does not take into account the increased expansion capabilities per PC since the 1986 study was done. Hard drives are bigger, CRTs use more power, and many networks have downsized to raise the percentage of power you can attribute to PC use. It can no longer be ignored. One San Francisco–based company, for instance, saved nothing after paying big for sophisticated control mechanisms designed to lower the company's energy costs a fat 20 percent. The culprit: the simultaneous rise of the number of PCs purchased and unaccounted for along the way.

Typical Per-Office Drain

Jeff Harris, a staff scientist for Lawrence Berkeley Labs (Berkeley, CA) explained a typical power scenario using the example of his own temporary work area at the U.S. Department of Energy. His PS/2 with a VGA monitor and expansion cards consumes 150 watts, and his laser printer uses about 250 W on average. He estimated power consumption at nearly 1½ W per square foot of office space. Lighting, the known factor in interpreting utility bills, has traditionally required the same wattage.

An added cost of running computer equipment, the cooling of work areas ranging from one-person offices to big data centers, must also be addressed. Citibank tackled this issue head-on in a Wall Street building it uses primarily for nighttime order entry and cash management. In this facility, the company optimized its

You Can Look

And you'll want to take a look at NANAO's newest monitors. All day. Every day. Because these NANAO monitors deliver the highest *flicker-free* resolution in their class and conform to the strict new Swedish MPR II requirements. Some even meet the TCO guidelines, the world's toughest VLF and ELF emission standards. You'll also find that each monitor has NANAO's *intelligent* front control panel.

Designed for computer graphics professionals, the award-winning FLEXSCAN **T-Series** features Trinitron CRTs, providing the sharpest contrast and brightest images in the industry. Low distortion and a wider display

1991 BYTE AWARD OF DISTINCTION applies to T560i monitor.

Circle 131 on Inquiry Card (RESELLERS: 132).

HVAC (heating, ventilation, and air conditioning) system, since turning off the mainframe and the many busy workstations wasn't an option. The result: 10 percent fewer kilowatt-hours. A figure like this translates into thousands of dollars annually.

Frequently, however, companies must cut back on energy devoted to cooling simply because of the number of PCs running—they literally don't have enough power coming into the building to run all the computers and the air conditioning at the same time. As a result, these companies chill offices overnight when the PCs are off and let them warm up gradually throughout the workday.

Energy Efficiency in the Desktop

It has taken portable technology to show us how much savings in energy can eventually be achieved in desktops (see the figure). The need for portable computers to conserve energy has driven the development of LCDs, low-power storage devices, and 3.3-volt components. "I would be surprised if anyone is designing 5-V systems by the end of 1994," said Jim Reinhardt, manager of marketing and applications for Motorola's 68000 processor line. (Part of his reasoning is that the new 0.5-micron technology can only operate at voltages lower than 5 V.) A 3.3-V design not only reduces power requirements, but it also cuts down on the heat a system produces. This eliminates the need for a cooling fan and helps relieve the strain on air-conditioning systems.

Another portable feature that is migrating to the desktop is power management. The computer center at Lawrence Berkeley Labs notified other departments that for $50 per year, it would back up all data on their Macs' hard disks every night provided the users left the machines running. But when Harris calculated how much power a department of Macs expended overnight, he found it exceeded the price they were paying for the backups. "The answer wasn't that we shouldn't back up our data," Harris explained. "What these machines needed was a sleep mode—to sleep until they did the backup, then to go back to sleep."

The Environmental Protection Agency's Global Change division has already signed agreements with several computer makers to affix an "Energy Star" logo to identify desktop systems incorporating a sleep-mode capability. Sleep mode in some form should be a part of any design for low-power desktop systems. And so should a phase-out of CRTs in favor of some variety of flat-panel displays. But beyond that, said Reinhardt, there are no standards on what would constitute a low-power system.

How much power can portable technology save on the desktop? Assume that you have a desktop PC (with a 386 processor, a color VGA, a 3½-inch floppy drive, and a 40-MB hard drive) that gets 3100 hours of use a year. Of the 3100 hours, 600 are active and 2500 are standby—the PC is on but not being used. This PC takes up 150 W, or 465 kWh a year. If you can incorporate portable-PC-like sleep-mode capability into a standard desktop machine (same configuration in high-power parts), you can bring the power consumption down to 153 kWh for a 67 percent savings per PC on your electric bill. In contrast, a similarly equipped laptop with an active-matrix color screen would use a mere 31 kWh per year.

Monitoring Monitors

Screen savers may do wonders for the phosphors in your monitor, but they do nothing for your electric bill. "The only point of keeping on a monitor is for someone to look at it," said Harris.

continued

At Us All Day.

F750i

F550i

area make the *flat-square* FLEXSCAN **F-Series** the ideal monitors for those seeking an ideal Graphical User Interface and Desktop Publishing environment. For uncompromising quality at an affordable price, the FLEXSCAN **S-Series** is your choice. And every NANAO monitor comes with a relentless attention to detail.

Whether you work in front of a 14" or 21" monitor, for two hours or twelve, you'll appreciate the performance and ergonomics of NANAO monitors.

Take a look at your nearest NANAO dealer today, or for more information call NANAO.

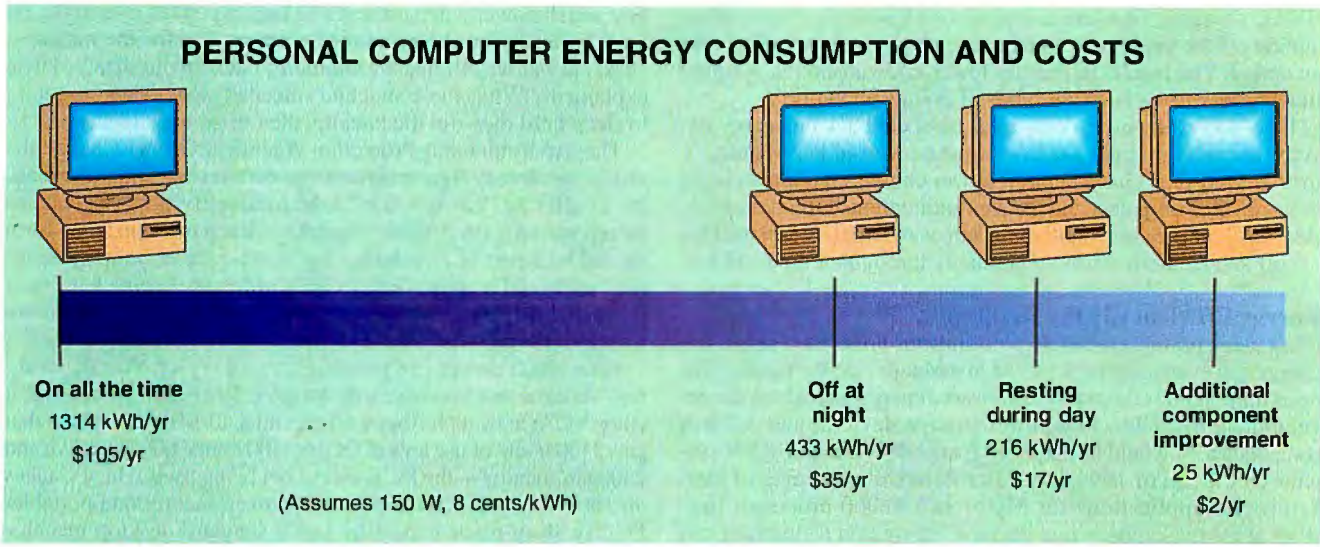
NANAO

1-800-800-5202

1-310-325-5202 (CA)

Fax: 1-310-530-1679

Trinitron, Windows and FLEXSCAN are trademarks of their respective companies.



The practice of leaving a personal computer running around the clock may have some marginal benefit for the system components, but it wreaks havoc on your electric bill. In large installations, energy costs could easily run thousands of dollars a year. Smart use of personal computers and the implementation of low-power components promise to dramatically lower energy requirements. (Data courtesy of EPA Energy Star Computers)

Some monitor vendors, mainly in response to government pressure in Europe and Asia, have introduced energy-saving monitors. Eizo, the Japanese monitor manufacturer known in the U.S. as Nanao, is leading the way. Its first energy-saving monitor, the F340i, is designed to power itself down when the PC doesn't transmit a signal. So, if you turn the system box off and forget to turn off the monitor, the monitor automatically switches off once it senses that the PC isn't sending a signal.

The F340i was launched last fall. Eizo is already working on a more sophisticated second-generation monitor that can recognize when a screen saver is active, so it can power itself down, too. Since Eizo develops video cards as well as monitors, it would not be difficult to develop a card/monitor pair that, through the use of a software driver, exhibited this property. But Eizo is looking for a more general solution. By using a custom Windows screen driver, Eizo claims it will be able to generate a unique output signal from any video card that the power-saving monitor will recognize. Then when the screen saver kicks in, the signal will be sent, and the monitor will power down, saving the screen and power.

Printing Smarter and Cheaper

The so-called paperless office, even on a relative scale, is another potential energy cost-cutter. "We need to ask, 'Do we really need all the faxing and printing we do?'" said Lawrence Berkeley Labs' Harris. E-mail, the strategic use of LANs for messaging and announcements, can greatly eliminate some of the power draw of these devices. Les Norford, an assistant professor of building technology at MIT's department of architecture, notes a common practice that is also an energy saver: sharing printers (particularly lasers), desktop scanners, and other peripherals.

If you're shopping for a printer, consider that ink-jet printers, while slower than lasers, use much less power—according to a 1990 study by Competitek (a research arm of the Rocky Mountain Institute), 80 percent less in standby energy and 97 percent to 99 percent less in printing energy. What about nonimpact printers already in service? You can dig into the manual for information on setting a quiet or power management mode, which uses less power on standby but takes an extra instant to come up to speed. "Printer companies," said Harris, "told me this feature is always disabled when the unit is sold." If it weren't, they explained, the printer would score poorly on computer magazine tests of the time spent printing a single page.

The Industry Responds

Fortunately, the computer industry has begun to hear what utilities, major users of energy, and researchers are telling them. A major task force comprising the Department of Energy, the EPA, the Electric Power Research Institute, and several utilities met June 17–18 for the first time with representatives of all the big computer makers. "This is the first significant effort to bring together this group with the computer industry," said MIT's Norford. Vendor members include Zenith Data Systems, NCR, Apple, Smith Corona, IBM, HP, Compaq, and DEC. Each of these companies has said it will introduce energy-efficient models within a year.

The coalition's initial goals are to agree on and publicize a list of equipment features that are desirable from an energy standpoint and to come up with a test procedure for equipment purchases that would calculate the lifetime cost of running computers and related equipment. The American Society of Testing and Materials has long had a test for photocopiers' various modes of power usage, and this may serve as a model. Once test procedures become standardized and computer vendors reveal test data in product labeling, it should be far easier to make volume purchases with some confidence of forecasted increases in your company's utility expense.

During periods of peak usage, it is not unusual for a utility to call its biggest users and

Computer Companies with Recycling Programs

- **Apple**
- **Canon**
- **Hewlett-Packard**
- **IBM**
- **Intel**
- **Lexmark International**
- **NEC**

Northgate® ZXP™ 486SX/20 Through 486DX2/66 Systems

DX2/66 Available Now!

Unlimited Upgradability, One Motherboard, Five Intel® Processors and Three Cabinet Styles – 15 Northgate ZXP Systems!

"We recommend the upgradable ZXP without reservation... Best Buy"
PC World, August 1992

"The pride of the system, the ZIF socket, should stand as an example to anybody who wants to manufacture an upgradable system. The Northgate ZXP is our favorite upgradable – by a large margin!"
Computer Shopper, August 1992

Here's Just One Power-Packed ZXP System!

- Intel 80486DX/33 MHz processor
- 4MB of RAM; expands to 32MB
- 240MB hard drive
- 1.2MB and 1.44MB floppy disk drives
- 1024 x 768 color monitor with 1 MB video card
- Space-saving desktop case
- *OmniKey*® keyboard
- MS-DOS® 5.0 and QBasic
- Microsoft® Windows™ 3.1 and mouse
- Award-winning Northgate service and support
- 30-day money back guarantee

Only $2719

Lease as low as $92.99/month*

Other ZXP Systems Configured As Shown:

486SX/20 . . . . . .$2469
Lease as low as $84.44/month*

486SX/25 . . . . . .$2519
Lease as low as $86.15/month*

486DX2/50 . . . . . .$2919
Lease as low as $99.83/month*

Microsoft® Windows™ Ready-to-Run

intel inside

Call for complete custom configuration information.

800-345-8709

Major corporations, volume purchasers and government agencies call National Business Accounts: 800-545-6059
GSA# GS00K91AGS5193 PS01

Charge it to your VISA, MasterCard, Discover, American Express or Northgate Big 'N' Card.

NORTHGATE COMPUTER SYSTEMS, INC.

"When it has to work right"™

© Copyright Northgate Computer Systems, Inc. 1992 All rights reserved. Northgate, Elegance, ZXP and the Northgate 'N' logo are U.S. trademarks or registered U.S. trademarks of Northgate Computer Systems. 80486DX and 80486 are U.S. trademarks of Intel. MS-DOS, Windows and Microsoft are U.S. trademarks or registered U.S. trademarks of Microsoft Corporation. All other products and brand names are U.S. trademarks and registered U.S. trademarks of their respective companies. Prices and specifications subject to change without notice. Prices shown do not include shipping/handling charges and appropriate sales taxes. Northgate reserves the right to substitute components of equal or greater quality or performance. All items subject to availability. We support the ethical use of software. To report software copyright violations, call the Software Publishers Association's Anti-Piracy Hotline at 1-800-388-PIRB. All systems shipped with DingBat™ QA Plus™ software. *Monthly lease payments are based on a 36-month standard fair-market value open-ended lease. 12-60 month leasing options available for qualified businesses.

CODE B4709

Guide to Green Computing Groups, Products, and Services

ORGANIZATIONS

International Cartridge Recycling Association
1101 Connecticut Ave., Suite 700
Washington, DC 20036
(202) 857-1154
fax: (202) 857-1115
Circle 976 on Inquiry Card.

National Office Paper Recycling Project
U.S. Conference of Mayors
1620 Eye St. NW
Washington, DC 20006
(202) 223-3089
fax: (202) 293-2352
Circle 977 on Inquiry Card.

Partnership for Plastics Progress
1275 K St. NW, Suite 400
Washington, DC 20005
(800) 243-5790
(202) 371-5319
fax: (202) 371-5679
Circle 978 on Inquiry Card.

Silicon Valley Toxics Coalition/ Campaign for Responsible Technology
760 North First St.
San Jose, CA 95112
(408) 287-6707
fax: (408) 998-2642
Circle 979 on Inquiry Card.

Solid Waste Information Clearinghouse Hotline
Solid Waste Association of America
P.O. Box 7219
Silver Springs, MD 20910
(800) 677-9424
fax: (301) 585-0297
Circle 980 on Inquiry Card.

ON-LINE SERVICES

BIX
1030 Massachusetts Ave., Fourth Floor
Cambridge, MA 02138
(800) 695-4005
(617) 491-3342
fax: (617) 491-6642
(Offers an environment conference)
Circle 981 on Inquiry Card.

EcoNet
18 De Boom St.
San Francisco, CA 94107
(415) 442-0220
fax: (415) 546-1794
(A service of the Institute for Global Communications)
Circle 982 on Inquiry Card.

PRODUCTS

Kyocera Electronics, Inc.
100 Randolph Rd.
Somerset, NJ 08875
(908) 560-3400
fax: (908) 560-8380
Circle 983 on Inquiry Card.

National Research Council of Canada
Institute for Research in Construction
Montreal Rd., Building M24
Ottawa, Ontario,
Canada K1A OR6
(613) 993-9539
fax: (613) 954-3733
(Make long-term assessments of idle computer-on periods using free DOS or Mac memory-resident software)
Circle 984 on Inquiry Card.

Sequence Electronics
150 Rosamond St.
Carleton Place, Ontario,
Canada K7C 1V2
(613) 257-4773
fax: (613) 257-1840
(SmartBar uses a microprocessor and software in your PC to shut off power individually to each of six sockets depending on time of day or user-specified periods of keyboard inactivity)
Circle 985 on Inquiry Card.

The Complete Portable
505 Shawn Lane
Prospect Heights, IL 60070
(800) 328-4827, ext. 3317
fax: (708) 577-6551
Circle 986 on Inquiry Card.

Video Display Corp.
1868 Tucker Industrial Dr.
Tucker, GA 30084
(800) 241-5005
(404) 938-2080
fax: (404) 493-3903
Circle 987 on Inquiry Card.

ask them to see if they can shut down any unused equipment to avoid possible brownouts. HVAC systems at these companies are usually already automated. Lighting fixtures, an easy target for energy savings, have often been retrofitted throughout a company's facilities. What's left? The equipment that people use to keep their businesses alive: computers, which until recently were lumped under the "Other" category. "We need to break out of that 'Other' category," said Harris.

Ethics or Edge?

Is "environmental sensitivity" merely this year's marketing catchphrase? Or do the programs outlined above represent a real shift in the computer industry toward protecting the earth? The answer is somewhere in the middle.

Many of the companies whose programs now lead the way in green computing have long had public commitments to environmentalism. Other companies are merely jumping on the bandwagon because it is advantageous from a financial or marketing standpoint. But whatever the motives, the small changes in expectations and practices that these companies are now instigating could eventually add up to big economic savings. ■

Andy Reinhardt is BYTE's West Coast bureau chief. Ed Perratore is a BYTE news editor in New York. Andy Redfern is BYTE's U.K./Europe bureau chief based in London. Rich Malloy is an executive editor for BYTE in New York. You can reach them on BIX as "areinhardt," "eperratore," "aredfern," and "rmalloy," respectively.

FEATURE

The Outlook for Pen Computing

Pen-based computing struggles with its problems but looks to a bright future

NICHOLAS BARAN

Jimmy Cliff's hit from the 1970s, "Many Rivers to Cross," could well be the theme song of pen-based computing. Despite early systems such as the GridPad, the pen-based industry first received major attention in January 1991: Go Corp. announced its PenPoint operating system, and Microsoft acknowledged Windows for Pen Computing. Although it's received a great deal of hype over the past year and a half, pen-based computing must overcome major technical and market challenges before it lives up to the expectations of potential users.

Both PenPoint and Windows for Pen Computing began shipping in April. The first pen-based systems that support these interfaces are too heavy, too expensive, and too hard to read. Also, they run at best for 3 hours on batteries. (See "Rough Gems: First Pen Systems Show Promise, Lack Refinement," April BYTE.) On the software side, most applications are still in the beta stage, and handwriting recognition is only marginally acceptable.

Nevertheless, pen-based computing represents the most exciting and promising area of computing to come along since the desktop personal computer. Desktop computers have reached a degree of maturity in which most new development represents refinements to the existing technology. Pen-based computers, on the other hand, represent an arena ripe for major technical breakthroughs.

The High Road and the Low Road

The young pen-based computing market can be divided into two categories: the high end and the low end. On the low end, DOS-based systems using the 8086 or NEC V20 architecture prevail. The most popular of these systems is the GridPad from Grid Systems (Fremont, CA), which was one of the first companies to enter the pen-based computer market. Grid offers an interface layer called PenWrite and a set of development tools called PenRight for developing forms-based applications running on DOS. Fujitsu Personal Systems (Santa Clara, CA), formerly Poqet Computer, has introduced a V20-based system, called the PoqetPad, which supports Grid's PenRight development environment.

The driving concept behind machines like the GridPad and the PoqetPad is to provide a no-frills system for data entry and retrieval using custom forms—no GUI, no multitasking, but enough power to run a basic forms-based application with limited handwriting recognition. These systems are well designed for that purpose. Grid's recently announced PalmPad straps to your wrist and weighs less than 3 pounds. It has a

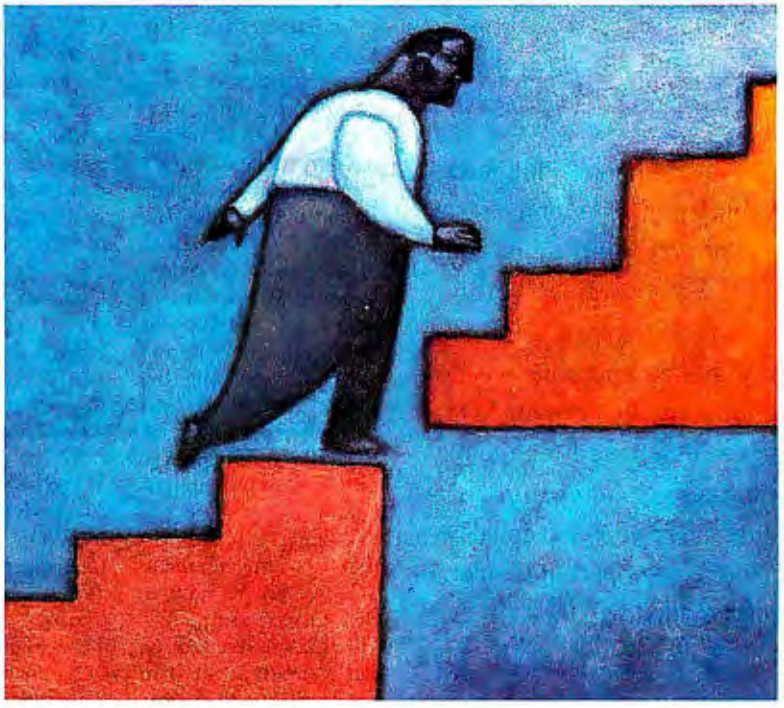


ILLUSTRATION: TED PITTS © 1992

detachable battery pack that you wear on your belt.

This type of system may be all that's required for many pen-based applications, particularly in vertical markets. For example, Detroit Edison recently purchased over 300 GridPads for use in filling out work orders and time cards in the field.

To make things more interesting, GeoWorks (Berkeley, CA) has announced a version of its PC/GEOS graphical operating environment for pen-based systems, called Pen/GEOS. Pen/GEOS is targeted toward 8086- and V20-based systems and provides a GUI. Jeff Hawkins, a former Grid vice president, founded Palm Systems (Menlo Park, CA) to develop handwriting-recognition software and other applications for Pen/GEOS. Pen/GEOS should start appearing on systems like the PoqetPad by early next year.

Tandy (Fort Worth, TX) and Casio Computer (Tokyo, Japan) recently announced that they are jointly developing a family of pen-based "personal information processors." GeoWorks and Palm Computing are providing the operating system and handwriting-recognition software, respectively. Tandy would give no introduction date as of this writing, however.

Hawkins, who developed the handwriting-recognition engine used on the GridPad, says that Pen/GEOS will be "a key part of the palmtop market." He's impressed with the truly object-oriented environment of Pen/GEOS and its ability to support multitasking. Hawkins says he can run several applications simultaneously on an 8088 with 512 KB.

In the near term, systems like the GridPad will be very attractive to users who need to get a basic job done. You can expect to see hand-held devices sporting the Pen/GEOS interface next year, according to Hawkins. Chips & Technologies, a Santa Clara chip vendor, joined GeoWorks at the introduction of Pen/GEOS, promoting its single-chip PC architecture as an ideal match for Pen/GEOS. Chips & Technologies plans to sell this strategy to OEMs.

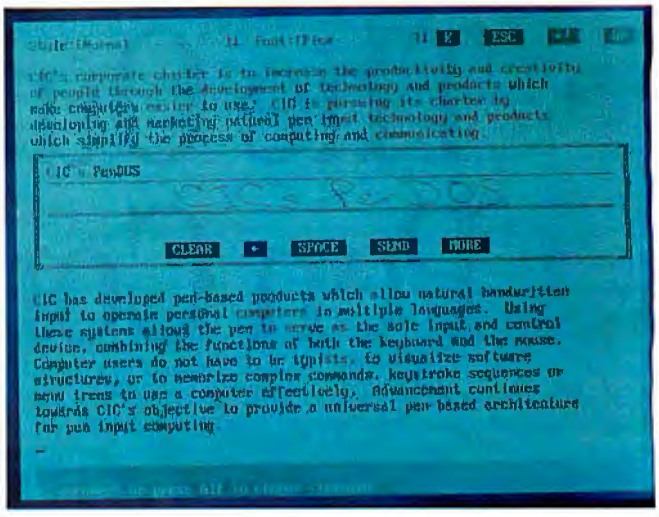
The question remains, however, if the 8086 architecture can hold its own against more powerful processors, such as the processor based on the ARM (Advanced RISC machine), which will appear in Apple's Newton and other hand-held devices (see "The PC Gets More Personal," July BYTE). Considering the processors used, the GridPad and PoqetPad systems are not inexpensive: They cost $2000 to $3000, depending on the configuration. Smaller, more powerful devices will soon be on the market for about half the cost.

BYTE ACTION SUMMARY

Inadequate handwriting recognition, battery life, and display technology keep pen-based computing mired in vertical niches. However, a great deal of research and software development are encouraging signs. Pen-based technology will begin to enter the mainstream next year and could become a major part of the computer market by 1994.

Nevertheless, Grid's president, Bruce Walter, is confident in the success of Grid's DOS strategy. In a recent speech, Walter stated that Grid will support PenPoint and Windows for Pen Computing, but said, "PenWrite has proven to be exactly what the forms-application-based vertical markets want."

Doug Gauthier, information management supervisor for the Human Services Department in Phoenix, Arizona, used PenWrite to develop an application that lets caseworkers record client information. When his project began, Grid was really the only choice. Gauthier was able to do all development on existing 286-based PCs. He has had such good success with PenWrite that he would not consider switching, unless compelling applications were available on other platforms (e.g., Lotus 1-2-3). Gauthier's application consists of 40 on-line forms up to 16 or 17 pages long. The 200-KB executable file "fully utilizes" the GridPad's capabilities, Gauthier said.



Screen 1: *PenDOS is shown in conjunction with a Microsoft Word document. You can use the pen interface provided by PenDOS to edit the document, using handwritten text for insertion or cutting and pasting. PenDOS commands appear in the upper right corner of the screen.*

Fitting somewhere between the low end and the high end is the PenDOS operating environment from Communication Intelligence Corp. (Redwood Shores, CA). It is on the low end in the sense that it runs as a layer on top of DOS. PenDOS is on the high end because it requires a 386 processor (primarily because of CIC's handwriting-recognition engine, which is bundled with PenDOS). According to CIC's marketing engineer Bruce Leong, the main goal of PenDOS is to enable DOS applications to work with a pen-based interface and to take advantage of CIC's handwriting-recognition technology.

PenDOS lets you use a pen and handwriting to execute DOS commands and to run DOS applications. It provides a set of pen gestures for performing operations such as inserting and deleting text and cutting and pasting. These gestures will work with any DOS application that supports a mouse without modification. You simply point with the pen at the upper right corner of the screen to activate the PenDOS interface (see screen 1). CIC provides a software development kit for developers who are using PenDOS. PenDOS is likely to gain some support in the marketplace. It offers a straightforward solution for developing forms-based applications with handwriting recognition on top of DOS.

Windows for Pen Computing and PenPoint

The high end is dominated by Windows for Pen Computing and PenPoint. Both operating environments require 386 systems or higher, a minimum of 4 MB of RAM (Go recommends 8 MB), and at least 20 MB of mass storage, although 40 MB is more realistic. A recent demonstration of PenPoint using an IBM ThinkPad with 20 MB of storage was barely adequate. The system constantly swapped applications from disk. Both systems offer full-featured GUIs with multiple fonts and handwriting

recognition. However, Windows for Pen Computing and PenPoint are very different environments, built from completely different foundations and concepts.

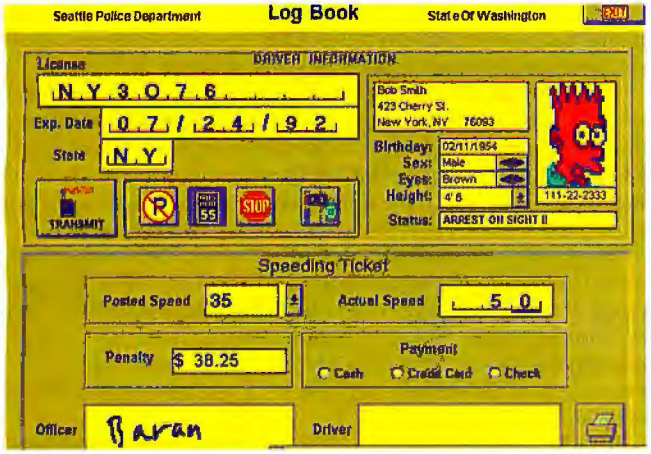
Windows for Pen Computing is simply an extension of the desktop, mouse-based version of Windows. Although it is an extension of a desktop interface, it handles pen input remarkably well (see "Windows Meets the Pen," June BYTE). For Windows users, Windows for Pen Computing offers a familiar interface with the pen replacing the mouse. It offers the added functions of handwriting and drawing with the pen.

In support of Windows for Pen Computing, Microsoft is promoting its Visual Basic programming toolkit as a platform for developing pen-based applications. I've been impressed with some of the initial demonstrations and prototypes of forms-based pen applications developed with Visual Basic. For example, Microsoft has developed a prototype of a traffic accident and citation report form application for police work using Visual Basic (see screen 2). The form lets the officer fill in the details of the accident or traffic violation (e.g., license numbers, speed, or a sketch of the accident scene).

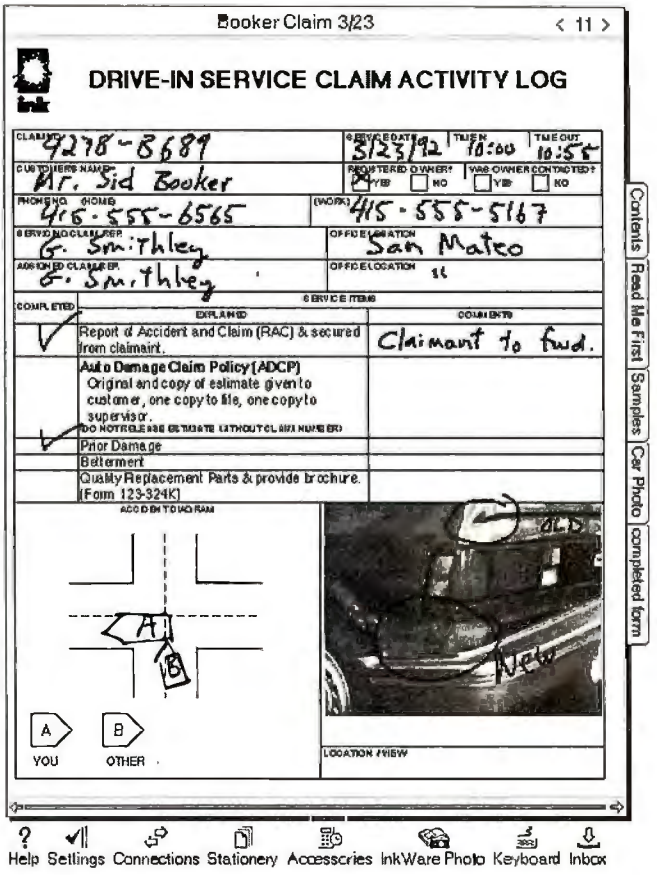
There is little question that Windows for Pen Computing will play a major role in the pen-based market. The sheer numbers of Windows users and applications developers virtually guarantee its success.

PenPoint, on the other hand, faces the formidable challenge of establishing itself as a new operating system and as the one of choice for pen-based computing users. From a technical standpoint, PenPoint has significant advantages over Windows for Pen Computing. I spent a week using both environments on an NCR 3125. As Go claims, PenPoint is a far more intuitive interface for pen computing than is Windows for Pen Computing. With PenPoint, the computer behaves much like a paper notebook (see screen 3). It has tabs on the side. It has page numbers. Each file appears as a document or page in the notebook and is automatically updated and stored.

PenPoint is a multitasking environment, so you can switch from page to page or document to document without thinking about closing files or waiting for applications to load. This lets you interact with the computer in a manner similar to working with a notebook; by tapping on the appropriate tab, the notebook "turns" to the correct page. You can concentrate on the work at hand rather than on details such as saving files.



Screen 2: *A screen from a Windows for Pen Computing prototype application developed using Visual Basic. The traffic accident and citation form lets you enter the details of the accident with the pen.*



Screen 3: *A screen from the Note Taker application running under PenPoint. The right edge of the screen shows the notebook-like tabs. PenPoint looks and behaves much like a paper notebook.*

Another feature that differentiates PenPoint from Windows for Pen Computing, and may be one of its most important advantages, is its automatic networking capability. PenPoint has a built-in version of the TOPS peer-to-peer network called PenTOPS from Sitka (Alameda, CA). Simply by tapping on the Connections icon and specifying that you want to establish a network connection, you can automatically connect to another node, by a wireless connection or by standard AppleTalk cabling. You can automatically detach from the network, and you can "defer" output for later connection to a network.

These features will be of major importance in the pen-based computing environment. For example, deferred output and automatic network connection will be an important feature for mobile workers who return to the home office at the end of the day to download data and to upload data for the next day's work.

But in spite of its technical elegance, PenPoint has a great deal to prove. Although PenPoint may be technically superior, Windows for Pen Computing works surprisingly well and will meet the needs of many pen users. Although it's easier to learn than Windows for Pen Computing, PenPoint still has idiosyncrasies and obscure functions that are not readily obvious. For example, I couldn't figure out how to change the names of the tabs on the side of the notebook page.

Another problem is the lack of PenPoint development tools, other than the Watcom C compiler. Windows for Pen Computing has a big advantage, with tools like Visual Basic and many others that are familiar to the software development community.

continued

But PenPoint development tools are a key priority for Go and will appear in the next year, according to Go's cofounder Robert Carr. In addition, Norm Francis, founder of PenMagic and developer of Numero for PenPoint, pointed out that all operating systems suffer from a lack of development tools in the early going. He added that for a new operating system, PenPoint is remarkably stable and robust.

In the final analysis, PenPoint is an impressive technical accomplishment that is just in its infancy. In the years ahead, PenPoint will appear on other processor architectures and will undergo many refinements and improvements. Although Go will not comment on its plans for porting PenPoint, it points out that PenPoint is written in C and designed to be portable. Reliable sources indicate that PenPoint will appear on AT&T's CRISP (C-machine Reduced Instruction Set Processor). PenPoint is likely to have a bright future.

Handwriting Recognition Must Be 100 Percent

Perhaps the biggest limitation that is common to both Windows for Pen Computing and PenPoint (and to environments such as PenDOS) is the current state of handwriting recognition. Both environments come with handwriting-recognition engines. And it is supposedly possible to substitute other vendors' engines. I've tried Microsoft's, Go's, CIC's, and Momenta's engines, and none of them offer 100 percent accuracy, even after you've trained these systems to better recognize your handwriting.

While it may seem like a harsh requirement, handwriting recognition must be *100 percent accurate* to be successful. It is simply not acceptable to worry about whether the machine recognized your last name correctly or got an *S* and a 5 mixed up. Nor is it acceptable to go back and overwrite an incorrect character, often several times before it gets it right. Users won't put up with it, especially when these systems cost $5000 or more.

The current technology is really aimed at filling in "small things, like names and addresses," according to Hawkins. He added that anybody who expects a computer to recognize a person's notes will be disappointed. Writing tends to get sloppy when people start dealing with sentences, and at that point the recognition engines start having problems. But Hawkins believes that handwriting recognition is not the real issue. He says that people will buy pen-based systems "because of the valuable things you can do with the pen interface."

Perhaps the key to more acceptable handwriting recognition is the development of cursive handwriting-recognition engines. Several companies are working on cursive recognition, including Paragraph International (a Russian firm that has offices in Moscow and Boulder, Colorado), Microsoft, CIC, Nestor (Providence, RI), and AT&T. While Paragraph has demonstrated its cursive recognition system, this technology still has a long way to go before it appears commercially. Both Apple and Microsoft have announced that they are licensing Paragraph's technology. Much of the research involves neural networks and DSPs (digital signal processors), which would require different hardware designs than those currently used on pen systems.

The process of cursive handwriting recognition requires that several complex algorithms be solved simultaneously. This includes so-called "feature extraction" and "segmentation" of various components of the cursive script, application of context-sensitivity to determine heuristically what characters most likely apply to the script, and then coordinating these processes to arrive at the recognized character. Neural networks provide the software intelligence, and DSPs provide the coordination and speed for responsive recognition. AT&T, Intel, and Motorola have been working on neural-network architectures intended for solving complex problems such as cursive handwriting recognition.

Third-Party Software

Most third-party pen-based applications are still under development. Any standard Windows application runs on Windows for Pen Computing but does not offer features designed for pen-based input (e.g., handwriting data-entry fields and check boxes).

There are promising products for both PenPoint and Windows for Pen Computing for forms entry, address book and Day-Timer scheduling, financial and spreadsheet modeling, drawing and note taking, and document reference and retrieval systems. For example, Slate (Scottsdale, AZ) is working on a product called PenBook, with versions for both environments. This product is designed for searching and browsing through large documents (e.g., parts or instruction manuals, dictionaries, or encyclopedias).

In the vertical-software arena, there is tremendous interest from the medical community. For example, Pi Systems is targeting its Infolio pen-based system toward the medical profession. Other vertical markets include insurance and real estate appraisal, delivery systems, building and railroad inspection, and more.

Pen-based computing presents a new arena for software developers and offers the opportunity for innovation that has virtually disappeared from the desktop arena. It's a chance for small companies to score a hit. We can expect to see some powerful and innovative applications in the next two years.

Hardware Is the Key

While the software has some rough edges, the real technical hurdles in pen-based computing are in the hardware. Current machines suffer from two related and serious limitations: limited battery life and inadequate readability. Display readability can be improved by backlighting, but backlighting consumes a lot of power. While hard drives and memory-storage devices are also substantial power consumers, displays represent the most power-hungry components, requiring from 3 to 5 watts.

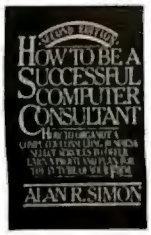
Reflective displays, such as that on the NCR 3125, don't require backlighting. However, they simply don't provide enough contrast to be readable, except with excellent ambient lighting. Some newer LCDs boast a 12-to-1 contrast ratio, but backlit displays provide a minimum of 15 to 1.

Both reflective and backlit displays suffer from extremely limited viewing angles. Pen-based systems that I've seen require head-on viewing. Two people sitting side by side have difficulty with both seeing what's displayed on the screen. LCDs on laptops have improved dramatically in the last few years. But pen-based systems face the added complexity of layering a digitizing tablet together with the LCD and providing a ruggedized surface, both of which reduce the contrast of the display.

Scriptel, which manufactures digitizing tablets for pen-based systems, minimizes the problem by binding the digitizer layer directly on the protective glass. Scriptel's technology allows for 88 percent transparency; the digitizer's indium tin oxide coating blocks 3 percent of the light from passing through, while the glass itself blocks 9 percent.

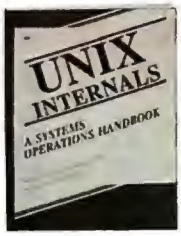
According to David Mentley of Stanford Resources, a San Jose, California, display-technology consulting firm, the next round of LCDs will have better film compensators for improving the viewing angle and will feature more efficient and higher-intensity backlights. However, Mentley foresees no major breakthroughs in backlighting technology: "Lighting has been beaten to death," he says.

If LCDs are stuck with backlighting, the major improvement will have to occur in battery technology. Some promising developments are on the horizon. Zinc-air batteries were shown in a prototype pen-based system at a recent conference. They ran for up to 10 hours. However, no vendor has publicly committed to using zinc-air batteries, which are expected to cost up to four times



9339-XX $32.95
Counts as 2

3679P $22.95
Softcover



2951P $19.95
Softcover

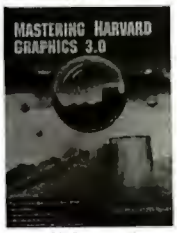
3661P $24.95
Softcover

3922P $16.95
Softcover

062885-XX $44.95
Counts as 2

3943 $29.95

3755 $34.95

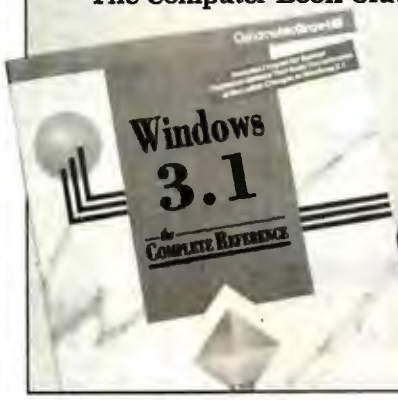


3602P $18.95
Softcover

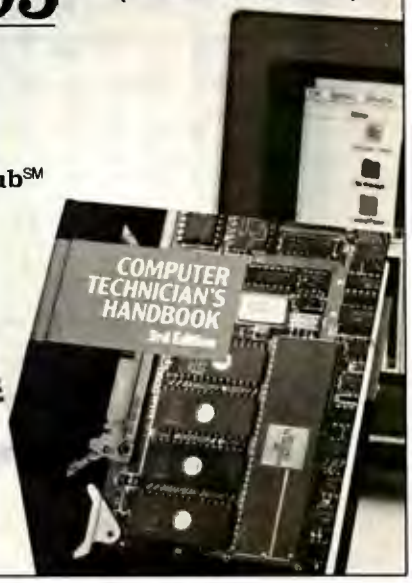
Select any 5 books for only $4.95

(Values to $162.75)

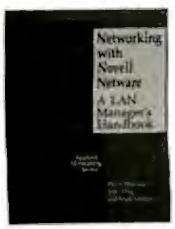
when you join the
The Computer Book ClubSM



881747 $29.95
Softcover



3279-XX $36.95
Counts as 2



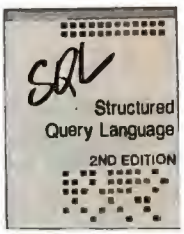
3283P $19.95
Softcover

3490P $19.95
Softcover

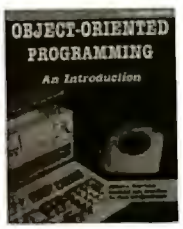
053614-XX $52.95
Counts as 2

881693 $29.95
Softcover

9309P-XX $29.95
Counts as 2/Softcover



3803 $32.95

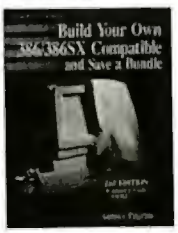


881682 $24.95
Softcover

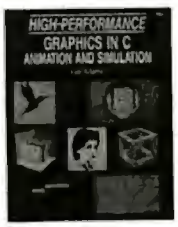
881700-XX $29.95
Counts as 2/Softcover

3875P $24.95
Softcover

029662 $24.95



4089 $29.95



3049P $27.95
Softcover

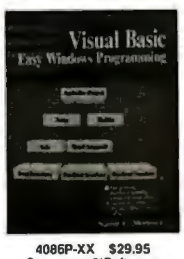
3744 $34.95

881654-XX $29.95
Counts as 2/Softcover

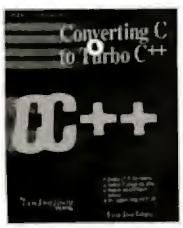
Special Book/Disk Offer

3382P $29.95
Softcover

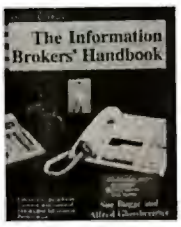
3916-XX $36.95
Counts as 2



4086P-XX $29.95
Counts as 2/Softcover



4084-XX $39.95
Counts as 2



4104 $39.95
Counts as 2

er Book Club . . .

. . . you'll en receiving Club bulletins every 3-4 containing e ing offers on the latest books in tl at savings of to 50% off of regular publishers' ices. f you want t Main Selection do nothing and it will be shipped aute atically. If you want another book, or no book at all, si nply return the reply form to us by the date specified. Yo 'll have at least 10 days to decide, and if you ever receive a boc you do t want, due to late mail delivery of the Bulletin. you can return it at our expense. Your only obligation is to purchase 3 more books during the next 2 years, after which you may cancel your membership at any time. BY992

All books are hardcover unless otherwise noted. Publishers' prices shown. A shipping/handling charge and sales tax will be added to all orders. If you select a book that counts as 2 choices, write the book number in one box and XX in the

If card is missing, write to:
ok Club, Blue Ridge Summit, PA 1729

Circle 145 on Inquiry Card.

Use PCTEX Typesetting Software

Name	Definition
Gamma	$\Gamma(z) = \int_0^\infty t^{z-1} e^{-t}\,dt$
Sine	$\sin(x) = \frac{1}{2i}(e^{ix} - e^{-ix})$
Error	$\operatorname{erf}(z) = \frac{2}{\sqrt{\pi}} \int_0^z e^{-z^2}\,dz$
Bessel	$J_0(z) = \frac{1}{\pi} \int_0^\pi \cos(z \sin\theta)\,d\theta$
Zeta	$\zeta(s) = \sum_{k=1}^{\infty} k^{-s} \quad (\Re s > 1)$

To Make Your Books, Manuals, Articles, & Math Formulas Look Their Best!

For professional publishing and the power to produce high-quality books, technical documents, mathematical formulas, and tables, rely on PCTEX to make your work look its best.

PC TEX provides a full-function TEX formatting system for including mathematical formulas in books, journals, and other documents.

The next step beyond standard desktop publishing, PCTEX is the difference between average and expert. And with our PC TEX Systems, you get everything you need in one package, with no extra costs.

The ***PC TEX System for Laser Printers*** includes:

- PC TEX and PC TEX/386
- Our screen previewer, PTI View
- HP LaserJet, PostScript, and DeskJet printer drivers
- AMS-TEX and LATEX Macro Packages
- The *PC TEX Manual* and *LATEX for Everyone*
- Free Technical Support

Call for our free catalog and demo disk!

PERSONAL TEX INC
12 Madrona Street
Mill Valley, California 94941
(415) 388-8853; Fax: (415) 388-8865

PCTEX is a registered trademark of Personal TEX, Inc. TEX is a TM of the American Mathematical Society. Site licenses available. Inquire about PTI distributorships. This ad was typeset using PCTEX, Computer Modern, and Bitstream fonts.

as much as nickel-cadmium batteries (see "Zinc-Air Batteries: Long May You Run," May BYTE, page 28).

Another component on current pen-based systems that contributes to higher power consumption, size, and weight is the hard drive. The 1.8-inch hard drives consume between 1 and 1.5 W of power during read/write operations. Hewlett-Packard's 1.3-inch Kittyhawk hard drive requires between 1.5 and 1.7 W. Flash-memory devices such as SunDisk's (Santa Clara, CA) SDI series have many advantages over hard drives, except that they cost about 10 times as much. Flash-memory devices are much more durable (500 gs of operating shock versus about 100 gs for the Kittyhawk), weigh less, and fit in a narrower space.

Flash-memory devices, however, cost about five times more per megabyte than the 1.8-inch hard drives and require at least 5 volts to operate. Small computing devices are moving toward 3.3-V designs to minimize power requirements.

Because of its convenience and durability, flash-memory storage will eventually be the choice for mass storage for pen-based systems. Prices must come down first. Intel has announced that it will offer a 20-MB flash card for about $600 in quantity pricing. This represents a drop of about $20 in cost per megabyte for flash memory.

Intel recently announced a 3.3-V version of its 386SL processor. This chip has what Intel calls a FlexibleVoltage feature, which allows system designers to build computers without reengineering their existing power management strategies. This low-power CPU, along with others from companies such as AMD, represent one more step toward reasonable battery life on pen-based systems.

The Crystal Ball

What people want in a pen-based system, says Hawkins, "is a very powerful device that weighs under a pound and costs under $500." Clearly, pen-based computing technology has a long way to go to meet that goal. Consider the evolution of the PC from 1982 to 1992—how much machines improved, and the relentless downward progression of the price/performance curve. A similar pattern of evolution is foreseeable with pen-based computing technology. By next year, you will see improved displays and batteries and considerably less expensive flash-memory devices. This trend will be more dramatic by 1994.

In 1993, you will also see more hand-held pen systems (e.g., Apple's Newton). Coupled with these new devices, you will see new processor architectures emerge in the pen market. Newton will use the ARM processor. AT&T's CRISP is expected to appear in pen-based systems from a company called Eo Computer (largely staffed by former Go engineers). PenPoint is likely to appear on the CRISP platform as the main operating system.

In conjunction with these developments, you can expect major advances in wireless networking. The FCC is expected to provide a dedicated frequency band for spread-spectrum wireless networks within the next two years, thus opening up the possibility for true wireless networking using pen-based systems (see "Wireless Networking," April BYTE).

Overall, the future looks bright for pen-based computing. But, as with the early days of the PC, users and customers will have to be patient. In the initial phases, only "early adopters" like large corporate accounts with specific problems to solve will buy pen-based systems. By 1994, you can expect pen-based systems to be affordable enough and to work well enough that the market will open up and start to take on the dimensions of the PC market. ■

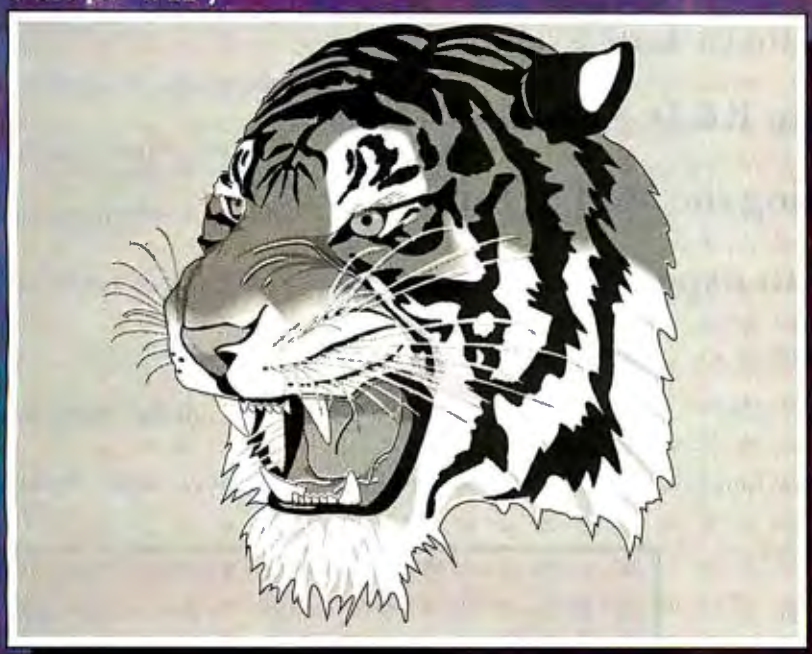
Nicholas Baran is a consulting editor for BYTE and coeditor of Pen-Based Computing *(Sandpoint, ID). He can be reached on BIX as "nickbaran."*

All the benefits of a laser printer

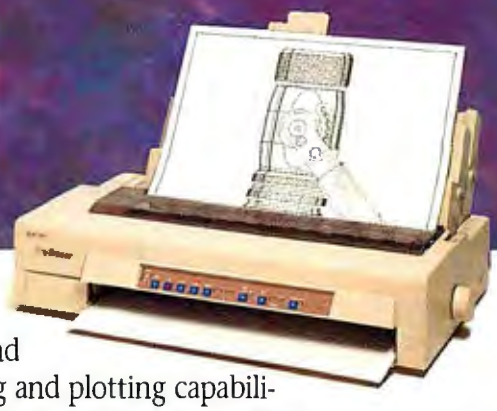
DESKTOP CONVENIENCE
RELIABILITY
LOW COST
SHARP, HIGH QUALITY OUTPUT
FAST PRINTING SPEED
PLAIN PAPER

A-size (8.5" x 11")

C-size (17" x 22")



On a much larger scale.



At last. A personal output device that combines the best features of a desktop laser printer with the ability to produce large format drawings. It's called ProTracer™ — a 360 dpi desktop printer/plotter that produces A, B, as well as C-size output.

FEATURES INCLUDE:

- High performance inkjet engine from Canon®
- Fast, Intel i960™ processor—drawings that take over one half hour on pen plotters take as little as five minutes on ProTracer!
- Optional HP-GL® and PostScript® language emulations, memory expansion boards, and sheet feeders
- Unsurpassed customer service—60 day money back guarantee of satisfaction, one year warranty, and free lifetime technical support

See us at Seybold, booth #1132

If you'd like to expand your printing and plotting capabilities, call Pacific Data Products at (619) 597-3200 ext. 2112, Fax (619) 552-0889.

PROTRACER BASE UNIT	PROTRACER WITH HP-GL	PROTRACER FULLY CONFIGURED
■ Customized ADI and PADI drivers for AutoCAD users ■ Epson and ProPrinter emulations	■ ProTracer base unit ■ HP-GL emulation card ■ 5 MB memory	■ ProTracer base unit ■ HP-GL emulation card ■ PostScript language emulation card ■ 5 MB memory* ■ Sheet feeder (100 sheet)
$1499	$2249	$2897

PACIFIC DATA PRODUCTS

* If outputting C-size PostScript documents, an 8 MB memory board must be used. Pacific Data Products, Inc., 9125 Rehco Road, San Diego, CA 92121. ProTracer is a trademark of Pacific Data Products, Inc. HP-GL is a registered trademark of Hewlett-Packard Co. i960 is a trademark of Intel Corporation. PostScript is a registered trademark of Adobe Systems, Inc. Canon is a registered trademark of Canon, Inc. PhoenixPage is a registered trademark of Phoenix Technologies Ltd. © 1987, 1988. All other trade names referenced are the trademarks or registered trademarks of the respective manufacturer. Siberian Tiger image provided by Totem Graphics Inc. ProTracer uses the latest in high technology innovation including PeerlessPage™, the advanced Imaging Operating System from Peerless. EUROPEAN OFFICES: England Tel 0800 51 5511, Fax (44) 442 236540; France Tel 05 90 65 09, Fax (33) 1 39 63 31 20; Germany Tel 0130 81 3685; Ireland Tel (353) 61 475609, Fax (353) 61 475608; Switzerland Tel (41) 22 341 26 50, Fax (41) 22 341 06 82; Belgium Tel 078 111292; Netherlands Tel 06 0222065. © 1992 Pacific Data Products, Inc.

THE COMPAQ DESKPRO/i. SO A LIMITED PRICE LEADS

The company most qualified to advance the state of the desktop computer announces four systems that represent a breakthrough in R&D. At prices that won't ruin your P&L. Reflecting the level of thinking and quality that you've come to expect from Compaq.

At Compaq, there's a fundamental belief held by all of us that when you set extraordinary goals, extraordinary people will meet them.

Recently, for example, you made it clear to us that you wanted new PCs, with everything from advanced graphics to audio capability to affordable prices. Our response: the COMPAQ DESKPRO/i Family of PCs. Four new systems loaded with features to enhance productivity.

The built-in COMPAQ QVision 1024 Graphics Controller, for example, allows you to scroll, resize windows and pull down menus up to ten times faster than most popular video graphic subsystems. So quickly, as a matter of fact, you may find your computer waiting for you. Instead of the other way around.

Its unique processor upgrade path ensures that your PC won't be swept into obsolescence.

Simple chip upgradability and a 64-KB cache

*This service is provided by contracted Service Providers and may not be available in certain geographic locations. Contact the Compaq Customer Support Center for further details. © 1992 Compaq Computer Corporation. All Rights Reserved. Printed in the U.S.A. COMPAQ DESKPRO Registered U.S. Patent and Trademark Office. QVision and

MUCH FOR THE IDEA THAT TO LIMITED THINKING.

memory module option provide quantum leaps in performance. Without

Intel 386/25, 386/33, 486SX/25, 486/33 ‹ *QVision accelerated graphics* ‹ *Chip upgradability* ‹ *Integrated business audio* ‹ *4 MB RAM (expandable to 32 MB)* ‹ *Cache memory standard* ‹ *3 ISA expansion slots* ‹ *3 drive bays* ‹ *84-MB to 510-MB hard drive options* ‹ *Multi-level security features* ‹ *Microsoft MS-DOS 5.0 as published by Compaq*

similar outlays of cash.

The fully integrated audio system brings an unprecedented, yet not unfamiliar dimension to mainstream business computing: your voice. The result of a collaboration between Compaq and Microsoft, it allows you, among other things, to actually paste voice messages into spreadsheets and documents. Either as notes to yourself or as voice-mail across your entire network.

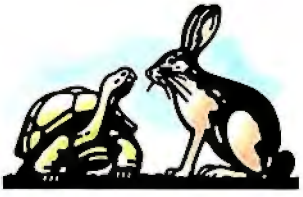
And we've engineered this breadth of technology right onto the PC's system board, preserving the small footprint, large storage capacity and expansion of the COMPAQ DESKPRO/i.

Not to mention your financial integrity.

Add CompaqCare, a new service and support program with our free, one-year, on-site* limited warranty. An Asset Management Provision that gives you and your network administrator a snapshot of your PC's configuration. And you have nothing short of a system that breaks a lot of new ground. Without breaking the bank.

For more detailed information, just call us at 1-800-345-1518, ext. 210 in the U.S., or call us at 1-800-263-5868, ext. 210 in Canada.

We bet you'll be as excited about the COMPAQ DESKPRO/i as we are.



In scrolling, window resizing and accessing menus, our new QVision accelerated graphics beat the competition by as much as 10 to 1.

You can paste voice messages into Microsoft Windows 3.1 business documents and spreadsheets with our integrated business audio system.

intel inside

COMPAQ

CompaqCare are trademarks of Compaq Computer Corporation. Product names mentioned herein may be trademarks and/or registered trademarks of their respective companies. The Intel Inside logo is a trademark of Intel Corporation.

Circle 577 on Inquiry Card.

ILLUSTRATION: KEN COFFELT © 1992

PHOTONICS: REVOLUTION OR EVOLUTION?

Processing with light is poised to live up to its potential to help you compute faster and better

JACK WEBER

Revolutions never happen overnight—unless you're not expecting them. The wind of change that's now blowing through the silicon corridors and magnetic hallways of computing is bringing with it a profound shift in the ways people will process, store, and transmit data. Optical technologies are infiltrating what was once the exclusive preserve of electronics, introducing not just new devices or different data structures but a fundamental change in the physical fabric of information.

No one is suggesting that electronics will disappear or that its own evolution and growth are about to end. But optical and optoelectronic technologies will certainly rewrite the ground rules of the computing game.

Already we've seen the inexorable growth of optical storage. CD-ROM and WORM drives are commonplace and are being joined by new technologies, such as magneto-optical and phase-change drives. And optical techniques based on lasers and LEDs have virtually reshaped the printer market.

More significant than these new technologies is the rise of networking and remote access. Data communications through the telephone network could never have developed without the high bandwidth and low error rate provided by optical fibers. Optical LANs and WANs (wide-area networks) are bringing fiber to users' desks, and, for the first time, optical connections are starting to appear in individual computers.

The one area that hasn't yet succumbed to the revolution is the very heart of computing: the processing logic that manipulates data, and the memory that holds it ready for use. But even these are poised for change. OEICs, or optoelectronic ICs (see the glossary "Unbending Lightwave Terminology" on page 171), which combine both technologies, are starting to find their way into commercial machines while, in laboratories around the world, experimental all-optical processors and memories offer a glimpse of the future (see photo 1).

A research team headed by scientists at Conductus, Inc. (Sunnyvale, CA), is attempting to integrate optical technologies into a prototype computer designed to eventually bring supercomputing performance to desktop machines. This development will combine photonics with cooled semiconductor and advanced superconductor technologies to achieve performance said to be orders of magnitude greater than that of personal computers and workstations being used today.

The team that will develop the machine is composed of scientists from TRW Space Technology Group (Redondo Beach, CA), the University of California–Berkeley, NIST (National Institute of Standards and Technology) (Boulder, CO), Hewlett-Packard Research Division (Palo Alto, CA), and Stanford University (Palo Alto, CA).

It would be easy to perceive optical technology as a threat to silicon's status quo or as a panacea for all its problems. It is neither. The attraction is that it addresses precisely those problems that are emerging as limits in the electronic domain—problems like pin congestion on ICs, the tangle of tracks on printed circuit boards, signal skew, cross talk, pulse degradation, and electron tunneling. The list goes on and on, but all these problems—and their solutions—arise from a few fundamental properties of electricity and light.

Let There Be Light

Electronics is a technology that manipulates the flow of electrons. Photonics, a technology that is its optical equivalent,

Photonics: Revolution or Evolution?
BY JACK WEBER
168

Parallel Optical Memories
BY DEMETRI PSALTIS
179

Light Switches
BY MOHAMMED N. ISLAM
183

Is What You See What You Get?
BY DAVID CASASENT
189

Resource Guide: OPTICAL PRODUCT SAMPLER
195

Photo 1: *Polymer memory cubes such as these prototypes developed by UCI's Peter Rentzepis are capable of storing information in three dimensions. Data can be written and read in thousandths of a second by two laser beams. (Photo courtesy of University of California–Irvine)*

manipulates photons. The differences are simple but profound: Electrons have mass and an electric charge; photons have no mass and no charge—they are simply packets, or quanta, of electromagnetic energy.

As a result, electrons interact with each other through capacitive and inductive effects; photons do not interact at all. In addition, mobile electrons require energy proportional to the distance they travel—it's the cost of carrying an electric field around. Photons have no such baggage; they can travel across the universe with no more energy than they set out with.

The consequences for computing are that electrons are more easily controlled but slower and less efficient than photons. Their interactions produce cross talk between adjacent signal paths. Photons, on the other hand, can travel freely through open space, crossing other light beams with no effect. Because they have no mass, they can reach the maximum speed allowed by nature: the speed of light.

One of the most important measures of potential computing power is the energy required to transmit a bit of information. In this respect, light is efficient, but it requires more complex technology that is less developed than that of the electronic domain.

Those are the trade-offs, but electrons and photons also have something in common: They are both quantum phenomena. This means that if you look at them one way, they'll behave like particles, but if you look at them another way, they'll appear as waves. In electronics, this wave-particle duality can be ignored most of the time. Photonics, however, demands that engineers grasp and deal with quantum mechanics, because understanding and using the physics are central to many of the devices and systems of optical computing. The challenge is to fabricate the technology.

As in electronics, the devices required for optical processing must be capable of generating and detecting bits of information, transmitting them from one point to another, performing logical operations, and storing and retrieving data. The first and obvious requirement is a light generator, usually a laser or an LED. In these devices, as electrons pass through a semiconductor junction, they acquire sufficient energy to jump to an excited energy level. This is an unstable state for electrons, so they quickly jettison their extra energy in the form of photons and return to their stable ground state. In an LED, this process happens randomly. In a laser, the electrons fall back in step, and the light they produce is coherent (i.e., in a state in which all the photons have the same phase).

Solid-state lasers are relatively efficient and capable of switching at tens of gigahertz, which makes them a mainstay of high-bandwidth communications and processing. Until recently, the problems were their large physical size and their restricted range of wavelengths. Not anymore.

In 1989, Bellcore researchers produced the first microlasers, some of which measured only 1 micron across. Although the power of each laser is low, millions of lasers can be packed tightly together. Most important, they emit light perpendicular to the chip surface, a factor that will be essential for transmitting data directly from an IC.

The other problem diminished in 1991, when researchers from 3M Corporate Research Center (St. Paul, MN) broke the wavelength record and developed solid-state zinc selenide lasers emitting blue and blue-green light at wavelengths as short as 490 nanometers. Being able to produce these shorter wavelengths is important because they can be focused more tightly, allowing higher densities in optical storage and better resolution in laser printers.

Recently, scientists from the Defence Research Agency (Malvern, U.K.) made an exciting discovery: photoluminescence and electroluminescence in acid-etched silicon. Normally, only semiconductors like GaAs (gallium arsenide) can emit visible wavelengths, but they're not widely used in computers. So, this discovery of silicon light may be a crucial factor in bringing optoelectronics into the mainstream.

Generally, solid-state generators and photodiode detectors are well-established technologies, but optical processing will require more novel devices. What's needed is the ability to control light with light, just as transistors use one current to control another. But electrons interact with each other; photons don't. Thus, special materials, called *nonlinear optical materials*, are needed to mediate this action.

New Materials and Devices

Ordinary glass is linear because its optical properties are independent of the light level. Photochromic glass (e.g., that used in eyeglasses that darken in bright sunlight) is nonlinear, however: Light alters the glass's optical properties. A great many substances exhibit various nonlinear effects (e.g., as the light intensity changes, they alter their color, refractive index, opacity, or polarization), and new types of these materials are being developed all the time. Scientists have high hopes that people will eventually be able to use some newly developed devices and materials, such as lithium niobate and S-SEEDs (symmetric self-electro-optic effect devices), as processing elements for optical computers (see the figure).

One of the most important nonlinear effects is photorefraction. In a photorefractive substance, light intensity alters the speed at which light travels through the material. Differences in the speed at which light travels are what cause refraction. It is possible that these materials may one day be used to steer light beams or to work as optical switches (see photo 2).

Some photorefractive materials change their refractive index rapidly in response to variations in light level. Others will hold the refractive changes for some time after

BYTE ACTION SUMMARY

Optical technologies already have had a profound effect on digital communications, data storage, and printing. One day, the computers you use will contain optical memories, optical interconnections, and even optoelectronic processors.

If you're looking for a notebook computer that's easy to use, there are basically only two ways you can go.

The hard way.

New programs, $506 each. *Unless you buy programs specifically designed for Windows 3.1, you'll have to use conventional character-based programs and their awkward commands.*

Extra memory, $210. *Most notebook computers in use today simply aren't fast enough to make Windows 3.1 practical. And many that are fast enough may require extra memory, which can add hundreds of dollars to their price tags.*

Clip-on trackball, $172. *If you're going to try to use Windows 3.1 on many portable computers, you may have to plug this in and clip it onto the side of your computer. (Be careful not to catch the cord in your airplane tray.)*

Fax/data modem, $142. *The ability to communicate on the road is what makes a notebook PC really valuable. So you'll have to pack one of these. Once you get back to the office, be prepared to shell out another $138 to update the files on your desktop PC, and over $500 just to access network file servers and printers.*

Added weight. *Many notebook computers may claim to weigh less than 7 pounds, but by the time you add all the components you need to make Windows 3.1 work well, you're likely to find yourself with an additional 4 or 5 pounds to lug around.*

Your time, name your price. *Fiddling around with MS-DOS or Windows 3.1 on the road can cost you plenty of time. How much is yours worth?*

Ordinary notebook, $2,497. *The typical notebook computer of today was designed to run DOS only, not Windows 3.1. It doesn't have enough memory, speed or screen brightness, and its screen isn't fast enough for high-quality graphical computing.*

The coach seat factor. *If you want to run Windows 3.1 on most portable computers, you'll find that you need a front-mounted keyboard and a side-mounted trackball or mouse. What you won't find is enough room on an airplane tray to hold it all.*

Comfort *is something most notebook computer ads never talk about. Because, truth is, they're not very comfortable to use. Which may explain why they don't win awards for being well designed. (PowerBook, of course, has won more design awards than all other notebook computers combined.)*

Instruction manual, 2 pounds. *There's nothing like forgetting a DOS command when you're 2,000 miles from home, so you may want to carry a manual with you. And since Windows 3.1 is based on DOS, you'll definitely want instructions handy.*

The Apple® Macintosh® PowerBook™ is the only personal computer to make the Products of the Year lists of *Business Week*, *Fortune*® and *InfoWorld*. And the only notebook computer to be named one of the Best Designed Products of the Year by *Time*®. Because it's the only computer designed as

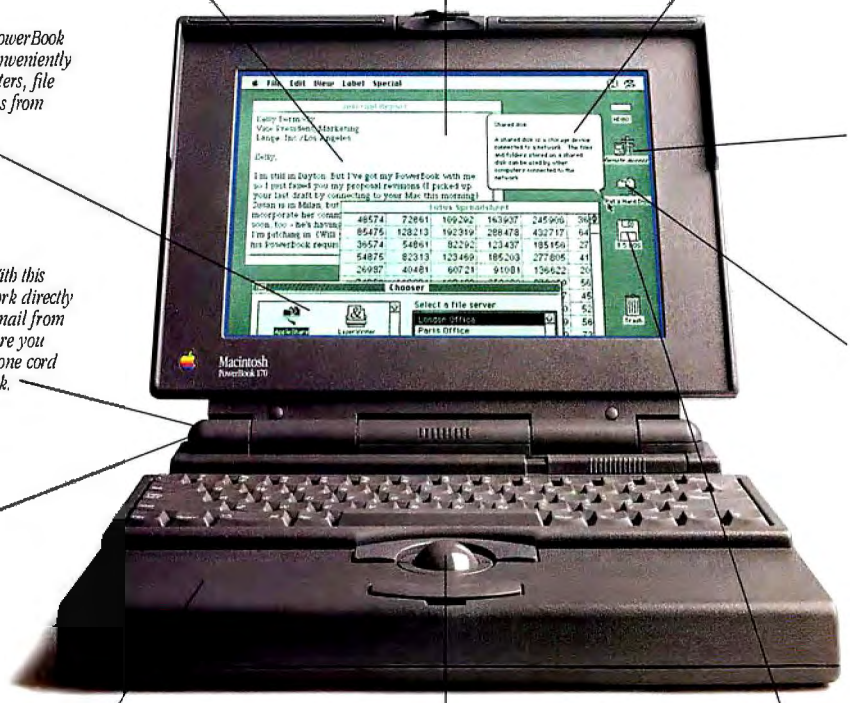
The easy way.

Consistent applications. *Every PowerBook runs thousands of Macintosh programs (including Lotus 1-2-3 and WordPerfect) that all work in the same consistent, intuitive way. You learn one, you know the basics of all of them.*

Blistering speed. *Because Macintosh computers are optimized for graphical computing, PowerBook can significantly outperform comparably priced notebook computers running Windows.** Both the PowerBook 170 and the new PowerBook 145 deliver an impressive combination of speed and power at an affordable price.*

Built-in Balloon Help.™ *Point at what you want to know about, and your Macintosh will tell you what it's for. So you can leave your manual in a desk drawer at home.*

Built-in networking. *Plug your PowerBook into an AppleTalk® network, and conveniently access all network resources—printers, file servers, e-mail, even other networks from Novell, IBM and Digital.*



AppleTalk Remote Access. *This remarkable software comes with every Macintosh PowerBook. It not only allows you to access all the files on a modem-equipped Macintosh at your office or at home, it also gives you complete access to your network—printers, files, file servers, e-mail—from anywhere there's a phone.*

Built-in fax/data modem. *With this option, you can send your work directly to a fax machine or access e-mail from almost any telephone anywhere you happen to be. Just plug the phone cord into the back of the PowerBook.*

Built-in file sharing. *On most notebook computers, sharing information with a desktop computer is virtually impossible. But every PowerBook has powerful file sharing built in. So you can easily connect your PowerBook to a desktop Mac® or another PowerBook and copy files from one computer to the other.*

Built-in peripheral support. *Like every Macintosh, PowerBook lets you add up to six external hard drives, CD-ROM drives, scanners or other peripherals simply by plugging them in.*

Palm rests. *Working on the road isn't like working at your desk. So Apple designers provided a place to rest your hands, making it much easier and more comfortable to work in tight quarters—such as a middle seat on an airplane.*

Integrated trackball. *Everything about Macintosh computers is designed to make it easy for you to work. In the case of PowerBook, the pointing device is integrated into the computer. There's nothing to hook up or clip on. Open it up and you're ready to go. (It's comfortable whether you're left- or right-handed, too.)*

It's compatible. *Like every Macintosh, PowerBook is compatible with the personal computers you use at the office. It can read from and write to floppy disks from MS-DOS or OS/2 PCs, or even run DOS software using programs such as SoftPC.*

a totally integrated system. Combining hardware, software and industrial design to make working on the road as comfortable as working at your desk. It's more intelligent. It's more convenient. It's power anyone can use, anywhere you happen to be. The power to be your best®.

How to connect to a network file server.

The hard way:	The easy way:
1. Purchase an external network adapter. 2. Install the network adapter. 3. Connect the network cable. 4. Plug in AC power supply if needed. 5. Install network software and configure parameters. 6. Start Windows. 7. Run Windows Setup to load network software. 8. Restart. 9. Start Windows. 10. Start File Manager. 11. Select the desired file server.	1. Connect the network cable. 2. Open Chooser. 3. Select AppleTalk "Active" button. 4. Select desired file server.

How to retrieve a deleted file.

The hard way:	The easy way:
1. Purchase a utility program. 2. Install it on your computer. 3. Restart the computer. 4. Start Windows. 5. Start the utility program. 6. Start the unerase feature. 7. Find the directory where your file existed. 8. Click on that directory. 9. Select the deleted file. 10. Choose unerase command.	1. Double-click on the trash can. 2. Drag the deleted file out of the trash can.

How to rename a directory.

The hard way:	The easy way:
1. Double-click on the Main group in Program Manager. 2. Start File Manager. 3. Highlight the directory you want to rename. 4. Select "Rename" from the file menu. 5. Type in a new name for the directory (must be 8 characters or less). 6. Go to Program Manager if needed. 7. For each application in the renamed directory, select "Properties" from the file menu. 8. For each application in that directory, change the command line to reflect the new path to the application program.	1. Highlight the directory (folder) you want to rename. 2. Type a new name (up to 31 characters).

How to add an external hard disk drive.

The hard way:	The easy way:
1. Purchase a parallel-to-SCSI adapter. 2. Connect it to the parallel port. 3. Plug the drive into the adapter. 4. Insert the adapter's installation disk in drive A:. 5. Select drive A:. 6. Type "INSTALL." 7. Select appropriate options for your drive. 8. Select appropriate drive for software installation. 9. Restart. 10. Run installation test program.	1. Plug the drive into the SCSI port. 2. Start up the PowerBook.

How to play a sound.

The hard way:	The easy way:
1. Purchase a sound upgrade kit. 2. Attach sound upgrade hardware. 3. Install sound upgrade's software drivers. 4. Start the sound recorder program. 5. Select Open from the file menu. 6. Select the sound file you want to play. 7. Choose OK. 8. Click on the Play button.	1. Double-click on the sound's icon.

How to add a pointing device.

The hard way:	The easy way:
1. Purchase a pointing device (such as a mouse or trackball). 2. Open notebook's back panel. 3. Attach appropriate port adapter to pointing device (if other than 9-pin). 4. Connect pointing device to proper port. 5. Choose appropriate clamp arms. 6. Attach pointing device to clamp arms and adjust tilt angle. 7. Start the computer. 8. Install driver software. 9. Restart.	1. The trackball is built in.

Macintosh. The more you do, the easier it gets.

For an authorized Apple reseller, call 800-538-9696, ext. 150. "This price and all the prices noted here reflect average Manufacturer's Suggested Retail Prices. "Comparisons are based on a 1991 independent research study conducted by Ingram Laboratories that tested a variety of personal computers running applications available for both the Macintosh and Microsoft Windows 3.0 environments. © 1992 Apple Computer, Inc. All rights reserved. Apple, the Apple logo, AppleTalk, Mac, Macintosh and "The power to be your best" are registered trademarks of Apple Computer, Inc. PowerBook and PowerBook are trademarks of Apple Computer, Inc. Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation. MS-DOS is a registered trademark and Windows is a trademark of Microsoft Corporation. OS/2 is a registered trademark of International Business Machines Corporation. SoftPC is a registered trademark of Insignia Solutions Inc. WordPerfect is a registered trademark of WordPerfect Corporation. L02791LL/A

Unbending Lightwave Terminology

diffraction The bending of light at the edge of an opaque object. Usually, diffraction is a problem because it introduces unwanted distortion, but it has useful applications—for instance, in a grating.

electro-optics Not to be confused with optoelectronics, electro-optics is a technology in which electrons are steered and focused as if they were light (e.g., in a CRT or electron microscope).

generator (or source) and detector (or receiver) There are several methods of generating and detecting optical output signals in real time and converting them to electrical signals that can be stored or otherwise manipulated. LEDs and lasers are among the devices used as generators. Photodiodes, photoconductors, and photomultipliers are some of the tools used to detect the optical output signal.

grating A pattern of microscopically fine lines that can be used to focus or redirect a beam of light. Gratings need less space than lenses and are easier to build into small photonic devices.

hologram A 3-D optical image formed by storing 3-D information about an image or a pattern of light. Where two beams of laser light cross, they produce an interference pattern of microscopic light and dark fringes. If this pattern is recorded, the result is a hologram that contains full information about the two beams that formed it.

laser A device that generates light in which all the photons are exactly in step and produce a coherent beam. Laser light has one wavelength and is more easily controlled than other kinds of light. A laser is one way to create and read holograms.

MBE (molecular-beam epitaxy) A semiconductor fabrication process used to build up devices by adding one molecular layer at a time. MBE allows different materials and types of doping to be sandwiched precisely in layers. It is an expensive and slow process, but it's essential for manufacturing various photonic devices (e.g., S-SEEDs).

nonlinear material A substance whose optical properties vary with the intensity of the light. In fact, most optical substances are very weakly nonlinear, but a lot of research has gone into finding materials with stronger nonlinearities.

OEIC (optoelectronic IC) A hybrid IC that uses both electronic and photonic technologies. One significant challenge is fabricating chips that combine silicon with optically active materials, such as GaAs (gallium arsenide).

photorefractive material A material whose refractive index (i.e., the measure of the speed of light in the material) varies with the light intensity. Photorefractive materials are widely used in photonic processing and memory.

reflection The ability of a surface to rebound light. A smooth surface (e.g., a mirror) may produce a specular reflection. A rough surface (e.g., a sheet of paper) produces a diffuse reflection.

refraction The bending of light as it passes from one medium to another. It is the phenomenon that enables a lens to focus light and that makes a stick appear to bend where it dips into water.

solitons Stable pulses that can travel indefinitely or pass through each other without losing their shape. In a soliton, the tendency for different wavelengths to travel at different speeds is canceled by the fact that different intensities also have different speeds.

S-SEED (symmetric self-electro-optic effect device) A nonlinear device consisting of hundreds of alternating GaAs and GaAlAs (gallium aluminum arsenide) layers sandwiched in a photodiode. Positive feedback in the device allows it to act as an optical switch.

waveguide A device that constrains or guides the propagation of electromagnetic waves along a path defined by the physical construction of the waveguide.

being exposed to a pattern of light, allowing the materials to operate as an optical memory (see "Parallel Optical Memories" on page 179). In fact, one of the most potent of all photonic techniques is the use of photorefractive crystals to store data as a hologram.

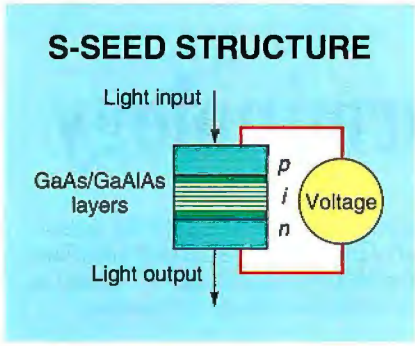
Nonlinear effects are usually not strong, but they can be amplified with a little help from the electronic world. The S-SEED links optical I/O with an electronic effect to initiate a hard nonlinearity. The S-SEED behaves as an optical transistor, performing a NOR function by allowing one light beam to switch another. S-SEEDs are difficult to make and expensive. But they provide excellent performance, with switching rates better than 1 GHz. Because they can be fabricated into arrays, S-SEEDs are also well suited to parallel processing.

Discussing his team's latest optical CPU, the O-CLIP (Optical Cellular Logic Image Processor), Desmond Smith, a professor at Heriot-Watt University (Edinburgh, U.K.), says, "Compared to electronic logic, we get gains in cycle times of a few hundred to several thousands. It's one of the best arguments that optical computers have a good future." The O-CLIP uses a 16×8 array of S-SEEDs, and holograms are used to configure the interconnections. Using improved lasers, Smith expects to boost performance by a factor of 1000 in the next few months.

AT&T Bell Laboratories (Holmdell, NJ) also has several photonic processors. Some centers (notably the California Institute of Technology) are making good progress with optical neural networks (see "Is What You See What You Get?" on page 189).

Fabrication Challenges

Whatever the design, fabrication is a big issue. The materials involved in developing optical techniques and components are often difficult to process, and many optoelectronic devices require time-consuming molecular beam epitaxy. The need to



An S-SEED is a p-i-n photodiode built around multiple layers of GaAs and GaAlAs (gallium aluminum arsenide). These layers act as quantum wells, trapping electrons and holes close by. The resulting energies determine the optical transmission of the device.

ensure precise alignments makes optical systems fragile and often bulky.

What the industry would like best is to manufacture photonic devices using the same fabrication techniques used to manufacture silicon electronic devices—hence the tremendous interest in electroluminescent silicon and the ability to combine GaAs with silicon on the same substrate. According to Nan Marie Jokerst, assistant professor of electrical engineering at the Georgia Institute of Technology, "The use of conventional techniques may bring to optoelectronic devices the same economy of scale that has helped lower the cost of conventional silicon circuits."

Making the Connections

One of the major obstacles to creating a working marriage between photonics and electronics is the problem of how to integrate two dissimilar technologies. If low-cost silicon-based OEICs do appear, it will be electronics, not photonics, that will benefit first. Optical interconnections will solve the connection-congestion problems in electronic computers long before optical processing becomes a commercial reality (see the text box "Interconnecting the Pieces" on page 192).

Four possible levels of optical interconnection exist inside a computer: rack-to-rack (in larger computers), optical backplanes (linking groups of circuit boards), interchip links on a single board, and intrachip connections within a single IC. Each level presents both benefits and problems, among them cost, physical size, cross talk, energy efficiency, and speed.

Choosing the most appropriate technology is a matter of trade-offs. If you want to send data from New York to London, photons are the obvious choice. If you want to send data 2 inches across a circuit board, the choice is not so clear-cut.

Electrons are less trouble because they require simpler technology. On the other hand, when space is tight, only photonics can cut through the electronic gridlock. The final decision has to be based on a balance between cost and complexity.

At present, implementing the larger-scale interconnections is easier to justify, and it's this level of implementation that has progressed the most. One of the pioneering examples of optical interconnections on the rack-to-rack scale is the 5-ESS pulse-code-modulation system developed and used by AT&T for switching long-distance and local calls. The 5-ESS contains up to 190 switching modules, each linked to central communication and administration modules by 32-Mbps optical fibers.

Honeywell (South Bloomington, MN) has demonstrated photonic backplane interconnections on the massively parallel Connection Machine produced by Thinking Machines (Cambridge, MA). Honeywell is starting to produce optical backplanes for use in conventional computer architectures (see photo 3). In a recently announced collaboration with Intel, Honeywell will develop gigabit photonic interconnections to join several Touchstone Delta supercomputer modules into a single mesh. The firm anticipates that this development will provide at least a 16-to-1 reduction in connection complexity.

The technologies now available for use in optical backplanes include free-space beams, optical fibers, and polymeric waveguides, which can be integrated into circuit boards and multichip modules (see the text box "Smart Pixels and Free-Space Interconnection" on page 174). Polymeric waveguides using channels of high-refractive-index polymer in a low-index substrate have demonstrated good performance and complex routing in conventional motherboard-daughterboard layouts.

Other researchers are investigating the practicality of different kinds of board configurations that would replace the traditional backplane. They are experimenting with optical signals that broadcast through space to several boards simultaneously. In the long run, it seems likely that board and cabinet layouts will have to adapt to photonics, just as they adapted in the evolution from vacuum tubes to transistors.

If you look at the smaller scale of intrachip links, photons begin to look less attractive than electrons. Whereas a photon's energy is independent of distance traveled, the energy required to move an electron decreases as the distances become smaller. Thus, the cost/performance ratio of electrons at the intrachip level is much

Photo 2: *Testing a new polymer that has photorefractive properties. These characteristics may lead to the development of applications such as optical memories or optical data storage many times denser than what is available today. (Photo courtesy of the IBM Research Division, Almaden Research Center, San Jose, CA)*

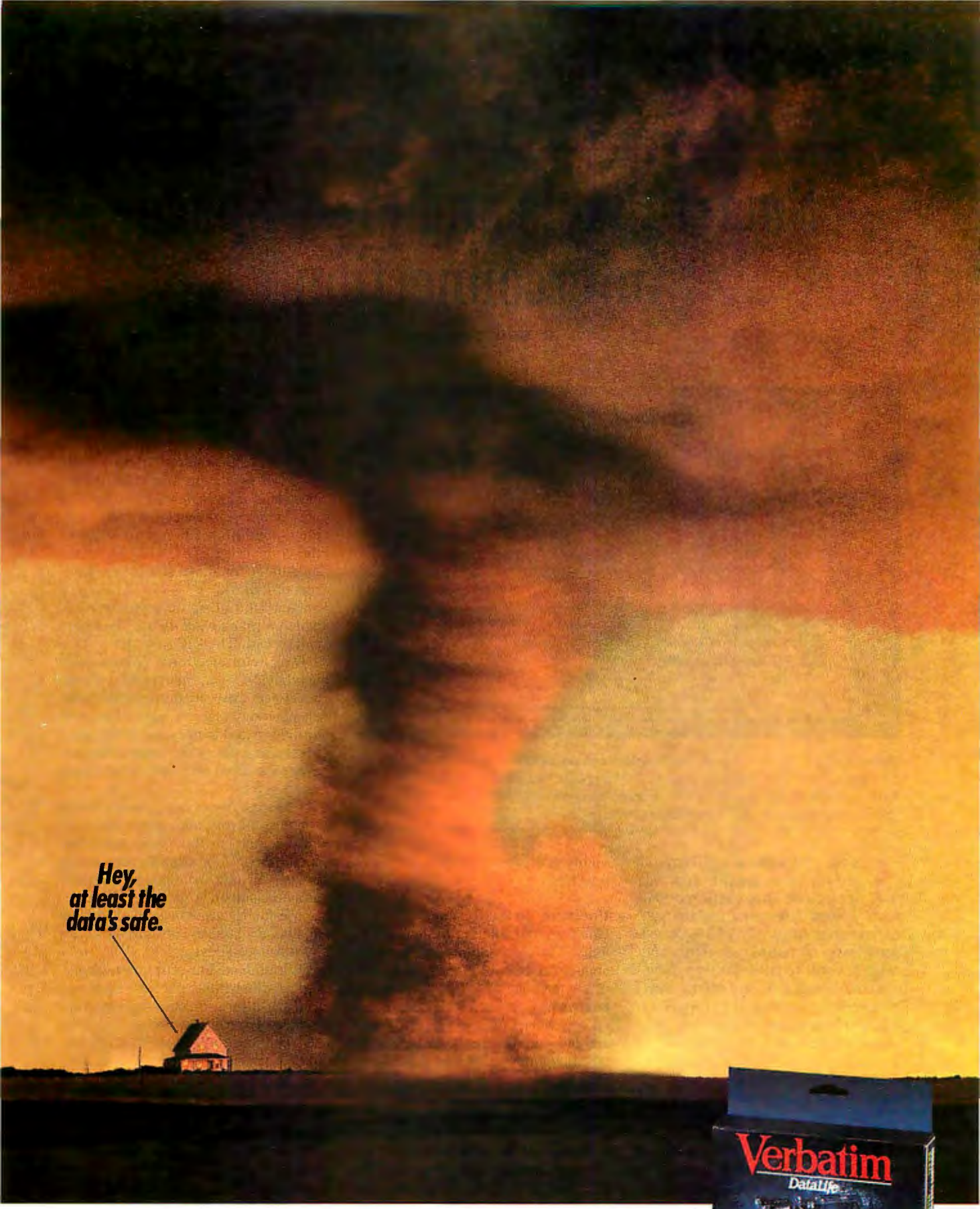
better. When you get down to IC dimensions, light begins to look like a more expensive alternative.

Will the computer industry ever implement intrachip photonics? Possibly, but not necessarily. New 3-D layered packaging technologies may use integrated optical generators and detectors to communicate between layers of the IC while retaining electronic links within each plane. Researchers at Hiroshima University in Japan have been developing one such design called the 3D-OCC (3-D optically coupled common memory). In this memory, data written electrically into any one layer propagates optically into all the others. All the layers then contain identical data, a condition that allows multiple processors to simultaneously access the same memory space for parallel computation.

Other intrachip applications may use optical waveguides fabricated in silicon to overcome cross talk or to distribute clock signals. It seems unlikely, however, that photonic transfer can ever play a large role inside 2-D devices.

Optical Transmission Developments

Outside the computer, there is no uncertainty: Communications via optical fiber is unrivaled, and new networking strategies



Verbatim® tapes, optical and floppy disks. Your best defense against data loss.

Circle 180 on Inquiry Card.

Smart Pixels and Free-Space Interconnection

H. SCOTT HINTON

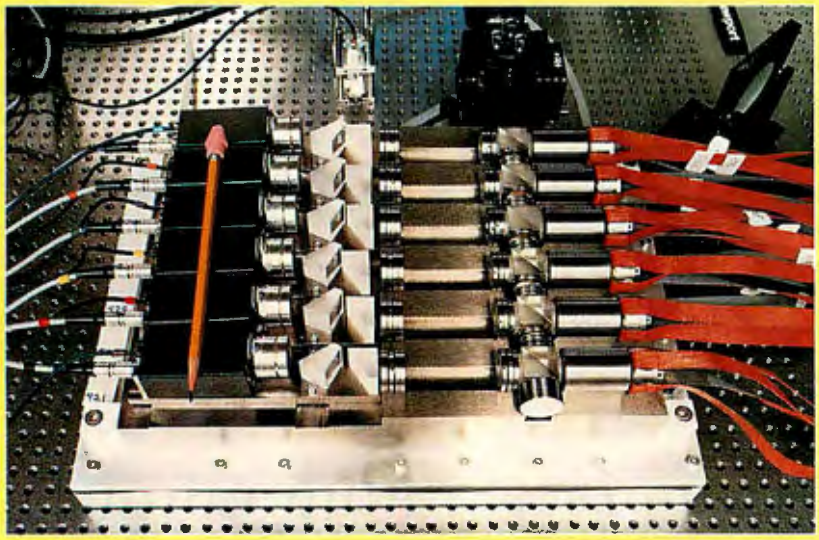


Photo A: *A 16- by 32-bit-wide multistate-interconnection-network prototype developed by AT&T Bell Laboratories (Naperville, IL). This switching fabric is based on free-space digital optical interconnections and S-SEED devices. (Photo courtesy of AT&T Bell Laboratories)*

As the performance of electronic technology continues to improve, it faces the same challenge confronted by humans: the ability to communicate effectively. The increased complexity of future processors and other ICs will require that they move more information on and off the chip. This need for increased I/O capability will lead to more pin-outs per chip. Not only will there have to be more physical channels, but the timing and synchronization of the information-bearing signals will demand tighter control.

Furthermore, as bit rates increase, so will the size and power requirements of the output drivers. These increased needs will require that more real estate per chip be devoted to I/O, a situation that in turn implies more on-chip dissipated power. Finally, as new computing architectures head away from the standard bus structures and evolve toward parallelism, they will need more highly synchronized I/O connections per chip.

Photonics to the Rescue

One potential solution to these problems is to use photonic I/O to interconnect electronic ICs. Photonic I/O offers the hope of lower communications energy per bit, which leads to less on-chip power dissipation per pin-out and less required real estate per pin-out. In addition, this will make skew rates significantly lower than with standard electrical interconnections, thus leading to improved synchronized systems.

One approach to meeting these interconnection needs is through the use of 2D-OEIC (2-D optoelectronic ICs) and free-space optical interconnections (see photo A). A 2D-OEIC is an IC that is composed of FETs (field effect transistors—standard electronic gates) with photonic I/O. The term *free space* results from the fact that the light passing from one place to another is not confined in a physical waveguide, such as a fiber.

A 2D-OEIC input is typically composed of p-i-n detectors, followed by electronic amplification. The input signals are processed electronically, with the output information transmitted to the connecting 2D-OEICs by either modulators or active sources (e.g., lasers or LEDs).

One kind of optoelectronic IC is called a *smart pixel array.* It's a special type of 2D-OEIC that consists of a 2-D array of electronic circuits with photonic I/O (i.e., smart pixels). To interconnect these smart pixels, you need a technology that can collect the spots of light (a 2-D image), leave the smart pixels, and direct the light to the appropriate input detectors of the next smart pixel.

Classical optics (e.g., lenses, beam splitters, mirrors, and holograms) is an ideal match for this interconnection need. It's one approach that can move images of light from one smart pixel array to another. A second approach is to use microlenses instead of the big and bulky classical lenses to direct the light between devices.

With the advent of frame-to-frame optical-fiber links, photonics has begun the migration into high-performance electronic systems. The next step could be shelf-to-shelf and board-to-board interconnection with both fiber and/or free-space photonic backplanes. Finally, free-space interconnection of multichip modules and 2D-OEICs could provide the connectivity necessary for future parallel systems.

H. Scott Hinton is head of the photonic switching department at AT&T Bell Laboratories. His research interests include photonic switching and optical computing systems. You can reach him on BIX c/o "editors."

Photo 3: *Optical backplane hardware assembled in a VME card cage. Its function is to implement 32 fanouts distributed over four double-sided daughterboards inserted in the four card slots on the left side of the card cage. The prototype device was produced by Charles T. Sullivan, Bruce L. Booth, and Anis Husain. (Photo courtesy of Honeywell Systems and Research Center, Bloomington, MN)*

are proliferating—too much so, perhaps, with the winners still to be decided and compatibility keeping a low profile. The important point is that optical solutions are available for every level of networking.

One current example at the LAN scale is the FDDI (Fiber Distributed Data Interface), which provides a dual-ring topology that can reconfigure itself to survive fiber damage or faulty nodes. FDDI operates at 100 Mbps with a token-passing protocol. Some companies (e.g., 3Com of Santa Clara, CA) offer FDDI adapters as personal computer cards.

Another recent and important development is SONET (Synchronous Optical Network), a networking protocol that operates in the optoelectronic world and offers data transfer rates of up to 2.4 Gbps for metropolitan-area networks and WANs. The benefits of SONET include rapid recovery from failure and the ability to combine and separate signals at many different bit rates (see the text box "SONET: A Standard for Today" on page 186).

The first public SONET circuit was installed this year in a 5.5-mile loop around downtown Cincinnati, Ohio. Eventually, SONET may form the basis of B-ISDN (broadband ISDN) technology, which would combine voice, data, and video into one public optical network.

The thrust behind fiber research comes not from the computing environment but from the telephone world. But computer users will benefit a great deal from this work. The past year has seen significant advances in three key technologies: optical amplifiers, soliton transmission, and WDM (wavelength division multiplexing). Taken together, they could drive data transmission speeds toward the terabit range.

Optical amplifiers use erbium-doped glass and a pump laser to boost pulses as they travel through the fiber, without any need to convert and amplify them electronically. Researchers at BT Laboratories (Ipswich, U.K.) recently demonstrated an optically amplified network capable of distributing 39.8 Gbps of data simultaneously to 43.8 million terminals. And not long ago, AT&T demonstrated the use of optical-fiber amplifiers (i.e., spliced-in segments of erbium-doped optical fiber) to transmit lightwave signals error- and attenuation-free at a rate of 5 Gbps over distances of up to 5580 miles.

Solitons (i.e., pulses that maintain their shape as they travel) make optical amplifiers more efficient. They used to be a lab curiosity but are now on the verge of becoming a practical technology. Recently, AT&T Bell Laboratories' researchers have reached error-free soliton data transmission speeds of 10 Gbps over 6820 miles.

Since solitons of different wavelengths don't interact, they make possible the third emerging technology, WDM, in which separate wavelengths are used to multiplex many channels through a conventional fiber.

Without optical amplifiers, WDM would need separate boosters and lasers for each wavelength, but optical amplifiers work

Holographic Applications

Advances in holographic technology have given birth to a wide range of applications, and there are some waiting in the wings. The following is a sampling of current and near-future holographic applications.

- Computer memories
- DBMS
- Storage
- Image preprocessing and processing
- Analysis and pattern recognition
- High-resolution and 3-D displays (Toyota already has holographic heads-up displays in some of its cars.)
- Image and data encryption and compression
- Submicrometer lithography
- Computer-generated images with holographic dimensionality for application in the areas of CAD, medical imaging, and scientific visualization
- Fiber-optic wavelength division multiplexing and demultiplexing
- Precursors of systems that compute with light
- Spatial imaging (e.g., holovideo and photographic holography)
- Laser printers and scanners
- Lookup tables
- Drives
- Interferometry (e.g., nondestructive stress testing and analysis of building materials and machine parts)
- Medicine
- Infrared and x-ray imaging
- Teaching image libraries
- Optical contouring
- Optical clones of mirrors, lenses, and prisms
- Kinegrams (e.g., security images on credit cards and software)
- Packaging

over a range of wavelengths, completing the three-way synergy of erbium, solitons, and WDM.

The results of all this research are two to five years in the future, but work is well under way. Mohammed N. Islam, a research scientist at AT&T Bell Laboratories, is developing a soliton LAN that uses optical gates to read packet headers and route data without any electronic intervention (see "Light Switches" on page 183). IBM's Rainbow Project intends to use WDM to create a 1000-node optical network capable of data transfer rates of 1 Gbps per node.

Optical Storage

It's exciting to think about the coming of gigabit data channels and TFLOPS processors, but you won't get to enjoy their use without having the storage technology to match. Whether you plan to tackle the "grand challenge" problems of scientific modeling, make meaningful multimedia, or just sift through a mountain of on-line information, you'll soon need to access terabits of raw material.

For the foreseeable future, you can expect to continue with the rich mix of incompatible and semicompatible CD formats, together with WORM, magneto-optical, and phase-change drives. Static, nonrotating alternatives, such as Drexler Technology's Lasercard, are now being tested in the U.K. and the U.S. for archiving large files (e.g., medical records).

In addition, the use of short-wavelength lasers could raise storage densities by a factor of four. With this technology, you could store about 2.5 GB on a standard 4¾-inch CD, but improvements will have to be made in head design to significantly improve access times.

Optical drives and cards are not the only way to go, though. To see the essence of optical storage, you must step into the third dimension. Imagine, for example, a plastic block, the size of a sugar cube, packed solidly with a terabit of information; think of a crystal containing in its lattice the holographic image of a whole library.

Peter Rentzepis, a professor of chemistry at the University of California–Irvine, has been working on a photochromic material, spirobenzospyran, that changes from clear to blue when simultaneously exposed to two different wavelengths of laser light. By scanning the beams, Rentzepis can record bits as microscopic blue dots in the material. To read them back, he uses two ultraviolet beams. Where the beams cross at a blue dot, the dot fluoresces, allowing a photodetector to read any location. Rentzepis anticipates that his system could achieve potential read/write speeds of around 1 Gbps.

At IBM and in Japanese and German universities, other work is taking laser recording technology into the realm of individual atoms. For now, all these techniques are still in the research environment, but they give us a glimpse of the future of data storage.

Holo-Computing

Consider two apparently unrelated facts. First, the trend in all areas of high-end computing is toward greater parallelism. Second, because of its quantum nature, a photon has no path or position until it is detected. How do these facts connect? One way is in the domain of holography. Using the properties of holography and creating holograms with computers provide lots of computer-oriented applications (see the text box "Holographic Applications" at left).

In a hologram, two beams of laser light set up an interference pattern that is recorded in a photosensitive material. It's then possible to shine one beam through the hologram in such a way that it will recreate the image information and direction that was originally contained in the other beam.

Because light is a quantum phenomenon, no part of a holographic image is localized anywhere—all the parts of the hologram affect every photon in the beam. This technique is a good example of *unparalleled parallelism.*

The true beauty of holography is its versatility. Applications of the technology are many and varied. At Caltech, Demetri Psaltis has been building optical neural networks from holograms recorded in nonlinear crystals (see "Parallel Optical Memories" on page 179). At Heriot-Watt University, Desmond Smith uses holograms to direct light beams in and out of the logic arrays in his optical cellular processors. And at the Georgia Institute of Technology's Research Institute, Carl Verber, a professor of electrical engineering, is building POHMs (page-oriented holographic memories) that can store multiple patterns of data or programs and apply them in parallel to a CMOS array of processors.

Holographic techniques will be central to photonic computing, but a great deal

...IT'S TIME YOU LOOKED AT THINGS A LITTLE DIFFERENTLY.

The new Honeywell mouse works better because it has two "feet" instead of the conventional ball mechanism.

If you turned this page over, you're probably inquisitive enough to appreciate the difference between our new Honeywell Mouse and every other mouse on the market today.

Turn your mouse over and you'll find a conventional ball device. The ball picks up dust and dirt that can roll up and contaminate the internal mechanism, which will make your cursor hop, skip and jump across the screen.

So, we replaced the ball with two "feet." Our new patented design keeps the mouse free of debris. You don't need any special pads, and you never need to clean the mouse. Plus, your cursor will go precisely where you want it – when you want it – forever.

In fact, we're so sure the new Honeywell mouse will outperform your current mouse that it comes with a limited lifetime warranty.*

So dare to be different. Go get a new Honeywell mouse. You'll find out that, in this case, different *is* better.

(O.K. – you can turn your magazine back over now.)

Compare The New Honeywell Mouse To The Others

Technology	"Feet" Ball	Ball	Ball	Ball
Maintenance Free	YES	NO	NO	NO
Works On Any Surface	YES	NO	NO	NO
Works At Angle	YES	NO	NO	NO
Works Upside Down	YES	NO	NO	NO

Honeywell | Microsoft | Logitech | IMSI

*The new Honeywell mouse is Microsoft® Windows™ compatible.*works with IBM. compatibles and PS/2 systems.

Honeywell

Helping You Control Your World

*See warranty for complete details.©1992 Honeywell Inc. Keyboard Division 4171 N. Mesa Bldg. D El Paso, TX 79902 1-800-445-6939. All product names are trademarks of their respective companies.

Circle 113 on Inquiry Card (RESELLERS: 114).

BYTE

BYTE Reprints

The BYTE Reprint Department will provide free quotations for reprints of BYTE articles.

Reprints can serve as high quality, inexpensive promotional tools:

- Train and educate key personnel
- Present information at conferences/seminars
- Provide literature to users of your products

Call
603-924-2525
for information and a free price quotation.

Minimum order: 500

McGraw Hill

Photo 4: *Carl Verber of the Georgia Institute of Technology is building POHMs that can store multiple patterns of data or programs and apply them in parallel to a CMOS array of processors. Here you see Mark Jones, a student assistant, adjusting laser beams in a holographic switching experiment. (Photo courtesy of Georgia Institute of Technology)*

more research is required to fulfill this technology's promise. Says Verber, "The problem that's foremost in my mind is the materials problem."

In the lithium niobate crystals that Verber is using, reading the hologram erases the data. New photorefractive polymers may fix that problem, but these materials have other limitations. Scientists are confident that you will eventually be able to write and modify stable holograms as easily as any other form of memory. Then you'll see the arrival of true photonic computing (see photo 4).

Using Light

Making predictions about new technology is just asking to be proved wrong, but I can make some educated guesses about a few trends. Photonics is perhaps the only technology I know of that is capable of breaking through some of the barriers that plague electronics. In addition, this technology comes with a proven track record in the communications industry. Mohammed Islam sums it up by saying, "You're changing the application rather than the technology."

The range of possibilities that optical technologies provide is tremendous. Photonics has the power to provide us with virtual machines composed of a network of supercomputers scattered worldwide. Photonics also has the capability of squeezing an entire world of information into a handful of hologram.

There will, however, be some trade-offs. One of the many questions that will have to be faced in the future is whether software can be developed that can cope with the coming of the photonic environment. Other challenges will have to be solved, too.

Optical techniques and devices are already being integrated into our computing environment. Because of the possible commercial and technical applications they bring with them, they have the potential to greatly improve the way people process and store data. The growth of parallel and distributed computing will fuel the development of these optical technologies and be driven forward by them.

People may never compute with all-optical computers; pure optical computing may not be the way to go. Electrons offer a lot of advantages for I/O and—at least in the short term—for processing. The important need now is for the commercialization of technologies that will marry electronics and photonics so that each can fulfill its potential and allow us to use the best of both those worlds.

The photonic revolution won't be without its difficulties or its failures. In a few years' time, however, people may be wondering how they ever managed before the lights came on. ■

Jack Weber is a TV producer working for the BBC, making documentary films and producing the weekly prime-time science-and-technology program called Tomorrow's World. *You can contact him on BIX c/o "editors" or on the Internet at jweber @cix.compulink.co.uk.*

In The Beginning, There Was One 3.5″ Drive.

SONY

Some of Sony's innovations from 1981 to 1992: 3.5" floppy drive, CD-ROM drive, multi-frequency monitor, 12" write-once optical drive, 5.25"

Sony Invented The 3.5" Floppy Disk Drive. Co-Developed CD-ROM. Brought Trinitron® Tube Technology To Computer Monitors. Developed The Multi-Frequency Monitor. Originated Rewritable Optical. Invented DDS. And Pioneered Multimedia.

An early Trinitron CRT

And you thought all we did was make great TVs.

In fact, Sony has been one of the leading producers of computer peripherals for more than 10 years, inventing or introducing many of the storage and display technologies being used today. Sony innovations are spread across a wide range of feature-rich products, including DDS, optical disk, multimedia, and high-performance monitors.

1968: The Trinitron one-gun, three-beam picture tube.
1981: The first 3.5" floppy disk drive.
1982: The first audio compact disc.
1983: Co-developed CD-ROM technology.
1984: The first multi-frequency monitor.
1986: The first 3Gb 12" write-once optical disk drive.
1987: The first DAT drive.
1988: The first 5.25" rewritable optical drive.
1989: The first DDS tape drive.
1990: The first writable CD.
1991: The video/computer integration protocol (VISCA™).
1991: The first 3.5" rewritable optical drive.
1992: The first portable CD-ROM XA player.

rewritable optical drive, DDS tape drive, writable CD drive, VISCA multimedia products, 3.5" rewritable optical drive, CD-ROM XA player.

Inventing The First 3.5" Floppy Disk Drive Wasn't An Accident. It Was The Result Of A Monumental Effort That Took Advantage Of More Than 40 Years Of Pioneering R&D In Fields As Diverse As Audio Tape And Semiconductors.

Do you remember buying your first album on cassette tape? How convenient it was compared to vinyl records? Or the first time you heard a familiar song on CD? Remember the clarity and brilliance of the music? In both cases you were experiencing the results of Sony R&D.

Applying the results of R&D efforts from various disciplines has helped Sony become one of the world's leading suppliers of peripherals. Our magnetic tape research led to the invention of the 3.5" floppy disk drive, which helped make portable and laptop computers practical. Our audio tape research led to the development of DDS, a major advance in both high-capacity storage and miniaturization. Inventing the audio compact disc led directly to the development of CD-ROM, WORM and rewritable optical storage technology, helping propel the development of multimedia.

Sony product innovations spring from R&D in basic materials and new technologies. Our semiconductor research has led to new SRAM designs. Basic optical research led to the laser diodes that made CD and CD-ROM possible. And research in materials composition for magnetic and optical media led to improvements in the drives themselves.

But innovation itself isn't enough. Extraordinary effort also goes into making Sony peripherals extremely reliable.

Sony Trinitron Monitors Captivated Users From The Moment They Were Introduced In 1984. Vertically Flat Screens Produce Sharp Images From Corner To Corner. Black Screens Display Bright, Rich Color. And Sony Multiscan® Monitor Technology Means Compatibility With All The Current Major Graphics Standards.

It's not often you can choose computer products that use Emmy Award winning technology.* Sony monitors do. Trinitron technology, with its innovative and advanced one-gun, three-beam design.

Sony Trinitron monitors also have a unique Aperture Grille with long, unbroken vertical slits between the electron gun and the screen to help focus the beams. The Grille lets more electrons through, delivering maximum color to the screen for a bright, rich image.

Trinitron monitors have another advantage: a vertically flat screen that produces straight lines and minimal distortion corner to corner. It also helps alleviate eye fatigue by dramatically reducing ambient light reflection.

Sony Trinitron monitors come in the most popular sizes: 14," 17," and 20," for applications ranging from basic spreadsheet and text, to CAD/CAM, desktop publishing, and multimedia presentations.

*1973 Emmy Award for picture quality.

TRINITRON
Super fine pitch

Sony Is One Of The World's Leading Suppliers Of Storage Products. That's Not Just An Advertising Claim: In Both Performance And Marketshare, Sony Now Holds Commanding Positions In Rewritable Optical, WORM, CD-ROM, DDS, And Floppy Disk Drives.

It's no surprise that Sony has been a leading supplier of mass storage components to the world's major computer manufacturers for the past 10 years. As demands for storage capacity increase, they look for the products that offer the highest capacity, best data integrity, most flexibility, and greatest reliability. The same reasons you should look to Sony for your storage needs.

The range of Sony storage devices is impressive: floppy disk drives, rewritable and write-once optical, CD-ROM, DDS. No matter if you need megabytes, gigabytes, or terabytes of storage, the chances are good there's a Sony device to satisfy that need.

Another example of Sony's leading position in the computer industry is the quality of our cooperative relationships. Besides being an active member on many of the standards committees, Sony has co-developed products and technologies with many major hardware and software companies.

SONY

Decades Of Experience Developing The Industry's Leading Storage, Display, And Video Products All Come Together On The Desktop And Make Sony The Natural Choice For Multimedia Applications.

Lights! Action! Computer!

The world is quickly moving toward combining image, motion and sound on the desktop. Sony is already there. With a complete suite of display, storage, video, and playback products, plus VISCA, the platform-independent video/computer protocol developed by Sony and supported by other major computer and software companies.

Start with Trinitron computer and video monitors. They're sharp, bright, colorful, and very reliable.

Add the Vdeck™ video drive, the first Hi8® VCR designed specifically for computer use. Add a Vbox™ video/computer interface for computer control of consumer and professional video equipment. An 8mm camcorder to create your own video images. Laserdisc players for access to a world of image and sound. And external speakers to enhance audio quality.

You can also add CD-ROM players for an even wider selection of programs. And rewritable optical and DDS drives for storing digital audio and digital video.

The story of Sony computer products that began with that 3.5" floppy disk drive doesn't end there. For more information, call 1-800-352-SONY (352-7669).

SONY

©1992 Sony Corporation of America. All rights reserved. Sony Trinitron, Multiscan, Vbox, Vdeck, Hi8, and VISCA are trademarks of Sony. Monitor CRT sizes are measured diagonally. AutoCAD® image courtesy of Autodesk, Inc. AutoCAD is a trademark of Autodesk, Inc. Medior Renaissance image courtesy of Medior, Inc.

PARALLEL OPTICAL MEMORIES

All components necessary for building parallel-access optical memories are available

DEMETRI PSALTIS

Everyone has become familiar with optical memories and storage through their commercial applications for audio and video recordings. The same basic technology has also been applied to computer memories, with conventional systems available from many different manufacturers.

The primary advantage of optical memories is that optical disks are easily removable, which makes them attractive for applications ranging from workstations to electronic photography. In addition, it costs relatively little to produce a large number of permanent copies of an optical disk. Other properties of optical disks are roughly comparable to those of magnetic recording media.

For example, the current storage density for optical and magnetic media is approximately 1 bit per square micron. The capabilities of optical disks, however, can be dramatically augmented through parallel access. The idea is simple: The disk is illuminated with a broad optical beam instead of a tightly focused spot.

As a result, many stored bits are addressed in parallel. The bits are transferred to the computer by imaging the illuminated portion of the disk onto a 2-D detector array. The electronically detected signal can then be mapped to the RAM space of a computer through an optical RAM. Thus, it's possible to optically load information at each memory cell (see figure 1).

ILLUSTRATION: KEN COFFELT ● 1992

Doing It in Parallel

The degree of parallelism that you can achieve with this method can exceed 100,000 channels. The speed at which the data can be transferred depends on the available optical power. For example, with

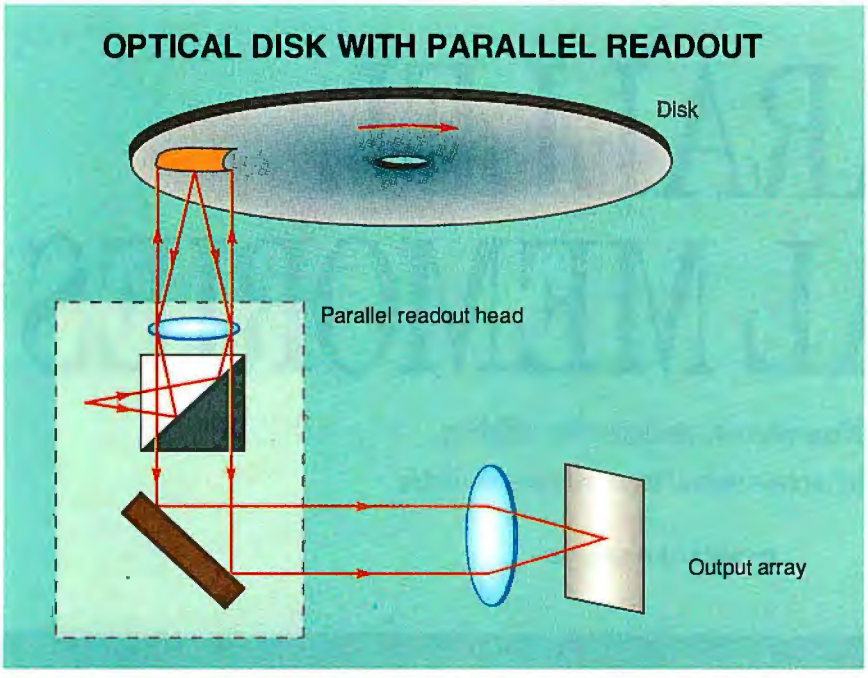


Figure 1: *A conventional optical memory disk is illuminated with an unfocused beam to address thousands of stored bits in parallel. The illuminated portion of the memory is imaged onto a detector array, and the detected signal becomes part of the computer's RAM space.*

100 milliwatts of optical power and a parallel readout of 100,000 bits, the readout speed is less than 1 microsecond, resulting in an effective data transfer rate of 10^{11} bps between the optical memory and RAM. The access time to any block of data is the same as that of a serial readout disk (approximately 50 milliseconds).

At Caltech, my colleagues and I recently demonstrated such a system using a prototype disk recorder made by Sony's Corporate Research Laboratories (Tokyo, Japan). This system is similar to any commercial optical disk system except for two important features.

First, the recording format is such that information recorded on different tracks can be spatially aligned. Second, the error-correcting coding is bypassed. These two features make it possible to draw arbitrary 2-D images on the disk. Data is recorded on the disk as 2-D blocks, with each block readout in parallel.

The recording of the 2-D patterns can be either a direct recording or a computer-generated hologram of the bit pattern that you intend to store. The advantage of the hologram is that the readout system doesn't require any lenses, simplifying the design and speeding up the access time. More important, holographic recording makes it possible to minimize the accuracy with which the disk has to be aligned with the detector array that senses the output.

Holograms are stored in a thick medium by recording the interference of an image and a plane wave reference beam. The image is retrieved by reilluminating the hologram with a reference beam similar to the one used to record the hologram. In a thick medium, the image is reconstructed only if the angle at which the reference beam illuminates the hologram is the same as when the hologram was recorded. This *angular selectivity* allows the storage of multiple images in the same volume and the retrieval of any of the images by illuminating the hologram at the proper angle.

All the components necessary for the construction of parallel-access optical memories are well developed and available. Therefore, if there is a market for the capability they offer, it's possible to manufacture such systems now.

BYTE ACTION SUMMARY

Optical memories, for use in easily removable optical disks, are attractive for applications ranging from workstations to electronic photography.

Image processing, databases, and neural networks are some of the potential applications for parallel optical memories. In such applications, you need the capability to rapidly (and sequentially) search large data sets. Using an efficient search process, it's possible to take advantage of a parallel optical memory's fast data transfer rate without its being constrained by the slow random-access time.

Associative Memories

In applications such as neural networks, it's often convenient to use an associative memory. You can use a parallel-access optical disk as an associative memory by recording a pattern that you wish to search for on an SLM (spatial light modulator). The SLM imprints the search pattern on the light beam that illuminates the disk.

The intensity of the light reflected from each location on the disk is the product of the intensity of the incident light and the disk reflectance at that point. The light that is reflected from the illuminated area is collected on a single light detector, and the detected signal is normalized to account for variations in the average intensity of different patterns. This normalized signal is at its maximum when the illuminating pattern from the SLM matches the illuminated pattern from the disk.

The system searches the associative memory by rotating the disk, sequentially illuminating different patterns on its surface and detecting the total reflected signal. With a simple maximum-detection operation, you can locate (and thus identify) the pattern that gives the best match. The output of the system is a label for the identity of this pattern.

Optical disks have advantages over magnetic storage for certain applications.

Several such systems have been demonstrated recently. In one, a handwritten-digit-recognition experiment, examples of the numbers 1 through 9 were recorded on the disk, and new patterns were classified by locating the best match between the input

Special Introductory Price
CALL 1.800.543.5835

Real Stats. Real Easy.

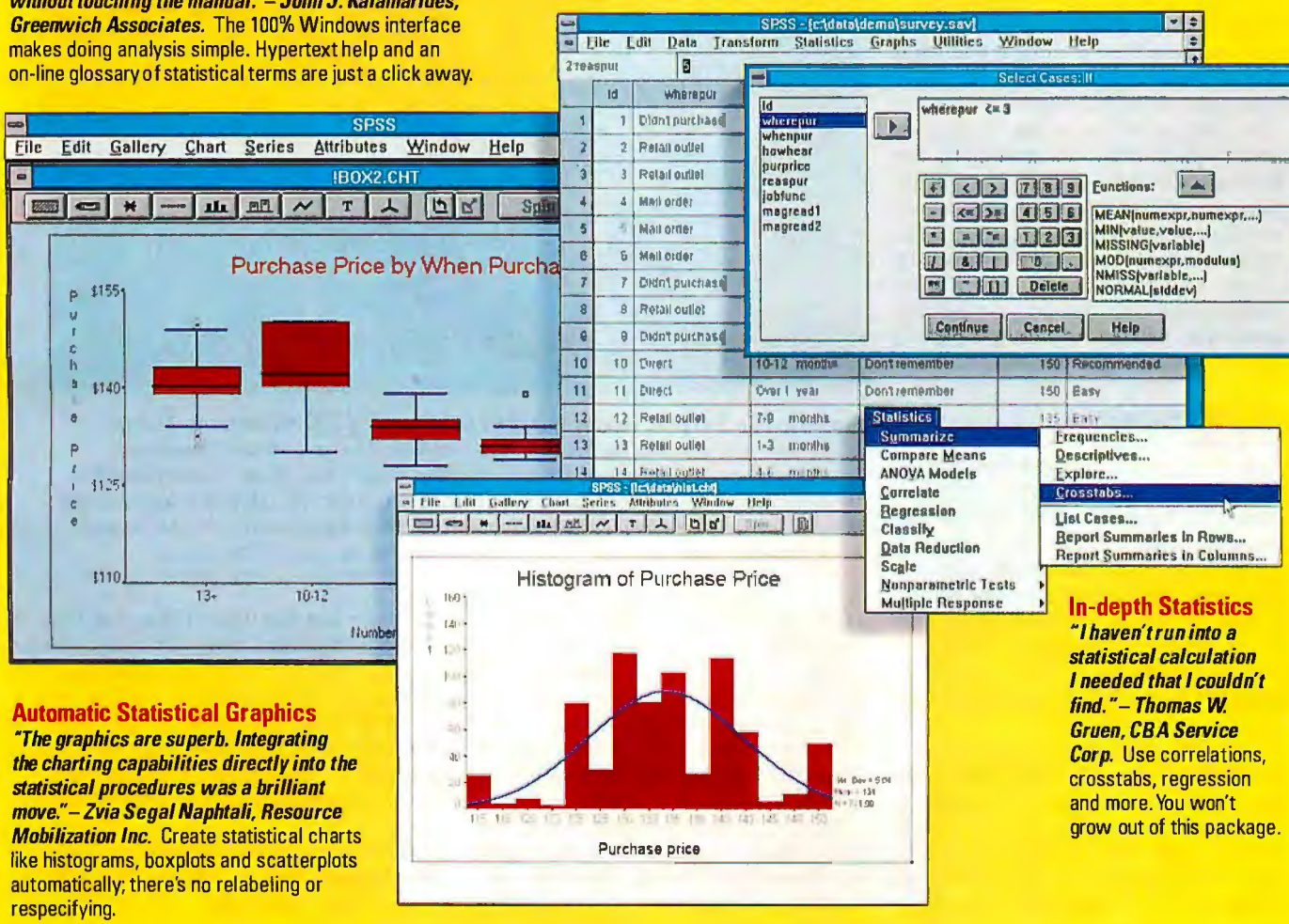
Answer Your Really Tough Questions with SPSS for Windows.

Learn Fast, Work Fast

"It's extremely easy to learn and use. With just the little bit of Windows experience I have, I got through without touching the manual."– John J. Kalamarides, Greenwich Associates. The 100% Windows interface makes doing analysis simple. Hypertext help and an on-line glossary of statistical terms are just a click away.

Complete Data Management and Editing

"The data management capabilities are excellent – even better than dBASE."– William O'Hara, Ph.D., Patrick Associates. Enter data or read it directly from Excel,™ Lotus,® dBASE® and SQL™ databases, then edit it and use it many ways – easily.



Automatic Statistical Graphics

"The graphics are superb. Integrating the charting capabilities directly into the statistical procedures was a brilliant move."– Zvia Segal Naphtali, Resource Mobilization Inc. Create statistical charts like histograms, boxplots and scatterplots automatically; there's no relabeling or respecifying.

In-depth Statistics

"I haven't run into a statistical calculation I needed that I couldn't find."– Thomas W. Gruen, CBA Service Corp. Use correlations, crosstabs, regression and more. You won't grow out of this package.

What factors influence purchases? Is service quality high? Are dosage levels optimal? You need answers you can be confident in. But, you can't do in-depth analysis with your spreadsheet or database – they only give you simple sums and percentages.

Don't stay locked in a spreadsheet cell. Break out with **SPSS® for Windows.™** Subset, sample, aggregate, explore, summarize, poke, prod, slice and dice your data to get the answers you need. Analyze surveys, dig into databases, improve quality, conduct research studies, forecast sales and prepare reports with ease. All without writing complex macros or queries. Find relationships, see patterns and trends, determine significance and use the past to predict the future.

Learn fast, work fast. Prepare for your analysis quickly with SPSS' full-featured Data Editor. Choose from a broad range of statistical routines that produce full-color charts automatically. Hot button between charts and related numerical output. Share information using DDE and OLE. Put together a great presentation with our business graphics, reports and tables. If you need help, the documentation is full of statistical "how to," and experienced technical support is just a phone call away.

MICROSOFT® WINDOWS™ COMPATIBLE

For a limited time, you can get answers to your really tough questions at a really special price.

Call 1(800) 543-5830 now for details.

SPSS

Chicago · Washington, DC · Chertsey, UK · Gorinchem, The Netherlands · Munich · New Delhi · Singapore · Stockholm · Sydney · Tokyo · And Distributors Worldwide.

Circle 164 on Inquiry Card.

and the stored examples (up to 10,000 on one disk). Because the search completes in one disk revolution, the optical memory provides fast access to a large database.

Optical vs. Semiconductor Memories

Due to their removability and parallel access, optical disks have advantages over magnetic storage for certain applications in the near term. However, you must also consider semiconductor memories when you contemplate the long-term prospects.

Japanese manufacturers have already demonstrated experimental RAM chips that can store approximately 64 Mb, or one-tenth of the data that one disk can store. It's clear that unless the storage density of optical disks is substantially improved, semiconductor memories will become preferable except for applications where nonvolatile storage is essential. The semiconductor lasers in development with shorter (i.e., blue) wavelengths will increase storage densities, because the minimum area required for storing a pixel is equal to a wavelength squared.

3-D Optical Disks

An optical 3-D disk is similar to a conventional optical disk except that the storage medium is thick. Because of this difference, it is possible to record multiple images at each location and access any one of the images. The system mechanically rotates the disk and moves the parallel readout head so that the illuminating beam reaches the appropriate position. The system then sets the angle of illumination to select one of the images stored at that location (see figure 2).

My colleagues and I recently stored 3 minutes of a movie on a 3-D disk using lithium niobate as the recording medium, filling only a tiny portion of the available memory space. With a 5-centimeter disk radius, each hologram occupying 10 square millimeters, and 1000 frames superimposed at each location, the storage capacity of the disk approached 10^{12} pixels—enough for more than 10 hours of video. Using such an optical 3-D disk, we could play back a 10-hour movie in approximately 10 seconds. Even though no one would want to watch movies at this speed, the capabilities of optical technology may prove critical for applications such as image recognition.

3-D Optical Memories and the Future

Two decades ago, researchers extensively explored 3-D holographic memories, but there wasn't enough progress or significant practical applications to make their development worthwhile. Now, because of advances in volume holography, there is a strong resurgence of interest in holographic 3-D memories. Contributing to this comeback are advances in optoelectronic devices, the development of new holographic recording materials, and the increased need for memories with large storage capacity.

In a recent demonstration, more than 500 images—each consisting of roughly a million pixels (10^9 bits per cubic centimeter)—were stored in a crystal with a volume less than a cubic centimeter. The large storage density, combined with the high data transfer rate and fast random access (approximately 10 µs when using an acoustooptic deflector to set the angle of the reference beam), make holographic 3-D memories exciting candidates for optical memories.

Remembering Optically

Optical memories have already proved their value in such commercial applications as audio and video recordings, but the technology's ultimate role in the computing environment has yet to be determined. Optical disks' removability offers a flexibility useful in a wide range of applications. And parallel-access optical memory's fast data transfer rates make it a potential candidate for use with image processing, neural networks, and databases. The speed and high storage density of 3-D holographic memories is a force that bears watching. In fact, there are strong indications that 3-D holographic memories could reach practical applications in three to five years.

Where research will take optical memories remains to be seen. For now, the watchword is wait and see. ■

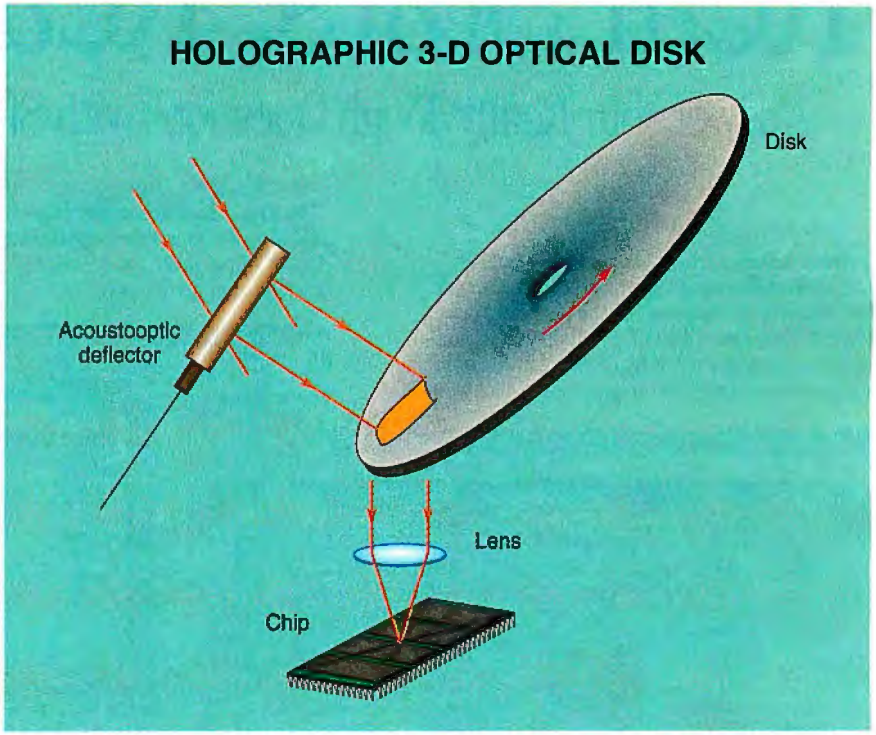


Figure 2: *In a 3-D disk, data is stored as holograms of 2-D bit patterns. Multiple holograms are stored at each location on the disk. The area of each location is approximately 10 square mm. You can retrieve each hologram by illuminating it at the appropriate angle specified by the acoustooptic deflector. Different locations on the disk are accessed by mechanically rotating the disk and translating the readout head. You can store up to 10^{12} bits on a disk 1 cm thick with a 5-cm radius.*

BIBLIOGRAPHY

Fai Mok, M. Tackitt, and Hal Stoll. "Storage of 500 High-Resolution Holograms in a LiNbo_3 Crystal." *Optics Letters*, April 1991.

Psaltis, Demetri, Mark Neifeld, Alan Yamamura, and Seiji Kobayashi. "Optical Memory Disks in Optical Information Processing." *Applied Optics*, May 1990.

Demetri Psaltis is a professor of electrical engineering at the California Institute of Technology. His current research is in the areas of optical information-processing systems, memories, and neural networks. You can reach him on BIX c/o "editors" or on the Internet at psaltis@caltech.edu.

LIGHT SWITCHES

Optical switches let you take full advantage of the amazing communications bandwidth provided by fiber optics

MOHAMMED N. ISLAM

Working with computer technology, you are always running into limitations that can adversely affect your applications. Not so long ago, if you didn't optimize the memory usage of your applications (even at the expense of the readability of the program code), you could easily overwhelm the capacity of your system. Now, with an abundance of memory and linear address spaces, memory requirements are less of a problem.

In communications and computer networks, however, there are still many applications that either must be optimized or can't be attempted because of bandwidth limitations. One major step toward the goal of limitless bandwidth has been the advent of optical fibers. For example, in the low-loss telecommunications wavelength range (between 1.3 and 1.6 microns) in fibers, there is approximately 40 THz of bandwidth. This bandwidth-rich environment invites innovative use of the resource. Fibers have become the transmission medium of choice for long-distance as well as short-haul telecommunications (see the text box "SONET: A Standard for Today" on page 186).

Although optical communications technology is replacing the copper wires and much of the intervening electronics in telecommunications networks, you can't get anything near 40 THz of bandwidth for your applications because electronic switches still perform the routing and logic decisions in the network. Electronic switching may be blindingly fast in human terms, but it's tortoise-like when compared to pure optical technologies.

To achieve transmission speeds approaching a terabit per second, you need

ILLUSTRATION: KEN COFFELT © 1992

Circle 88 on Inquiry Card.

all-optical *light-pipe* networks, where data remains in optical format throughout the network and converts to electronics only at the source and the destinations. By making bandwidth an inexpensive and virtually limitless commodity, you can tailor your system to optimize its functionality without regard to bandwidth.

The Case for Optical Switching

All-optical switching means that one light beam controls, or *modulates*, the passage of another light beam by interacting with it in a nonlinear medium. Light-light manipulations can be fast if nonresonant virtual optical interactions are used: The interaction is through deformation of electron clouds or wave functions rather than through the generation of electron-hole pairs, which must then recombine before the switch is reused.

There are several compelling reasons for turning toward all-optical switching for serial terabit-rate processing. First, you can achieve switching speeds exceeding 50 Gbps, which is beyond the capability of electronic systems. Second, by processing optically, you can remove the bottlenecks that arise from converting signals between optics and electronics, which is particularly important if the information enters and exits in optical format.

Third, electronic gates or devices that absorb light tend to generate heat, which is a major problem at high bit rates. On the other hand, if nonresonant interactions are exploited, then, in principle, heat dissipation is not a limiting factor.

Finally, and perhaps most important, all-optical gates let you distribute intelligence throughout the network. For example, because the data and routing information can be in the same optical format, the destination can be encoded with the data. This lets you assemble *self-routing packets*, which can steer themselves through the network to their destinations.

At AT&T Bell Laboratories, my colleagues and I have invented all-optical logic gates based on solitons that can operate at speeds of 200 Gbps. Solitons are light pulses that travel distortion-free for long distances in optical fibers. Also, we have demonstrated the components and designed the architecture for an ultrafast optical-fiber-ring LAN that is designed to have a peak data transfer rate of 100 Gbps, making it more than 1000 times faster than today's electronic systems. Although it's in the early stages of research, the optical LAN demonstrates the viability of this technology.

Solitons and Switches

Solitons are self-trapped pulses that arise from the balance between group-velocity dispersion and nonlinearity in an optical fiber. Group-velocity dispersion means that different frequencies of light travel at different speeds, and nonlinearity means that the index of refraction, or optical density, of the glass fiber changes with the intensity of light. Because of these two counteracting effects, the soliton is a stable pulse with a restoring force that makes it behave in many ways like a single particle or fundamental data unit. This is a crucial property for switching applications.

Fibers are an attractive medium in which to make all-optical gates because they have an almost instantaneous response and low-loss and excellent guiding properties—they minimize the natural property of light to diffract and lose intensity over distance. By using long lengths of relatively inexpensive fiber, you can achieve low switching energies for the logic operations.

Soliton-dragging logic gates satisfy all the requirements for devices in a digital optical processor: cascadability (i.e., the ability of one gate to drive a similar gate), fan-out, and the ability to create gates that perform the complete range of Boolean operations. They also have switching energies approaching a picojoule, which is not out of line with high-speed electronic gates. In soliton dragging, the speed, or *propagation time*, of the control pulse depends on whether it propagates alone or if it's accompanied by one or both of the signals. Physically, when the two pulses are coincident, they "chirp" each other, or change each other's center frequency, which leads to a change in velocity because of the group-velocity dispersion in the fiber.

A schematic of a NOR gate is shown in figure 1. The gate is made up of two lengths of fiber (typically the first measures about 75 meters and the second about 350 meters) coupled through a beam splitter and ending in a polarizer. The control, or power-supply pulses, propagate

BYTE ACTION SUMMARY

Much of the bandwidth of optical fiber is not used because electronic switches can't keep up with the speed of optical transmission. Soliton switching lets you eliminate electronic switching in a network. You can thus create *light pipes* that fully exploit optical technology.

along one axis, and the signal pulses are launched into the orthogonal axis.

The system assumes that you are using a clocked digital system, and the logic is based on time-shift keying (i.e., the control pulse arriving within the clock window corresponds to a Boolean one, and any other result is a Boolean zero). For example, in a typical time-shift keyed output from a soliton-dragging NOR gate, the gate is regenerative (i.e., it shows optical-level restoration); at each operation, the signal pulses are replaced by a fresh control and the signals are removed from the system by an output polarizer.

At the boundary of the all-optical system, we used another type of logic gate, a *soliton-trapping gate*, which doesn't exhibit gain or cascadability but is sensitive to the timing of the input pulses and provides an energy contrast at the output. Consequently, the trapping gates convert the time-shift-keyed signal to an amplitude-shift-keyed output, which can be detected and converted to electronic format.

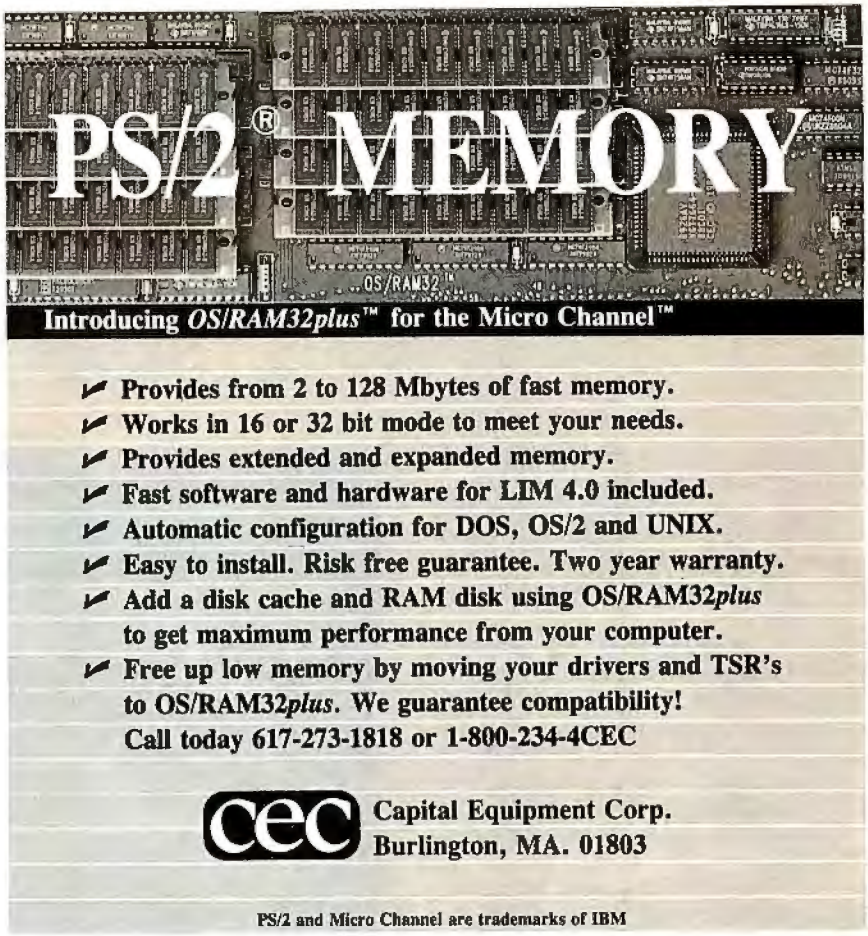
Soliton-Ring Network

To explore the opportunities and challenges of using all-optical devices in system applications, my colleagues have designed the architecture for a soliton-ring network that spans several tens or hundreds of kilometers and that interconnects several hundred users. This is a self-routing packet network in which the packet size equals a typical computer word (i.e., 32 bits), so the network can be used to interconnect computers.

A simple analogy for the nodes, or information-switching points on the network, is a post office with a conveyer belt to move packages. The speed of the conveyer belt and the number of packages that are moved are limited by the speed at which a postal worker can read the addresses and sort the packages. If the worker is a speed reader, the package flow rate can be greatly enhanced. In this network design, four logic gates in the code-matching logic module are used to read the address and decide whether the packet has arrived at the proper destination. Thus, the ultrafast soliton gates serve as a speed-reading postal worker.

The design concentrates on the network access nodes, where data enters or exits the network. The code-matching logic module operates at the bit rate and uses the ultrafast logic gates to select and decode the packet address. The exchange/bypass network operates at the packet rate (i.e., 1.25 GHz) and routes incoming or new packets, and the network can be implemented using electro-optic devices. When the packet reaches its destination, it's bit-rate down-

Circle 89 on Inquiry Card.



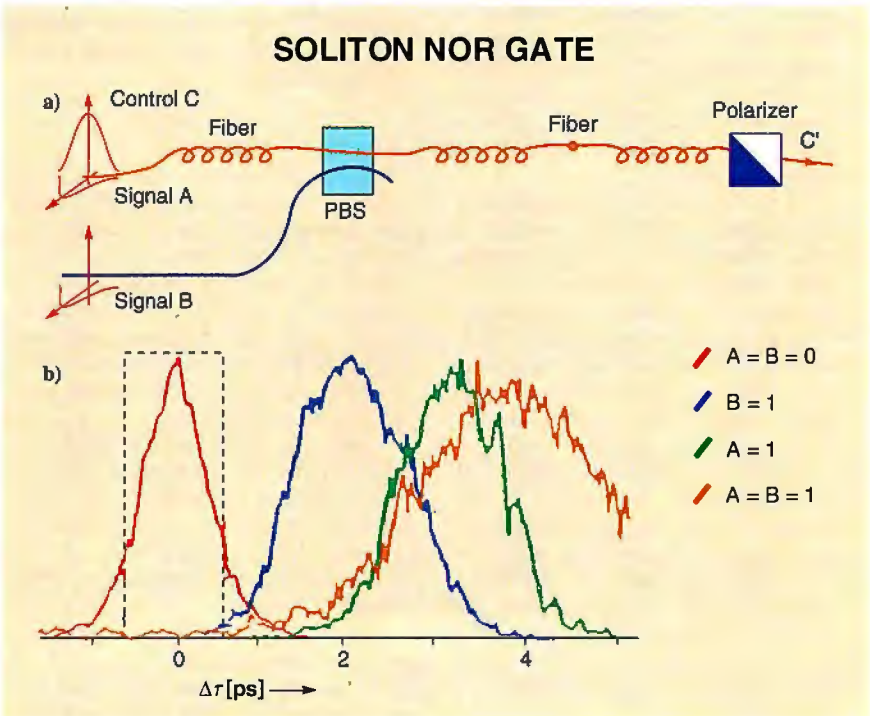


Figure 1: *Soliton-dragging NOR gates can operate at speeds of 200 Gbps, and the logical operation is based on time shifts of a control, or power supply pulse. A NOR gate consists of two fibers connected through a PBS (polarizing beam splitter) and ending in a polarizer* (**a**). *In the output of a NOR gate* (**b**), *the dotted lines correspond to the clock window, and the signal pulses drag the control out of this window in accordance with Boolean logic.*

SONET: A Standard for Today

MARK A. CLARKSON

The world is shrinking, and it's bound tighter and tighter in loops and nets of copper wire and glass fiber. Everything is connected to everything else—telephones to TR-LANs to cable TV, Tokyo to Wichita Falls.

As the information in this global network increases in volume and velocity, the links are increasingly being fashioned of optical fiber. New data services, such as broadband ISDN, require high bit rates, and optical fiber is technically superior to cable at the broadband speeds (about 150 MBps or higher).

SONET (Synchronous Optical Network) is a standard that establishes an optical communications hierarchy, ensuring that optical-fiber networks in every country "speak the same language." First proposed by Bellcore in 1984, the standard is currently under development by ANSI as SONET and by Europe's CCITT as SDH (Synchronous Digital Hierarchy). Thus, SONET and SDH are effectively the same standard.

By defining standardized interfaces, SONET lets you put one company's transmission and switching equipment on one end of the fiber and another company's equipment on the other. Each company can use whatever technologies suit it. Dozens of companies (e.g., Bellcore, AT&T, IBM, and Nippon Telephone & Telegraph) are actively involved in SONET R&D.

SONET is service-independent, with no regard for the contents of the information it carries. Digital electrical signals can be transformed into digital optical signals and put directly on SONET without changing their information content. In existing systems, the contents of an electrical signal have to be modified for broadcast over the fiber network.

SONET provides for high-capacity data links a few miles long. It carries existing services (e.g., voice, video, and ISDN) and has sufficient capacity to handle future demands.

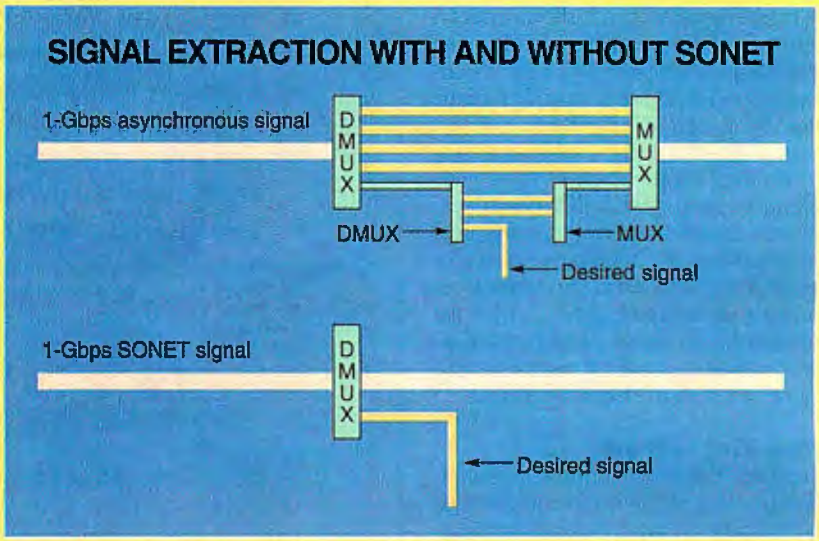


Figure A: *To extract a particular channel from an asynchronously multiplexed signal, the entire signal must be demultiplexed (DMUX) and then remultiplexed (MUX). A single channel can be extracted from a SONET signal with one demultiplexing.*

Virtual Containers

The SONET signal consists of two parts: payload and overhead. Payload is the data being transported over the network (e.g., voice, video, or text). The overhead portion of the signal carries information needed to maintain the integrity of the link, including data parity, frame and channel information, network maintenance information, and user-defined functions.

The payload portion of a SONET signal is carried in VCs (virtual containers). Like real containers, VCs come in an assortment of capacities. For example, a VC-12 carries 2 Mbps. VCs of different sizes are combined to form SONET signals.

VCs can easily be individually added, subtracted, and rearranged as they travel the network. Network providers will be able to dynamically shift bandwidth around the network, providing bandwidth on demand to end users. Also, high-bandwidth links to a customer will be easier to provide and manage.

In addition, VCs provide an advantage over asynchronously multiplexed data. Any change in the allocation of bandwidth within an asynchronously multiplexed signal requires that the entire payload be manipulated. In contrast to that, an individual channel in the form of a VC can easily be stripped from a SONET signal. The remainder of the payload passes by ignored. (See figure A.)

Such convenient signal switching also provides a basis for self-healing networks. In the event of a disruption (e.g., a cut cable or faulty equipment), traffic can quickly be rerouted over alternative links.

But is SONET fast? Its speeds range from 51.84 Mbps (one copy of the *Encyclopaedia Britannica* every 15 seconds) to 2.488 Gbps (three encyclopedias per second). The basic SONET signal is called STS-1.

STS-1 signals can be concatenated, their bytes interleaved, to create higher-speed signals. For example, three 51.84-Mbps STS-1s can be concatenated to

produce one 155.52-Mbps STS-3C. This rate is adequate to transport sophisticated services, such as broadband ISDN.

So What About FDDI?

In contrast to SONET, FDDI (Fiber Distributed Data Interface) is designed to implement LANs over relatively short pieces of fiber. FDDI has an internal clock—it can't be synchronized with the telecommunications networks. SONET could be used to connect FDDI rings, but not vice versa.

In theory, FDDI runs at 100 Mbps. In fact, however, the speed of an FDDI ring drops rapidly as terminals are added, and it's never faster than the slowest node.

Users are seeking broadband services to handle the next generation of computer applications. These applications might involve transporting huge databases around or supplying continuous streams of high-quality audio and video to the desktop.

Europe and Beyond

Optical networks are gaining ground fast in Europe, where tougher noise-emission standards make them preferable to electronic wire-based networks. As Europe's SDH evolves, SONET changes to conform with it. Both standards present a moving target to developers. Most, if not all, implementations are incomplete in one way or another. SONET and SDH have yet to be seen in their final form. Meanwhile, across the Pacific, Japan is moving, perhaps faster than anyone else, to adopt and implement SONET.

Some developers doubt that SONET, which was designed to carry gigabit signals over long distances, will be a factor in linking personal computers to each other and to their peripherals. Others aren't so sure. They think you can always use just a little more speed.

Mark A. Clarkson is a freelance science writer living in Wichita, Kansas. You can reach him on BIX c/o "editors."

converted, or demultiplexed, to speeds accessible by electronic shift registers. An optical feedback loop is used to synchronize the local clock to the ring data, and optical amplifiers are used to compensate for the insertion and splitter losses.

Future Applications

In general, ultrafast gates enhance the capabilities of networks whenever it is the bandwidth of the switch that limits system performance. Although the latency (i.e., delay between I/O) of the fiber gates described here is long, the devices can be used in pipelined feed-forward applications. Telecommunications applications tend to be relatively insensitive to latency, and examples of such applications that require serial terabit-rate switches include high-performance front/back ends of long-haul systems, LANs, and metropolitan-area networks.

You can also use ultrafast gates for high-speed encoding and decoding of signals to guarantee secure transmission. In addition, if the latency of all-optical gates can be reduced by using more nonlinear materials, you could find applications in distributed computing systems. Computer networks may benefit by using high-speed gates for clock synchronization and communication between memory and processors, workstations and processors, or multiple-processor machines.

All-optical devices and systems are still in the infancy of their development, and several technological areas require major breakthroughs before the field can thrive. The crucial device issue remains the lowering of the switching energy and the exploration of novel nonlinear materials to make compact devices with reduced latency and increased thermal stability. Perhaps the main missing component for all-optical systems is a compact laser source with average power approaching a watt that can act as the power supply.

Although commonly overlooked as an "engineering detail," accurate time-synchronization circuits are needed for bit periods approaching a picosecond. Finally, in a broader context, researchers and designers must craft architectures that use the switch bandwidth to enhance the capabilities of the system, enabling this ultrafast technology to make an impact. The day when network bandwidth ceases to be a limitation in your applications is in sight. ■

Mohammed N. Islam is a research scientist at the AT&T Bell Laboratories (Holmdel, NJ) and a consultant at the Lawrence Livermore National Laboratory. You can reach him on BIX c/o "editors" or on the Internet at mni@spin.att.com.

Announcing the

BYTE EURODECK

The First Computer Postcard Deck Targeting the Exploding European Market!!!

By the end of 1992, the European Community will be a $14 trillion market. In fact, behind the US, it's the largest microcomputer market in the world!

If you are a BYTE subscriber in Europe, watch for the new EURODECK coming to you soon! The BYTE EURODECK contains a selection of state-of-the-art products important to you and your business.

Advertisers!
The BYTE EURODECK offers you a unique direct mail approach to increasing sales in this fast-paced computer market.

Circulation of the BYTE Eurodeck is targeted to 50,000 computer buyers in over 20 countries in Western Europe. Take full advantage of the benefits of the upcoming unification of Europe in 1992! For information on the next BYTE EURODECK,
call Jim Ball today at
603-924-2533!

Companies outside of North America, please contact your local representative.

THIS IS WHAT A MASSACRE LOOKS LIKE IN THE WORLD OF APPLICATION DEVELOPMENT.

DATAPRO
DBMS USER SURVEY

	PROGRESS SOFTWARE	SYBASE	INFORMIX	INGRES	FOCUS	ORACLE
ATTRIBUTES						
Reliability	9.3	8.7	8.9	8.1	7.7	8.8
Ease of Use	9.1	8.2	8.2	7.9	7.9	7.4
Ease of Install/Upgrade	8.9	8.0	8.8	7.1	8.1	7.6
Price/Perform Return	9.1	8.3	8.5	7.5	8.1	7.1
FUNCTIONALITY						
Flexibility	9.1	8.8	8.6	9.0	8.4	8.6
Interface Capabilities	8.9	8.9	8.4	8.7	8.7	8.0
Comprehensiveness	9.1	8.8	8.8	8.3	8.7	8.7
User Friendliness	8.9	7.7	8.3	7.9	7.5	7.3
OS Compatibility	9.6	8.4	8.9	9.1	8.8	9.0
PRODUCT SUPPORT						
Documentation	9.0	8.2	8.6	5.7	6.2	7.3
Vendor Training	8.7	7.9	8.0	7.2	7.6	8.0
Problem Response Time	8.8	7.5	7.2	6.1	6.4	6.7
Quality of Vendor Support	9.0	7.8	7.6	6.4	6.9	7.0
Frequency of Releases	8.5	7.5	6.7	7.2	7.7	7.2
Response to User Request	8.8	7.5	7.8	7.0	7.0	7.3
Overall Satisfaction	9.3	8.7	8.5	8.3	8.0	7.9

Compiled from the 1991 Datapro Reports on Software/Computer System Series Software, available for each product listed (Sybase from 1992). The results are those of actual users of the products as surveyed by Datapro.

VARBUSINESS
DBMS REPORT CARD

	PROGRESS SOFTWARE	INFORMIX	ORACLE	ASHTON-TATE	INGRES
PRODUCT FEATURES					
Ease of use	9.02	7.07	6.00	6.19	5.90
Memory requirement	7.37	6.16	4.25	6.19	5.22
Ease of programming	9.03	7.09	6.06	6.20	5.90
Ability to manipulate data	9.19	7.41	7.44	6.81	5.67
Sorting capabilities	9.02	7.44	7.69	6.65	5.78
Provision for software security	8.56	6.93	7.28	5.07	5.78
Report writing capabilities	8.39	6.72	6.59	5.71	4.11
Ease of use of interface	8.51	7.05	6.15	6.10	6.10
Software integration capabilities	8.34	7.26	7.24	6.27	6.10
Ease of data retrieval	9.08	7.68	7.66	6.61	6.11
Satisfaction with product profitability	8.26	7.04	6.22	5.58	5.13
Overall quality of product	8.94	7.37	6.69	6.32	5.44
Product Features Average	8.64	7.10	6.61	6.14	5.60
SUPPORT FEATURES					
Provision for customer support	7.74	5.98	5.76	5.77	5.50
Charges for training time	8.88	4.49	4.59	5.64	4.56
Provision for technical support	7.81	5.76	5.72	5.87	5.22
Provision for marketing support	6.89	5.88	6.09	6.13	3.80
Documentation & product information	8.74	6.73	6.56	6.45	5.56
Frequency of updates & revisions	8.35	5.88	6.34	5.57	5.00
Support Features Average	7.73	5.79	5.84	5.90	4.94
Overall Average	8.34	6.66	6.35	6.06	5.38

©1991 VARBUSINESS Software Report Card reprinted with permission.

Rated on everything from performance and reliability to service and support, PROGRESS trounces all of its competitors in the 1991 Datapro user surveys and the 1991 VARBUSINESS Software Report Card.

Topping the Datapro surveys for the fourth year in a row, users give PROGRESS a rating of 9.3 for overall satisfaction. The highest mark ever awarded. Against all comers, PROGRESS is unsurpassed in all 15 categories (okay, we tie once). With a 9.0 or higher in eight categories.

PROGRESS
SOFTWARE

Also, PROGRESS becomes the first product ever to capture all 18 categories of the VARBUSINESS Report Card. Racking up 9's in five categories, where no one else even gets an 8. Anywhere. So, if you're considering a 4GL/RDBMS for building and implementing high performance applications that are fully portable across major platforms, isn't it time you rated PROGRESS? For more complete information, or for our fully functional Test Drive, simply call 800-4 PROGRESS.

PROGRESS applications are fully portable across the broadest spectrum of hardware platforms, operating systems, network protocols and user interfaces. So many, in fact, that we had to list them here in small type: AIX,™ CTOS, HP/UX,™ NOVELL NLM, OSF/1,® OS/2,® OS/400,™ UNIX,® ULTRIX,™ VMS,™ XENIX,® MICROSOFT® WINDOWS,™ X WINDOWS,™ DECNET,™ LAN MANAGER,™ NETBIOS,™ NOVELL® SPX/IPX, TCP/IP and SNA APPC LU 6.2. Also, PROGRESS lets you process information in other databases, including AS/400, C-ISAM,™ CT-ISAM,™ ORACLE, Rdb, and RMS. BYTADV05

Circle 149 on Inquiry Card (RESELLERS: 150).

IS WHAT YOU SEE WHAT YOU GET?

Since images are optical, why not process them optically?

DAVID CASASENT

Improvements in performance and resolution have benefited traditional image-processing applications such as robotics, product inspection, reconnaissance, earth resources, and missile guidance. But despite advances in storage and processing speed, it is increasingly difficult to implement many operations in real time without a very large and expensive multiprocessor.

Recent optical pattern-recognition hardware and algorithm advances may offer a solution. Why not process an input optical image directly without converting it to digital data? Photons instead of electrons can perform the processing. (See the text box "Interconnecting the Pieces" on page 192.)

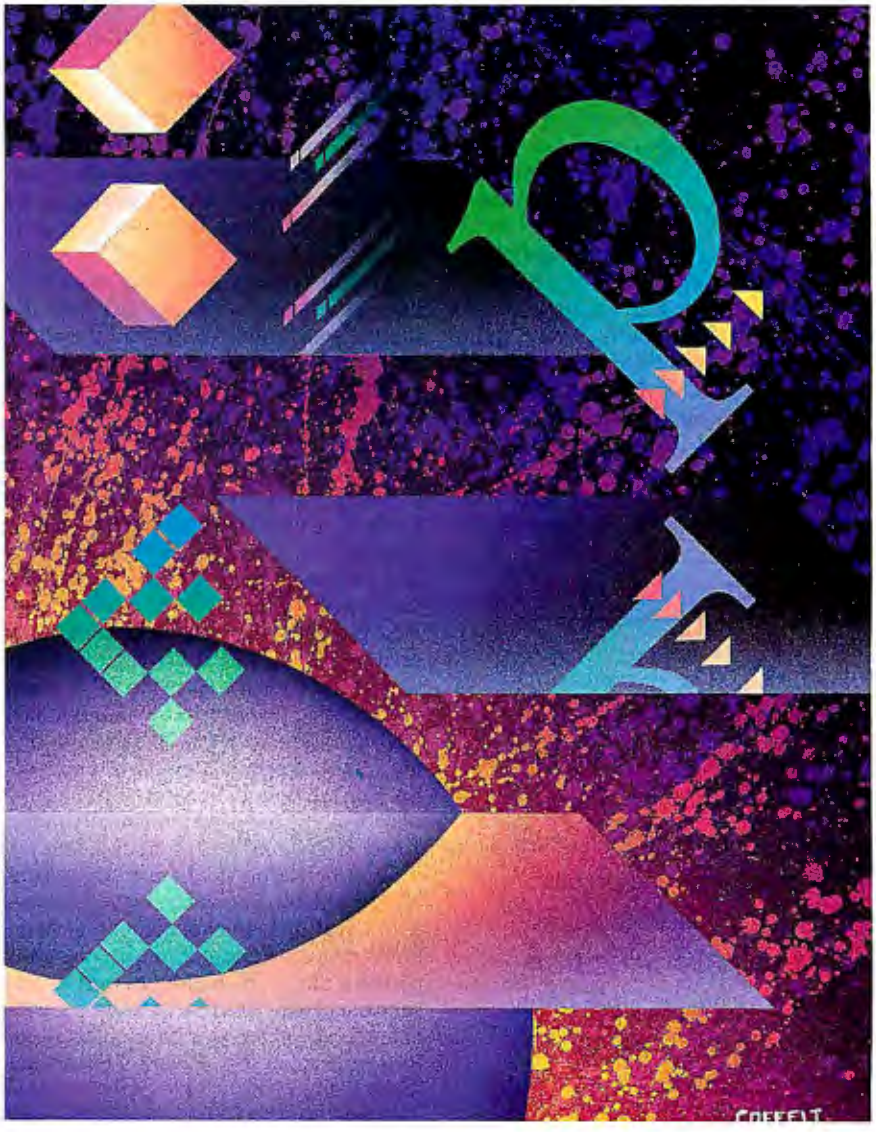


ILLUSTRATION: KEN COFFELT © 1992

What Is Optical Information Processing?

Optical information processing is the use of optical hardware to process data such as images and memory contents, data between processors, and digital—as well as analog—information. Within this broad optical processing category, there are at least five separate elements: computing, interconnections, signal processing, pattern-recognition systems, and neural networks.

Optical computing refers to the use of optical-processing techniques and devices to perform logic and numeric operations to produce general-purpose optical computers or special-purpose optical coprocessors. *Optical interconnections* are unique since the paths of photons can cross without any interaction or cross talk. You will be able to optically interconnect electronic components to reduce computer clock skew, size, and volume and to improve speed, fan-out, and fan-in.

continued

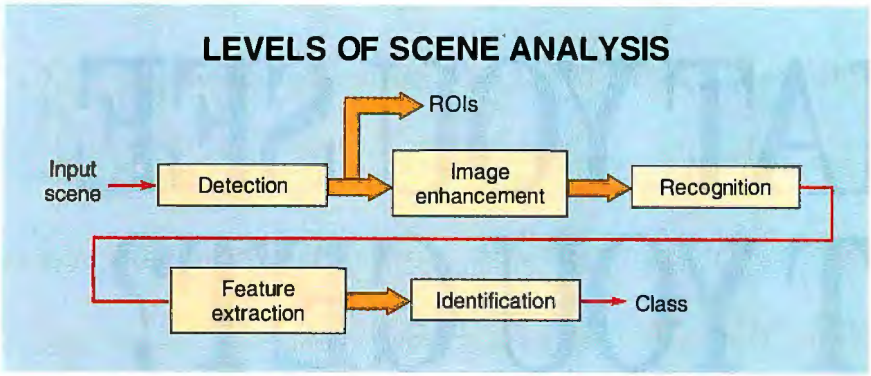


Figure 1: *The first two operations let you locate and enhance a candidate ROI (region of interest) in a scene. Then, typically, you calculate features that describe the contents of each ROI and input them to a classifier that determines the identity of the object in each ROI.*

Optical signal processors will be used for high-speed RF signal-processing functions in radar and electronic warfare. *Optical pattern-recognition systems* already perform image-processing and image-recognition functions to locate and identify objects in a scene that has clutter, multiple objects, and object distortions. This process is referred to as *scene analysis.*

For example, if you want to perform image processing for robotics or product-inspection applications, you need to locate the objects of interest in the field of view and then identify them and their orientation. This technique is called *pattern recognition.* (In product-inspection applications, the location of the object is generally known.) The operations required are feature extraction, determination as to whether or not an item (i.e., a product) is good or defective, and discovery of the nature of any defect. Finally, *optical neural networks* are coming into being for use in applications such as control, optimization, and classification.

BYTE ACTION SUMMARY

It has become more difficult to implement many operations in real time without a very large and expensive multiprocessor even though progress has been made in storage and processing speed. Advances in optical-information-processing hardware and techniques may offer solutions to this challenge.

What Do You Need?

One application for which optical processors are being used today is scene analysis. Processors for this purpose can use optical-image-processing, pattern-recognition, and neural-network techniques. If you want to combine these approaches, you can try using a hierarchical/inference approach (see figure 1), with each level of the system having a different purpose and function. A plan such as this is OK if the use of optical processing can address each level using the same multifunctional optical architecture. Figure 2 shows how an optical correlator system achieves each of the separate operations in figure 1.

The optical correlator system in figure 2 can achieve a wide variety of improved processing functions using different filters at P_2. *Correlation* is a process that locates objects *h* in a scene *f*. The operation involves placing *h* over each region of *f* and measuring the similarity of *h* and each local portion of the image. The output correlation pattern has peaks at those locations in *f* that most closely resemble *h* in a scene. Thus, you can locate multiple objects in a scene with this operation. In figure 2, the correlation is performed by multiplying the Fourier transforms of *f* and *h*, thus avoiding the need to manually move *h* over *f*.

With detection filters and structuring element filters, you can achieve all morphological or low-level computer-vision functions on a scene at P_1. These functions perform clutter reduction as well as enhancement and detection of ROIs (regions of interest). Once you have selected an ROI, you input it to P_1 and then extract features from it.

When different CGH (computer-generated-hologram) filters are placed at P_2, different features' spaces are produced at P_3. The locations and values of P_3 outputs denotes the amount of a given feature that is present. Many successful product-inspection applications use these optical feature-extractor systems.

These same features are then input to a classifier that performs the identification. (Classification is the final process that denotes the identity of each object that's in a scene—and often, too, its orientation and scale.) In this case, I'll use a neural-network classifier whose analog input neurons are these features.

These input neurons are massively interconnected to a second layer of neurons where a nonlinear weighted sum of the input neuron values is produced. Free-space optics (i.e., optical techniques using space instead of fiber as the medium) is an especially attractive way to provide the interconnection weights. (Recall that two photons can cross without any cross talk or interference; electrons and wire connections create all sorts of cross talk and interference problems.) It is also worth noting that a correlator is a most powerful shift-invariant neural network. (*Shift*, or translation, *invariance* refers to a system's ability to classify an image wherever the image appears in the visual field.) In this type of neural network, the P_2 filter is the set of weights that are simultaneously applied to all local P_1 regions (by multiplying the local P_1 neurons and summing each local product into a correlation peak output at P_3).

The advantage of neural networks over conventional classifiers is that they can simultaneously calculate multiple discriminant functions and combine them into the

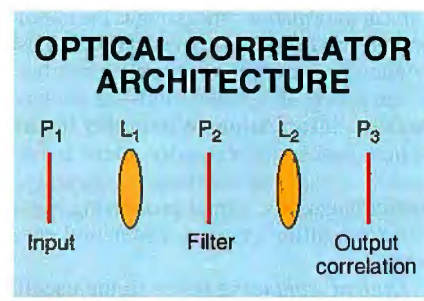


Figure 2: *You can use this optical system to compute a wide variety of features. The input image is placed at P_1, a filter is placed at P_2, and the correlation of the input and filter function appears at P_3. By using various P_2 filters, you will find that this architecture can achieve all major low-, medium-, and high-level computer-vision operations and all functions needed in figure 1.*

COMPUTING KNOW HOW

with computer books from Abacus

DR DOS 6.0 Complete

The user's guide to running DR's new DR DOS 6.0 operating system. From introduction, to the basics, to using and understanding DR DOS 6.0, you'll learn to optimize your DR DOS system to your needs.

Item #B144. ISBN 1-55755-144-8. Suggested retail price $34.95 with 3.5" companion diskette.

DOS 5.0 Complete Special Edition

Learn the 'ins and outs' of DOS 5.0.

- Using the new SHELL, DOSKEY, EDIT, and QBASIC
- Complete comprehensive DOS command reference section
- Includes **Tempest** - the graphic shell for DOS 5.0

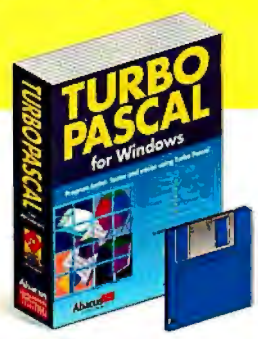
Item #B151. ISBN 1-55755-151-0. $39.95 with **Tempest** and utilities disk.

PC Intern

The encyclopedia of DOS programming know how for the professional programmer. Includes parallel working examples in ML, C, Pascal and BASIC.

- DOS and BIOS internal structures and functions
- Programming video cards, sound and TSRs

Item #B145. ISBN 1-55755-145-6. $59.95 with over 2mb of source code on one diskette.



Turbo Pascal for Windows

Introduction to the standard elements of Turbo Pascal.

- Development of the WinCrta, WinCrt and WinDOS units
- Comprehensive coverage of the Object Oriented Programming (OOP) features

Item #B141. ISBN 1-55755-141-3. Suggested retail price $39.95 with 3.5" companion diskette.

Windows 3.1 Complete

Learn to optimize & customize Windows 3.1.

- Improve your productivity with the built-in Windows applications
- Includes dozens of useful tips and techniques
- Includes two valuable Windows utilities: Backup & SnapShot

Item #B153. ISBN 1-55755-153-7. $34.95 with Windows utilities disk.

Windows 3.1 Intern

Introduces the reader to the overall concept of Windows programming and events using dozens of easy-to-follow examples. It's a solid guide for beginning to intermediate Windows programmers who need to know more, faster.

Item #B159. ISBN 1-55755-159-6. Suggested retail price $39.95 with 3.5" companion diskette.

The 486 Book

Explains the features that make this processor so advantageous - the memory capabilities, the math coprocessor, the specialized software that maximizes the CPU's performance and more.

Item #B155. ISBN 1-55755-155-3. Suggested retail price $34.95 with 3.5" companion diskette.

OS/2 COMPLETE

From installation, to overview, to the basics of the Presentation Manager, you'll learn how to take full advantage of this new operating environment.
Item #B157. ISBN 1-55755-157-X. Suggested retail price $24.95.

Stepping Up To OS/2 V2

The upgrader's guide to learning OS/2 in a hurry. ISBN 1-55755-160-X. Item #B160. Suggested retail $16.95.

Available at B. Dalton Booksellers, CompUSA, Crown Books, Software etc, Waldensoftware, Computer City, and other retailers nationwide. In the UK call Computer Bookshops 021-706-1188. In Australia call Pactronics 02-748-4700.

Abacus

Dept. B9, 5370 52nd Street SE, Grand Rapids, MI 49512
Phone: (616) 698-0330 • Fax: (616) 698-0325

Order Toll Free 1-800-451-4319

In US and Canada add $5.00 postage.
Foreign orders add $13.00 postage per item. We accept Visa, Mastercard or American Express.

Circle 71 on Inquiry Card (RESELLERS: 72).

Please rush me the following books:

___ DR DOS 6.0 Complete	$34.95 ea.
___ DOS 5.0 Complete S.E.	$39.95 ea.
___ PC Intern	$59.95 ea.
___ Turbo Pascal for Windows	$39.95 ea.
___ Windows 3.1 Complete	$34.95 ea.
___ Windows 3.1 Intern	$39.95 ea.
___ The 486 Book	$34.95 ea.
___ OS/2 COMPLETE	$24.95 ea.
___ Stepping Up to OS/2	$16.95 ea.
Subtotal:	
CA & MI orders include correct sales tax:	
In US & Canada add $5.00 shipping:	
Foreign orders add $13.00 per item:	
Total amount (US funds):	

For fast delivery Order Toll Free 1-800-451-4319 EXT. 29, or FAX (616) 698-0325

Or mail this coupon to: Abacus, 5370 52nd Street SE, Grand Rapids, MI 49512

Method of Payment: ❑ Visa ❑ Master Card ❑ Am.Express ❑ Check / M.O.

Card#:|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| Expires:___/___

Name: _____

Company: _____

Address: _____

City: _____ State: ___ Zip: _____

Phone#: _____ Fax#: _____

❑ **Yes, please rush your free catalog of PC books and software.** Dept. B9

Interconnecting the Pieces

SING H. LEE

Optical interconnections is the term often used to describe optical communication channels linking functional units in a digital computing system. At times, it also is used to refer to the use of optics to link a number of computers for distributed processing.

Performing interconnections optically offers several important advantages over performing them electrically. Among these benefits are higher speed and larger bandwidth, freedom from electromagnetic interference or crosstalk, and less drive power when the interconnection distance is longer than the break-even line length. (*Break-even line length* refers to the interconnection distance over which a level amount of energy has to be supplied at the input to achieve interconnection.)

Other advantages of using optical interconnections include fan-out without impedance discontinuities that cause unwanted reflections, freedom from planar and quasi-planar constraints, and the ability to implement parallel pinout. All result in higher interconnection density. For the end user, these benefits result in higher-performance computing systems that are more compact and consume less power.

The field of optical interconnections is still in its infancy, although some successful examples of optical interconnections have begun to surface. One such example is the connection of computers via optical fiber with the implementation of the FDDI (Fiber Distributed Data Interface) standard. Operating in this mode provides a tenfold improvement over Ethernet speeds.

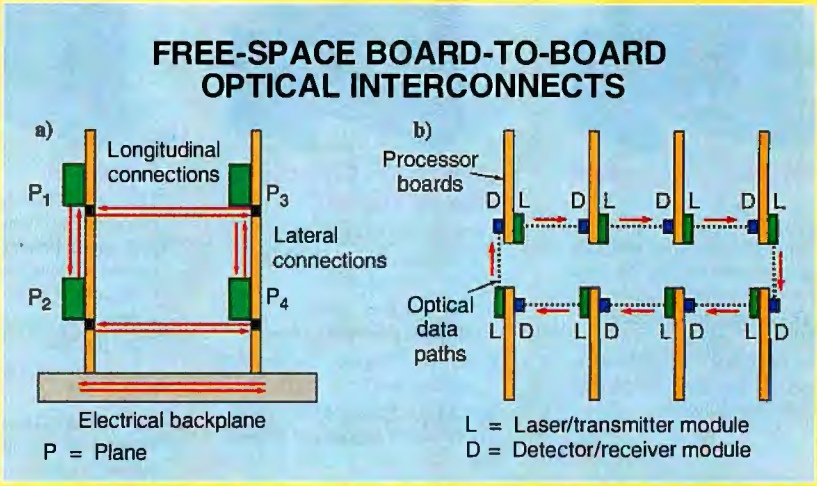


Figure A: *MIT Lincoln Laboratory research:* **(a)** *experimental module of 1-Gbps digital data links and* **(b)** *application of the high-speed data link to connect RISC-based multiprocessors on a number of boards into a ring network.*

Waveguides

Many current activities in the field are devoted to researching the applications of optical waveguides and diffractive optics. (See the glossary "Unbending Lightwave Terminology" on page 171.) These techniques solve some of the board-to-board and chip-to-chip interconnection problems encountered in high-performance computers as well as in multiprocessor parallel computing systems.

Generally, optical waveguides can provide higher interconnection densities than fibers, because fibers typically have larger dimensions—the bulk of which are associated with the cladding of fibers. Also, waveguides can be bent with smaller radii than fibers, and they can be more easily fabricated using standard microfabrication procedures. Researchers at Honeywell are working

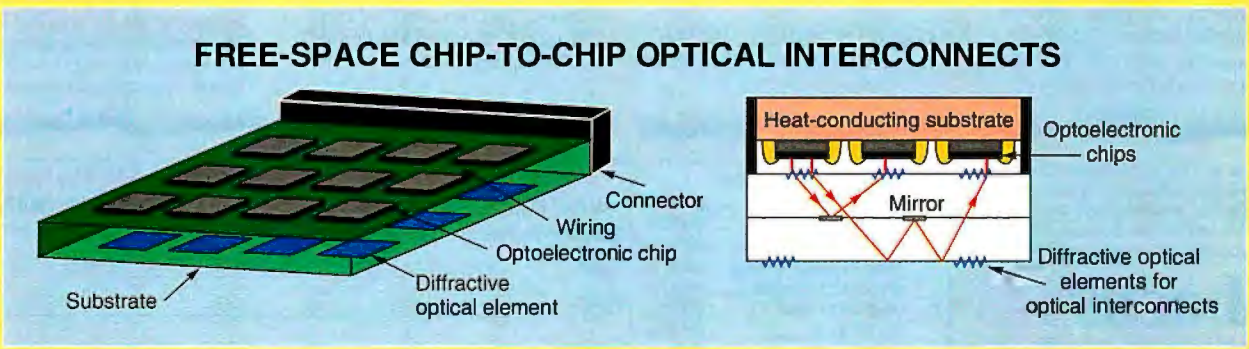


Figure B: *Optically transparent substrates are the medium used for free-space transmission in* **(a)** *AT&T's packaged module and* **(b)** *UCSD's packaged module.*

on the design of a high-density optical backplane that uses polyimide waveguides to connect many processing elements on different boards.

Researchers at the University of Arizona are working on another type of optical backplane. Polyimide waveguides are not used in this design. Instead, university scientists are employing holographic or diffractive optical elements (e.g., diffraction gratings) and the phenomenon of total internal reflection (i.e., total reflection of the optical beams between the side walls of the dielectric substrate) to guide the interconnecting beams from board to board. Since these beams are not restricted to propagating only on the surface of the substrates, it may be possible to achieve interconnection densities that are even higher than those achieved when waveguides are used.

Free-Space Techniques

Researchers at MIT's Lincoln Laboratory also are experimenting with free-space board-to-board interconnection modules (see figure A). Free-space optical interconnections allow for freedom from planar or quasi-planar constraints. (See the text box "Smart Pixels and Free-Space Interconnection" on page 174.) AT&T also is experimenting with free-space optical interconnection techniques. In much of its massively parallel optical interconnection work, scientists at AT&T are using off-the-shelf optics, custom optics, lenslet arrays, optical bistable SEED arrays, and microlaser arrays.

Applying free-space optical interconnections to chip-to-chip interconnections offers parallel pin-outs that would lead to even higher interconnection densities and large fan-out without impedance discontinuities. This would result in improved signal-to-noise ratios. Figure B shows the approaches that AT&T and UCSD (University of California at San Diego) are trying, to replace layers of electrical interconnections by free-space optical interconnections.

One important challenge facing free-space interconnection technology is packaging. Researchers at AT&T and UCSD are working on this challenge, especially in the area of packaging electronic systems that use diffractive optical elements to perform chip-to-chip interconnections and a transparent substrate for the free-space medium.

Global Interconnection Efforts

The development of optical interconnection technology is, of course, not limited to activities in the U.S. In fact, there are very strong efforts both in Japan and in Europe. For example, optical interconnections is an important part of MITI's recently launched Real World Computing program—a 10-year program with participation from many strong industrial and academic institutions, including Fujitsu, NEC, Mitsubishi Electric, Oki Electric, Hitachi, the University of Tokyo, and the University of Osaka.

At NTT, a Cosine-2 project is devoted to building a multiprocessor system using automatically rearrangeable free-space multichannel optical switches. In Europe, the focus of the Esprit II Olive program is on optical interconnections for VLSI and electronic systems. Five industrial and five academic institutions are participating in this 60-workforce-year effort.

Because of all the concurrent activities and efforts taking place around the world aimed at developing optical interconnection technology, it isn't easy to predict how much optics future computing systems will use. However, it appears safe to say that there will be more optical devices and techniques put into computers.

Present-day computers are designed to minimize interconnections. Given a technology that could support thousands of interconnections operating at a gigabit per second each, it will be interesting to see if the architecture of future computers will remain the same or change dramatically.

Sing H. Lee is a professor of electrical and computer engineering at the University of California–San Diego. You can contact him on BIX c/o "editors" and on the Internet at shlee@ucsd.edu.

higher-order surfaces needed to discriminate many classes of objects. Optical systems are not able to easily support all the operations required in advanced neural-network learning algorithms. Thus, for learning, you use digital-hardware neural networks to calculate the required weights.

After learning has finished, you download these weights to an optical neural network. When a neural network is used as a classifier, it is a one-pass feed-forward system with no iterations, and optics provides the multiplications, additions, parallel free-space interconnections, and nonlinear functions required. Many other uses exist for neural networks (e.g., control and retinal modeling) besides their use as classifiers.

But Can I Buy It or Build It?

Perhaps five years ago, you briefly considered optical processing. You probably dismissed the idea, however, because of those huge optical benches or 2-foot-long lasers necessary to carry out the process. Also at that time, optical processors could perform only a limited number of image-processing functions. You had to use a different optical system every time you wanted to carry out another function. Besides, you couldn't go out and buy a unit or order one as a peripheral for your vision system. Well, things have changed.

Soon you will be able to more easily create your optical image-processing system.

DARPA (Defense Advanced Research Projects Agency) has now established a consortium of optoelectronic suppliers and users. Although it's not the Japanese MITI, it is bringing together sources and users. DARPA has also launched a program called TOPS (Transition of Optical Processors into Systems). TOPS's mission is to develop modular optical image- and signal-processing hardware for the major data-processing functions. With the implementation of this consortium and

A Message To Our Subscribers

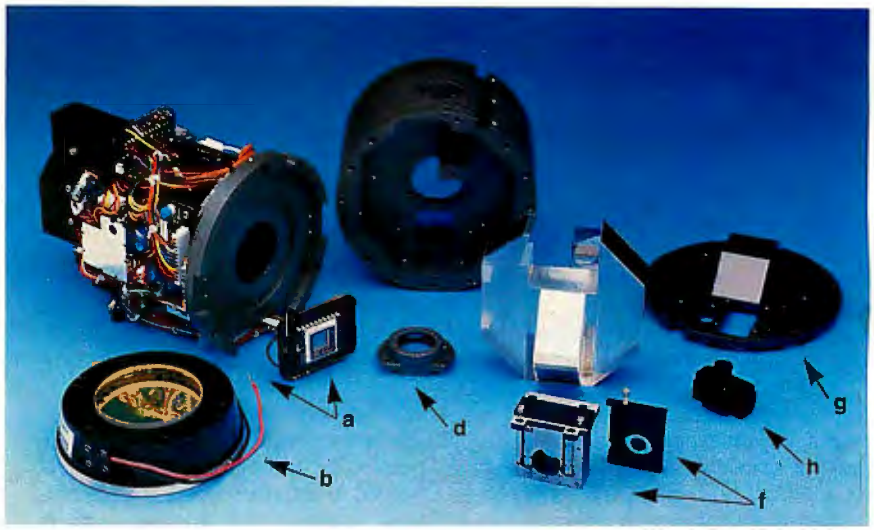
From time to time we make the BYTE subscriber list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services or information we feel would be of interest 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

IS WHAT YOU SEE WHAT YOU GET?



The Solid Block MCSS Optical Correlator, developed by OCA Applied Optics (Garden Grove, CA), is contained inside a 4-inch-diameter cylinder. It looks at a scene through a lens with a 200mm focal length and outputs a live black-and-white video image. The components are **(a)** *the input optics and CCD (charge-coupled device) camera electronics: A 200mm lens forms a white-light input image onto the spatial-light modulator, and the camera records the correlator's output;* **(b)** *the spatial-light modulator: A liquid crystal light valve converts the input imagery's intensities into modulated polarizations that are imprinted onto the internal laser beam. These polarizations are converted back to equivalent intensities, but now they are in laser light;* **(c)** *the main housing;* **(d)** *the FT (Fourier transform) lens, which performs a 2-D FT of the input scene and images it onto the matched spatial filter;* **(e)** *the solid-block-prism assembly, which folds the correlator's optical path into a small rugged package and guarantees the optical alignment of the fold mirrors;* **(f)** *the matched spatial filter and cell, which kinematically register the photographic FT in the optical path at the FT plane: The filter diffracts all the laser energy from the object it "recognizes" into a focused spot on a CCD chip, and all other energy is scattered into a low-level background signal;* **(g)** *the rear cover; and* **(h)** *the diode laser, which is the source of coherent light for the correlator, required for FT analysis. The laser beam is confined within the correlator.*

program, soon you will be able to more easily create your own optical image-processing system.

Many recent developments in optical-processing hardware have now made it practical to build optical systems. Teledyne Brown Engineering (Huntsville, AL) has produced an optical correlator that uses modular optical elements and a solid-optics construction (i.e., no air gaps) to reduce vibration and other external effects.

Litton Data Systems (Van Nuys, CA) is currently fabricating a system called the Hockey Puck Optical Correlator. In this system (which is the size of a hockey puck), the manufacturer has mounted the optical components (all of which operate in reflection mode) around the perimeter of the device.

Through a subcontract to Optical Corp. of America (OCA) Applied Optics (Garden Grove, CA [formerly Perkin Elmer]), the Jet Propulsion Laboratory in Pasadena, California, assembled an optical correlator that is 100 millimeters in diameter and 50 mm thick (see the photo). It is to be used by MICOM (the U.S. Army Missile Command in Huntsville, Alabama). The Japanese have fabricated an optoelectronic neural-network chip, one of the first of its kind.

These are merely a few of the present optical image-processing algorithms and hardware. When the proper sequence of correlation filters is used in the hierarchical inference system of figure 1, they provide a general-purpose, programmable, optical scene-analysis processor that achieves low- to high-level computer-vision functions. ■

David Casasent is George Westinghouse professor and director of the Center for Excellence in Optical Data Processing at Carnegie Mellon University in Pittsburgh, Pennsylvania. You can contact him on BIX c/o "editors" or on the Internet at marlene@gauss.ece.cmu.edu.

Optical Product Sampler

The following companies offer products based on optical technology.

OPTICAL CORRELATORS

Litton Data Systems
8000 Woodley Ave.
Van Nuys, CA 91406
(818) 902-4000
fax: (818) 902-5052
Circle 1162 on Inquiry Card.

OCA Applied Optics
7421 Orangewood Ave.
Garden Grove, CA 92641
(714) 895-1667
fax: (714) 895-4356
Circle 1163 on Inquiry Card.

Teledyne Brown Engineering
P.O. Box 070007
Huntsville, AL 35807
(205) 726-1000
fax: (205) 726-1033
Circle 1164 on Inquiry Card.

OPTICAL MASS STORAGE

Corel Systems Corp.
1600 Carling Ave.
Ottawa, Ontario,
Canada K1Z 8R7
(613) 728-8200
fax: (613) 761-9176
Circle 1165 on Inquiry Card.

Digital Interfaces, Ltd.
13 Headlands Business Park
Salisbury Rd.
Blashford, Ringwood
Hampshire BH24 3PB
U.K.
44-425-478811
fax: 44-425-470366
Circle 1166 on Inquiry Card.

Hewlett-Packard Co.
700 71st Ave.
Greeley, CO 80634
(303) 350-4000
fax: (303) 352-3350
Circle 1167 on Inquiry Card.

Hitachi America, Ltd.
Office Automation Division
50 Prospect Ave.
Tarrytown, NY 10591
(914) 332-5800
fax: (914) 332-5834
Circle 1168 on Inquiry Card.

Introl Corp.
2817 Anthony Lane S
Minneapolis, MN 55418
(612) 788-9391
fax: (612) 788-9387
Circle 1169 on Inquiry Card.

Laser Magnetic Storage International Co.
4425 Arrows West Dr.
Colorado Springs, CO 80907
(719) 593-7900
fax: (719) 599-8713
Circle 1170 on Inquiry Card.

Mass Microsystems
810 West Maude Ave.
Sunnyvale, CA 94086
(408) 522-1200
fax: (408) 733-5499
Circle 1171 on Inquiry Card.

Mass Optical Storage Technologies
11205 Knott Ave.
Cypress, CA 90630
(714) 898-9400
fax: (714) 891-5126
Circle 1172 on Inquiry Card.

Micro Design International, Inc.
6985 University Blvd.
Winter Park, FL 32792
(407) 677-8333
fax: (407) 677-8365
Circle 1173 on Inquiry Card.

MicroNet Technology, Inc.
20 Mason
Irvine, CA 92718
(714) 837-6033
fax: (714) 837-1164
Circle 1174 on Inquiry Card.

Mountain Network Solutions, Inc.
240 Hacienda Dr.
Campbell, CA 95008
(408) 379-4300
fax: (408) 379-4302
Circle 1175 on Inquiry Card.

NEC Technologies, Inc.
1255 Michael Dr.
Wood Dale, IL 60191
(708) 860-7600
fax: (708) 860-9500 ext. 1126
Circle 1176 on Inquiry Card.

Online Computer Systems, Inc.
20251 Century Blvd.
Germantown, MD 20874
(301) 428-3700
fax: (301) 428-2903
Circle 1177 on Inquiry Card.

Panasonic Communications & Systems Co.
Office Automation Group
2 Panasonic Way
Secaucus, NJ 07094
(201) 348-7000
Circle 1178 on Inquiry Card.

Peripheral Land, Inc.
47421 Bayside Pkwy.
Fremont, CA 94538
(510) 657-2211
fax: (510) 683-9713
Circle 1179 on Inquiry Card.

Philips Key Modules
2001 Gateway Place, Suite 650W
San Jose, CA 95110
(408) 453-7373
fax: (408) 453-6444
Circle 1180 on Inquiry Card.

Pinnacle Micro
19 Technology Dr.
Irvine, CA 92718
(714) 727-3300
fax: (714) 727-1913
Circle 1181 on Inquiry Card.

Plasmon Data Systems
1654 Centre Point Dr.
Milpitas, CA 95035
(408) 956-9400
fax: (408) 956-9444
Circle 1182 on Inquiry Card.

Procom Technology, Inc.
2181 Dupont Dr.
Irvine, CA 92715
(714) 852-1000
fax: (714) 852-1221
Circle 1183 on Inquiry Card.

Ricoh Corp.
5 Dedrick Place
West Caldwell, NJ 07006
(201) 882-2000
fax: (201) 882-5840
Circle 1184 on Inquiry Card.

Sony Corp. of America
1 Sony Dr.
Park Ridge, NJ 07656
(201) 930-1000
Circle 1185 on Inquiry Card.

Storage Dimensions, Inc.
1656 McCarthy Blvd.
Milpitas, CA 95035
(408) 954-0710
fax: (408) 944-1200
Circle 1186 on Inquiry Card.

Tecmar, Inc.
6225 Cochran Rd.
Solon, OH 44139
(216) 349-0600
fax: (216) 349-0851
Circle 1187 on Inquiry Card.

Ten X Technology, Inc.
4807 Spicewood Springs Rd.
Building 3, Suite 3200
Austin, TX 78759
(512) 346-8360
fax: (512) 346-9580
Circle 1188 on Inquiry Card.

Toshiba America Information Systems, Inc.
9740 Irvine Blvd.
Irvine, CA 92718
(714) 583-3000
fax: (714) 583-3499
Circle 1189 on Inquiry Card.

MEMORY CARDS

Drexler Technology Corp.
2557 Charleston Rd.
Mountain View, CA 94043
(415) 969-7277
fax: (415) 969-6121
Circle 1190 on Inquiry Card.

HOLOGRAPHIC PROCESSORS AND SYSTEMS

Advanced Digital Holographics & Holographic Dimensions
16115 Southwest 117th Ave.,
Unit 21A
Miami, FL 33177
(305) 255-4247
fax: (305) 255-0339
Circle 1191 on Inquiry Card.

Advanced Holographics
10440 Ontiveros Place, Unit 1
Sante Fe Springs, CA 90670
(310) 941-2067
fax: (310) 946-5743
Circle 1192 on Inquiry Card.

American Bank Note Holographics
4 Westchester Plaza
Elmsford, NY 10523
(914) 592-8860
fax: (914) 592-3348
Circle 1193 on Inquiry Card.

The Lasersmith
1000 West Monroe St.
Chicago, IL 60607
(312) 733-5462
fax: (312) 733-5926
Circle 1194 on Inquiry Card.

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.

WE'RE ONLINE. AND IN LINE WITH YOUR OBJECTIVES.

BUSINESS WEEK

AEROSPACE DAILY

AIRPORTS

AVIATION DAILY

AVIATION WEEK & SPACE TECHNOLOGY

BIOTECHNOLOGY NEWSWATCH

BYTE

CHEMICAL ENGINEERING

CLEAN-COAL/SYNFUELS LETTER

COAL WEEK

DATA COMMUNICATIONS

ELECTRIC UTILITY WEEK

ENGINEERING NEWS-RECORD

HAZARDOUS WASTE BUSINESS

INDEPENDENT POWER REPORT

INDUSTRIAL ENERGY BULLETIN

INSIDE ENERGY/ WITH FEDERAL LANDS

INSIDE F.E.R.C.

INSIDE N.R.C.

INTEGRATED WASTE MANAGEMENT

LAN TIMES

NUCLEONICS WEEK

POSTGRADUATE MEDICINE

PLATT'S INTERNATIONAL PETROCHEMICAL REPORT

PLATT'S OILGRAM NEWS

PLATT'S OILGRAM PRICE REPORT

S&P'S EMERGING & SPECIAL SITUATIONS

S&P'S REVIEW OF BANKING & FINANCIAL SERVICES

S&P'S REVIEW OF SECURITIES & COMMODITIES REGULATION

SECURITIES WEEK

TECH TRANSFER REPORT

UTILITY ENVIRONMENT REPORT

THE WEEKLY OF BUSINESS AVIATION

UNIXWORLD

AND MORE. . .

When you need business information, why not get the total story, instantly! Word for word. The McGraw-Hill Publications Online database gives you just that. Unedited, full-text retrieval (except graphics) of articles exactly as they are published in McGraw-Hill magazines and newsletters.

Now you can get information on companies, people and products on any topic — pertaining to one particular industry, or search the entire McGraw-Hill library (over 35 leading publications online) for diverse editorial perspectives. Only McGraw-Hill, the world's foremost business information publisher, can deliver it all so completely — immediately! McGraw-Hill unabridged.

Access an entire universe of business information. Go online with our line. McGraw-Hill Publications OnLine. For more information, including our latest list of publications, contact Andrea Broadbent at **(609) 426-5523**. Or fax this coupon to **(609) 426-7352**.

Or send it to the address below.

Available through Dialog®, Dow Jones News/Retrieval®, NewsNet® and Nexis®.

McGRAW-HILL PUBLICATIONS ONLINE

Princeton-Hightstown Road
Hightstown, NJ 08520 U.S.A.

Please send me the complete 1992 list of your publications online. BY

Name

Title

Company

Address

City State

Zip/Postal Code Country

Tel.

GO ON LINE WITH OUR LINE.

Your network buy for today's business technology market.

McGraw-Hill TechNet

McGraw-Hill Magazines. Your Best Business Partners.

■ 4– Architectural Record ■ 7– A/C Flyer, Aviation Week & Space Technology, AW & ST China Quarterly, AW & ST USSR, Business & Commercial Aviation, World Aviation Directory and Buyer's Guide ■ 20– Business Week, Business Week China, Business Week Hungary, Business Week International, Business Week USSR ■ 28– Chemical Engineering ■ 32C– BYTE, Data Communications, Data Communications International, LAN Times, UnixWorld ■ 39–Electrical World ■ 41– ENR, Construction News Publishing Network (11 magazines, 4 newspapers) ■ 46– Global Finance ■ H6– The Physician & Sportsmedicine, Postgraduate Medicine ■ 114– Modern Plastics, Modern Plastics International ■ 117– Power, Power International

Mc Graw Hill

PROFILES IN DOCUMENT MANAGING

Businesses generate billions of pages and terabytes of data a year; a good DMS can help you keep track of all that information

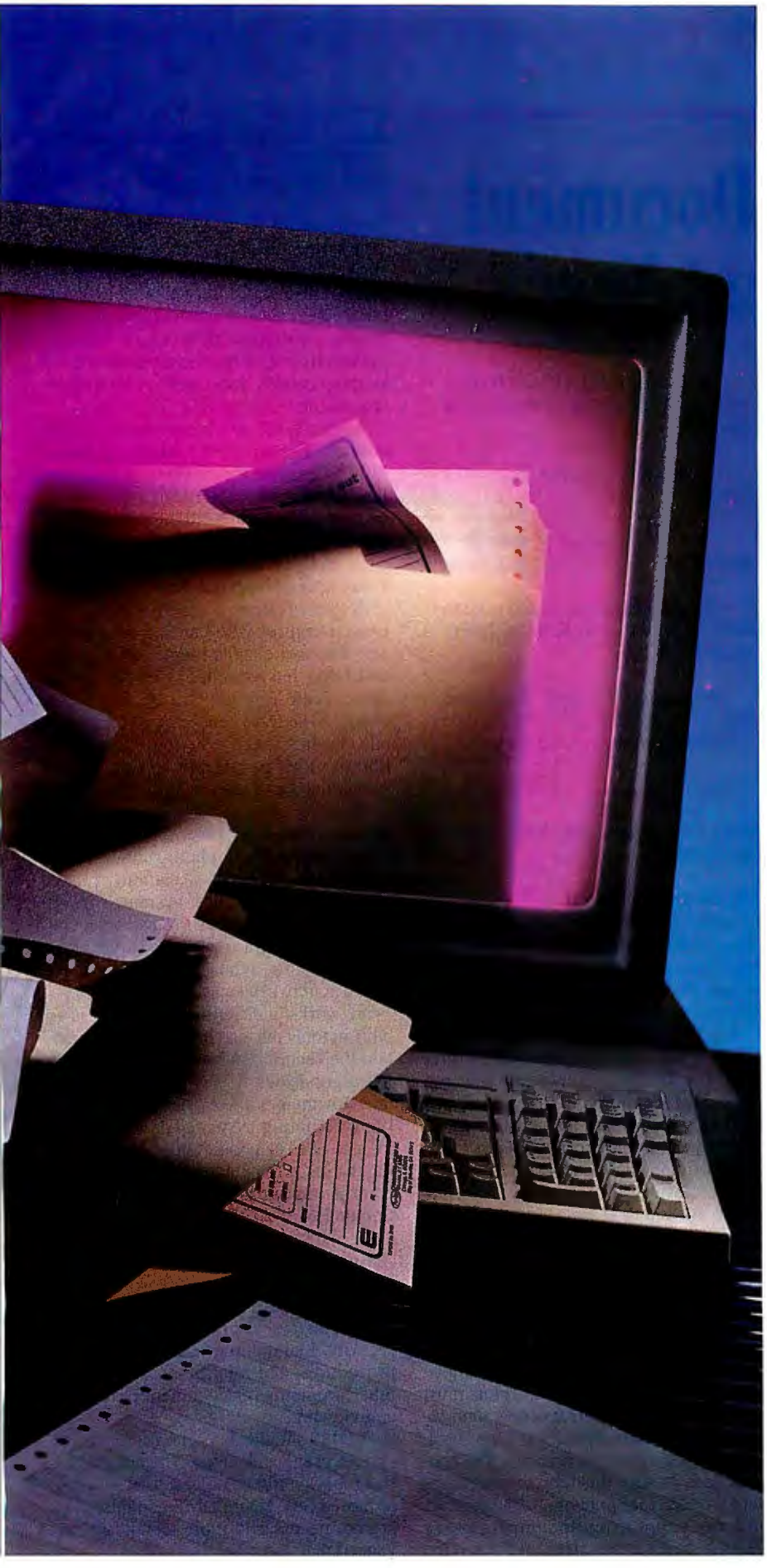
RAYMOND GA CÔTÉ
AND BEN SMITH

Every day, businesses spend countless hours generating and filing forms, reports, contracts, letters, records, marketing material, and engineering diagrams. They also spend hours looking for those documents—or looking not just for one but for a number of related documents. Finding everything in the corporate filing cabinet that has to do with Subject A is not easy with traditional paper-based filing methods, even in the best libraries.

One approach to organizing tons of text is with so-called text management programs (see "Searching for Common Threads," June BYTE). These programs are good at indexing documents and then searching them for specific words or phrases. But DMSes (document management systems) go far beyond that. They file everything—text and images coming straight from a computer or scanned in from paper—in an electronic library, storing it all in a form that can be quickly searched for, retrieved, shared by hundreds of people, and kept in a tiny space. Most DMSes also provide a means for passing documents around, either across a network or from fax to fax. Although they will not reduce the amount of information pouring into your office, DMSes, such as the ones we review here, can help you get a handle on the problem.

In broad terms, DMS products fall into two categories: those designed primarily to handle text (i.e., feeding it into an indexed archive) and those designed primarily to handle images (i.e., turning a page of print into a digital picture and then storing it in an indexed archive); some programs can handle both text and images. For this review, we chose products representative of each approach. SoftSolutions for DOS and PC DOCS (Document Organization & Control System) are indexing and retrieval engines extended with functions to manage the gathering, tracking, storing, and searching of documents. Imara and Keyfile are image-based systems. They handle documents that come in from a scanner or fax, store them as pictures, and provide the means for sharing the library of imaged documents. (See the table

PHOTOGRAPHY: MEL LINDSTROM © 1992



BYTE ACTION SUMMARY

- **WHAT DOCUMENT MANAGEMENT SYSTEMS DO**
  They let you store, search, and manipulate documents electronically to maintain a library of text and images in a compact space.
- **LIKES**
  The ability to conduct fast searches through volumes of data and quickly retrieve documents; reduction in paper clutter.
- **DISLIKES**
  Initial installation and learning curve can be daunting.
- **RECOMMENDATIONS**
  Keyfile 1.0a is a good image management system with an excellent iconic interface. PC DOCS 4.1 doesn't have the extensive search capabilities that SoftSolutions for DOS 3.0 has, but it's still a good, easy-to-use desktop system for managing megabytes of text documents.

for summary information about the four DMSes profiled in this review.) While there are many other DMSes on the market offering a wide range of capabilities (see the text box "Tools for Lassoing the Paper Cyclone" on page 206), the four products we reviewed represent accessible, PC-based systems that won't tax your bank account.The elements of document management are the following:

- document content profiling
- indexed search and retrieval
- document work flow
- access and version control
- administration
- LAN/WAN (wide-area network) support

We examined these main areas as we evaluated the products. They are the basic aspects to consider when you're looking to buy a DMS. Setup and operation are also important. If a DMS isn't easy to learn and use, it will seem more like a hindrance than a helpful tool. Performance is also important, but it will depend greatly on how many documents you have, what type of documents they are, what sort of network you're running on, what your server is, what sort of load it endures, and so on. (See the text box "Evaluating Document Management Needs" on page 200 for more on this subject.)

In our tests, the different systems all

Evaluating Document Management Needs

Document management systems are necessarily complex, but they should be simple to use and manage. To evaluate what you need in the way of document management (or to determine if you even need it), ask yourself the following questions:

√ How many different document formats do I need to manage?

√ How many documents of each format do I anticipate?

√ What are the storage requirements for each format?

√ Do I need full-text searching or will document profile information be enough?

√ How many people will use the system?

√ How much control of work flow do I need?

√ What kinds of access and version control methods will best satisfy my needs?

√ Do I expect to manage distributed sets of documents and need support for a WAN (wide-area network)?

turned up documents quickly, but a more rigorous test for a DMS is an enterprise that handles thousands of pages a day, with dozens of people tapping into the network to hunt for and retrieve documents. In the following sections, we'll discuss the main areas you should investigate when evaluating a DMS.

Profiles

A profile is the information that describes a document. It includes the type of document (e.g., a WordPerfect file, a scanned image in TIFF, a Lotus .WK1 file, and so on) that was entered into the system, who created it and where, where it is stored in the DMS, and other bits and pieces. The profile screen is often the point of entry for using the system.

The work of profiling documents can be time-consuming if done by hand, and the process should be automated as much as possible. A good document management environment will already have information about who created what document, when, and with what application. Some DMSes gather this information by monitoring the system and capturing a document as soon as you store it. (For example, when a PC DOCS user finishes writing a document and closes the file, the DMS automatically grabs the text and adds it to the document library.) The ability to define your own profiles is the mark of a good DMS.

Search and Retrieval

In most DMS installations, finding documents is the most important function. The objective is to locate a specific document as quickly as possible with as little specific information as possible.

A good retrieval system produces a hit list of documents found that contain the word or concept you are searching for. Some DMSes index just keywords and profiles, which means that you can search only keywords and profiles. Others index every word in every document in the system. Retrieval also involves logging a record of document access and launching a viewer for a particular file type.

Work Flow

A real DMS can process documents, shepherding them through stages of editing and review. Different kinds of documents may have to take different paths. For example, a contract may start with a draft that must first be approved by an attorney, then reviewed by concerned parties and the client, and finally returned for revision. The contract goes through this loop several times until it is ready for printing. As the contract and any supporting documents move through their various steps and stops, the DMS has to track their location and contents. A complete DMS can associate a predefined path with a document and track and control what is happening to it.

Version and Access Control

One common danger in working with shared documents is that an early version can be mistaken as the most recent. Another concern is that when different people modify a document, their changes may not get reconciled. A third issue is security—keeping certain documents hidden or unsearchable.

A good DMS provides tools for version control. The simplest systems maintain full copies of all the versions; others keep just the original and a file of any changes made to it; and others maintain a copy of the most recent version and a list of changes that lets you reconstruct any previous version from the most recent one.

Security features let the system administrator control who can see documents and who can change them. Any competent DMS lets you hide documents, and some even hide keywords. The DMS blocks a file from being changed if someone else has already checked it out of the library. Other people may be able to view it, but they can't alter it.

Servers and Networks

Since DMSes are implicitly composed of servers and clients, they naturally run on networks. The simplest systems support only one network, but the more general DMSes can handle distributed collections of documents, where several different kinds of networks may be involved.

Networks and multiuser systems have built-in tools that can help the DMS maintain the security and integrity of data, so it's a good idea to buy a DMS that can take advantage of your network's underlying operating system. The administrator also needs a good interface for accessing the underlying network resources and controls through the DMS's administration tools.

Administration

DMS administration involves more than installing the software and backing up the files. It also means managing access and security, maintaining indexes, enforcing procedures, and interfacing the DMS to other programs for document processing and viewing.

A DMS should also generate reports on system usage and status. The administrative tools should be at least as easy to use as those of the DMS; DMS administrators are not necessarily more technically advanced than the other users.

continued

DOES YOUR DATABASE GIVE YOU SALES REPORTS, INVENTORY AVAILS, PRICE LISTS, CATALOGS, DIRECTORIES, FINANCIAL REPORTS, RATE GUIDES, TABLES, AND SCHEDULES?

CUSTOMIZED? ON DEMAND?

NOT WITHOUT THIS.

Because this is Ventura DataBase Publisher.®

Without it, your database printouts are just a pile of green-bar. Or waiting for a programmer.

With it, you can extract the information you need. Convert it. Format it. And publish it with Ventura Publisher,® PageMaker, or Interleaf—all with push-button simplicity. . . all without programming.

Ventura DataBase Publisher gives you the flexibility to publish database documents when you want. With only the information you want. Any way you want.

If you need to transform data into information, you need Ventura DataBase Publisher.

Don't go without. Make database publishing simple, automatic, and push-button quick. See your local Ventura dealer, or call **(800) 822-8221.**

Ventura DataBase Publisher. When it comes to database publishing, it doesn't get any easier than this.

Ventura Software Inc.
A Xerox Company

15175 Innovation Drive, San Diego, California 92128 • (800) 822-8221

©1992 by Ventura Software Inc. All rights reserved.

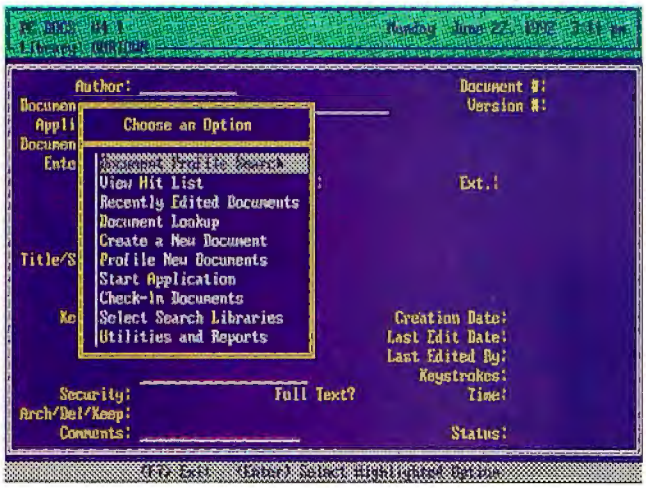
Ventura DataBase Publisher® and Ventura Publisher® are registered trademarks of Ventura Software Inc., a Xerox Company. XEROX® is a registered trademark of Xerox Corporation. All other product names and trademarks are the property of their respective owners.

Circle 178 on Inquiry Card (RESELLERS: 179).

PROFILE OF FOUR DOCUMENT MANAGERS

PC DOCS and SoftSolutions are aimed primarily at managing text files. Keyfile and Imara are primarily for handling documents as images.

	PC DOCS 4.1	SoftSolutions for DOS 3.0	Imara 2.1	Keyfile 1.0a
Price	$295 per workstation	$495 per server, $295 per workstation	$2995 per two users (includes server software)	$995; LAN: Windows, $1995 for 5 users; OS/2, $4995, unlimited users
Platform	DOS	DOS, Windows, Unix	OS/2, Windows	OS/2, Windows
Key features	Document control, full-text searching, version tracking, activity log, NetWare integration, WordPerfect interface, WAN support	Document control, full-text searching, SpeedSearch, activity log, mass importing of documents, version tracking, WAN support	Converts documents to images, E-mail, fax in/out, OCR option, query by form or keyword, iconic interface	Handles images and text, work flow, fax in/out, files-and-folders metaphor, iconic interface



Screen 1: *PC DOCS presents a menu-driven interface. From this point, you can access the program's main functions, such as searching profiles, making new documents, and searching for documents.*

PC DOCS 4.1

PC DOCS is a text-oriented client-/server-based DMS that has DOS clients and a NetWare/Btrieve server. Like SoftSolutions for DOS, it uses character-based menus and forms for document management operations. The program is tightly coupled with NetWare (using Btrieve as its database manager) and WordPerfect, intercepting WordPerfect keystrokes and letting you invoke PC DOCS from within the word processor.

Menus seldom exceed nine items. They can, however, extend three or four levels deep. From PC DOCS's main menu (see screen 1), you can search document profiles, view hit lists, see recently edited documents, look up documents, create new documents, profile new documents, start applications, check in documents, select search libraries, and run utilities as well as reports.

The default operation is a profile search. It is through the profile-search form that you can access the full-text search. The search functions let you create combined profile and full-text searches. Boolean operations are not limited to the full-text search but can be applied in any of the profile fields as well.

With the Search Libraries function, you can look in more than one collection of documents. You can even have the separate libraries on separate servers, as well as under separate directories.

PC DOCS returns from a search with a *hit list*—the list of documents that match the criteria you have specified. As you scroll through the hit list, the top half of your screen pages through a brief summary of the profile of the document associated with the current hit-list item. Retrieving a document means that you are using an external application for viewing or modifying it.

PC DOCS's built-in file viewer is geared to looking at WordPerfect documents, but it can also handle many other word processing files. Looking at documents in the file viewer, however, requires that you select a document from the list and then return to the viewer. This seriously slows down the process of visually selecting documents from the hit list.

Depending on how the administrator sets things up, PC DOCS will let you look at an image file either by launching the application used to generate the image or by using a third-party package to view it. In the case of an image file that contains prose—a Harvard Graphics presentation, for example—you can have PC DOCS add the text to the index.

With PC DOCS, you can interface to just about any DOS application. PC DOCS merely launches the application with the parameters that the supervisor has specified in the application installation and maintenance table.

PC DOCS relies heavily on NetWare and its Btrieve engine for maintaining security, but it also goes further and provides profile-level security and hidden profiles. This DMS controls which users and groups can launch which application programs.

The program's version-control system lets you retrieve any version of a document. You can also start a branch version from any version. For example, if your most recent version is 4, you can still retrieve version 3 and use it to create new versions: 3a, 3b, and so on. This sort of version control is especially useful when you're working with legal documents, where there may be different versions for different jurisdictions.

PC DOCS also lets you check a document out of the system. This essentially locks the document so that no one else can revise it until you return it.

For a DMS, PC DOCS's resource requirements are modest. To run PC DOCS, you need a server running NetWare 286 version 2.15 or 2.2 or NetWare 386 version 3.11. You also need about 1.5 MB of

"The importance of the program cannot be overlooked... it so fundamentally alters the mechanics of mathematics."
New York Times

"Mathematica is a startlingly good tool."
Nature

"Mathematica has the potential to change the world of science at least as much as word processing has changed the world of writing."
InfoWorld

Mathematica®

A System for Doing Mathematics by Computer

Function: Numerical, symbolic, graphical computation, interactive programming. Integrated technical computing environment.

Numerical Computation: Arbitrary-precision arithmetic, complex numbers, special functions (hypergeometric, elliptic, etc.), combinatorial and integer functions. Matrix operations, root finding, function fitting, Fourier transforms, numerical integration, numerical solution of differential equations, function minimization, linear programming.

```
In[1]:=
 3^70
Out[1]=
 2503155504993241601315571986085849
In[2]:=
 Hypergeometric2F1[7,5,4.1,3-I]
Out[2]=
 -0.00403761 - 0.00295663 I
```

Numerical Computation

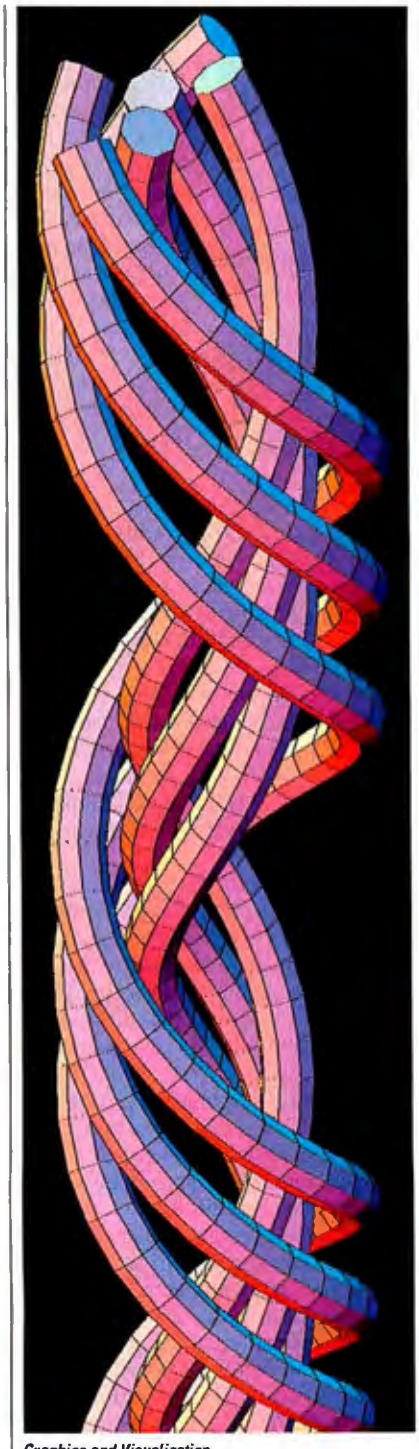
Symbolic Computation: Equation solving, symbolic integration, differentiation, power series, limits. Algebraic operations, polynomial expansion, factorization, simplification. Operations on matrices, tensors, lists, strings.

Graphics and Sound: 2D, 3D plots of functions, data, geometrical objects. Contour, density plots. 3D rendering with intersecting surfaces, lighting models, symbolic descriptions. Combining and labeling graphics. Color PostScript output, publication quality graphics, animation (most versions). Sampled sound generation from functions and lists.

```
In[1]:=
 Integrate[x/(a + Exp[x]), x]
Out[1]=
                                  x Log[1 + E^x/a]
 x^2/(2a) - ------------------ -
                    a
                                  PolyLog[2, -(E^x/a)]
            ---------------------
                    a
```

Symbolic Computation

Programming: High-level, interactive, symbolic system. Full procedural language, functional programming constructs. General transformation rule paradigm based on pattern matching.



Graphics and Visualization

External Interface: Input from external files, programs. Expressions, strings, words, records, numbers (in *Mathematica* or Fortran format), with arbitrary word and record delimiters. Output in TeX, C, Fortran, PostScript. System functions, file manipulation. External function calls, general interprocess communication, and data exchange via *MathLink*™.

Notebook Front End (Macintosh, NeXT, Microsoft Windows): Based on word processor analogy. Notebook interactive documents mixing text, graphics, animations, *Mathematica* input, output. On NeXT and Macintosh, front ends can be used with kernels on other computers, and support sound.

Documentation: *Mathematica: A System for Doing Mathematics by Computer*, Second Edition, by Stephen Wolfram (Addison-Wesley, 1991) available at bookstores. Additional documentation supplied with specific versions. *The Mathematica Journal* published quarterly by Miller Freeman. Many other *Mathematica* books also now available.

Versions Available: Macintosh • MS-DOS • Microsoft Windows • CONVEX • DG AViiON • Digital Equipment Corporation VAX/VMS, RISC ULTRIX • HP 9000 • HP Apollo • IBM RISC Systems/6000 • MIPS • NeXT • Silicon Graphics • Sony • Sun-3 and SPARCstations • Educational, volume, reseller, and other discounts available • Now shipping Version 2.

```
log[1] = 0
log[E] = 1
log[x_ y_] := log[x] + log[y]
log[x_^n_] := n log[x]
log'[x_] := 1/x     (* derivative *)
log/: InverseFunction[log] = exp
log/:
Series[log[x_], {x_, 1, n_}] :=
 Sum[-(-1)^k (x-1)^k/k, {k,1,n}] +
                    O[x,1]^(n+1)
```

High-Level Programming

Implementation: 843 pre-defined *Mathematica* functions (kernel C source 330,000 lines).

Typical Applications: Research, engineering, education, mathematical modeling, publication graphics, data analysis, visualization, systems analysis, algorithm development.

Awards: *MacWelt*, 1991 • *Macworld*, 1990-91 • *Discover*, 1990 • *BYTE*, 1989 • *MacUser*, 1989 • *Business Week*, 1988 • *InfoWorld*, 1988

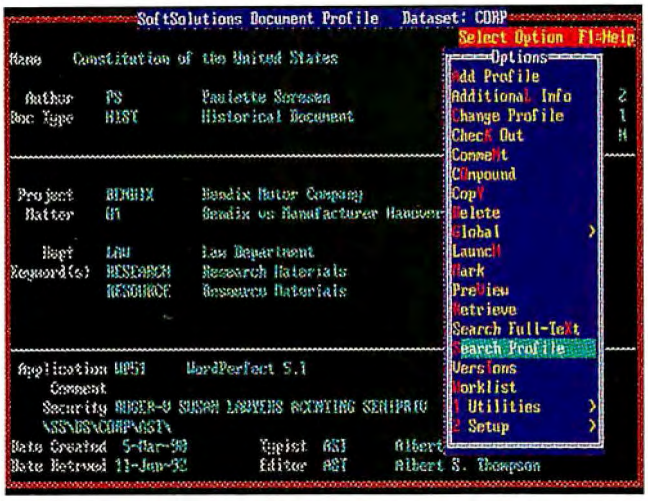
Wolfram Research, Inc.
100 Trade Center Drive, Champaign, IL 61820-7237, USA.
Information: 217-398-0700. Orders: 800-441-MATH.
Email: info@wri.com. Or visit your local software dealer.

© 1989-92 Wolfram Research, Inc. *Mathematica* is a registered trademark and *MathLink* is a trademark of Wolfram Research, Inc. *Mathematica* is not associated with Mathematica Inc., Mathematica Policy Research, Inc., or MathTech, Inc. All other product names mentioned are trademarks of their producers. Prices and specifications are subject to change without notice. Graphic is part of a tubular neighborhood of a six-strand braid generated by *Mathematica*.

For Macintosh information circle 187, for IBM/Compatible information circle 188, for UNIX information circle 189 on Inquiry Card.

storage space per 1000 documents and 1 MB of RAM for each 100 MB of server disk space. For a workstation, you must have at least a 286 with 640 KB of memory, plus 1 MB of extended or expanded memory; you'd most likely want a 386 with 2 MB of memory and a hard drive.

PC DOCS doesn't pretend to be a feature-rich DMS along the lines of those designed for mainframes or big Unix systems (e.g., BRS Software Products' BRS/Search). It is not intended for operations where there needs to be sophisticated control of work flow. Rather, it succeeds admirably as an easy-to-use desktop DMS that lets you index, store, and search reams of documents. It relies on NetWare and plugs into WordPerfect, so if you are already using those two products, PC DOCS will be a natural fit. What it does, it does well and in a predictable way.



Screen 2: *A SoftSolutions profile screen gives you the who, what, and where for every document. From here, you pick options such as searching text, launching other applications, and checking documents in and out.*

SoftSolutions for DOS 3.0

A database engine is at the core of all these DMSes. In the case of SoftSolutions for DOS, the database engine is designed for text search and retrieval, making this DMS well suited for managing purely textual documents. Some other systems are built on standard database engines (e.g., PC DOCS uses Btrieve) that may not be as good at handling pure text.

SoftSolutions for DOS focuses on indexing and search technology. It has a rich syntax for wild-card and Boolean searches. With one command, the program looks across profile fields and examines the text of every document in the database to find a particular word. In contrast, using PC DOCS, you would have to specify the search fields separately. SoftSolutions' indexing and SpeedSearch tools are exceptional.

SoftSolutions for DOS is menu- and form-driven (see screen 2). Most of the fields in the forms have associated tables that you can query. For example, the Document Type field in the profile search form has an associated table. If you don't know which document types are available to you, the F1 key lets you scroll through the table and pick a type. When there is no associated table, there is a help screen.

This system is customizable. Not only can you limit different users to the document types they can access, but you can also create different menus and query screens for different users. For example, a customer may be able only to view the documents relating to a project and not be able to modify anything; a document librarian may be able to access everything and even check documents in and out but not be able to change anything; and a document editor may be given privileges to add, delete, and modify documents in only a few document types. The administrator defines what users can do and what their menus show.

The administrator can also add new document types on the fly. SoftSolutions for DOS can launch any application or batch file based on the information in the document profile. You can define any kind of document profile as well as different user profiles, each with its own menus and available resources.

As you locate documents, you can select (i.e., mark) the ones you want to send to an application. As with some other DMSes, you can launch the appropriate application programs for editing and viewing the documents that you have indexed with this system. "Mark and launch" is the system's facility for taking a document out of the SoftSolutions archives and bringing it into another application.

SoftSolutions for DOS can operate in a heterogeneous network with Unix and DOS/NetWare servers. It even works in a WAN, dialing up remote machines and checking out documents on remote sites. This means that the document base can be completely distributed across several networks. This is a capability to consider if your business has scattered offices that need to share information.

Activity accounting is a strong feature of SoftSolutions for DOS. It not only reports on the current document status, archival state, and so on, but it also keeps track of every time the article is edited, copied, or even previewed; which user initiated the activity; and when it occurred. There is also a built-in work log and accounting system that includes a report writer. Each document type and operation can have an associated fee. This greatly facilitates accounting in law firms.

As you would expect from the fact that its underlying database is designed for full-text indexing and searching, SoftSolutions for DOS excels at finding documents. The program addresses most major issues in document management but has a few shortcomings. For example, although you can pick and choose the layout of the query and report screens, you cannot remap the keyboard, which WordPerfect strongly influences.

While you can define user privileges, you cannot define a work flow for a document type. You can maintain separate versions of a document but only as separate, full-size files. If you want to compare versions, you can use a third-party program, such as Jurisoft's CompareRite. You would mark the files you want to compare and then launch the document-comparison application. You can mark up to nine files at a time.

You can configure the menus, but even the default menus lack clear organization. They are very complex and require too many key presses to do simple operations, such as viewing the next document in a list.

The document viewer is not intelligent enough to recognize when a document is not a piece of text; it simply views all files as if they were textual documents. As with PC DOCS, if you want to look at an image file, you have to resort to using a third-party viewer.

SoftSolutions has an add-on module, the Image Manager, that lets you link a

WHY HARDLOCK IS THE PREFERRED *network* PROTECTION SYSTEM

Developers Say...

"Hardlock is Networking! Now everyone on the Network can access my application without having the Hardlock on their PC. NET Hardlock's interface allows me to easily limit the number of simultaneous users without having to build this up myself. Since NET Hardlock contains an algorithmic response ASIC, I'm assured of the highest level of copy protection effectiveness. Glenco's software interface choices couldn't have been easier to use!"

Accountants Say...

"NET Hardlock is a welcome addition to the Hardlock family of revenue protection products. Now limiting and expanding the simultaneous user portion of the license agreement is the easy part! Our costs are lowered and the end user benefits - it's a perfect solution!"

End Users Say...

"NET Hardlock is the easiest protection system I've ever used! Once the NET Hardlock is plugged in, I don't even know it's there. Now the application can find the NET Hardlock regardless of which PC I'm using. We can easily add more users to the license without shipping Hardlocks back and forth. Just knowing the software developer is paid for their efforts makes me feel confident that the next upgrade is coming and my investment is secure!"

Other products in the Hardlock Family:
Hardlock & Hardlock with Memory (Single User)
Harcllock DES (Data Security)
Hardlock SE (Workstations)

Supporting DOS, Windows, OS/2, Xenix

Shown actual size.

The *only* product that combines a memory option with programmable, algorithmic response — all in one compact unit.

Made in the USA

HARDLOCK™
The Preferred Protection System!
1-800-562-2543

GLENCO ENGINEERING INC.
SERVING THE SOFTWARE INDUSTRY SINCE 1979

270 Lexington Drive Buffalo Grove, Illinois 60089-6930
708/808-0300 Fax: 708/808-0313

For a distributor in Europe contact Fast Electronic GmbH, Tel: 49-89-538-800-0 Fax: 49-89-539-800-40
In Korea contact Finecom, Tel: 82-2-690-5811 Fax: 82-2-605-5729 In Brazil contact HT-MACH, Tel: 21-257-0314 Fax: 21-235-6808
In Chile contact Datasoft S.A., Tel: 562-246-7443 Fax: 562-208-0591 In Peru contact V.C.H.I., Tel: 51-14-440537 Fax: 51-14-475984
For International information circle 110, For End-User information circle 111 on Inquiry Card.

Tools for Lassoing the Paper Cyclone

D. BARKER

There's a scene in the film *Brazil*, set in a dim, information-crazed future, where the Robert De Niro character is literally engulfed in a swirling cyclone of paper. If you've had days at work when you thought this was about to happen to you, you probably need a document management system.

There are now dozens of products that can help you manage images and text. They all provide tools for receiving electronic data, filing it, and then finding it pronto. The brief descriptions that follow will point you toward the product that's right for your situation.

BASISplus

Document management for the Fortune 500, BASISplus (from Information Dimensions) can be simplistically described as a comprehensive set of tools for searching and retrieving compound documents in a relational database. Documents can consist of mixed objects—text, graphics, alphanumeric characters, sound, and video—and can come from almost any application or device. Documents can be huge: up to 8000 sections, each holding 128 million characters. The system is noted for its advanced search-and-retrieval functions, including concept, proximity, and "sounds like" searches.

BASISplus is not the sort of thing you throw together over the weekend (the manuals stack 3 feet high). The system runs on IBM mainframes, DEC VAXes, and Unix machines, such as Sun Microsystems' Sparcstations, the HP 9000, the Bull HN series, and Unisys 6000. Front ends for searching and viewing are available for ASCII and EBCDIC terminals and for PCs running Windows. Prices range from $2500 to $179,000. According to a Datapro report, even users who criticize parts of BASISplus remain impressed by what it can do.

BRS/Search

A system from BRS Software Products, a company specializing in on-line research databases, BRS/Search excels at the fast finding of needles in haystacks. It is used by businesses that generate tons of text, including newspaper publishers, law firms, and government agencies. No matter how big the database, BRS/Search can retrieve documents in 5 to 10 seconds, according to the company.

The software does full positional indexing whenever a document is loaded into the system (i.e., it indexes each word in terms of its location within a sentence). You can search for words, phrases, or concepts. BRS/Search can handle just about any type of document, from common word processor files to compound documents. Security functions let the administrator hide not only documents but specific words as well.

Although BRS/Search lacks imaging functions, you can link it to an image management system. An API lets you integrate BRS/Search's retrieval engine with other applications. BRS/Search runs under major operating systems, from MVS and VM to VMS and most variants of Unix, as well as DOS and NetWare. The company recently announced a Windows front end for searching and viewing documents. Prices start at $2500.

Desktop Document Manager

A combination of Windows-based software and a controller card, Desktop Document Manager (from Alacrity Systems) is designed to process documents that come in via scanner or fax. There are applications for scanning documents into files, receiving and sending faxes, and compressing and decompressing images.

The software is iconic. For example, you drag files to a file-to-fax icon or click on a scan-to-file icon. The hardware component is a card that holds a Texas Instruments 34010 (50-MHz) graphics processor, which Alacrity Systems says speeds up printing time and raises print resolution to 600 by 300 dots per inch. Alacrity estimates that as many as 500 document images can be compressed into 10 MB of hard disk space, making this system a good solution if storage resources aren't plentiful. The price is $1995.

Document Administrator

Interpreter's Document Administrator falls into the same basic category as PC DOCS and SoftSolutions. This DOS-based program indexes and archives text, tracks revisions, prevents simultaneous editing, and lets you search for document profiles or particular words, or use wild cards and Boolean operators. Profile cards, which provide information on every document entered into the system, are extensive (providing up to 38 fields) and very flexible; the administrator can set them up to fit any situation (i.e., design it so that some fields have to be filled in). You can work within your regular applications and then send only the files you want to the document manager.

Document Administrator currently lacks the handsome interface of more graphical products, but its menus are straightforward. It works with NetWare, Vines, Etherlink, and other DOS-based LANs. It costs $2495 for up to 10 users.

FilePower

You can tailor Optika's modular imaging system, based on Windows, to fit your situation, whether it is one user or 500. Software modules include ImageFiler—for scanning, indexing, storing, and retrieving image documents; DataFiler—for doing those same things to text rather than images; ImageFinder—a network package for retrieving and printing documents; software for

managing various optical disks; FaxServer—for sending and receiving faxes; TransAct—for pulling data from mainframes, minicomputers, and other PCs; communications software that allows remote access; and ImageEngine Development Kit—for customizing the system, integrating it with other applications, and linking it to external databases.

The system works with major LANs. Prices run from $7500 to $100,000. Kenwood USA, a big audio company, is using a FilePower system to process and store warranty claims and invoices, replacing microfiche with optical disks.

ImageFast

A Windows-based imaging system with work-flow and text-indexing modules, ImageFast (from Benson Computer Research) uses the folders-in-file-cabinets metaphor. As with Keyfile, you can drag a file onto an icon to initiate actions such as sending a fax. Although it is image-oriented, the program has features for handling text, including an OCR (optical character recognition) module that can extract text from an image and save it as an ASCII file or flow it into specified fields of a form (extracted text can be automatically indexed). Users can set up data and query forms. An API allows developers to plug in their own modules or integrate the system with other applications.

For businesses that use lots of forms or faxes that need to be stored and quickly retrieved, ImageFast could be an excellent solution. A five-user LAN (NetBIOS) version starts at $9500; OCR, text, and work-flow modules are $650, $500, and $750, respectively.

Imagic

An image management system that runs under Windows, Imagic receives scanned and faxed pages and files them in an ISAM (indexed sequential-access method) database. The Westbrook Technologies' system is designed for people who work with images, whether they are drawings or forms, rather than for people who handle lots of text; however, the software can store and index any user-selected text on a page.

The program accepts TIFF and PCX files but converts them to its own proprietary format. Westbrook emphasizes that its approach allows you to use hardware you've probably already got installed. For workgroups, Westbrook's ImagicLAN lets multiple users simultaneously access images on a server. It works with popular PC LANs. Imagic is $895; the LAN version is $1895 per server, with unlimited users.

KIPP

The KIPP (Kofax Image Processing Platform) family of PC products turns paper into digital documents and stores them in a library. There's software and hardware to control the scanning and storing of documents, software for printing or faxing documents, and software for retrieving images across a network. For faster retrieval, decompression, and display, Kofax offers hardware engines (AT or Micro Channel boards).

KIPP also includes a display controller geared toward handling images, a document display system, and software for quick printing under Windows (if you must have paper). The KIPP Developer's Toolkit, available for DOS, Windows, OS/2, and Unix, lets you create applications that tie into Kofax software and hardware. KIPP is supported by a number of image management systems, including Keyfile, Imara, Imagic, and FilePower. Prices for the scanning/printing board start at $2400; display boards start at $1000.

MARS

Micro Dynamics' MARS (Multiuser Archival and Retrieval System) is a rarity: a heavy-duty document-imaging solution that's based on the Macintosh. Built on a client/server model, MARS converts scanned pages into image files and then stores them on optical devices.

The company also has a text search-and-retrieval program called FreeForm, which will hunt for words on every Mac on the network; Micro Dynamics claims that FreeForm will find every occurrence of a word within 500,000 pages of text in 5 seconds. An API called MARS Shuttle offers tools for customizing the system and integrating it with other applications. MARS sites include paper-laden companies such as Motorola, McDonnell Douglas Missile Systems, and the legal department of Ernst & Young. The single-user setup, which includes a Mac Quadra, a printer, a scanner, and the software, is $30,000. The network version starts at $70,000.

NCR DMS

This is very serious document management. NCR describes its DMS as "a general-purpose imaging system" geared toward businesses with a high volume of paper transactions (e.g., claims, applications, records, and orders). It provides data-entry, storage, search-and-retrieval, work-flow automation, and relational database functions. NCR recently added a module that recognizes handwritten numbers. DMS can use AT&T's Interspan frame-relay technology to allow access to images across a WAN; thus, NCR's office in Munich can view files on the server in the New York headquarters.

DMS runs on NCR's System 3000 multiprocessor computers. Prices start at about $800,000 for a setup that includes a server, 20 workstations, scanners, optical storage devices, and laser printers.

Team Document Library

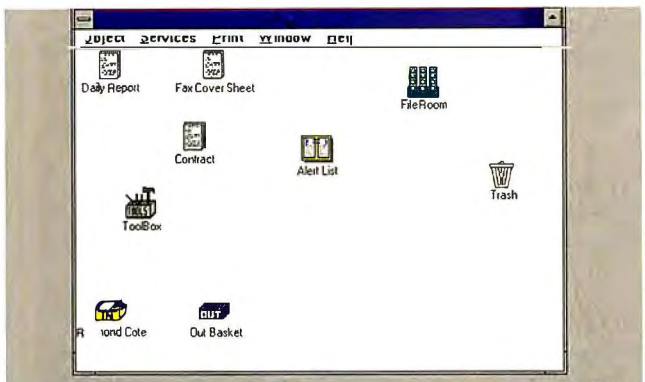
Aimed at departments that need to share a collection of compound documents, DEC's Team Document Library can be accessed by users of Windows-based PCs and Macs across a DEC Pathworks LAN. The system is based on Information Dimensions' BASISplus, powerful search-and-retrieval software built on a relational database. The system offers check-in/check-out control and a good set of search tools. Documents can come in from almost any source. Users can work with their regular word processor and other applications.

The system runs on a MicroVAX 3100; client machines need to be at least 386s or Mac IIs. Prices for the Windows version start at $59,950 for 20 users. Prices for the Mac version were not set at press time. The latest piece in DEC's Document Factory offerings, Team Document Library reflects the company's strides in integrating heterogeneous systems over a network.

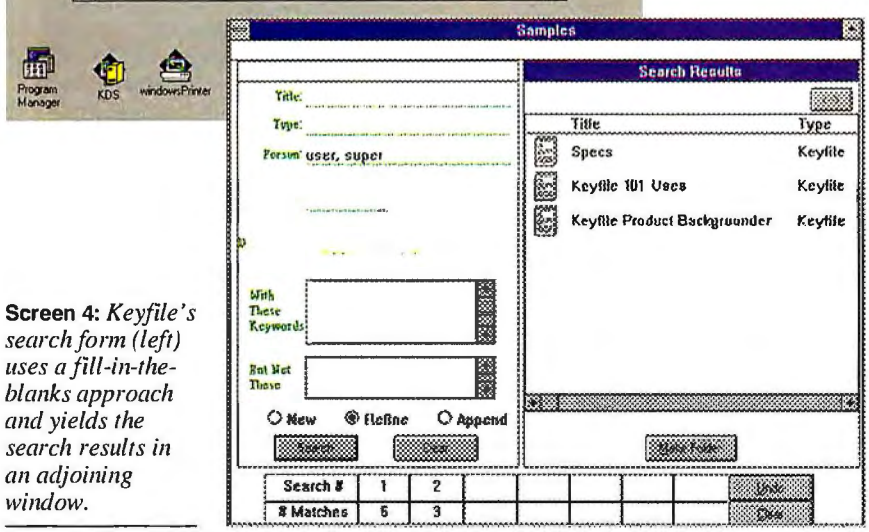
D. Barker is a BYTE Lab editor specializing in software applications. You can reach him on BIX as "dbarker."

graphic to a text file. If you call up a document associated with an image, the program lets you know the image file is out there and tells you where it is.

Overall, the performance of SoftSolutions for DOS is good, and it's flexible enough to fit many businesses, but the user interface is far from intuitive. A Windows version is about to be released, but basically it just replaces the character-based menus and forms with Windows-style versions. SoftSolutions for DOS's underlying engine is excellent; what the program needs is an intuitive interface more like that of Keyfile.



Screen 3: *The main Keyfile window presents you with a drag-and-drop environment.*



Screen 4: *Keyfile's search form (left) uses a fill-in-the-blanks approach and yields the search results in an adjoining window.*

Keyfile 1.0a

A client/server application based on Windows, Keyfile can handle images and text. The program recognizes three page types: ASCII, TIFF, and "container pages." Container pages consist of data generated with another application (Word for Windows, for example). The data is kept on the Keyfile document server; when a user wants to view or edit that data, it's passed back to the application used to create it. The program lets you mail, store, and archive any type of file. The system architecture permits file viewers to be added, and the company says that it is working on new viewers for the most popular program formats.

At its simplest, the Keyfile environment consists of a single document server connected to multiple network clients. Although you can run a client and a server on the same computer, the server software is usually placed on a dedicated machine. In our test setup, we ran Keyfile on a pair of Dell 486D/25 machines using NetBIOS to communicate over NetWare. Our NetWare server was a Compaq Systempro. The program requires a Windows-capable PC with at least 3 MB of RAM; the server has to be a Windows or OS/2 machine with at least 4 MB of RAM.

You provide system services, such as printing, scanning, and OCR (optical character recognition), by adding specialized servers. The servers can reside on the central server machine, or you can install them on individual computers. The company recommends that you place compute-intensive services, such as the Calera OCR engine, on dedicated computers to ensure the most rapid throughput. However, if cost is an overriding consideration, you can place as many servers as you need on a single computer; you just have to be prepared to accept slower performance.

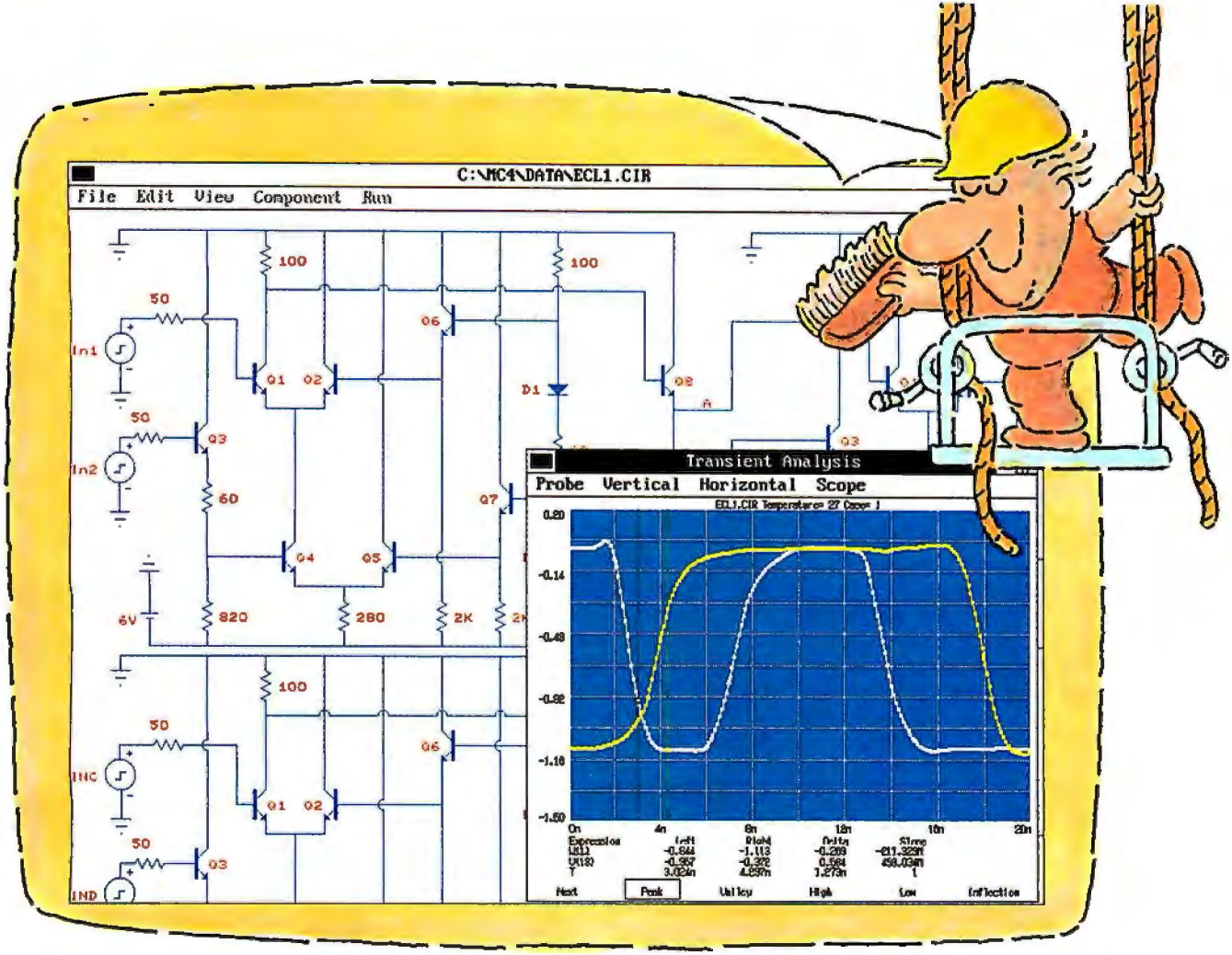
The main Keyfile window (see screen 3) presents you with a drag-and-drop environment. For example, dragging a document icon from the upper left corner of the screen onto the Out Basket icon automatically brings up the outgoing mail form. (A container page cannot be printed or faxed by dropping the document icon on the print or fax icon.) Likewise, dragging a document onto the File Room icon files the document away for future reference. The Application tool lets you place icons in your work area that you can then click on to launch DOS and Windows programs (or you can drag a document onto an icon to launch an application).

Original documents can come from many sources. They can be imported from existing files, scanned through an integrated scanner server, or received via a fax server.

Once a document is added to Keyfile, you can annotate it with text, graphics, and dictation (using a card like Creative Labs' Sound Blaster). Each annotation, which appears as an icon, is tagged with the name of the user who created it. Annotations can be hidden and viewed on a user-by-user basis. OCR data extracted from the image also appears as an annotated icon.

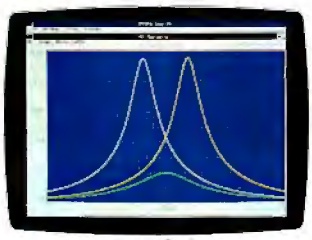
A Keyfile document has an associated profile that contains the title, creator, creation date, file type, and description. The profile also contains two sets of keywords. You enter one set of keywords when profiling the document. Keyfile extracts the other set from the text of the document (if it is ASCII text) or from the attached OCR data. Keyfile does not let the administrator predefine a set of words for the document type, description, and keyword list, so users can enter any information they choose in these fields. Unfortunately, this opens the way for the entry of misspelled or unique words.

Document retrieval is simple: Keyfile presents a simple search form, as shown in screen 4; you fill in the form with the appropriate information and press the search button. You can refine the results further through additional searches. You can also undo the result of your last search operation if you find that the results are too limited. A Browse option lets you scan through the document profiles sorted by title, type, creator, or date. Within the search window, you can see a list of any



INTRODUCING MICRO-CAP IV.™ MORE SPICE. MORE SPEED. MORE CIRCUIT.

PC-based circuit analysis just became faster. More powerful. And a lot easier. Because MICRO-CAP IV is here. And it continues a 12-year tradition of setting CAE price/performance standards.



AC Analysis

Put our 386/486 MICRO-CAP IV to work, and you'll quickly streamline circuit creation, simulation and edit-simulate cycles — on circuits as large as 10,000 nodes. In fact, even our 286 version delivers a quantum leap upward in speed. Because, for one thing, MICRO-CAP IV ends SPICE-file-related slowdowns; it reads, writes and analyzes SPICE text files and MC4 schematic files. It also features fully integrated schematic and text editors. Plus an interactive graphical interface — windows, pull-down menus, mouse support, on-line HELP and documentation — that boosts speed even higher.

Now sample MICRO-CAP IV power. It comes, for example, from SPICE 2G.6 models plus extensions. Comprehensive analog behavioral modeling capabilities. A massive model library. Instant feedback plotting from real-time waveform displays. Direct schematic waveform probing. Support for both Super and Extended VGA.

And the best is still less. At $2495, MICRO-CAP outperforms comparable PC-based analog simulators — even those $5000+ packages — with power to spare. Further, it's available for Macintosh as well as for IBM PCs. Write or call for a brochure and demo disk. And experience firsthand added SPICE and higher speed — on larger circuits.

Spectrum

1021 S. Wolfe Road
Sunnyvale, CA 94086
(408) 738-4387 FAX (408) 738-4702

Circle 163 on Inquiry Card.

keywords you've entered. After you select any of these keywords, Keyfile puts them into the search window and runs the search.

You can have any number of filing areas active in your Keyfile work area. You can select a single file cabinet or all file cabinets to search through. If you wanted to "find everything we've ever done with the Bilbo Baggins Travel Agency," you would go into the File Room menu and tell the program to search through all the cabinets.

The isolated computer is becoming a rarity in today's office. Most likely, your computer and your work need to be coordinated with many other people. Keyfile provides several basic communications options. Documents can be sent and received via fax, internal Keyfile mail, standard Windows E-mail servers, MHS Communication Server, and even printed and shipped via the U.S. Postal Service.

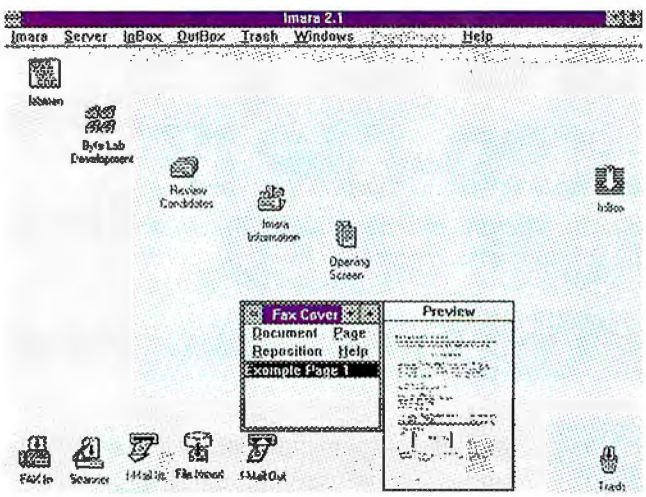
Of course, it is easy to lose track of documents as they move around and are shipped from person to person. The JobMaker tool can help keep track of the progress of of documents by creating work-flow Jobs. Each Job consists of a series of steps detailing who should be sent a specific document or set of documents. Jobs can automatically distribute documents to mailing lists and then wait for responses. If responses are not received within a defined period of days, you receive a notice that the step is not completed. In fact, Jobs can notify everyone involved in a project that the step was not completed.

Keyfile is best at tracking and filing static documents, not documents that frequently change. Keyfile does not automatically maintain different versions of a file. If files change, you must keep different versions as distinct documents. Keyfile is, however, prepared to manage large amounts of data. It supports several popular jukeboxes, as well as single-sided WORM drives.

One important aspect of Keyfile is the Koala (Keyfile Open Access Layer) interface. Koala is a scripting language that you can use locally from the Keyfile environment or externally through DDE. Although the ability to construct scripts is important, the ability to control and be controlled by other applications is central to Keyfile.

Keyfile is sold only through independent resellers, who typically use it to build customized file management systems. Although many customized environments are constructed totally within Keyfile, the ability to rapidly construct a Visual Basic front end to the Keyfile engine lets vendors quickly design and deliver customized vertical applications.

Keyfile is still a young product in need of maturity, but its user interface is simply the best of any document management package we've seen. We like its style of electronic office, with its use of folders, cabinets, and other intuitive elements. The program needs support for more document types and better searching tools to compete with strong search-and-file engines like SoftSolutions for DOS and PC DOCS.



Screen 5: *Imara's desktop depicts documents and activities as icons. The icons along the bottom of the screen represent methods for adding and transmitting documents to and from the system. In the foreground is a preview of a page to be used as a fax cover sheet.*

Imara 2.1

Imara from Imara Research is a client/server application based on a SQL (Structured Query Language) database. The client versions we evaluated ran on OS/2 Presentation Manager and Windows 3.1. The Imara environment consists of a SQL Server that maintains document-tracking information. The actual documents are not stored in the Imara system but are kept on network drives accessible to users through remote log-in. Index information is stored in the SQL database. In our test setup, we placed the Imara SQL Server and document-storage directories on an AcerFrame 3000MP; the Windows 3.1 client was on a Dell 486D/25. The Windows and OS/2 PM interfaces are similar.

To use Imara, you need an OS/2-compatible network, a SQL database server (Microsoft SQL Server, IBM Database Manager, or Oracle Server), and Windows workstations (386s or 486s) with at least 6 MB of RAM (8 MB on the server). You also need a scanner and probably some optical storage.

Screen 5 shows a typical Imara desktop. The icons along the bottom of the screen represent the various methods through which documents can be added to and transmitted from the system: fax, optical scanner, Imara E-mail, printer, and file import and export. The trash can holds documents for discarding that haven't yet been wiped from the system. (You can hide all these icons from view when you're not using them.) The desktop presents a drag-and-drop interface. You can move documents, in Mac style, by dragging them from folder to folder. You mail or discard documents by dragging them to the appropriate icon.

This drag-and-drop ability, while useful, is problematic. Contrary to what you expect with this sort of interface, you cannot drag and drop documents that are displayed as icons on the desktop. In our opinion, this is a serious bug. Since you see a nice interface with icons and the documentation states that you can drop documents on icons to mail or print them, you simply assume that this process is possible from the desktop. You can drag a document to the fax icon, but once a document is left on the desktop as an icon, you can't. The first time we encountered this problem, we spent half an hour trying to determine what we had broken. It took a call to Imara's technical-support group to learn that we hadn't broken anything.

Imara arranges documents into a rather rigid hierarchical structure. At the highest level are servers. Each server may contain multiple sets. Sets contain categories, which in turn hold folders. Documents are stored in folders. This hierarchy cannot be circumvented. You must place documents in folders; you cannot store them directly in a category. This means that you must dig down through four layers before finding documents. Although you can prevent

the intermediate levels from displaying on your desktop, switching from one folder to another requires a lot of activity. Imara does provide a shortcut. Selecting Document Finder from the menu lets you search through all the folders.

The documents that Imara handles best are faxes and scanned pages. Although it can manage and view TIFF images, Imara defaults to storing image documents in CCITT Group 3 or 4 fax compressed formats. The default scanner driver for the HP ScanJet or ScanJet Plus produces CCITT formats. Imara also lets you store and view ASCII files and faxes. (The company says version 2.2, not ready in time for this review, will let you fax text documents.) Currently, the program supports only the GammaLink GammaFax fax board. Release 2.1 allows you to launch applications that let you view and manipulate document types that Imara cannot directly view.

Importing previously created documents is time-consuming. You start by selecting the New Document option in the File Import tool. Then you open the document, create a new page (either text or image), select the file you want to import into this page, and close the page. You then add access and profile information to the file through two more dialog boxes. If you want to import large numbers of documents, you have to use Imara's script-like language, called IXL.

Because Imara is based on a rather serious, industrial-strength database, you would expect its searching capabilities to be pretty sophisticated. Surprisingly, they are rather mundane. Searches, called *queries* in Imara, are performed at two levels: query by keyword and query by form.

A query by keyword compiles a list of documents matching keywords, action dates, and document priorities. You enter all these profile values manually when you create a document. A Quick Keyword feature lets you select keyword phrases from a pick list. This helps to ensure that you enter keywords consistently. The scope of the keyword search is determined by the level at which you start the query. Starting a query from a folder searches only the files in that folder. Starting a query from a set searches all documents in all folders in all categories contained in that set.

Associated with each Imara folder is a form, which the user or the administrator defines, that describes the type of document located in the folder. A query by form searches all the information associated with each folder in a category and returns a list of folders that match the search criteria.

Imara's solution to document archiving is to let users move files to optical storage devices and take them off-line. You can move categories, folders, and documents to archive sets.

Work-flow and workgroup options are also lacking. Although Imara contains integrated fax and mail services, it cannot track documents sent to groups, determine if tasks are completed, or alert you when task completions are overdue.

Imara has many little quirks to trip the unwary user. Some of them (e.g., the inability to drag icons and drop them on destinations, which even surprised some Imara personnel) are major problems. Others are minor annoyances. For example, the Windows menus do not stay activated when you click on them with the mouse; instead, they act like Macintosh menu bars and disappear when you release the mouse button. This feels wrong even if you are a frequent Mac user, because you are expecting normal Windows behavior.

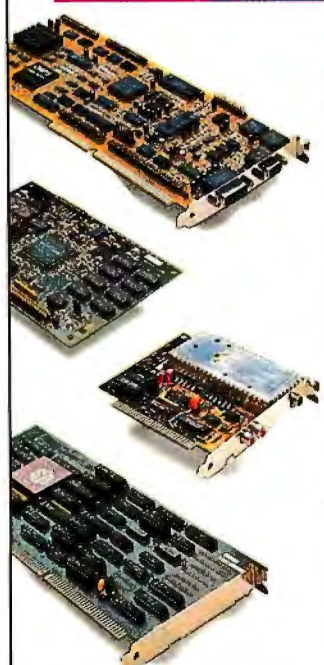
The program's dependence on SQL

New Low Cost Multimedia Product Family

Add multimedia to your PC

Run under MS Windows 3.0, HP NewWave, or MS DOS

Powerful new silicon offers unbeatable functionality at super, low prices



Super VideoWindows – $895

Display full motion video in a window on VGA monitor. Scale, crop, freeze. Image capture, save and restore. Sound control. Accepts VGA input for graphics/text overlay. Required software sold separately.

Super VGA Daughter – $395

Industry standard VGA (Headland's Video 7) attaches to Super VideoWindows for compact 1-slot solution of graphics/text overlay. IMB buffer.

Super TV Tuner – $395

Computer selectable antenna or 122 channel cable TV input. Combine with Super VideoWindows to watch TV on PC.

Super Still-Frame Compression – $995

JPEG compression up to 75:1 of color or grayscale images. Takes only seconds. All TGA file formats—TARGA 16, 24, and 32.

Celebrating Our 10th Year

NEW MEDIA GRAPHICS

New Media Graphics Corp.
780 Boston Road
Billerica, MA 01821

TEL: 508/663-0666
FAX: 508/663-6678

Order Now: 1-800-288-2207 VISA, M/C, and AMEX accepted.

Circle 135 on Inquiry Card.

Server means that response times are slow. We ran Imara on some fairly powerful systems and still spent a lot of time waiting for responses to button pushes and menu selections. Imara's worst problem is that the interface looks as if it should be intuitive. You start work on problems with certain expectations but often receive surprises. Imara is a good concept that needs some polishing.

Final Sort

All the products we reviewed here have impressive features. They also have weaknesses. If we could put together our dream DMS, it would combine the excellent interface of Keyfile with the sophisticated indexing and searching technology of SoftSolutions for DOS. Unfortunately, it is not yet possible to purchase that product in one box.

If you want a DMS primarily for handling image files—either drawings created with a PC or pieces of paper turned into digital images—Keyfile is a good solution. Its interface is creative and consistent, and it takes advantage of a graphical environment; it's convenient to be able to drag a document onto an icon and have the system fax that file for you. Also, the work-flow system is impressive and intuitive.

If you want a DMS primarily for handling vast amounts of text files, PC DOCS is a good solution. It doesn't have the extensive searching tools of SoftSolutions for DOS, which is more flexible and far-reaching, but its interface is more consistent, and it's generally easier to set up and use. PC DOCS is tied to Btrieve as a database, but in smaller work settings, that shouldn't be a limitation. Bigger companies, with greater database demands and the need to search across a WAN, might eventually be stifled by PC DOCS. They should have a look at SoftSolutions for DOS but also check out one of the Unix-based systems, such as Information Dimensions' BASISplus, BRS Software Products' BRS/Search, or DEC's new Team Document Library.

DMS software is such a complex subject that no review can guide you unerringly to the system that's right for you. We have simply tried to give you some criteria to go on when evaluating a DMS and considering a possible purchase. ■

Raymond GA Côté is a BYTE Lab editor continuing his 15-year love affair with computers as tools and toys. He has worked in the industry designing interpretive languages and user interfaces. He can be reached on the Internet at rgacote@bytepb.byte.com. Ben Smith is a BYTE Lab testing editor and the author of Unix Step-by-Step *(Howard W. Sams, 1990). You can contact him on the Internet at ben@bytepb.byte.com.*

COMPANY INFORMATION

Alacrity Systems, Inc.
(Desktop Document Manager)
43 Newburg Rd.
Hackettstown, NJ 07840
(908) 813-2400
fax: (908) 813-2490
Circle 988 on Inquiry Card.

Benson Computer Research
(ImageFast)
7926 Jones Branch Dr., Suite 260
McLean, VA 22102
(703) 442-4545
fax: (703) 893-7499
Circle 989 on Inquiry Card.

BRS Software Products
(BRS/Search)
8000 Westpark Dr.
McLean, VA 22102
(703) 442-3870
fax: (703) 827-0686
Circle 990 on Inquiry Card.

DEC
(Team Document Library)
146 Main St.
Maynard, MA 01754
(800) 344-4825
(508) 493-5111
Circle 991 on Inquiry Card.

Imara Research Corp.
(Imara)
111 Peter St., Suite 804
Toronto, Ontario,
Canada M5V 2H1
(416) 581-1740
fax: (416) 581-1605
Circle 992 on Inquiry Card.

Information Dimensions, Inc.
(BASISplus)
5080 Tuttle Crossing Blvd.
Dublin, OH 43017
(614) 761-8083
fax: (614) 761-7290
Circle 993 on Inquiry Card.

Interpreter, Inc.
(Document Administrator)
11455 West I-70 North Frontage Rd.
Wheat Ridge, CO 80033
(303) 431-8991
fax: (303) 431-9056
Circle 994 on Inquiry Card.

Keyfile Corp.
(Keyfile)
22 Cotton Rd.
Nashua, NH 03063
(603) 883-3800
fax: (603) 889-9259
Circle 995 on Inquiry Card.

Kofax Image Products
(KIPP)
3 Jenner St.
Irvine, CA 92718
(714) 727-1733
fax: (714) 727-3144
Circle 996 on Inquiry Card.

Micro Dynamics Ltd.
(MARS)
8555 Sixteenth St., Suite 700
Silver Spring, MD 20910
(301) 589-6300
fax: (301) 589-3414
Circle 997 on Inquiry Card.

NCR Corp.
(NCR DMS)
1700 South Patterson Blvd.
Dayton, OH 45479
(800) 225-5627
(513) 445-5000
Circle 998 on Inquiry Card.

Optika Imaging Systems, Inc.
(FilePower)
980 Enchanted Way, Suite 101
Simi Valley, CA 93065
(805) 520-9060
fax: (805) 520-9895
Circle 999 on Inquiry Card.

PC DOCS, Inc.
(PC DOCS 4.1)
124 Marriott Dr., Suite 203
Tallahassee, FL 32301
(904) 942-3627
fax: (904) 942-1517
Circle 1131 on Inquiry Card.

SoftSolutions Technology Corp.
(SoftSolutions for DOS 3.0)
ParkView Plaza
625 South State St.
Orem, UT 84058
(801) 226-6000
fax: (801) 224-0920
Circle 1132 on Inquiry Card.

Westbrook Technologies
(Imagic, ImagicLAN)
P.O. Box 910
22 Pequot Park Rd.
Westbrook, CT 06498
(800) 949-3453
(203) 399-7111
fax: (203) 399-7137
Circle 1133 on Inquiry Card.

When storms hit the Gulf, Texaco keeps the gas pumping...

With RealFlex,™ the QNX-based SCADA package by BJ Software Systems (a division of Baker CAC), operators can monitor and control remote well head devices throughout the Gulf of Mexico.

QUANTUM SOFTWARE SYSTEMS LTD.
175 TERRENCE MATTHEWS CRESCENT
KANATA, ONTARIO, CANADA K2M 1W8
TEL: 613-591-0931
FAX:613-591-3579

QNX IS A REGISTERED TRADEMARK OF QUANTUM SOFTWARE SYSTEMS LTD. REALFLEX IS A TRADEMARK OF BJ SOFTWARE SYSTEMS.
© QUANTUM SOFTWARE SYSTEMS LTD. 1992

QNX®
REALTIME OPERATING SYSTEM

... thanks to QNX®

Severe storms used to put a real damper on offshore operations, especially when personnel had to be evacuated from production platforms. And without operators, the platforms just sat idle until the skies cleared.

The bottom line is that shutting down production can cost $1.5 million per day.

But that was before STORMAC (System for Texaco Offshore Remote Monitoring And Control).

With this SCADA system, operators can now monitor and control offshore devices in real time from the safety of a land-based control center.

Texaco now maintains offshore gas production 24 hours a day, whatever the weather.

The QNX Operating System plays a key role in the STORMAC success story. Since QNX delivers *real* realtime performance, PC SCADA packages like BJ Software's RealFlex™ can compete with costly high-end hardware systems.

From its unique modular architecture to its transparent fault-tolerant network, QNX gives system designers a host of high-performance advantages. And as a POSIX-compliant OS, QNX follows *the* standard in system portability.

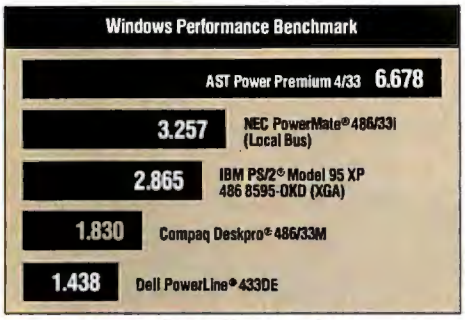
SCADA. Robotics. OLTP. POS. With an installed base of nearly 200,000 systems worldwide, QNX is the OS of choice for mission-critical applications.

To find out how QNX can help you develop responsive realtime solutions, call **1-800-363-9001** (ext. 101).

Architecture makes the difference.™

Circle 151 on Inquiry Card.

Introducing AST's New Power Premium® Family. With Microsoft® Windows™ performance 4½ times faster than Dell,® 3½ times faster than Compaq,® and 2 times faster than IBM® and NEC,® AST's new Power Premium computers have put this familiar Windows icon on the endangered species list.



Based on Graphics WINMARK™ results of testing performed on 33 MHz 486DX systems in 640×480 resolution with 256 colors using *PC Magazine Labs* Windows Benchmark software version 2.50.

From the creators of the world's first fully upgradable systems, comes a new generation of state-of-the-art desktop computers featuring:

Premium VGA Graphics. Unequalled speed is just the beginning. Our innovative subsystem supports enhanced video resolution modes of up to 1280 x 1024 and can display over 32,000 colors simultaneously.

Cupid-32™ Upgradability. AST's award-winning Cupid-32 technology is still the industry's best, most complete upgrade solution.

Extended Industry Standard Architecture (EISA). Take full advantage of today's EISA I/O cards while protecting your investment in existing ISA hardware.

AST FlashBIOS. Our simplified, software-based upgrade makes updating your Power Premium's BIOS quick and easy without chip replacement.

High-Performance Processors With Cache. Built into each Power Premium is a powerful Intel486™ or Intel386™ processor and an ample supply of fast-access cache memory.

To receive your FREE video, "AST's Power Premium: Innovation Reinvented," call **1-800-876-4AST.**

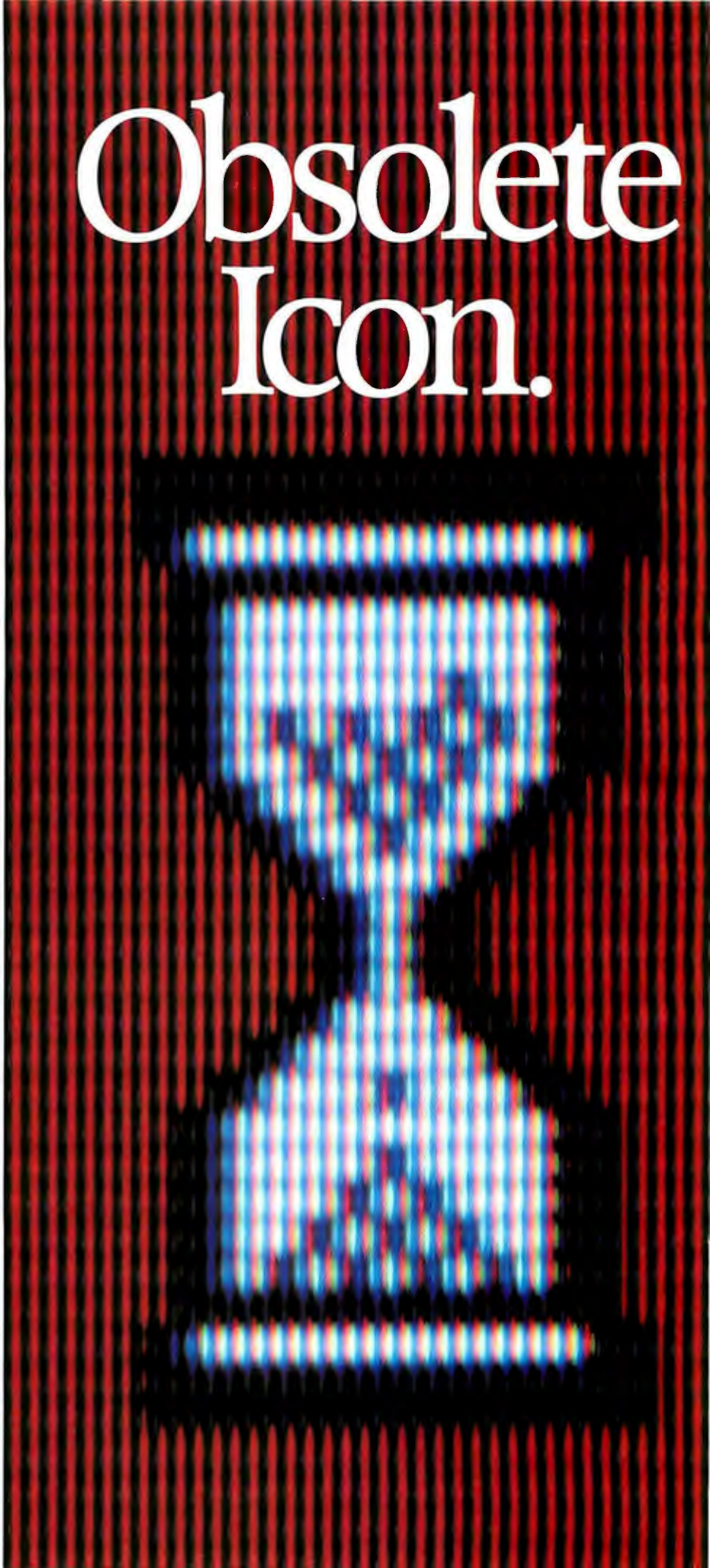
AST markets products worldwide. For more information call AST International on (714) 727-9292 or FAX to (714) 727-8585. AST is a supplier to U.S. government agencies, General Service Contract Number GS00K92AGS6064. AST, AST logo and Premium registered and Cupid-32, Cupid-32 logo trademarks AST Research, Inc. The Intel Inside Logo is a trademark of Intel Corporation. All other brand and product names are trademarks or registered trademarks of their respective companies. Copyright © 1992 AST Research, Inc. All rights reserved.

AST® COMPUTER

The Power Of Choice.

Circle 61 on Inquiry Card (RESELLERS: 62).

Obsolete Icon.



Workhorse Computers

The BYTE Lab puts 18 low-cost 386SX systems to the test

RICK GREHAN AND
STAN WSZOLA

Over the past year, the 386SX has earned recognition as the workhorse of microprocessors, usurping the title formerly held by the now virtually abandoned 286. There are plenty of reasons for the increased popularity of the 386SX. It can run any software that a 386DX or 486DX can handle, albeit a little more slowly. All existing hardware that is compatible with the 386DX works with the 386SX. And, of course, 386SX systems generally cost a few hundred dollars less than comparably equipped DX machines.

In fact, attractively priced 386SX machines are everywhere, which makes it hard to know which way to turn when scouting out systems. To make your job easier, we've done a little of the legwork, reviewing an assortment of models from companies who advertise machines costing less than $2000. Many of the makers are mail-order companies, but a number of manufacturers who typically sell through resellers or dealers also are represented. Our list, while by no means exhaustive, is extensive and is a representative sample of the field.

In all, we looked at 18 386SX computers: the AcerPower 386SX, the Acma 386SX/25, the Addtech Research SlimPro 386SX-25, AMAX Engineering's 386SX-25, Ariel Design's 386SX-25 Cache, Cardinal Technologies' PC10, Club American's Eagle 325SX, CompuAdd's 325SC, Dell Computer's System 325SX, Duracom Computer's Desksaver 386/25SX, Gateway 2000's 25MHz 386SX, JCC Systems' 386SX-25, NEC's PowerMate SX/25i, PC Brands' 386/SX-25, PolyWell Computers' Poly 386-25SX, Tandy's 2500 SX/25 HD, Tangent Computer's 325s, and the Wyse Technology Decision 386SX/25C.

In an attempt to provide a level playing field, we requested that each manufacturer supply a system with a 386SX running at 25 MHz, 4 MB of RAM, a 387SX math coprocessor chip, 80-MB hard disk drive, VGA adapter, VGA monitor, and a mouse. All of the review units met these specifications; some far exceeded them. As we opened up the machines, poured over spec sheets, and ran our battery of benchmarks, differences in both price and performance became apparent (see the features table, "25-MHz 386SX Desktop Computers," on page 226).

The Inside Story

At the heart of every 386SX machine lies an 386SX processor; chances are that processor will carry the Intel or American Micro Devices label. As the features table reveals, Intel maintains the edge when it comes to the number of CPU chips sold.

BYTE ACTION SUMMARY

- **WHAT 386SX SYSTEMS ARE**
  A 386SX processor retains all the capabilities of the original 386DX but employs a narrower 16-bit data path. The lower cost of SX chips makes it possible to provide low-end systems that still run 386-specific applications.
- **LIKES**
  For many mainstream applications, an SX system will do the job for less money.
- **DISLIKES**
  Systems based on a full-scale 386DX offer noticeably better performance and, in many cases, the price of SX systems is only $200 to $300 lower.
- **RECOMMENDATIONS**
  We recommend the PolyWell Poly 386-25SX and the Wyse Decision 386SX/25C. But you should seriously consider a 386DX if its price is right.

AMD has, however, become a strong contender, building its share to about 10 percent of the CPU market, in part by repeatedly bringing out faster-rated 386SX and 386DX chips ahead of Intel.

AMD took on Intel in mid-1991, introducing a 16-MHz 386SX chip to compete against Intel's 12-MHz processor. Intel countered by marketing 16- and 20-MHz 386SX chips, at which point AMD brought out its Am386SX/25 microprocessor. When Intel rolled out a 25-MHz 386SX chip, AMD upped the ante with its Am386SX/33. At the same time, AMD has priced its chips aggressively, forcing Intel to lower its prices and undoubtedly prompting the company's high-profile "Intel Inside" marketing campaign.

But in terms of performance, functionality, and reliability, neither company appears to have an edge: We noticed no difference between the AMD and Intel chips. The only way to tell which chip is inside a computer is by taking off its cover.

When it comes to math coprocessors, however, brand name may make some difference. Fully 10 out of the 18 test computers used the Cyrix FasMath 83S87 coprocessor rather than Intel's 387SX coprocessor. Our performance tests did not indicate any glaring advantage to using the Cyrix instead of an Intel (or AMD) math chip. In fact, most systems equipped with a Cyrix chip turned in LINPACK and low-level floating-point results on a par with systems running Intel chips. We should point out, however, that both of the systems that ranked highest in the scientific/CAD benchmarks—where a math coprocessor is most likely to provide the best performance boost—had Cyrix coprocessors. Interestingly, the extra kick won't cost you extra. A recent scan through several mail-order ads revealed that you can get Cyrix chips for about $20 less than Intel chips of equivalent speed.

The Compatibility Question

Backing up these computers' CPU and math chips are a host of other chips. In the bad old days, you had to worry about the "PC compatibility" of such chips. When clones of the original IBM PC first began to appear, BYTE reviewers routinely tested a system for compatibility to ensure, for instance, that a clone system's motherboard and BIOS would function just like the original PC's. Today it's a given that if a computer can run the BYTE low-level and application benchmark programs, it is compatible.

Our review systems used a wide variety of motherboard chip sets: OPTI, Chips & Technologies, Micronics, VLSI, Texas Instruments, Western Digital, and AMD. The systems also employed a variety of BIOSes from Phoenix, NEC, AMI, and other companies. We encountered no compatibility problems.

One big difference did strike us, however: the quality of the documentation explaining how to set up the various CMOS and chip-set features. The well-known brands, such as Dell, Gateway, and NEC included extensive documentation that made it easy to set up the systems for our benchmark tests. The instructions for other brands, such as the Addtech, covered only the bare essentials of system setup. (See the text box "A Carry-Along Alternative" for a closer look at this machine.)

Our recommendation? If you are inexperienced in system setup, stick with the well-known brands or have your dealer set up and explain the system to you.

A Carry-Along Alternative

The Addtech SlimPro 386SX-25 is significantly different from the other 386SX computers in this product report. While the rest of the machines are strictly desktop computers, the SlimPro is a transportable computer in the tradition of the Ergo Brick and the Flytech Carry1: a system for users who want to take their computers with them but can expect to find a full-size keyboard and monitor at their destination (see accompanying photo).

The monitor-less SlimPro measures 11.5 by 10.75 by 2.25 inches and weighs 8.1 pounds, making it small enough to fit into a standard briefcase. Our review model packed a 25-MHz 386SX CPU, a compact 81-key keyboard, and list price of $425; with a 16-MHz 386SX processor, the SlimPro costs $325. Standard features include 1 MB of RAM (expandable to 16 MB), a 1.44-MB floppy drive, a VGA card with 1 MB of video RAM and an IDE controller for connecting an internal 3½-inch hard drive. As tested, with 4 MB of RAM and an 85-MB Western Digital hard disk, the system lists for $1106.

The SlimPro is configured to use a standard VGA monitor and any keyboard that has a standard DIN connector. The unit has two 16-bit, three-quarter length expansion slots. A VGA adapter occupies one of the system's expansion slots, leaving only one empty slot. This setup doesn't offer you much room for expansion, but you can upgrade the video card in the future, thus extending the working life of the computer.

Although built to travel, the SlimPro will fit right in on your desk. Its beige case and small size—just large enough to slip under a monitor—make it attractive enough for any office.

The Addtech SlimPro, a transportable computer similar to the Ergo Brick and the Flytech Carry1, lets you carry your computer from site to site and be able to plug in a full-size keyboard and monitor.

The SlimPro handled our benchmarks reasonably well, placing in the middle of the pack in almost all tests. It did not exhibit any outstanding characteristics, good or bad.

Like many low-cost computers, the system comes with a minimum of documentation. The user's manual is a slender 41-page booklet, and its instructions for setting up the unit using AMI's setup utilities is terse almost to the point of uselessness. Many of the setup options, for instance, are not explained at all.

The SlimPro is made for the person who needs a reasonably fast computer that can be transported easily. Its diminutive footprint and quiet operation make it very attractive.

Don't Forget the Memory

The other chips of paramount concern are memory chips. Now that so many users are running Windows, it is foolish to offer base configurations with less than 4 MB of RAM. Yet many manufacturers still market systems that come with only 1 or 2 MB of memory—apparently so that they can advertise artificially low system prices.

If you plan to run Windows on a 386SX, give your system the 4 MB of RAM it needs to run comfortably. Adding more memory will give it the necessary breathing room to work with high-end applications and should improve the performance of any system. With all these systems, boosting memory ought to prove relatively simple. All accept standard SIMMs in 1-, 2-, or 4-MB increments. Most can handle as much as 16 MB of RAM on their system boards, and the JCC Systems motherboard accepts as much as 32 MB.

Driving a Hard Disk

For storing information more permanently, the hands-down choice in a hard drive interface is the IDE standard. The IDE design offers simplified controller design, and much of the electronics resides on the drives themselves. The IDE interface also pairs good performance with low-priced drives. Widely available, IDE drives showed up in all 18 of the review units, and in many of the units the IDE controller was integrated onto the motherboard and attached to the drive with a single ribbon cable.

The former standard hard drive capacity of at least 40 MB is woefully inadequate when confronted with software packages that demand 5 to 10 MB for just a minimum installation. Those requirements don't even take into account the files you might generate in day-to-day work. The minimum configuration today should be 80 MB; 100 MB is a better lower limit for users who work with graphics images or multimedia. Although we requested systems with an 80-MB capacity, many of the manufacturers provided drives in the 100- to 125-MB range.

Access times ranged from 16 to 18 milliseconds; the drive's original manufacturers were more diverse: Maxtor, TEAC, Western Digital, Quantum, Seagate, and Conner showed up in the test systems. But hard drive makes and models are subject to change. Many computer manufacturers frequently switch drive models and brands if they can get a better price or if a drive they have been using no longer is available. Consequently, the drive specified in the features table may have changed by the time you order a system.

Looking at Video

As with drive functions, many computer makers now are integrating video functions into the motherboard. This improves

Is It a Mac?

When we pulled the Cardinal out of its box, we thought for an instant that we were uncrating a new Mac clone that had been improperly substituted for the 386SX we requested. We haven't seen a PC clone with an integrated monitor for quite some time.

In truth, someone walking rapidly past this machine might mistake the Cardinal for a Mac SE. The Cardinal is about an inch bigger all around, but a Mac-like paper-white display and a 3½-inch floppy located in the same place as on Mac Classics and SEs (see accompanying photo). Although monochrome, the display can handle 64 shades of gray and is VGA compatible. (An included utility program lets you set the display to emulate any number of other monitor types: PC monochrome and Hercules monochrome, for example.) If you don't like black-and-white screens, the standard VGA connector around back will happily accept your favorite color VGA monitor.

Loosen two thumbscrews in the back and the monitor section slides off. Though the monitor remains connected to the motherboard by an umbilical of wires, the cables have enough slack that you can lay the monitor on its back behind the main chassis and do whatever work needs doing on the motherboard. Inside are a frightfully sparse motherboard and two horizontal 16-bit short slots that can hold boards as large as 4.2 by 8.8 inches. It amazed us that just a brace of VLSI chips—along with the CPU, of course—could provide two serial ports, parallel port, PS/2 mouse port, floppy and hard disk interfaces, and the VGA interface.

The Cardinal PC10, with its integrated monitor and compact design, looks more like a Mac than a PC. Unfortunately, its performance and price are not as attractive as its appearance.

Expanding the Cardinal should prove easy; the math coprocessor socket (our Cardinal came with an Intel 387SX) and SIMM connectors are accessible. The system has room for only one 3½-inch floppy drive and one 3½-inch IDE hard drive, however. The system we tested contained an 80-MB hard drive; if your storage needs are more modest, a 40-MB version is available.

Our unit's operating system was Digital Research's DR DOS 6.0. Although we can't do a full review of DR DOS 6.0, we will say that all benchmarks ran without fail. We did have to modify some of the entries in our standard CONFIG.SYS file, but we made those changes easily with the help of the unit's documentation.

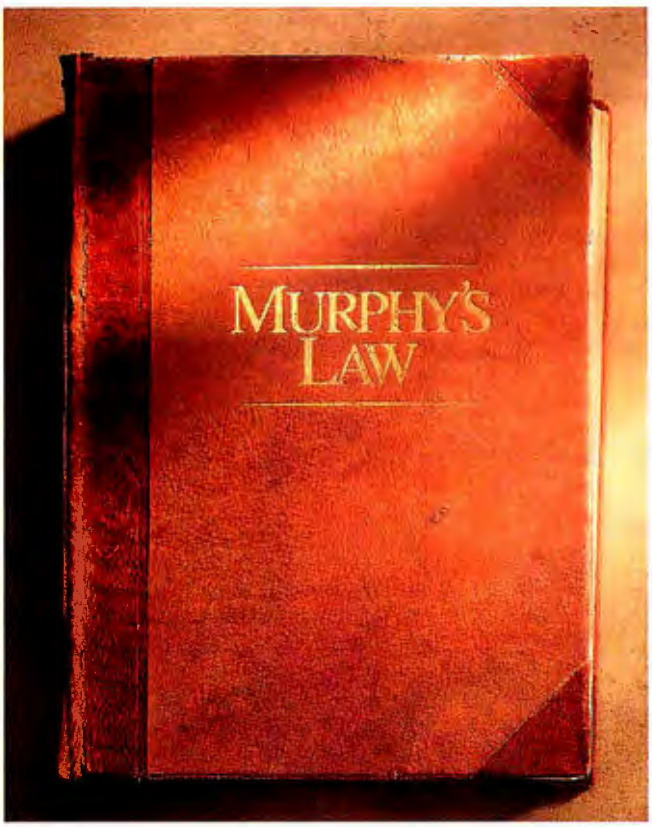
Unfortunately, the Cardinal's interesting look doesn't carry the day when performance is involved. On all our benchmarks, the Cardinal's scores were moderate to disappointing. Similarly, its price isn't cause for celebration; at $1299 it is neither a leader nor a follower. In addition, a 12-inch monochrome monitor is simply inappropriate for dealing with color graphics of even moderate resolution; this is especially true if you're running lots of Windows applications.

If a stylish and space-saving design is what you're after, then perhaps the Cardinal deserves scrutiny. Otherwise, it's likely your computing needs would be better served by other systems.

DELL INTRODUCES A CONCEPT SO IT BREAKS EVERY LAW IN

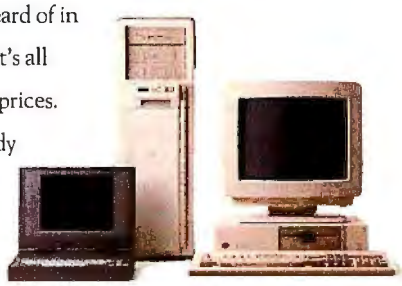
We've added services to help you get the most out of your computer.

If something can go wrong, it will. That's a law so fundamental, it's practically built into every brand of computers on earth. Fortunately, you've told us how to make it better. In millions of conversations with our customers, we discovered it's not just a great computer you want; it's how to get the most out of it.



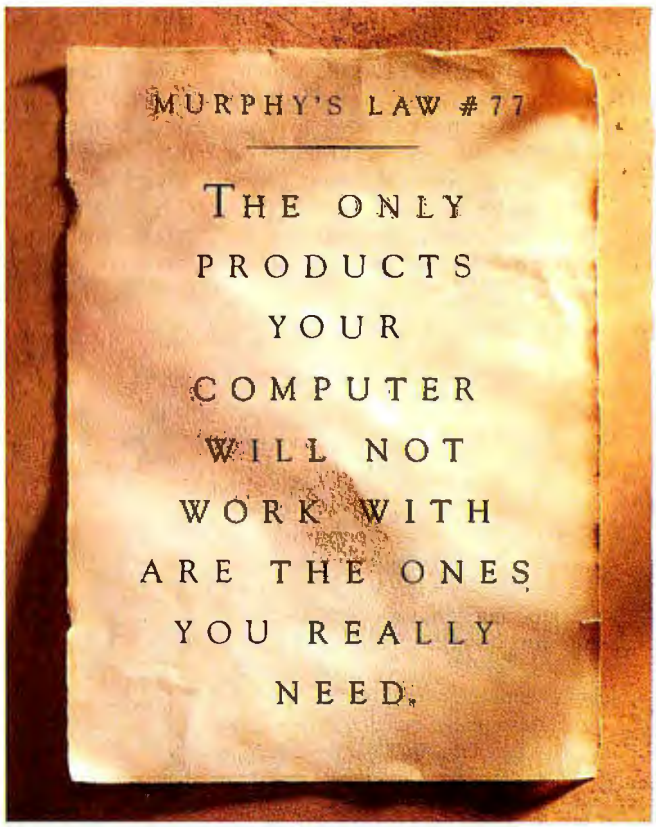
So we made substantial additions to our entire line of acclaimed computers to help you get more out of them now, and in the future. We added services, specialists, and in the three areas where you most want assurances — compatibility, quick answers and fast service — we're adding something unheard of in computers: guarantees. And it's all available at Dell's new lower prices.

It should make everybody happy. Except maybe our competitors. And Murphy.



INTRODUCING GUARANTEED COMPATIBILITY:

Dell® systems are designed and extensively tested to run all standard operating systems, application software, peripherals and network operating systems developed for ISA and EISA architecture systems. If you encounter a compatibility problem with your Dell Performance Series system anytime within three years after the original purchase,



we guarantee that Dell's engineers and technicians will work with you to identify the cause of the problem and recommend a solution. If the problem (other than software support for device drivers) can be solved by updating your system, we will provide you the change at no charge. Or, in the rare event we can't do that, you may return the system for a refund. You understand, of course, that we can't extend the guarantee to software or devices that were never intended to run on comparable ISA or EISA systems of the same vintage.[1]

We guarantee we'll work with you to ensure compatibility with future products.

[1]*Refund value is based on the sum of years digits depreciation of the original purchase price over a three-year period, calculated monthly. Refund offer is valid for registered owners of Dell Performance Series systems purchased after July 1, 1992. Guarantee not applicable outside the U.S. and subject to change without notice.* [2]*This guarantee applies to registered owners of Dell Performance Series systems purchased after July 1, 1992, but only one award per system per day. Please understand that the guarantee does not apply to support calls missed for reasons clearly outside of our control, such as power outages and interruptions to telephone service, or outside the U.S. Subject to change without notice.* [3]*This guarantee applies to registered owners of Dell Performance Series systems purchased after July 1, 1992. Please understand that the guarantee does not apply to service calls missed for reasons clearly outside of our control, such as interruptions to telephone service and the closure of airports required for parts delivery, or outside the U.S. Subject to change without notice.*

REVOLUTIONARY, THE BOOK.

INTRODUCING GUARANTEED RESPONSE: When you call Dells technical support center with a problem during operating hours (6AM-12 Midnight CT daily)*, you will talk to a technical specialist within 5 minutes. If you do not wish to hold for a technician, your call will be promptly returned by a technical specialist within one hour. In the rare event you don't reach a technician or a technician doesn't call back within one hour, let us know and you will receive your choice of a check for $25 or a credit of $25 toward your next purchase.[2]

Now, the price of your system includes this toll-free phone support mentioned in the above guarantee for as long as you own your computer. We'll solve most reported problems over the phone, usually in 10 minutes or less.

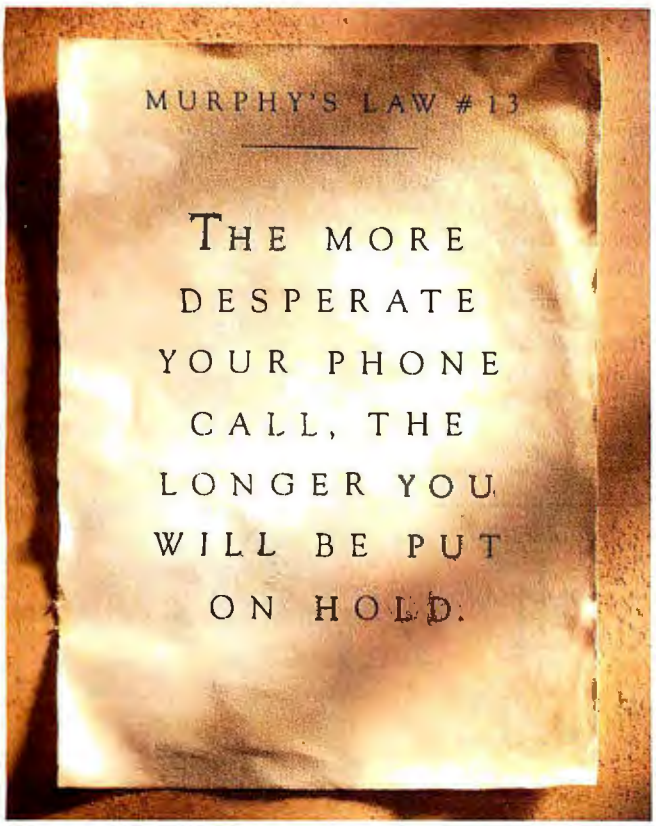
We also have a toll-free Getting Started Helpline, 24 hour-a-day system information via our TechFax℠ line and our own Dell Forum on CompuServe's Information Service.

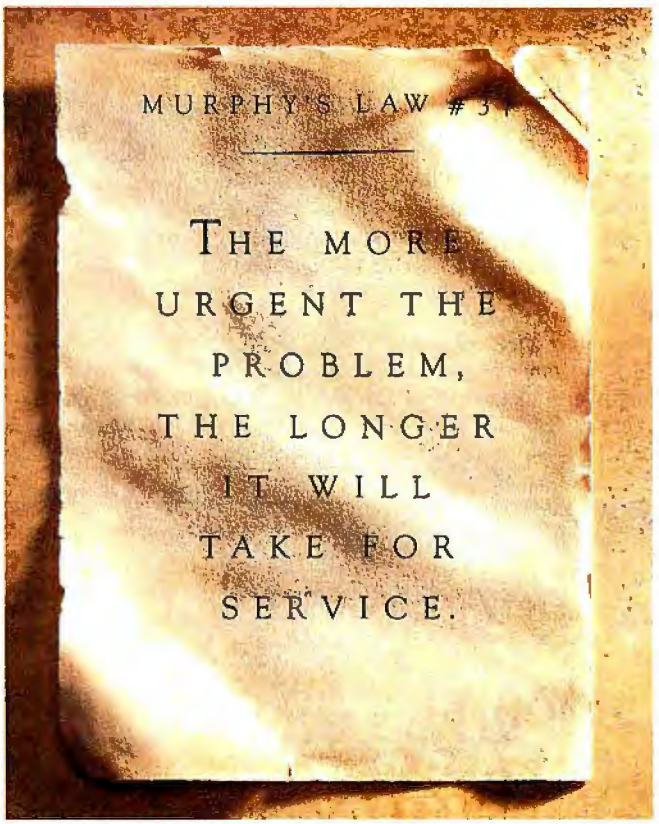
We solve most problems over the phone within 10 minutes.

INTRODUCING GUARANTEED NEXT-BUSINESS-DAY SERVICE: If there's a hardware failure with your Dell system while under a service contract purchased from Dell and you notify us before 5:00 PM CT, a technician, if needed, will arrive by the end of the next business day.Δ In the rare event the technician doesn't arrive, your situation will receive top priority, plus you will receive an additional month of service at no cost.[3] (By the way, the first year's service is included in the Dell system price.)

A technician will come by the end of the next business day.

And now, the final guarantee: a 30-day, no-questions-asked, money-back guarantee with each Dell computer.





Our philosophy of putting your problems before our rules is why two-thirds of the FORTUNE 500® buy Dell systems. It's a philosophy that's made us an $890 million company. And it's a philosophy we'll continue.We guarantee it.

DELL™

800-553-6039

WHEN CALLING, PLEASE REFERENCE **#11E76**.
HOURS: 7AM-9PM CT MON-FRI, 8AM-4PM CT SAT, 10AM-3PM CT SUN.
IN CANADA, CALL 800-668-3021.

¶Leasing arranged by Leasing Group, Inc. ΔService provided by BancTec Service Corporation. On-site service may not be available in certain remote locations. i386, i486 and the Intel Inside Logo are trademarks of Intel Corporation. Microsoft and MS-DOS are registeredtrademarks and Windows is a trademark of Microsoft Corporation. Lotus is a registered trademark of Lotus Development Corporation. FORTUNE 500 is a registered trademark of The Time Inc. Magazine Company. Dell disclaims proprietary interest in the marks and names of others. ©1992 Dell Computer Corporation. All rights reserved.

Circle 63 on Inquiry Card.

video response time because data no longer must pass through the slower system bus. Unless the built-in adapter can be disabled, however, this approach forces you to accept the video adapter installed on the motherboard. That's a problem if you anticipate some day using higher screen resolutions than your original adapter allows. In that case, filling up an expansion slot with a video adapter doesn't seem like such a bad idea.

Whether you have integrated video or a separate adapter card, the type of chips used and the amount of VRAM (video RAM) provided are important. Among the test systems, Orchid and Diamond chip sets figured prominently. Only two systems, the NEC and Wyse, used the Tseng ET4000AX video chip set, which—like the Orchid and Diamond chip sets—performs well in video tests. We encountered no compatibility problems running DOS and Windows benchmark tests; however, some of the systems skimped on VRAM, supplying 256 or 512 KB, instead of a full 1 MB. You need 1 MB to display 256 simultaneous colors at 1024- by 768-pixel Super VGA resolution.

The PC Brand CPU module makes upgrading microprocessors a snap. Inside the cartridge are the microprocessor, coprocessor, cache, and a few support chips. The 9- by 11-inch system board holds the BIOS and main memory, the IDE controller, floppy disk controller, SVGA display adapter, and one parallel and two serial ports.

All the systems, with the exception of Addtech's SlimPro, came with their own noninterlaced monitors. Resolutions ranged from 640 by 480 pixels to 1280 by 1024 pixels, and vertical refresh rates ranged from 60 to 72 Hz (indicating the screens were redrawn completely 60 to 72 times per second). The best-looking monitor was the NEC PowerMate's optional NEC 4FG display. The most unusual video setup we encountered was the monitor integrated into the system box of Cardinal Technologies' PC10 (see the text box "Is It a Mac?" on page 217).

The I/O Equation

Of course, like all computers these 386SX systems need connections to the outside world. Most of the computers come standard with two serial and one parallel port. The only exception, the NEC PowerMate, has a single serial port; a second serial port is optional.

The situation with mice proved a little more varied. We included a mouse in our base configuration because our tests involve extensive Windows benchmarking, but a few of the manufacturers' base models do not include one. The most prominent brand of mouse was Microsoft's. Only four of the systems

continued

UNIX Developers!

See Us At UNIXexpo (NY), Booth #1067

The only dongle smart enough for any open systems application.

Introducing MicroSentinelUX

It's simply the ultimate tool for providing developers more revenue generating options — and ensuring that you get paid for software that's used.

In fact, it is the most effective hardware key for open systems and UNIX applications. And it works on any hardware platform.

A Hardware Key With Brains

The real magic of MicroSentinel is its onboard intelligent microprocessor. This makes the key smart enough to provide the ultimate in cross-platform flexibility and marketing value. Each key features an algorithm and 32 bytes of non-volatile read/write memory. This allows the developer to customize the key for specific applications.

Cross-Platform Flexibility

MicroSentinelUX is flexible enough to be used as a portable host-ID on Sun, DEC, Silicon Graphics, Apollo, HP, even PCs and more. The key attaches to any RS-232 port and the software is instructed to look for it. Its operation is transparent to the user. Developers use it to control distribution, meter usage, count concurrent users, and much more. And, it's easy and quick to integrate into your application.

Try One Today.

Be smart. Order a low-cost evaluation package today from the UNIX specialists at world leader Rainbow Technologies.

SENTINEL
Securing the future of software

Call for more information:
1-800-843-0413

Look what MicroSentinelUX can do for you.

- Make demos and leases more secure
- Controls distribution
- Provides alternative to host-ID security
- Allows portability
- Manages site licenses
- Protects unauthorized use or duplication
- Update/upgrade software remotely

RAINBOW TECHNOLOGIES

MICROSENTINEL HEADQUARTERS
9741-I SOUTHERN PINE BLVD., CHARLOTTE, NC 28273 ■ 704/523-9500 ■ fax 704/523-7651

MicroSentinelUX is a trademark of Rainbow Technologies, Inc. All other products and brand names are trademarks of their respective owners.

Circle 400 on Inquiry Card (RESELLERS: 401).

EIGHT EXCEPTIONS TO MURPHY'S LAW.

DELL 325SX i386™SX
25 MHz SYSTEM
- 2 MB RAM
- 80 MB (17 ms) IDE HARD DRIVE
- VGA 800 MONITOR (14", 800 x 600, .39mm)
- ONE FLOPPY DRIVE (3.5" OR 5.25")
- MS-DOS® 5.0

NOW ONLY $1,149
LEASE0: $43/MO.

DELL 486P/25 i486™SX
25 MHz SYSTEM
- 4 MB RAM
- 120 MB (17 ms) IDE HARD DRIVE
- UPGRADEABLE PROCESSOR
- SUPER ACCELERATED VIDEO CONTROLLER
- SUPER VGA 1024i MONITOR (14", 1024 x 768, .28mm)
- ONE FLOPPY DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

NOW ONLY $1,899
LEASE: $70/MO.

DELL 486P/33 i486DX
33 MHz SYSTEM
- 4 MB RAM
- 170 MB (17 ms) HARD DRIVE
- SUPER ACCELERATED VIDEO CONTROLLER
- SUPER VGA 1024i MONITOR (14", 1024 x 768, .28mm)
- ONE FLOPPY DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

NOW ONLY $2,199
LEASE: $81/MO.

DELL 486P/50 i486DX2
50 MHz SYSTEM
- 4 MB RAM
- 230 MB (16 ms) IDE HARD DRIVE
- SUPER ACCELERATED VIDEO CONTROLLER
- ULTRASCAN™ 14C MONITOR (14", 1024 x 768, .28mm, NON-INTERLACED)
- ONE FLOPPY DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

NOW ONLY $2,599
LEASE: $96/MO.

DELL 486D/50 i486DX2
50 MHz SYSTEM
- 4 DRIVE BAYS, 6 ISA SLOTS
- 8MB RAM
- 230 MB (16 ms) IDE HARD DRIVE
- SUPER ACCELERATED VIDEO CONTROLLER
- ULTRASCAN 15FS MONITOR (15", 1024 x 768, .28mm, NON-INTERLACED)
- ONE FLOPPY DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

NOW ONLY $3,149
LEASE: $117/MO.

DELL 466DE i486DX2
66 MHz EISA SYSTEM
- 4 DRIVE BAYS, 6 EISA SLOTS
- 8 MB RAM
- 230 MB (16 ms) IDE HARD DRIVE
- ULTRA ACCELERATED VIDEO CONTROLLER
- ULTRASCAN 15FS MONITOR (15", 1024 x 768, .28mm, NON-INTERLACED)
- ONE FLOPPY DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

NEW ONLY $3,899
LEASE: $140/MO.

DELL 320SLi i386SL
20 MHz 3.6 LB. NOTEBOOK
- 2 MB RAM
- 60 MB (19 ms) IDE HARD DRIVE
- REFLECTIVE VGA LCD (9.5", 640 x 480)
- UP TO 4-HOUR BATTERY LIFE
- MS-DOS 5.0/MICROSOFT® WINDOWS™ 3.1/LOTUS® ORGANIZER/DELL KEYBOARD MOUSE

NOW ONLY $2,149
LEASE: $80/MO.

DELL 325NC i386SL
25 MHz COLOR NOTEBOOK
- 4 MB RAM
- 80 MB (19 ms) IDE HARD DRIVE
- VGA COLOR LCD (9", 640 x 480)
- 7.1 LBS. INCLUDING BATTERY
- 3-HOUR BATTERY LIFE
- MS-DOS 5.0

NEW LOW PRICE $2,899
LEASE: $107/MO.

intel inside

DELL™

800-553-6039

WHEN CALLING, PLEASE REFERENCE #11E76.
HOURS: 7AM-9PM CT MON-FRI, 8AM-4PM CT SAT, 10AM-3PM CT SUN.
IN CANADA, CALL 800-668-3021.

Circle 63 on Inquiry Card.

provide mouse ports; all the others use a serial mouse, which takes up a serial port that you might someday need for another device.

NEC is alone in providing an interesting I/O feature on its PowerMate SX/25i. To keep up with changes in computer technology, NEC equips the PowerMate with an upgradable BIOS that is stored in a "flash ROM" chip. When you need to add new hardware or a peripheral not accommodated by your current BIOS, you can obtain a BIOS update disk from a dealer or through NEC's BBS. The *NEC User's Guide* gives complete instructions on saving the old BIOS and copying the new BIOS into the flash ROM chips.

CPU in a Box

Another innovation that shows up in two of these machines is a CPU upgrade path. Substituting a more powerful CPU usually means buying a new motherboard and installing it in the old case—clearly not a job for an inexperienced user. The PC Brand 386/SX-25's CPU module makes this process as easy as sliding in a floppy disk. The microprocessor module is a 6- by 7 1/4-inch metal-encased cartridge just 5/8 of an inch thick. Inside the cartridge are a microprocessor, coprocessor, cache (8 to 32 KB), and a few support chips, a design identical to that used for some of Tandon's desktop computers. The 9- by 11-inch system board holds the BIOS and main memory and the I/O circuitry, including the IDE controller, floppy disk controller, Super VGA display adapter, and one parallel and two serial ports (see the photo on page 220).

PC Brand offers a complete series of microprocessor modules, including a 386SLC-50 for $299; a 386/40 (with a 387 math coprocessor) for $499; a 486/SX-25 for $499; a 486/33 for $799 and a 486/50 for $1099.

As with many upgrades to existing hardware, this setup has a downside. Although you can increase the performance of the PC Brand, you get a smaller performance boost than you would if you purchased another computer designed around a faster processor. The upgraded motherboard still is configured to support the 386SX CPU, which has 16-bit data lines rather than the 32-bit lines provided by a 386DX or 486 chip.

Ace in the Hole

The AcerPower 386SX has a different sort of CPU upgrade option. When we first unpacked the machine, we naively set it up, verified that we had the proper portions of the BIOS shadowed, loaded the benchmarks, and began running them. The results knocked us back like the wake of a passing speed boat, leading us to conjecture that Acer had perfected the 100-MHz 386SX or that something unusual was afoot. The latter proved true. The AcerPower 386SX is equipped with an "overdrive" CPU socket, a special socket on the motherboard that accepts Intel's clock-doubling CPU. Indeed, when we ran The Norton Utilities, they reported that the machine contained a 50-MHz 486 CPU.

The AcerPower's CPU upgrade socket is special, indeed. If you have an AcerPower with a 386SX currently installed, you simply take the top off the case and plug in the 486 chip. That's it; the system automatically detects the new chip and the proper BIOS kicks in at boot-up. This is possibly the most painless upgrade we've seen. And Acer had "painlessly" upgraded the machine before shipping it to us. Painfully, we downgraded the machine to its 386SX level but not without noting that the

PERISCOPE

New

Debug OS/2 2.0, Windows 3.1 Drivers

Save up to $500 on Model IV Hardware

Rent Model IV $6-$12 a day

Professional Software and Hardware-Assisted Debuggers for 80386 & 80486 Systems

If you need a debugger but have no room left in the lower 640K of your 386™ or 486™ system, Periscope now has a new SOFTWARE-ONLY solution for you—Periscope/EM.

- Periscope/EM takes advantage of the extended memory you already have, rather than using any memory in the lower 640K.
- No runaway program can corrupt Periscope/EM because it's write-protected.
- You don't have to use a slot since there's no board to install.
- You can add an optional break-out switch to recover from crashes.
- Periscope/EM costs only $295, half the cost of Periscope Model I, with most of the same functionality.

Periscope/EM requires 386MAX® or BlueMAX™, version 5.11 or later; a 386 or 486 system with about 300K of extended memory; 32K of memory between 640K and one megabyte; DOS 3.0 or later.

New Debugging Tools

"I needed a means to debug interrupt handlers where I could really see what was going on. The hardware trace buffer is great. I was able to debug code in 3 days that I have been trying to debug for months!"

...writes Peg Sestrich with Prime Computer, on why she chose Periscope Model IV.

If you need more than your current software-based debugger gives you, Periscope Model IV, with these advanced NEW features, may be just what you're looking for:

- Supports 386 and 486 systems running up to 33MHz with its ICE-like capabilities.
- Real-time hardware trace buffer holds up to 16K CPU events.
- Enhanced analysis and display of trace buffer makes you more productive.
- Periscope/EM functionality, built-in at no extra cost, saves you money.

Just call toll-free 800/722-7006 for details or to order.

The Periscope Company, Inc.

1197 PEACHTREE ST.
PLAZA LEVEL
ATLANTA, GA 30361
404-875-8080
FAX 404-872-1973

Real-time Periscope Model IV, shown with new 33MHz board and 486 pod.

Circle 68 on Inquiry Card (RESELLERS:69).

IIT ADVANCED MATH COPROCESSORS

MAKE YOUR PC FLY WITH NEW LOW FARES UNDER $100.

Great news for 386, 386SX and 286 PC owners! We've just lowered our prices on all IIT Advanced Math CoProcessors. *Now, for under $100, you can increase the speed and performance of most key business applications*—Spreadsheet, Graphics, CAD, Desktop Publishing, Database and other business productivity tools—by up to five times.

Get today's best value in a performance upgrade for your PC. Ask your dealer for an IIT Advanced Math CoProcessor.

IIT ADVANTAGES ADD UP FAST!

- Guaranteed 100% compatibility with all 386, 386SX, and 286 systems and software
- Speeds up over 2,000 applications by up to five times
- Up to three times faster than Intel
- Lifetime warranty
- Installs instantly and easily
- Toll-free support line

For more information or the IIT dealer nearest you, call 1-800-832-0770 or 408-727-1885.

© 1992, Integrated Information Technology, Inc. (IIT).
All other trademarks are property of their respective holders.

IIT INTEGRATED INFORMATION TECHNOLOGY

Circle 64 on Inquiry Card (RESELLERS: 65).

1-800-8

Your Natural Resource

Keyboards

- 8088/286/386 compatible
- Automatically switch between XT or AT
- One-year warranty

FKB4700 Fujitsu 101-key enhanced keyboard..$79.95
FK5001 130-key enhanced keyboard with calculator 89.95
JE2018 32-key serial keypad 59.95
K101 101-key enhanced keyboard (90-day warranty).....49.95

Power Supplies

- One-year warranty

JE1030 150 watt 8088.....$69.95
JE1030A 200 watt 8088 .....89.95
JE1036 200 watt 286/386 .....89.95
JE1038A 250 watt 286/386 .....99.95
JE1039A 300 watt 286/386 .....149.95

KaLok Hard Disk Drives

- 90-day warranty

KL320 20MB MFM hard drive.....$169.95
KL330 30MB RLL hard drive.....189.95

Call for information on controller cards.

Hard Drives (IDE)

Conner IDE

- 8088/286/386 compatible
- Requires host IDE adapter
- One-year manufacturer's warranty

Part No.	Capacity	Speed	Price
CP3000	40MB		$249.95
CP30084	80MB		399.95
CP30104	120MB		479.95
CP3204	200MB		699.95

Controllers

IDE Disk Drive Adapter Cards

Standard Features:

- Interfaces two IDE hard drives to system
- One-year manufacturer's warranty

ADP20 16-bit hard adapter.....$29.95
ADP20F 16-bit hard/floppy adapter 39.95
ADP50 8-bit hard adapter 79.95
ADP60 16-bit hard adapter with BIOS 79.95
ADP60F 16-bit hard/floppy adapter with BIOS..99.95

Tool Kit

Computer Service

- (2) Slotted screwdrivers: 1/8", 3/16"
- (2) Phillips screwdrivers: #0, #1
- (2) Nutdrivers: 3/16", 1/4"
- (2) Torque screwdrivers: T-10, T-15
- 14-16 pin IC inserter/straightener
- 3-claw parts holder
- Tweezers
- 14-40 pin IC extractor
- Black vinyl carrying case

CSK8 .....$19.95

Jameco Power Base

- Masterpower switch and 5 auxillary switches for each outlet
- 15A, 125 VAC, 1875 watts, 60Hz
- Maximum spike: 80 joules one time
- Maximum spike volts: 6,000V@ 4,500A
- Clamp volts: 175V
- Clamping response time: 10ns
- Color: beige

JE1190.....$29.95

Jameco Six-Outlet Power Strip

- Built-in safety circuit breaker (15 amps)
- Master switch with pilot light
- Three-prong, 6-foot power cord
- UL listed

JE1191.....$11.95

Floppy Disk Drives

Toshiba 1.44MB 3.5" Internal Floppy Disk Drive

- 8088/286/386 compatible
- One-year manufacturer's warranty

356KU.....$99.95

Additional Internal Floppy Disk Drives

- One-year manufacturer's warranty

FD55B 5.25" TEAC 360KB w/black faceplate$89.95
FD55G 5.25" TEAC 1.2MB w/gray faceplate....99.95

Floppy Controllers

- One-year warranty

JE1043 8088/286/386 two-drive controller.....$49.95
JE1049 8088/286/386 four-drive controller.....59.95

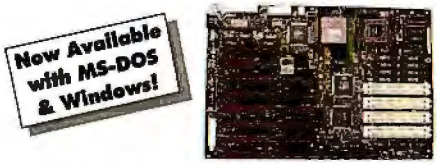
31-4242
Only A Phone Call Away

Announcing JAMECO ServiceLine™
Computer Repair and Support
1•800•831•8020

Jameco is your most convenient shopping call for computer kits, upgrades, add-ons and test/prototype equipment. Discover full service and competitive prices backed by skilled technical support. Call Jameco, your natural resource for computer products and electronic components for over 18 years.

Motherboards

Jameco 80386 64KB Cache Motherboard



- 33MHz motherboard
- Supports up to 32 MB of RAM on-board
- Supports 64KB, 128KB or 256KB direct mapped cache RAM
- Six 16-bir slots and two 8-bit slots
- One-year warranty

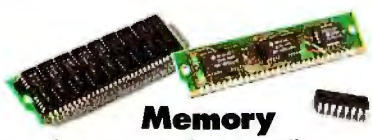
JE3633	80386 33MHz motherboard	$459.95
JE3633MS	80386 33MHz motherboard with MS-DOS 5.0 and Windows 3.1	579.95

Additional Jameco Motherboards

- One-year warranty

JE3625DN	80386 25MHz motherboard	$349.95
JE3616SN	80386SX 16MHz motherboard	209.95
JE3006	80286 12MHz motherboard	124.95
JE1002BE	8088 10MHz motherboard	69.95

Call for additional software options and information on our 8088, 286 and 386 computer kits!



Memory

Expand your memory. See our excellent select on at low pr ces for all types of RAM. Jameco also offers memory modules for Apple, AST, Compaq, Epson, IBM, Hewlett-Packard and Toshiba computers.

DIP

Part No.	Pins	Function	Price
41256-120	16	256K 120ns	$1.69
41256-150	16	256K 150ns	1.59
511000P-80	18	1MB 80ns	5.99
511000P-10	18	1MB 100ns	5.49

SIPPs and SIMMs

41256A9A-10	256K SIPP 100ns (has leads)	$18.95
41256A9B-80	256K SIMM 80ns	16.95
421000A9A-80	1MB SIPP 80ns (has leads)	54.95

Call for additional information on our selection of math coprocessors.

Computer Cards

16-bit VGA Card

- 8088/286/386 compatible
- Comes with 256KB video RAM expandable to 512KB
- Capable of 640 x 480 with 256 colors, 800 x 600 with 256 colors, 1024 x 768 with 16 colors (512KB RAM required for all modes)
- One-year warranty

VG7700 ..... $99.95

Additional Cards

JE1040	8088 floppy controller	$19.95
JE1050A	8088/286/386 monochrome graphics adapter	49.95
JE1058S	8088/286/386 Super VGA	149.95
JE1060	8088 I/O	59.95
JE1062	88/286/386 RS232 serial (16450 UART)	29.95
JE1062A	88/286/386 RS232 serial (16550 UART)	39.95
JE1065	80286/386 I/O	59.95
JE1075	8088 multi I/O w/floppy controller	69.95
JE1076	80286/386 multi I/O w/floppy controller	69.95
JE1080	8088 memory expansion half card	49.95
RAMQUEST	8088/286/386 Orchid 32MB memory card	169.95

Cables, Gender Changers, and Adapters

PPC6	6-foot parallel DB25-pin male to Centronics male printer cable	$8.95
PPC12	12-foot parallel DB25-pin male to Centronics male printer cable	11.95
SAT6	6-foot 9-pin serial DE9 female to DB25 male cable	5.95
25M10F	10-foot DB25-pin male to female cable extension	9.95
25M10M	10-foot DB25-pin male to male cable extension	9.95
GC25F	DB25-pin female slim line gender changer	4.49
GC25M	DB25-pin male slim line gender changer	4.49
AD925	DE9 female to DB25 male serial adapter	4.95
AD926	DE9 male to DB25 female serial adapter	4.95

Jameco Solderless Breadboards

JE27

Jameco's long-lasting breadboards feature screen-printed color coordinates and are suitable for many kinds of prototyping and circuit design. Larger models feature a heavy-duty aluminum backing with voltage and grounding posts.

JE23

Part No.	Dim. L" x W"	Contact Points	Binding Posts	Price
JE21	3.25 x 2.125	400	0	$4.95
JE23	6.50 x 2.125	830	0	6.95
JE24	6.50 x 3.125	1,360	2	12.95
JE25	6.500 x 4.25	1,660	3	17.95
JE26	6.875 x 5.75	2,390	4	24.95
JE27	7.250 x 7.50	3,220	4	32.95

Metex Digital Multimeters

M4650

- Handheld, high accuracy
- Measures AC/DC voltage, AC/DC current, resistance, diodes, continuity, and transistor current gain (except M3900)
- Manual ranging w/overload protection
- Comes with probes, batteries, case and manual

M3650 & M4650 only:
- Also measures frequency and capacitance

M3800	3.5 digit multimeter	$39.95
M3610	3.5 digit multimeter	59.95
M3900	3.5 digit multimeter with tach/dwell	59.95
M3650	3.5 digit multimeter w/frequency & capacitance	74.95
M4650	4.5 digit w/frequency & capacitance & data hold switch	99.95

JAMECO®
ELECTRONIC COMPONENTS
COMPUTER PRODUCTS

1355 Shoreway Road, Belmont, CA 94002

Sales: 1•800•831•4242
Outside US: 415•592•8097
FAX: 1•800•237•6948
Jameco ServiceLine™: 1•800•831•8020
Technical Support: 1•800•831•0084

GET A FREE JAMECO CATALOG
CALL 1•800•637•8471 MENTION MAIL KEY 001

© 9/92 Jameco Electronic Components/Computer Products All trademarks are registered trademarks of their respective companies.

Terms: Prices are subject to change without notice. Items subject to availability and prior sale. Complete list of terms/warranties is available upon request.

Circle 67 on Inquiry Card.

25-MHZ 386SX DESKTOP COMPUTERS

The mix of components a vendor supplies with its systems can change overnight. Make sure you know what you're getting before you buy.
(● = yes; ○ = no; N/A = not available.)

Company	Acer America Corp.	Acma Computers	Addtech Research	AMAX Engineering
Model	AcerPower 386SX	386SX/25	SlimPro 386SX-25	386SX/25
Chips				
Brand of CPU	Intel	Intel	AMD	Intel
CPU upgrade	●	○	○	○
Brand of math coprocessor	Cyrix	Cyrix	Cyrix	Cyrix
Brand of motherboard chip set	Acer	OPTI	Chips & Technologies	OPTI
Brand of BIOS	Acer	AMI	AMI	AMI
Memory				
Standard RAM (DRAM)	2 MB	4 MB	1 MB	4 MB
Max. RAM (DRAM)	8 MB	16 MB	16 MB	16 MB
No. of wait states	None	None	None	None
Standard cache (SRAM)	N/A	N/A	N/A	N/A
Max. cache (SRAM)	N/A	N/A	N/A	N/A
Storage media				
Standard floppy configuration				
5¼-inch floppy drive	Optional	●	Optional	●
3½-inch floppy drive	●	●	●	●
Standard hard disk configuration				
Brand and model	Maxtor 7120A	Quantum LPS 120AT	WD CA280	Quantum LPS 120AT
Capacity	125 MB	120 MB	85 MB	120 MB
Max. hard disk capacity offered	2 GB	1.4 GB	1 GB	1.4 GB
Interface type	IDE	IDE	IDE	IDE
Caching controller	●	○	○	○
No. of drive bays	4	4	1	4
Monitor				
Brand	Acer	Impression Plus	N/A	Impression Plus
Color (C)/Monochrome (M)	C	C	N/A	C
Max. resolution	1024 x 768	1024 x 768	N/A	1024 x 768
Expansion slots				
No. of ISA slots	4	8	2	8
Proprietary slots	CPU upgrade socket	None	None	None
Standard interfaces				
No. of serial ports	2	2	2	2
No. of parallel/printer ports	1	1	1	1
Video adapter/Resolution	Super VGA/1024 x 768	Super VGA/1280 x 1024	VGA/640 x 480	Super VGA/1024 x 768
Standard VRAM	512 KB	512 KB	1 MB	1 MB
Brand of video adapter	ATI	Diamond	Customer selects	Diamond
Mouse included	●	●	○	●
Serial mouse (S)/Mouse port (MP)	MP	S	S	S
Game port	○	●	○	●
Power Supply (watts)	145	250	60	250
Bundled software				
MS-DOS 5.0	●	●	○	●
Windows 3.1	●	●	○	●
Other	Utilities	None	None	None
Warranty	1 year parts and labor	1 year parts and labor; on-site service	1 year parts and labor	1 year parts and labor
List Prices				
Standard configuration	$1295	$1195	$560	$1495
Review unit price	$2449	$1995	$1106	$1705
Review unit options	Ultra 15C controller with 2 MB of RAM, 200 MB hard drive, 2 MB of RAM	2 MB of RAM, 387SX math coprocessor, 120 MB hard drive	WD 80-MB hard drive, Cyrix math coprocessor, mini-keyboard	120 MB hard drive, Cyrix math coprocessor

Ariel Design	Cardinal Technologies	Club American Technologies	CompuAdd Computer	Dell Computer
386SX-25 Cache	PC10	Eagle 325SX	325SC	System 325SX
AMD	AMD	AMD/Intel	Intel	Intel
○	○	○	○	○
Cyrix	Intel	AMD/Intel	Intel	Intel
Micronics	VLSI	VLSI	Chips & Technologies or TI	VLSI
Chips & Technologies	AMI	AMI	Phoenix	Phoenix
4 MB	1 MB	2 MB	2 MB	2 MB
16 MB	16 MB	16 MB	16 MB	8 MB
None	None	None	None	None
32 KB	N/A	N/A	32 KB	N/A
32 KB	N/A	N/A	64 KB	N/A
●	○	●	●	Optional
●	●	●	●	●
WD CA280	TEAC SD380/H	Quantum LPS 105AT	Quantum LPS120AT	Quantum LPS52AT
80 MB	86 MB	105 MB	120 MB	52 MB
500 MB	86 MB	425 MB	1.2 GB	500 MB
IDE	IDE	IDE	IDE	IDE
○	○	○	○	○
4	1	4	4	3
Viewsonic	Cardinal	Club	Samsung	Dell
C	M	C	C	C
1024 x 768	640 x 480	1024 x 768	1024 x 768	640 x 480
6	2	8	5	3
None	None	None	None	None
2	2	2	2	2
1	1	1	1	1
Super VGA/1024 x 768	VGA/640 x 480	Super VGA/1024 x 768	Super VGA/1024 x 768	VGA/1024 x 768
1 MB	256 KB	1 MB	512 KB	256 KB
Diamond	Cardinal	Diamond	CompuAdd	Dell
●	○	●	○	Optional
S	MP	S	S	S
○	○	○	Optional	○
250	135	200	200	85
●	○	●	●	Optional
●	○	●	●	Optional
None	DR DOS 6.0	None	Diagnostics/Utilities	Diagnostics/Utilities
30-day money-back; 1 year parts and labor	1 year parts and labor	1 year parts and labor; on-site service	1 year parts and labor	1 year parts and labor; on-site service
$1595	$1299	$1665	$1095	$1199
$1595	$1419	$2394	$1988	$1708
None	387SX math coprocessor	240-MB hard drive, 387SX math coprocessor	120-MB hard drive, 2 MB of RAM, mouse, 387SX math coprocessor	120-MB hard drive, 2 MB of RAM

25-MHZ 386SX DESKTOP COMPUTERS

(● = yes; ○ = no; N/A = not available.)

Company	Duracom Computer Systems	Gateway 2000	JCC Systems	NEC Technologies	PC Brand
Model	Desksaver 386/25SX	25MHz 386SX	386SX-25	PowerMate S /25i	386/SX-25
Chips					
Brand of CPU	Intel, AMD	Intel	AMD	Intel	Intel
CPU upgrade	○	○	○	○	●
Brand of math coprocessor	Intel, Cyrix	Intel	IIT	Intel	Intel
Brand of motherboard chip set	DCL	Western Digital	VLSI	Western Digital	Western Digital
Brand of BIOS	AMI	Quadtel	AMI	NEC	PC Brand
Memory					
Standard RAM (DRAM)	1 MB	4 MB	1 MB	2 MB	4 MB
Max. RAM (DRAM)	16 MB	16 MB	32 MB	26 MB	16 MB
No. of wait states	None	None	None	None	None
Standard cache (SRAM)	N/A	N/A	N/A	16 KB	N/A
Max. cache (SRAM)	N/A	N/A	N/A	16 KB	N/A
Storage media					
Standard floppy configuration					
5 1/4-inch floppy drive	●	●	●	Optional	●
3 1/2-inch floppy drive	Optional	●	●	●	●
Standard hard disk configuration					
Brand and model	Maxtor 7080A/S	WD CA280	Seagate ST-3120	Quantum LPS105S	Conner CP-30104
Capacity	80 MB	80 MB	105 MB	105 MB	105 MB
Max. hard disk capacity offered	535 MB	500 MB	200 MB	240 MB	400 MB
Interface type	IDE	IDE (Optional SCSI)	IDE	IDE	IDE
Caching controller	○	●	●	○	○
No. of drive bays	6	3	3	4	2
Monitor					
Brand	Duracom	Gateway	Samtron	NEC	Supercom
Color (C)/Monochrome (M)	C	C	C	C	C
Max. resolution	1024 x 768	1024 x 768	1024 x 768	1024 x 768	1024 x 768
Expansion slots					
No. of ISA slots	8	5	6	4	7
Proprietary slots	None	None	None	None	CPU upgrade cartridge
Standard interfaces					
No. of serial ports	2	2	2	1	2
No. of parallel/printer ports	1	1	1	1	1
Video adapter/Resolution	Super VGA/1024 x 768	Super VGA/1024 x 768	Super VGA/1024 x 768	Super VGA/1280 x 1024	Super VGA/1024 x 768
Standard VRAM	1 MB	512 KB	1 MB	512 KB	512 KB
Brand of video adapter	Western Digital	Paradise	JCC	Tseng Labs	Orchid
Mouse included	Optional	●	●	●	●
Serial mouse (S)/Mouse port (MP)	S	S	S	S	S
Game port	●	○	●	○	○
Power Supply (watts)	200	200	200	250	130
Bundled Software					
MS-DOS 5.0	●	●	●	●	●
Windows 3.1	●	●	●	●	●
Other	○	Choice of Microsoft package	○	Utilities	○
Warranty	1 year parts and labor; on-site service	30-day money-back 1 year parts and labor	1 year parts and labor; on-site service	1 year parts and labor; on-site service	30-day money-back 1 year parts and labor on-site service
List Prices					
Standard configuration	$1495	$1595	$1259	$1699	$1595
Review unit price	$1907	$1755	$1604	$3356	$1715
Review unit options	130-MB hard drive, Cyrix math coprocessor	387SX math coprocessor	2 MB of RAM, 387SX math coprocessor	4FG monitor, 2 MB of RAM, 387SX math coprocessor	387SX math coprocessor

PolyWell Computers	Tandy	Tangent Computer	Wyse Technology
Poly 386-25SX	2500 SX/25 HD	325s	Decision 386SX/25C
AMD	AMD	Intel	Intel, AMD
○	○	○	○
Cyrix	Intel	Cyrix	Cyrix
OPTI	AMD	OPTI	OPTI
AMI	Phoenix	AMI	AMI
2 MB	2 MB	4 MB	2 MB
16 MB	16 MB	16 MB	16 MB
None	None	None	None
16 KB	N/A	N/A	64 KB
64 KB	N/A	N/A	64 KB
●	Optional	Optional	Optional
Optional	●	●	●
Maxtor 7080	Quantum LPS120AT	Seagate ST-3120A	WD CA2120
80 MB	85 MB	100 MB	80 MB
535 MB	510 MB	510 MB	1.2 GB
IDE	IDE	IDE	IDE
Optional	N/A	○	●
5	1	5	5
Viewsonic	Tandy	Relisys	Wyse
C	C	C	C
640 x 480	1024 x 768	1024 x 768	1024 x 768
8	3	8	6
None	None	None	None
2	1	2	2
1	1	1	1
VGA/640 x 480	Super VGA/1024 x 768	Super VGA/1024 x 768	Super VGA/1024 x 768
256 KB	256 KB	512 KB	512 KB
Orchid	Western Digital	Diamond	Tseng ET4000
●	●	○	●
S	MP	S	MP
●	○	●	○
230	70	200	145
●	●	●	●
●	●	○	●
○	Microsoft Works for Windows	○	Utilities
1 year parts and labor; on-site service	1 year parts and labor; in-store service	1 year parts and labor	1 year parts and labor
$1200	$1299	$1595	$1599
$1650	$2823	$1715	$1719
2 MB of RAM,	512 KB VRAM,	Cyrix math	Cyrix math
120-MB hard drive, Cyrix math coprocessor	120-MB hard drive, 4 MB of RAM, 387SX math coprocessor, VGA monitor	coprocessor	coprocessor

AcerPower with its 486 upgrade in place turned in results that were between two and seven times those of the other machines we tested.

The CPU upgrade lets you triple or quadruple the performance of the Acer when running CPU-intensive applications. This performance increase lists for a nominal $175.

A Controller of Note

Another noteworthy feature also turned up in the AcerPower: a hefty UltraStor controller, the kind of device you'd expect to find in a beefy network server. Capable of handling up to two IDE hard drives and three floppy disk drives ($3^1/_2$- or $5^1/_4$-inch models) and carrying up to 8 MB worth of disk cache, the Ultra 15C comes with utility software that leads you through a slew of configuration options. For example, if you turn on the controller's deferred writing capabilities, you also can set a cache threshold that triggers a physical write. Writing occurs when the cache is filled to this threshold. Though we tested the AcerPower with only DOS and Windows applications, UltraStor claims compatibility with SCO Unix, NetWare, and OS/2. This surprise package will even support controller duplexing and drive mirroring.

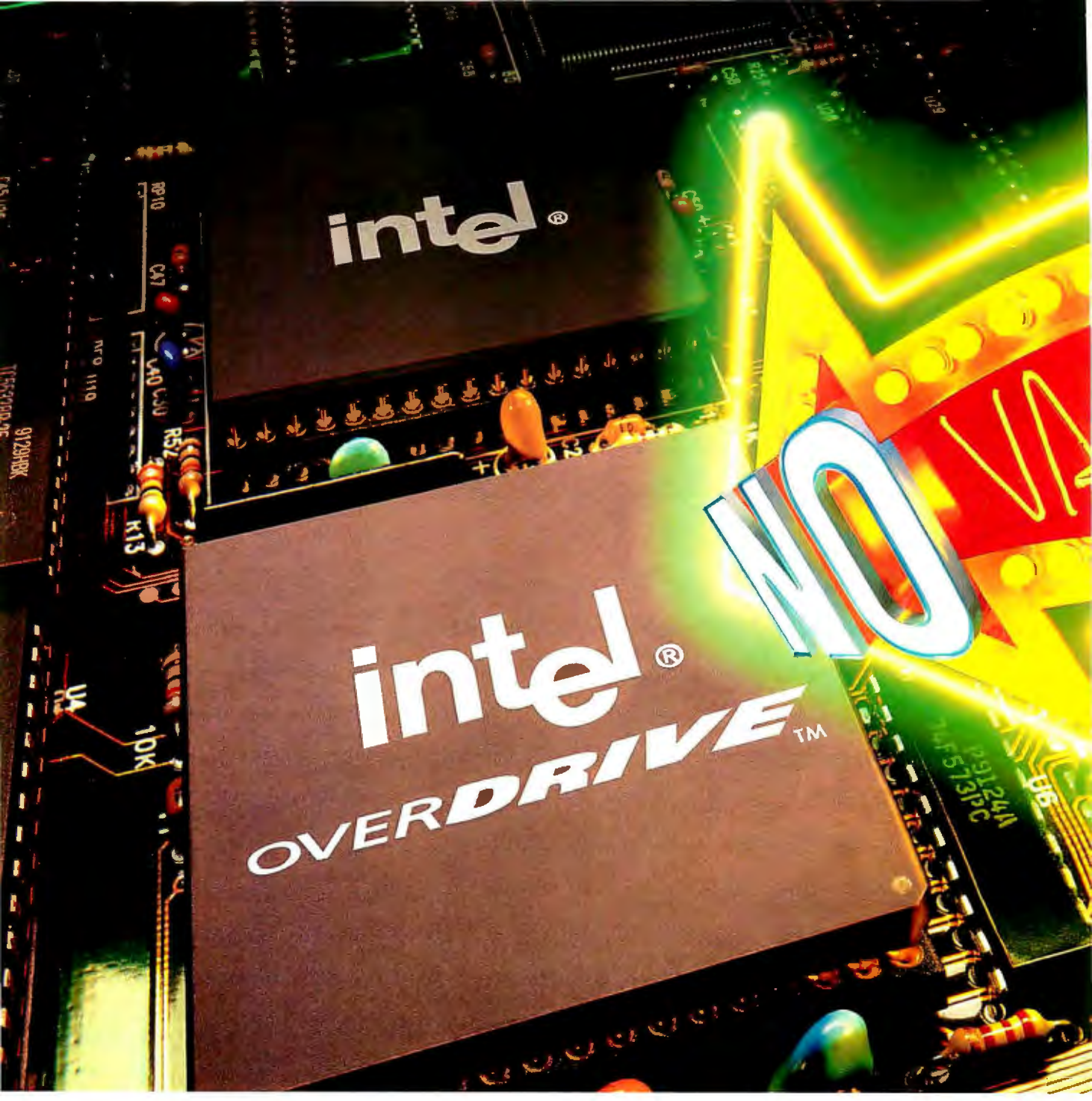
The Ultra 15C supplied with our AcerPower included a 2-MB cache. We disabled its deferred writing (which, if on, would certainly have significantly improved the AcerPower's file I/O and database results) and set its cache threshold to 84 percent. As our analysis of benchmark results shows, even with these restrictions the Ultra 15C provided the AcerPower with disk I/O figures anyone would be proud of.

The BYTE Benchmarks

But disk I/O is just one of the benchmarks in the standard BYTE test suites we used to compare the performance of this group of 386SX machines. As usual, we ran each system through low- and medium-level tests that let us focus on the particulars of hardware performance and used application tests to provide a good snapshot of how these machines would behave when running real software (see the figure on page 232).

The applications tests cover two classes of software: DOS- and Windows-based packages. Since we were looking at 386SX machines and it was unlikely that anyone would choose to use a 386SX as a Unix workstation, we did not run BYTE's Unix test suite.

continued



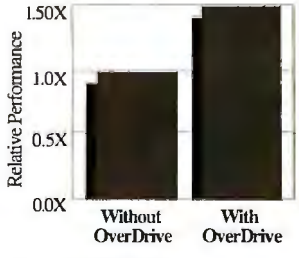
Your upgrade

Introducing Intel OverDrive™ Processors.

With built-in upgradability we promised you room for the future. Room for more power.

Well, the future has arrived. Presenting a revolutionary new category of single-chip upgrades: Intel OverDrive Processors. The easiest, most cost-effective way to add even more power to your system–for Intel486™ SX PCs now, and soon for all 486 systems and beyond.

i486™SX-20 System Performance: Microsoft Word for Windows*



Just pop in a new OverDrive Processor and you'll improve overall i486 SX system

©1992 Intel Corporation. Intel486, i486 and OverDrive are trademarks of Intel Corporation. *Windows is a trademark of Microsoft Corporation.

just checked in.

performance by up to 70 percent. Added performance that will benefit over 50,000 compatible software applications.

And that goes for today's demanding Windows software, too.

WE MAKE COMPUTERS WORK HARDER.
Find out more. Ask for ext. 98
1-800-538-3373

In fact, by adding an Intel OverDrive Processor, your 486 PC will even run multiple Windows applications faster.

To check in to the OverDrive Processor, see your local computer dealer now.

Or for a detailed brochure, call 1-800-538-3373, ext. 98. And hurry. The vacancies are filling fast.

intel®

Circle 66 on Inquiry Card.

Though our benchmarks are not specifically designed to measure compatibility, we often discover problems while simply loading and executing such a variety of applications—especially Windows programs. Happily, none of the systems we tested exhibited major problems.

Running so many systems through so many benchmarks creates a mind-numbing buzz of numbers. We distilled those numbers by grouping tests into five categories—word processing, spreadsheets, database, development, and scientific/CAD—and computing indexes for each category. The resulting collection of five indexes helped us to narrow our search for the top machines.

After examining the data, we were struck by how tightly the results were clustered. This was true for both our DOS and Windows tests. Indeed, if you consider performance alone, you find neither outstanding winners nor outstanding losers on the tests.

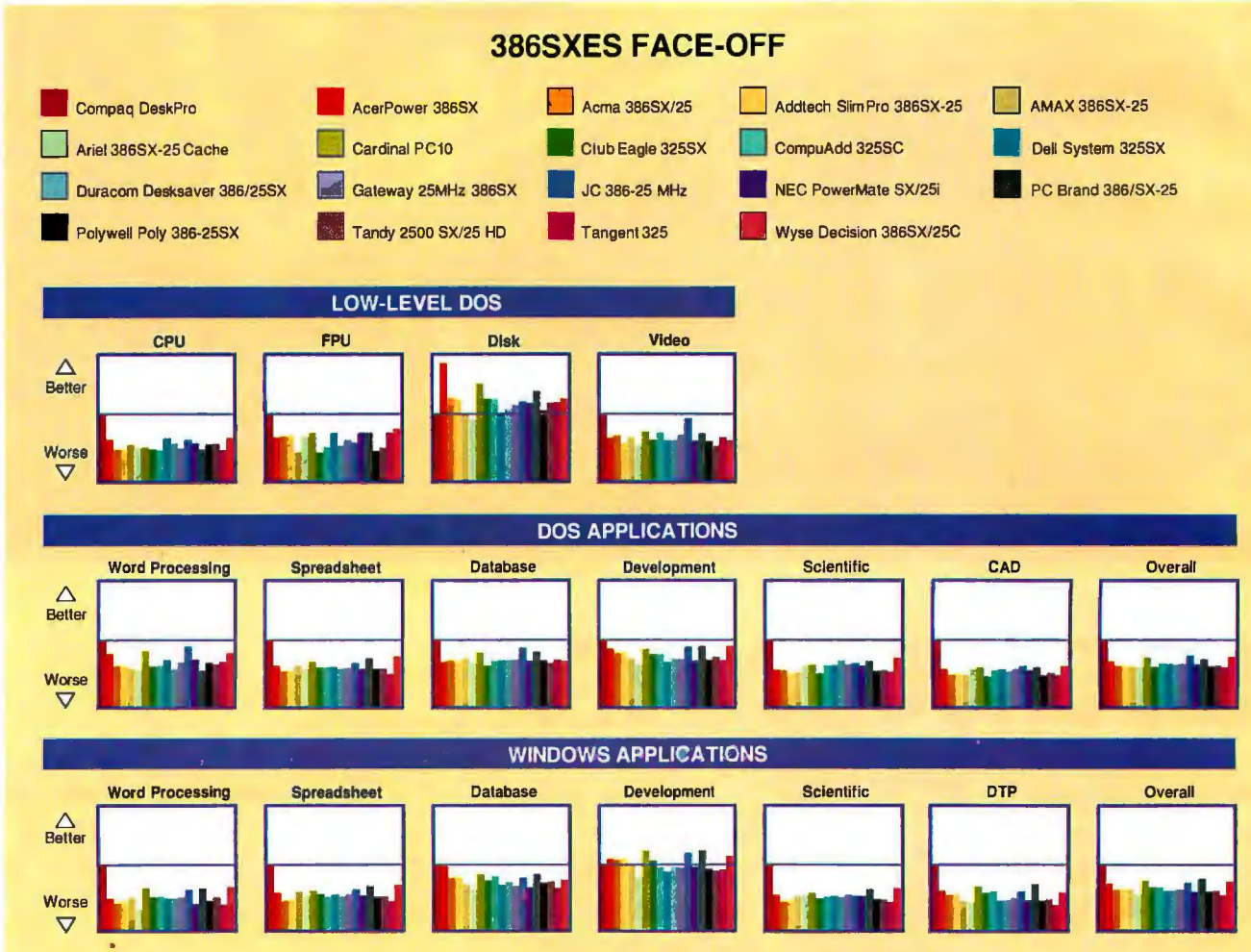
Of course, occasional anomalies cropped up, but their significance became obvious when we explored the benchmark results on a single large spreadsheet. For example, the AcerPower turned in unusually good figures for low-level I/O and Windows database tests. The Acer's fine showing can be traced to its Ultra 15C caching drive controller from UltraStor.

Ultimately, we managed to select two performance winners: the Wyse Decision 386SX/25C and the PolyWell Poly 386-25SX. Keep in mind, however, that our benchmark results reveal a close race. For example, the NEC PowerMate SX/25i showed up twice in the winner's circle—once for word processing and again for database performance. Also, our performance indexes reflect overall results; the anomalies mentioned earlier—outstanding performance on one or two tests—were smoothed out during the indexing process.

Buying Decisions

As we evaluated these systems, a question hung in the air: How wise an investment is a 386SX system really? None of these systems is *bad*, but all the advantages we can find seem so *marginal*. What are the advantages? Price...maybe. Space? Let's consider these issues.

continued



When it comes to performance, 386SX systems are closely grouped. Our two picks, the PolyWell Poly 386-25SX and the Wyse Decision 386SX/25C, placed well across the board. The NEC PowerMate SX/25i also performed well.

LAUNCH YOUR HARD DRIVE!

Promise Introduces the First Truly Affordable Caching Disk Controllers.

Prices Start at $169.00

Order an IDE Caching Controller today and watch your system operate at light speed!

Featuring

- .3ms Average Disk Access Speed.
- "Plug and Play" Operation.
- Easy to Follow Documentation.
- Two Year Warranty.
- Guaranteed to Run with All Operating Systems & Applications Software.

Our new ultra-low cost disk accelerators will finally end the data bottleneck that takes up so much of your valuable time and at a fraction of the cost of similar cache controllers. They install in minutes and require no special tools or expertise. Satisfaction guaranteed!

"If you're tired of watching your hard drive slowly give up its data, Promise Technology may be able to put the spring back into your data handling... There are other caching IDE controllers available, but they don't share the flexibility and simplicity of the DC-2032. These two attributes will make it a sterling addition to your computer." *Bill O'Brien, PC Sources.*

"★★★★ An enormous improvement in performance was immediately obvious compared to the un-cached controller . . . Overall, this controller increased performance by a factor of around 8 times when using large database applications. At a more general level, the whole machine seemed faster and more responsive . . . At the new lower price, this is an extremely good value and extra features make this controller (DC-2031) a particularly attractive option. *Dave Pearman, PC+ (U.K.) March '92*

Super IDE IDE-ISA | Super IDE: I/O IDE-ISA | DC-2032 IDE-ISA | DC-2040 SCSI-ISA | DC-4030 Local Bus | DC-3040 SCSI-EISA

VISA MasterCard

OEM and Dealer Inquiries Welcome.

ITALY:	GERMANY:	U.K.:	FRANCE:
Executive di Ascoli	CPS	Dan Technology	HTS
(39) 0341-282614	(49) 040-656-998-0	(44) 081-902-9922	(33) 042-20-59-59

Circle 70 on Inquiry Card.

Toll Free in USA 1-800-888-0245

Hard drive depicted is the Maxtor LXT535 IDE drive. Provided courtesy of Maxtor Corporation.

PROMISE TECHNOLOGY, INC.

1460 Koll Circle, San Jose, CA 95112
Tel. (408) 452-0948 Fax (408) 452-1534

With new 80x86 processors sprouting in Intel's fertile soil so frequently these days, it's difficult to tell what par is anymore, but 33-MHz 386DX machines are easily obtained at prices not far beyond what you'd pay for any of these 386SX machines. And it's obvious that a 33-MHz 386DX is going to run through tasks more quickly than a 25-MHz 386SX (our benchmarks indicate performance improvements of 200 percent to 500 percent when running a DX system).

Granted, you're not buying just a processor—you're buying a complete system, and that includes disk controllers and monitors and maybe tape drives and so on. A good caching disk controller loaded up with lots of memory can go a long way to making up for a sluggish processor. You can even get Windows accelerator cards to put zing in graphics operations.

But with price differences of only $200 to $300 in favor of the 386SX, the only economic reasons for going the SX route are if you're really strapped for funds and you don't have the time to shop around. A good shopper can easily make up a $300 difference. All those accelerator cards and caching controllers would be just as happy—*happier*, in fact—in a DX system.

Economics aside, someone might argue that the 386SX allows for space-conscious designs, and makes possible machines such as the Cardinal and the Addtech. But it's hard to imagine a space that could accommodate any kind of monitor worth spending time with but that can't fit a reasonably sized desktop computer. We've seen 486 systems as small as or smaller than many of the 386SX systems we tested in this product report.

If, knowing the breed's limitations, you still decide to buy a 386SX system, we recommend you seek out the PolyWell Poly 386-25SX or the Wyse Decision 386SX/25C system. But your rationale must be a good one—strong enough to warrant choosing the less capable 386SX over a 386DX. Frankly, we'd be hard put to think of a single such reason. ■

Rick Grehan is technical director of the BYTE Lab. He has a B.S. in physics and applied mathematics and an M.S. in mathematics/computer science. Stan Wszola is a BYTE Lab testing editor. You can reach them on BIX as "rick_g" and "stan," respectively.

COMPANY INFORMATION

Acer America Corp.
2641 Orchard Pkwy.
San Jose, CA 95134
(800) 733-2237
(408) 432-6200
fax: (408) 432-6221
Circle 1105 on Inquiry Card.

Acma Computers, Inc.
48501 Warm Springs Blvd.
Fremont, CA 94539
(800) 768-6888
(510) 623-1212
fax: (510) 623-0818
Circle on 1106 Inquiry Card.

Addtech Research, Inc.
41332 Christy St.
Fremont, CA 94538
(510) 623-7583
fax: (510) 623-7538
Circle 1107 on Inquiry Card.

AMAX Engineering Corp.
47315 Mission Falls Court
Fremont, CA 94539
(800) 888-2629
(510) 651-8886
fax: (510) 651-3720
Circle 1108 on Inquiry Card.

Ariel Design, Inc.
145 Webster St.
Hanover, MA 02339
(800) 882-7435
(617) 982-8800
fax: (617) 982-9095
Circle 1109 on Inquiry Card.

Cardinal Technologies, Inc.
1827 Freedom Rd.
Lancaster, PA 17601
(800) 233-0187
(717) 293-3000
fax: (717) 293-3055
Circle 1110 on Inquiry Card.

Club American Computers, Inc.
3401 West Warren Ave.
Fremont, CA 94539
(800) 524-2582
(510) 683-6688
fax: (510) 490-2687
Circle 1111 on Inquiry Card.

CompuAdd Computer Corp.
12303 Technology Blvd.
Austin, TX 78727
(800) 627-1967
(512) 250-1489
fax: (512) 331-6236
Circle 1112 on Inquiry Card.

Dell Computer Corp.
9505 Arboretum Blvd.
Austin, TX 78759-7299
(800) 426-5150
(512) 338-4400
fax: (512) 338-8700
Circle 1113 on Inquiry Card.

Duracom Computer Systems
1425 Greenway Dr., Suite 570
Irving, TX 75038
(800) 551-9000
(214) 518-1200
fax: (214) 518-1090
Circle 1114 on Inquiry Card.

Gateway 2000, Inc.
610 Gateway Drive
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
fax: (605) 232-2023
Circle 1115 on Inquiry Card.

JCC Systems
17990 East Ajax Circle
City of Industry, CA 91748
(818) 810-3696
fax: (818) 964-7331
Circle 1116 on Inquiry Card.

NEC Technologies, Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(800) 388-8888
(508) 264-8000
fax: (708) 860-7973
Circle 1117 on Inquiry Card.

PC Brand, Inc.
405 Science Drive
Moorpark, CA 90321
(800) 722-7263
(805) 378-7848
fax: (805) 378-7801
Circle 1118 on Inquiry Card.

PolyWell Computers, Inc.
61-C Airport Blvd.
South San Francisco, CA 94080
(800) 999-1278
(415) 583-7222
fax: (415) 583-1974
Circle 1119 on Inquiry Card.

Tandy Corp./Radio Shack
1800 One Tandy Center
Fort Worth, TX 76102
(817) 390-3011
Circle 1120 on Inquiry Card.

Tangent Computer, Inc.
197 Airport Blvd.
Burlingame, CA 94010
(800) 466-3300
(415) 342-9388
fax: (415) 342-9380
Circle 1121 on Inquiry Card.

Wyse Technology, Inc.
3471 North First St.
San Jose, CA 95134
(800) 438-9973
(408) 473-1200
fax: (408) 473-1972
Circle 1122 on Inquiry Card.

Northgate® SlimLine™ Is Back And Faster Than Ever!

DX2/66 Available Now!

New Northgate Local Bus Video – Up To 2000% Faster In *Both* Windows *And* DOS!

Universally-Upgradable Northgate ZXP™ System! Your Choice Of SX/25, DX33, DX2/50, DX2/66 And All OverDrives!

A Northgate Exclusive! No other computer offers all these features. Check them out! Then, call Northgate!

- Intel 80486SX™ /25 MHz processor
- 4MB of RAM; expands to 32MB
- Virtual Cache – Zero Wait State Performance
- 40MB hard drive
- 1.2MB or 1.44MB floppy drive
- High-speed local bus VGA with 1MB video RAM
- 1024 x 768 Panosonic monitor
- *OmniKey*® keyboard
- MS-DOS® 5.0 and QBasic
- Microsoft® Windows™ 3.1 and mouse
- Award-winning Northgate service and support
- 30-day no-risk money back guarantee

MICROSOFT® WINDOWS™ READY-TO-RUN

Call for complete custom configuration information.

800-345-8709

intel inside

Major corporations, volume purchasers and government agencies call National Business Accounts: 800-545-6059

GSA# GS00K91AGS5193 PS01

Charge it to your VISA, MasterCard, Discover, American Express or Northgate Big 'N' Card.

NORTHGATE COMPUTER SYSTEMS, INC.

"When it has to work right"™

©Copyright Northgate Computer Systems, Inc. 1992 All rights reserved. Northgate, SlimLine, ZXP and the Northgate 'N' logo are U.S. trademarks or registered U.S. trademarks of Northgate Computer Systems. 80486SX and 80486 are U.S. trademarks of Intel. MS-DOS, Windows and Microsoft are U.S. trademarks or registered U.S. trademarks of Microsoft Corporation. All other products and brand names are U.S. trademarks and registered U.S. trademarks of their respective companies. Prices and specifications subject to change without notice. Prices shown do not include shipping/handling charges and appropriate sales taxes. Northgate reserves the right to substitute components of equal or greater quality or performance. All items subject to availability. We support the ethical use of software. To report software copyright violations, call the Software Publishers Association's Anti-Piracy Hotline at 1-800-388-PIRS. All systems shipped with DiagSoft™ QA Plus ™ software. *Monthly lease payments are based on a 36-month standard fair-market value open-ended lease. 12-60 month leasing options available for qualified businesses.

CODE B4609

Compudyne™. Latest Technology. Highest

To Bruno & Heather goes the prize for the lowest wedding ever: in an ice cave, 15 ft. below ground, in Antartica, at 15° below zero.

Compudyne is the PC manufacturing and direct marketing arm of CompUSA™ – The Computer SuperStore (NASDAQ symbol; CUSA)—inventors of big volume, deep discounting PC retailing, and the largest chain of computer super stores in the country. Compudyne manufactures top quality, fully supported computers as available from only the largest PC manufacturers at prices typically found only

The First of a New Generation:

- Only 5.5lbs. with battery
- Slim, trim 11"x 8.5"x 1.6" (yes, only 1.6" thick!)
- Full 10", 64 grayscale *brilliant* VGA screen
- Internal 3 1/2" 1.44 MB floppy drive
- Built-in trackball saves carrying a mouse
- Microsoft® Windows 3.1 installed ready to run
- Polaris PackRat 4.0™ Personal Information Manager™
- External SVGA monitor and keyboard support
- Toshiba-compatible external expansion bus
- User-installable FAX modem and other options
- Full keyboard—dedicated 'page up/down', 'home' and 'end' keys
- Built-in serial (2) and parallel (1) ports
- FCC Class B certification

Notebook	CPU	RAM	HD	Battery Life	Price
		(MBs)	(MBs)	(Hrs)	
386SXL/25	386SXL–25 MHz Optional 80387SX	2 standard 4 & 6 options	60	3+	$1,599 $59/mo*
386SL/25	Intel 80386SL–25 MHz 64 K CPU cache Advanced SL power mgm't Optional 80387SX co-processor	2 standard 4 & 6 options	80	3+	$1,999 $74/mo*
486SX/25	Intel 80486SX–25 MHz Built-in 8K CPU cache	4 standard 8 & 20 options	80	2.5+	$2,499 $93/mo*
486DX/33	Intel 80486DX–33 MHz Built-in 8K CPU cache	as above	130	2.5+	$2,999 $111/mo*

Compudyne is probably the fastest growing PC company in the history of the industry.

ORDERING

- 1-800-932-COMP (2667)
- International callers dial: 1-214-702-0055
- 24 hour fax: 1-214-702-0300
- Corporate credit and volume terms available.

DISCOVER MasterCard VISA BTE0921

SERVICE & SUPPORT

- Toll-free technical support
- On-site service for desktops†† and overnight replacement for portables.
- Next-day shipping for most systems.

We are to notebooks what Griselda of Skyland was to Pomeranians; the lightest, at 1 lb., 12 oz.

†† Within 100 miles of any of over 400 Dow Jones Service Centers

COMPUDYNE

THE LOWEST OF THE LOW PRICES. GUARANTEED.

Prices and specifications subject to change without notice. Compudyne Direct, 15151 A Surveyor, Addison TX 75244.

Circle 384 on Inquiry Card.

Quality. Lowest Prices. Guaranteed.

at garage shop clone houses. Results? We're already one of the largest direct PC companies in the country and probably the fastest growing PC company in the history of the industry! And, we guarantee that our prices are the lowest of any currently advertised. If by chance another manufacturer got a late-breaking reduction to press a few minutes before us, rest assured, we'll beat it.

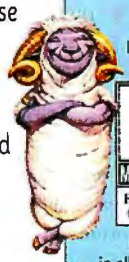
To Order Call Toll Free:
1-800-932-COMP (2667)
Int'l callers dial: 1-214-702-0055
24 Hour Fax: 1-214-702-0300
8am–7pm (CST) Mon.–Fri. & 9am–4pm (CST) Sat.

If you can find a PC that meets or exceeds our equivalent specification, but is shipping at a lower advertised price, we'll match the price.

Desktop	CPU	RAM (MBs)	HD (MBs)	Floppy	Display	Price
386SX/25	Intel 80386SX–25 MHz	1 standard 32 max	50	1.2 or 1.44	16 bit SVGA card 14" 640x480 VGA Color Monitor	$899** $33/mo*
386DX/33	Intel 80386DX–33 MHz	2 standard 32 max	80	as above	as above	$999 $37/mo*
486SX/25	Intel 80486SX–25 MHz Built-in 8K CPU cache	2 standard 32 max	80	1.2 & 1.44	16 bit SVGA card 14" 1024x768 SVGA Color Monitor	$1,299 $48/mo*
386DX/33 CACHE EXTRA CACHE	Intel 80386DX–33 MHz 64K CPU cache	4 standard 32 max	105	as above	16 bit SVGA card w/ 1MB video RAM & Hi-Color Support 14" 1024x768 SVGA Non-interlaced multisync Color Monitor	$1,499 $56/mo*
486DX/33 CACHE	Intel 80486DX–33 MHz 128K CPU cache	4 standard 64 max	130	as above	as above	$1,799 $67/mo*
486DX2/50 CACHE	Intel 80486DX2–50 MHz 128K CPU cache New Double Clock CPU	4 standard 64 max	130	as above	as above	$1,999 $74/mo*
486DX/50 CACHE	Intel 80486DX-50 MHz 128K CPU cache True 50 MHz CPU	8 standard 64 max	210	as above	as above	$2,499 $89/mo*

All Systems Feature:

- Rugged, aesthetic Macintosh style case on steel frame
- Microsoft® Windows 3.1 installed ready to run
- Microsoft compatible serial mouse
- Artisoft's LANtastic® LAN
- 101 AT-style keyboards
- Built in serial (2), parallel (1) and game (1) ports
- 8 i/o board slots
- 200 watt power supply
- FCC Class B certification
- U/L listed



LANtastic in all systems!

Options, Options, Options...

- **Displays:** Mono or color VGA; 1024 and 1280 interlaced or non-interlaced; 14" to 20"
- **Hard Drives:** 40; 80; 105; 120; 211; 483; 680 MBs or 1.2 GBs
- **Internal CD-ROM** (Inc. Groliers Encyclopedia, Toolworks, Reference Library and PC-SIG)
- **Internal FAX/Modem:** 9600 bps send/receive fax; 2400 bps modem; inc. WinFax and Quicklink Software.
- **And many, many more!**

WARRANTIES

- 30-days, no-questions-asked return policy.√
- 1 year limited warranty.

** Does not include Windows 3.1 and mouse
√ Must be returned as new in original packaging.

Intel™ 386 & 486 & the Intel Inside logo are trademarks of Intel Corp. ™/® Trademarks belong to their registered owners. *Leasing arranged through Leasing Group, Inc; payments based on 36 month open-end rate.

SYSTEM

Eight Notebooks Keep a Tight Grip on Power

JIM CARLS

Notebook computers run on batteries. Well, mostly. But the slightest chance that built-in batteries will not outlast a cross-country trip or carry you through an important presentation means you need to travel armed with an AC power cord and extra batteries. The Holy Grail of notebook users is a portable machine that will last a whole trip entirely on its own resources—one that lets you leave the accessories at home.

New processors and advances in power management have moved us closer to this ultimate goal. In this article, I'll review eight notebooks based on Intel's 386SL and AMD's 386SXL processors. These machines take advantage of the sophisticated power management features offered by these processors, along with other recent advances in portable technology, to extend battery life. BYTE's latest battery-life test suite (see the text box "A New Thumper" on page 250) will be the main proving ground. But I'll also evaluate the portability and the "feel" of Compaq's LTE Lite/25, Dell's NL25, Epson's NB-SL/25, Insight's 386SXL-25, NCR's 3170, NEC's UltraLite SL/20, Sharp's PC-6781, and Zenith Data Systems' Z-Note 325L.

Enabling Technology

Processors designed with power management in mind lead the list of new technologies driving improvements in battery life. Intel's 386SL provides System Management Mode, a software environment ideal for power management functions. The device also combines processor, cache controller, and bus controller into a single chip; a few other peripherals are included in Intel's companion 82369SL device. This high level of integration gives the system better control over its subsystems and reduces overall power requirements.

AMD offers its own 386-compatible, power management–aware processor called the 386SXL. This processor provides an interrupt line that manufacturers can incorporate into power-managed designs.

NiMH (nickel-metal-hydride) battery technology can increase notebook life by providing batteries with increased capacity per cubic inch. NiMH batteries provide 20 percent to 30 percent better capacity than more common nickel-cadmium batteries and are less subject to charge memory effects. They are more expensive (about twice as costly as nickel-cadmium batteries), but they give the manufacturer the option of shrinking the machine and maintaining duration of use.

Standard Features

The feature list for these computers shows a great deal of standardization in notebook design (see the table). While this trend may be driven by user wish lists, it also reflects these machines' greater level of integration. Each system includes a 60- to 86-MB hard drive, a backlit LCD, and a 1.44-MB internal floppy drive (the NCR 3170's floppy drive is external). All come with at least 2 MB of RAM; for this review BYTE requested a minimum of 4 MB. All accept an optional modem or fax modem card, except the NCR 3170, which already has one.

Each machine includes a power management system that allows you to regulate how and when the machine uses power, with at least one factory-set configuration. At a minimum, you can control processor speed, backlighting, and hard drive activity through time-outs. Each machine also has at least one standby or idle mode, in which the power manager stops the clock on the processor and shuts down all subsystems except memory. Each machine can resume operations if a signal comes in through the serial or modem port. All these machines have a configuration program to customize power management, but only four (the NL25, the NB-SL/25, the UltraLite SL/20, and the Z-Note 325L) offer access to system configuration from within an application.

In the following sections, I'll evaluate each machine for battery life and perfor-

PHOTOGRAPHY: SCOTT PARKER / AVIS STUDIO © 1992

Machines range in size from the bulky NEC UltraLite SL/20, which stands over 2 inches high, to the amazingly compact Sharp PC-6781, which crams a full system into less than 150 cubic inches.

BYTE ACTION SUMMARY

- **WHAT POWER-SAVING NOTEBOOKS ARE**
  Notebooks designed around Intel's 386SL and AMD's 386SXL to minimize power requirements and extend battery life.
- **LIKES**
  Long notebook life; integrated networking and communications; small and lightweight designs.
- **DISLIKES**
  Many poor keyboard layouts; some expensive price tags.
- **RECOMMENDATIONS**
  ZDS's Z-Note 325L is outstanding in most categories; Compaq's LTE Lite/25 and NCR's 3170 are more compact alternatives; and Dell's NL25 is comfortable and reasonably priced.

mance. You can find the benchmark graphs to back up these evaluations in the figure on page 249. I've also included subjective impressions on keyboard design and display usability, which often determine how pleasant (or uncomfortable) a notebook is to carry and use.

Compaq LTE Lite/25

The $2799 LTE Lite/25, boosted by strong video scores, ran close to the top in the BYTE application performance tests. It also performed very well on batteries, running second only to the Z-Note.

The LTE offers three preset levels of power management and one custom level. You cannot customize individual component controls from within a program, but you can step through the four predefined levels with a hot key. In addition to the zero-activity standby mode, the LTE offers an intermediate system-idle mode and a hibernation mode, in which the system saves a RAM image to disk and shuts off. You can activate a small pop-up battery gauge from the keyboard that remains visible as you work.

The LTE's keyboard is a good tradeoff between compactness and usability. All the most common keys are accessible without shifting, although the Home, End, PageUp, and PageDown keys are inconveniently located in the top row.

The screen on this machine is one of the best in the group, giving a very good range of contrast. The darkest "grays" look blue, which I found slightly distracting, but there was no arguing with the readability of the screen. It's a very solid piece of equipment.

Dell NL25

As one might expect from Dell, the $2178 NL25 is a very good value for its price. It's a well-balanced machine, with many good features and no bad ones. Its battery life was shorter than some, but still respectable; its performance marks were usually just behind the best in the group and occasionally surpassed them. Dell provides a pop-up configuration screen for power management, making it easy to adjust settings while you work.

The NL25 takes first place in keyboard quality. Not only does it have a very good touch, but all the keys are in the most

Price, size, and weight of these notebooks cover a broad range. Insight's and Dell's systems are the least expensive, selling for less than half the price of the full-featured NCR 3170. Sharp's PC-6781 is the smallest machine.
(● = yes; ○ = no.)

	Compaq LTE Lite/25	Dell NL25	Epson NB-SL/25	Insight 386SXL-25	NCR 3170	NEC UltraLite SL/20	Sharp PC-6781	ZDS Z-Note 325L
Price[1]								
Base unit		$1999	$3099	$1899				
As tested		$2178	$3298[3]	$1899				
Processor	i386SL-25		i386SL-25					
Clock speeds (MHz)	25/6.2						20/5	25/6.25
RAM (base/maximum; MB)	4/10	2/8	4/20	4/8	2/20	2/8	2/8	4/12
slot								
Display type[4]		Edgelit TSTN	Backlit STN	Edgelit TSTN	Backlit TSTN	Backlit STN	Backlit TSTN	
Ports[5]	M/K, N, E, D	M/K/N						
Dimensions (D × W × H; inches)								
Weight (lbs.)	6.0				4.9	6.4		
Battery technology	NiMH	Nickel cadmium	Nickel cadmium	Nickel cadmium	Nickel cadmium	Nickel cadmium	Nickel cadmium	NiMH

[1] Unless otherwise noted, as-tested price includes 4 MB of RAM, no modem, and features as listed in this table; base configurations vary.
[2] NCR 3170 configuration includes fax modem.
[3] NB-SL/25 configuration included 6 MB of RAM.
[4] All units include a VGA-compatible LCD and an external VGA port. STN = supertwist nematic; TSTN = triple-supertwist nematic.
[5] In addition to the ports listed, each unit includes one parallel and one serial port. M = mouse; K = keyboard; N = numeric keypad; E = expansion unit; D = external floppy drive; P = extra parallel port; B = external battery. Entries separated by a slash indicate a multipurpose port.

usable arrangement possible on a compact keyboard. The Insert, Delete, and all cursor-movement keys are placed individually around the lower right corner where they are easy to access. The function keys at the top of the keyboard are not quite full-size, but they're still big enough to use effectively.

Although the screen is not quite as bright as the best of the others, it has good cursor visibility. The NL25 is well designed, and I can recommend it for those who plan to write and edit a lot of text.

Epson NB-SL/25

For its $3298 list price, the NB-SL/25 gives you several good features, balanced by some unfortunate ones. For travelers, Epson provides a renewable "road service" guarantee, which will quickly replace all or part of a downed system at no charge. In computing speed, the NB-SL/25 held its own against the other top performers.

The NB-SL/25 comes with two batteries, between which the unit will switch automatically. You can change the battery not being used while the system is running. Despite the dual batteries, lifetime was below average.

This unit has a well-thought-out keyboard that minimizes the finger-twisting sometimes needed to access cursor-control keys on other units, but the murky screen lagged behind those of the rest of this group.

Insight 386SXL-25

Insight's machine lists at $1899 (including an 86-MB hard drive and a mouse), making it a very good deal despite performance that didn't quite keep pace. This is the only machine in the group that uses AMD's 386SXL chip; the 386SXL-25 held up very well on BYTE's battery-life tests. A command-line utility controls power management, offering fairly basic control over management settings.

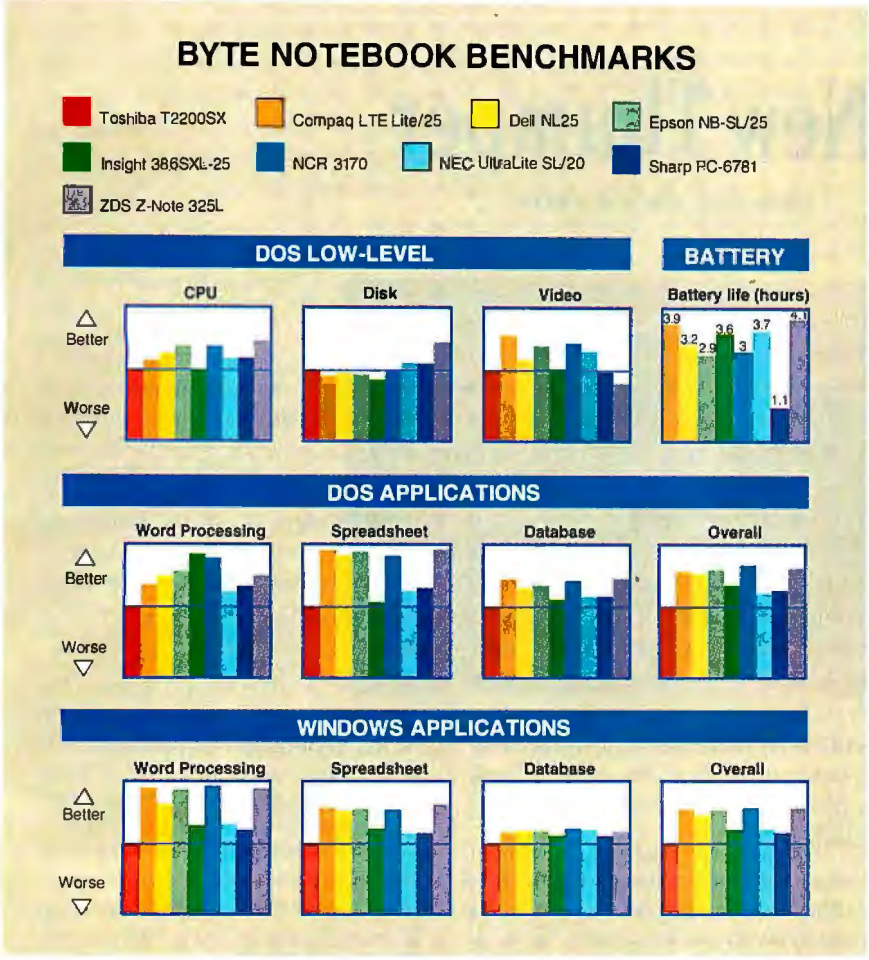
The keyboard has a slightly soft feel to it that some might not enjoy, but it reduced fatigue when I was typing flat-out. The 386SXL-25 has a good screen—almost as good as the Z-Note's.

NCR 3170

The 3170 (which until recently was called the Safari SSL/25) is the second-smallest and most expensive machine in the test group. The $5748 notebook is also the only machine with a built-in fax modem and an outboard drive, and one of only two with a PCMCIA slot. The LCD screen is extremely readable, and the 3170's designers have paid special attention to mouse pointer visibility. The keyboard is good, albeit a bit stiff, and it suffers from the location of the Home, End, PageUp, and PageDown keys at the top.

The 3170 offers a configuration screen that includes power management settings. Besides the standard set of time-outs, you can disable power for unused ports or slots, and you can lock the CPU speed for processing-intensive software. At just over 3 hours on BYTE's tests, battery life was reasonable, but the 3170 trailed most of the other systems.

For basic cursor and mouse control, the 3170 offers the FingerPoint Mouse, which consists of what might be called a "joy-



All results are indexed, and higher numbers indicate better performance. For each index in the DOS and Windows tests, a Toshiba T2200SX running DOS 5.0 and Windows 3.0 = 1.

The BYTE low-level benchmark suite identifies relative performance at the hardware level, breaking down performance by system component. The results of these tests can help you identify the relative performance of a given subsystem and determine where performance bottlenecks may lie. For a complete description of these tests, see "BYTE's New Benchmarks: New Looks, New Numbers," August 1990 BYTE. The BYTE low-level benchmarks, version 2.2, are available in the byte.bmarks conference on BIX, or you can contact BYTE directly.

BYTE's application performance suite measures the performance you can expect to see running a given application category under a given operating environment. We test under two environments: DOS 5.0 and Windows 3.0. We test three application categories for each environment, running test scripts using the following programs: Word Processing: WordPerfect 5.1 and Lotus Ami Pro 2.0; Spreadsheet: Lotus 1-2-3 release 2.3 and Microsoft Excel 3.0a; and Database: Software Publishing Superbase 4 version 1.3 and Borland dBase IV. The data files and test scripts are available from BYTE.

Battery-life tests illustrate the Z-Note 325L's and the LTE Lite/25's edge in power conservation; the two machines ran longest through BYTE's "typical use" suite. Although easily portable, the Sharp PC-6781 turned in a poor running time. The LTE and the Z-Note, along with the NCR 3170, are also the fastest notebooks in this class.

button" flanked by two other buttons used as left and right mouse buttons. With its dual speeds, the FingerPoint Mouse is a fairly effective pointing device, but NCR wisely notes that it is not meant to replace a real mouse or trackball.

The real value of the 3170 lies in its plug-and-play approach. It comes out of the carton loaded with Windows, AT&T Mail Access Plus, and BitFax 2.0, which works with the included cellular-ready 2400-/9600-bps fax modem. I typed a very quick message into Windows Write and was immediately able to fax it to a friend just by plugging in the phone line and selecting the fax as the current printer.

NEC UltraLite SL/20

This machine is one of the two 20-MHz machines included in this group. At $3268, it falls in the middle of the price range. The UltraLite proved an excellent battery performer—third in this group.

The UltraLite's CPU goes into an idle mode as soon as system activity stops. You configure power management features through a pop-up utility.

The UltraLite has a crisp screen framed

IF YOU READ THIS AD, THEN YOU'RE ONE OF BYTE'S 500,000 READERS WHO IS:

- INFLUENTIAL
- AUTHORITATIVE
- TECHNICALLY-ADVANCED
- KNOWLEDGEABLE
- INNOVATIVE

AND MOST OF ALL . . . BUSY!

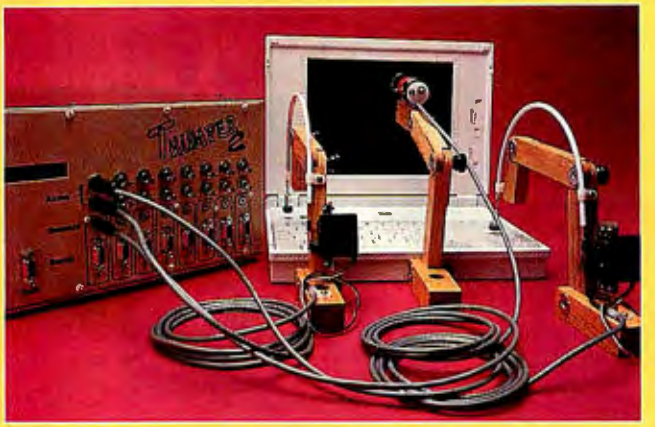
When you want to buy, turn to the **BYTE Buyer's Guide** in the back for fast access to buying direct from reputable suppliers. From computers to CAD, notebooks to networks, memory to mathematics, you'll find it in the **BYTE Buyer's Guide.**

Tell 'em you saw it in BYTE!

A New Thumper

HOWARD EGLOWSTEIN

Last December, the BYTE Lab introduced Thumper 2, our automated notebook battery tester (see "Testing Battery Life," December 1991 BYTE, page 252). The photo in the December issue was of the prototype—the real one was still on the drawing board. The new Thumper 2 makes testing a large group of notebooks much easier. It uses the same arm mechanism as the prototype, but it has 16 arms instead of three, and eight optical sensor heads instead of one. Depending on how many actuator arms a notebook needs, we can now test up to eight notebooks at a time.



Our battery-life tests approximate real-life notebook use by alternately using (i.e., typing on the keyboard) and not using (i.e., allowing power-saving features to kick in) each machine under test. We use Thumper 2 to press keys during the usage periods, to monitor LCD screens to check for signs of life, and to press reset key combinations when we need to wake the machine from standby mode.

All the testing takes place without requiring action on the part of the machine under test, except for short bursts of serial-port communication. Thus, all the battery-saving features, including screen dimming, hard drive shutdown, and CPU standby, have a chance to contribute to extended life. Thumper 2 allows us to run a group of DOS, Mac, or Unix notebooks simultaneously, using a PC or a Mac host.

Some manufacturers insist on placing the power/standby switches in inaccessible places. That's no problem for Thumper 2—the arm can reach just about any spot on the computer case. Removable tips allow for swapping the standard "fingers" for smaller, palmtop-compatible versions.

Thumper 2's controller is updated as well. This critter has a 6809 microprocessor, an LCD display, nine serial ports, and 32 front-panel connectors. The controller now handles all the low-level timing and interface responsibilities previously assigned to the host.

Howard Eglowstein is a testing editor for the BYTE Lab and the designer of the Thumper 2 battery-life tester. You can reach him on BIX as "heglowstein."

by a jet-black case. Although not quite as good as the screen of the Z-Note or LTE, it was quite readable in artificial light. In direct sunlight, it presented almost-black characters against a light-green background and was one of the more readable.

Sharp PC-6781

The PC-6781 packs an amazing number of features, including a built-in trackball and a PCMCIA slot, into a tiny, 4.9-pound rubberized case. At $2898, it easily matches the features of the other machines in its price range. However, it lags in both battery life and performance.

Although you can pop up the configuration screen while using another program, the machine resets when you exit. Like the LTE, this machine offers a "suspend-to-disk" shutdown mode.

The PC-6781's keyboard is adequate, although it is so flat that in some lighting conditions it looked painted onto the machine. It suffers from key-travel limitations. The trackball is, well, cute. It is a variable-response device, which moves the pointer farther the faster you turn the ball. This sounds like a good idea, but in practice it usually means you must spend several moments hunting down the pointer. The trackball is located on the right side, above the keyboard, with the buttons on the left, requiring two-handed use.

ZDS Z-Note 325L

Housed in a clean-looking white case, this computer leaps over most of the others in this group with its excellent display, performance, and ease of use. The $4299 Z-Note 325L comes with a built-in NE2000-compatible network adapter and several standard network shells; all you have to do is buy the appropriate cable adapter from ZDS. One great innovation is the optional Port Replicator, which lets you permanently attach your home or office cables to an adapter that snaps onto the rear of the Z-Note.

The Z-Note uses NiMH batteries. It proved untouchable on BYTE's battery-life tests, besting the second-place LTE by over a half hour. A pop-up configuration utility includes a screen of standard power management settings for both AC and battery operation.

The keys are full size, although a bit flat, with all the standard cursor-movement keys easily accessible at the right side of the keyboard. Unfortunately, the full-size keys make the Z-Note wider than most notebooks; this is the only unit that wouldn't fit vertically in my briefcase.

The screen is simply the best in this group, if not the best among all laptops I've seen. It was bright, with extremely good contrast, and Windows displays were flawless. Where most machines have simple normal or reverse controls on the LCD, ZDS provides a multistep adjustment that

Step On It!

At 5'4" and 280 pounds, Northgate's Ed Laehle is no lightweight. But our new SL25 Notebook is so rugged and durable, it can even stand up to a punishing demonstration like this.

MICROSOFT® WINDOWS™ READY-TO-RUN

intel inside

New Northgate SL25 Notebook.
Fast. Long Battery Life. And Tough, Tough, Tough!

Sleek, contemporary styling. *Customers say it's the "sexiest" notebook they've ever seen!*

Unique tilt display *lets you work comfortably in tight spaces!*

Northgate SL25 Stands Up To The Toughest Competition!

- Intel® 386SL/25 processor
- Uses Microsoft® Power Management to its full capability
- 4MB RAM (expands to 8MB)
- 64K cache with 25ns SRAM
- 80MB 19ms hard drive (120MB optional); 3.5" floppy drive
- 10" non-glare Triple SuperTwist VGA display supports 32 shades of gray
- 9600/2400 fax modem with WinFAX
- MS-DOS® 5.0 and Microsoft Windows™ 3.1 installed
- Microsoft PS/2 style mouse
- Lightweight – just 6 lbs. 9 oz.

Only $2599

Lease as low as $88.89 per month*

Order Now! If not completely satisfied, return it within 30 days for a full refund!

800-345-8709

Major corporations, volume purchasers and government agencies call National Business Accounts: 800-545-6059

GSA# GS00K91AGS5193 PS01

Charge it to your VISA, MasterCard, Discover, American Express or Northgate Big 'N' Card.

NORTHGATE COMPUTER SYSTEMS, INC.

"When it has to work right"™

CODE B4809

progressively changes the mapping between screen grays and image colors.

Top Notes

All these machines are fast and light, and they'll stay in action for long periods.

If you have the cash, the ZDS Z-Note 325L and the Compaq LTE Lite/25 stand out as excellent all-around machines. If you have even more cash, try to work a deal on the NCR 3170. And finally, if you want a reasonably priced, comfortable machine that lacks only some bells and whistles, give the Dell NL25 a try. ■

Jim Carls is a computer consultant and freelance writer from Memphis, Tennessee. You can reach him on BIX c/o "editors."

COMPANY INFORMATION

Compaq Computer Corp.
(LTE Lite/25)
P.O. Box 692000
Houston, TX 77269
(800) 345-1518
(713) 370-0670
Circle 1223 on Inquiry Card.

Dell Computer Corp.
(NL25)
9505 Arboretum Blvd.
Austin, TX 78759
(800) 289-3355
(512) 338-4400
fax: (512) 338-8700
Circle 1224 on Inquiry Card.

Epson America, Inc.
(NB-SL/25)
20770 Madrona Ave.
Torrance, CA 90503
(800) 922-8911
(310) 782-0770
fax: (310) 782-5220
Circle 1225 on Inquiry Card.

Insight Computers
(386SXL-25)
1912 West Fourth St.
Tempe, AZ 85281
(800) 755-9628
(602) 350-1176
fax: (602) 350-1182
Circle 1226 on Inquiry Card.

NCR Corp.
(3170)
Notebook Computing
Business Unit
P.O. Box 6497
Somerset, NJ 08873
(908) 302-5800
fax: (908) 469-4578
Circle 1227 on Inquiry Card.

NEC Technologies, Inc.
(UltraLite SL/20)
1414 Massachusetts Ave.
Boxborough, MA 01719
(800) 388-8888
(508) 264-8000
fax: (508) 264-8764
Circle 1228 on Inquiry Card.

Sharp Electronics Corp.
(PC-6781)
Sharp Plaza
Mahwah, NJ 07430
(800) 237-4277
(201) 529-9600
Circle 1229 on Inquiry Card.

Zenith Data Systems
(Z-Note 325L)
2150 East Lake Cook Rd.
Buffalo Grove, IL 60089
(800) 553-0331
(708) 808-5000
fax: (708) 808-4434
Circle 1230 on Inquiry Card.

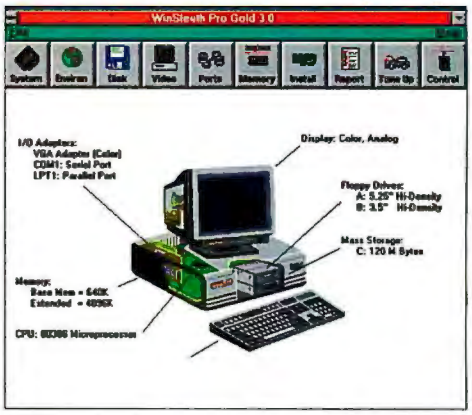
GOLD

WinSleuth Gold is the first tutorial/analysis/diagnostic program specifically written to operate under Windows 3.0/3.1. A newly enhanced graphical user interface makes WinSleuth Gold the easiest WinSleuth to use, EVER.

Novice and advanced users will appreciate WinSleuth Gold's access to low-level information and functions. WinSleuth Gold can actually test and evaluate memory chips, serial and parallel ports, the video adapter and other vital system components. New users will find the on-line help facility valuable as a learning aid. WinSleuth Gold helps make complex aspects of computing such as IRQs, hard disk drives and video easier to understand.

TuneUp is now more comprehensive in its analysis and not only can make performance-enhancing suggestions, but with a set of NEW 'smart editors', can make changes to system settings automatically that improve Windows operation! Installation Assistant is a partner in the frustrating task of installing new hardware. With Report Generator send hardcopy to the printer, or an ASCII file for import into your database manager.

PC Computing, July, 1992 – BEST VALUE – "WinSleuth...is a godsend to Windows users intent on fine-tuning their systems." "WinSleuth...is exceptionally easy to use." – Preston Gralla



BYTE Magazine, March, 1992 – First Impressions. "WinSleuth...is one of the few programs that I consider absolutely and positively necessary on my PC. One...should be on yours, too." – Stan Miastkowski

LIMITED TIME OFFER!
Order NOW!
Get CO/Session--
remote control program

MSRP
WinSleuth ($169.00)
AND
CO/Session ($179.00)

ONLY
$99!

Questions? Call:
714-236-1385
DARIANA, INC.

COMPUCLASSICS
YOUR SOURCE FOR SOFTWARE

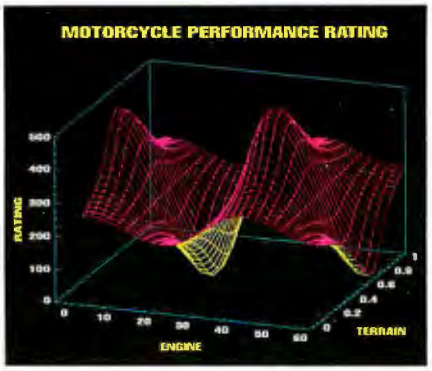
800-827-1994/818-347-7500/FAX 818-347-9977

Circle 91 on Inquiry Card.

We've Added Extra Power To An Already Great Ride. New STATGRAPHICS *Plus* Takes You Farther.

YOU DON'T HAVE TO BE AN EXPERT TO HANDLE NEW STATGRAPHICS *Plus* FOR THE 386/486.

If you've been wheeling around statistics for any time at all, you probably already know about STATGRAPHICS®, the statistical graphics system that anyone can use to quickly analyze data and *see* the results. The package that offers over 250 different statistical procedures, including regression analysis, ANOVA, quality control, experimental design, multivariate methods, forecasting, and much more. The product that Software Digest rated #1 for ease of use and learning. Now, we've done the only thing left to improve it: we've added all the horsepower you could want.



THE POWER AND SPEED FOR THE FAST TRACK.

If you've got a 386- or 486-based PC, grab your racing helmet. Because anything STATGRAPHICS can do, STATGRAP ICS *Plus* can do up to 5 times faster. And since it utilizes all of the RAM in your computer, it can handle the largest problems, including those that other stat packages choke on. And everything in this powerful new product works just like in STATGRAPHICS, right down to its easy-to-use menus and ability to import data from Lotus®, dBASE®, ASCII, or DIF files.

THINK OF IT AS A BETTER WAY TO SEE THE BIG PICTURE, FASTER.

Call today for more information and a free demo disk. And let STATGRAPHICS *Plus* keep you from spinning your wheels waiting for solutions.

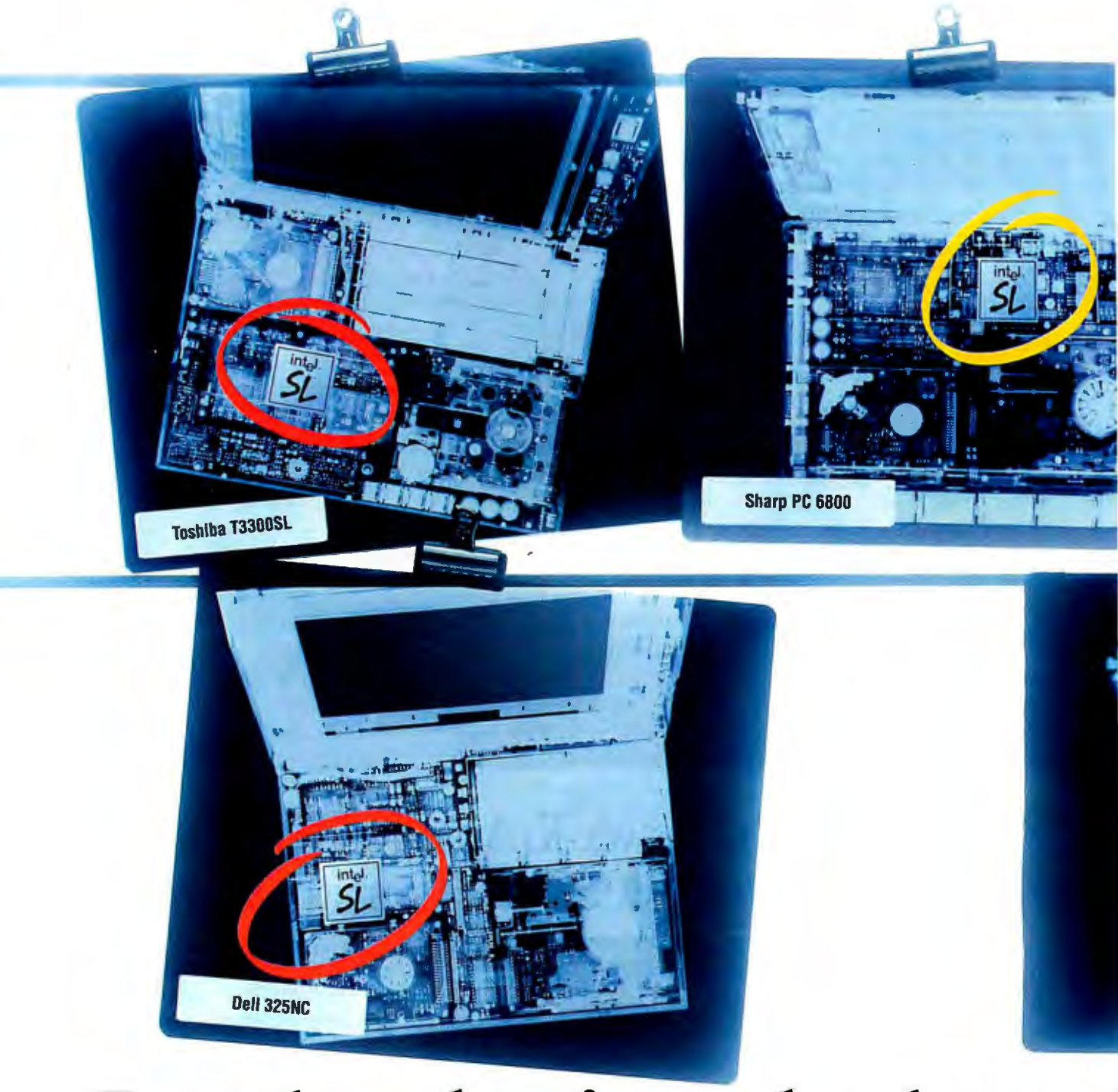
STATGRAPHICS

In Maryland, (301) 984-5123.
Outside the U.S., (301) 984-5412.

(800) 592-0050 Ext. 400

Manugistics, Inc., 2115 E. Jefferson St., Rockville, MD 20852. STATGRAPHICS is a registered trademark of Statistical Graphics Corporation. Other trademarks are the property of their respective owners.
Evaluation © Software Digest Ratings Report, Vol. 8 No. 5 issue covering Statistics Programs. STATGRAPHICS *Plus* runs on 386, 386SX, and 486 computers with at least 4 MB of RAM and a graphics card. © 1992 Manugistics, Inc.

Circle 167 on Inquiry Card.



Look what's at the heart

Take a closer look at some of the best notebook computers and it's easy to see why the prognosis is so good—they each have an Intel SL microprocessor. The Intel SL gives each of these unique notebooks a leg up, because it was designed specifically for the stop-and-go world of mobile computing.

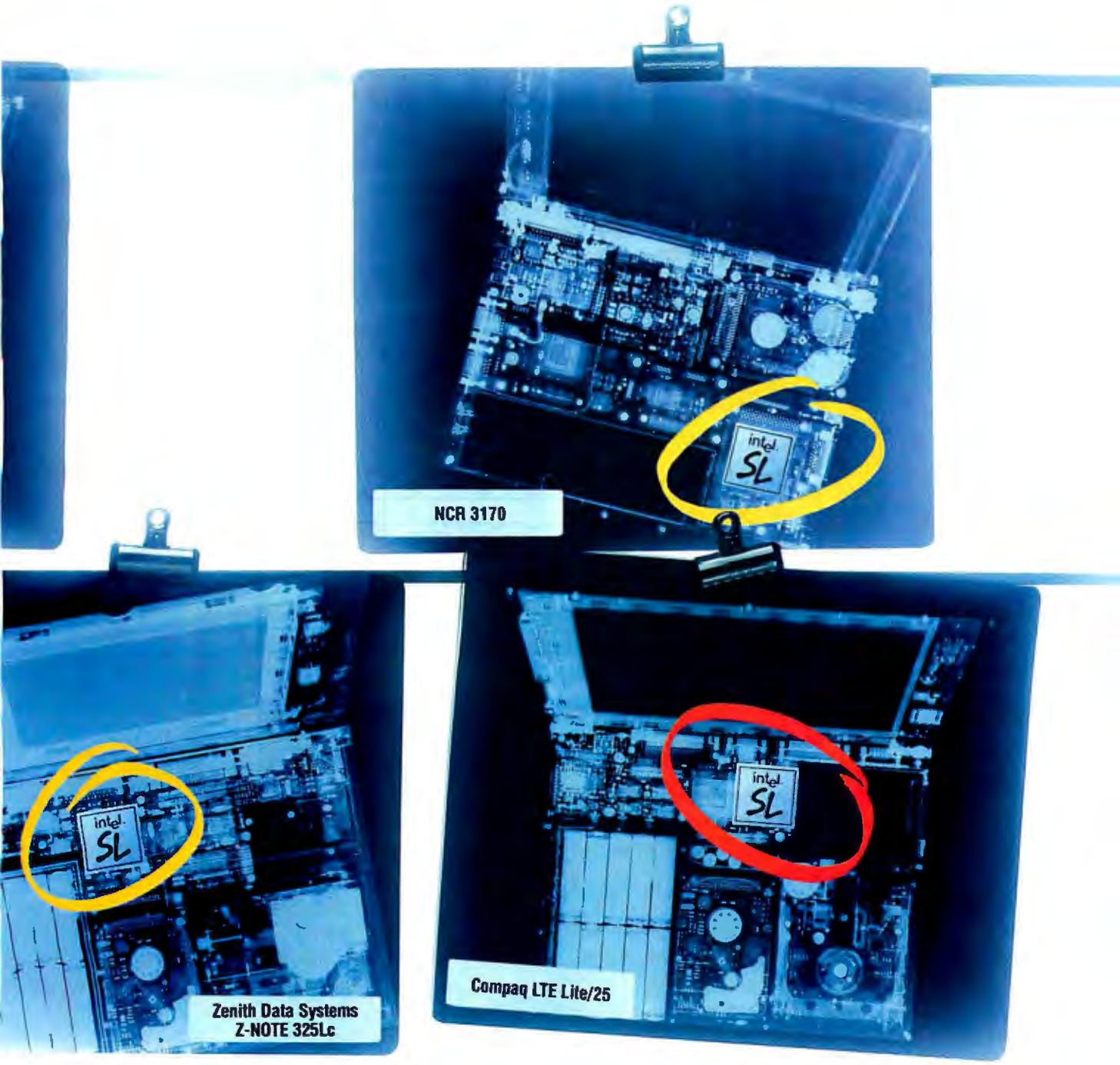
For example, the Intel SL has an instant on/off feature that eliminates long boot-up and shut-down sequences. If you're interrupted, the Intel SL holds your place and puts your entire system into suspended animation, using virtually no

Stop-and-Go Battery Life*

Average 386 SX 4.8 hours

Intel SL 8.3 hours

©1992 Intel Corporation. The Intel Inside logo, Intel386 and the SL logo are trademarks of Intel Corporation. Intel SL microprocessors in this ad are larger than actual size. *PC World Report, February 1992. Based on user profiles with power management features enabled.



# of all the best notebooks.

power and significantly extending precious battery life.

The Intel SL is a more highly-integrated microprocessor, which means lighter, more feature-rich notebooks that come in speeds up to 25 MHz. No wonder major manufacturers are prescribing the Intel386™SL microprocessor as a cure for traveling hassles.

Call 1-800-228-4549 to receive more information and a complete list of Intel SL-based notebooks.

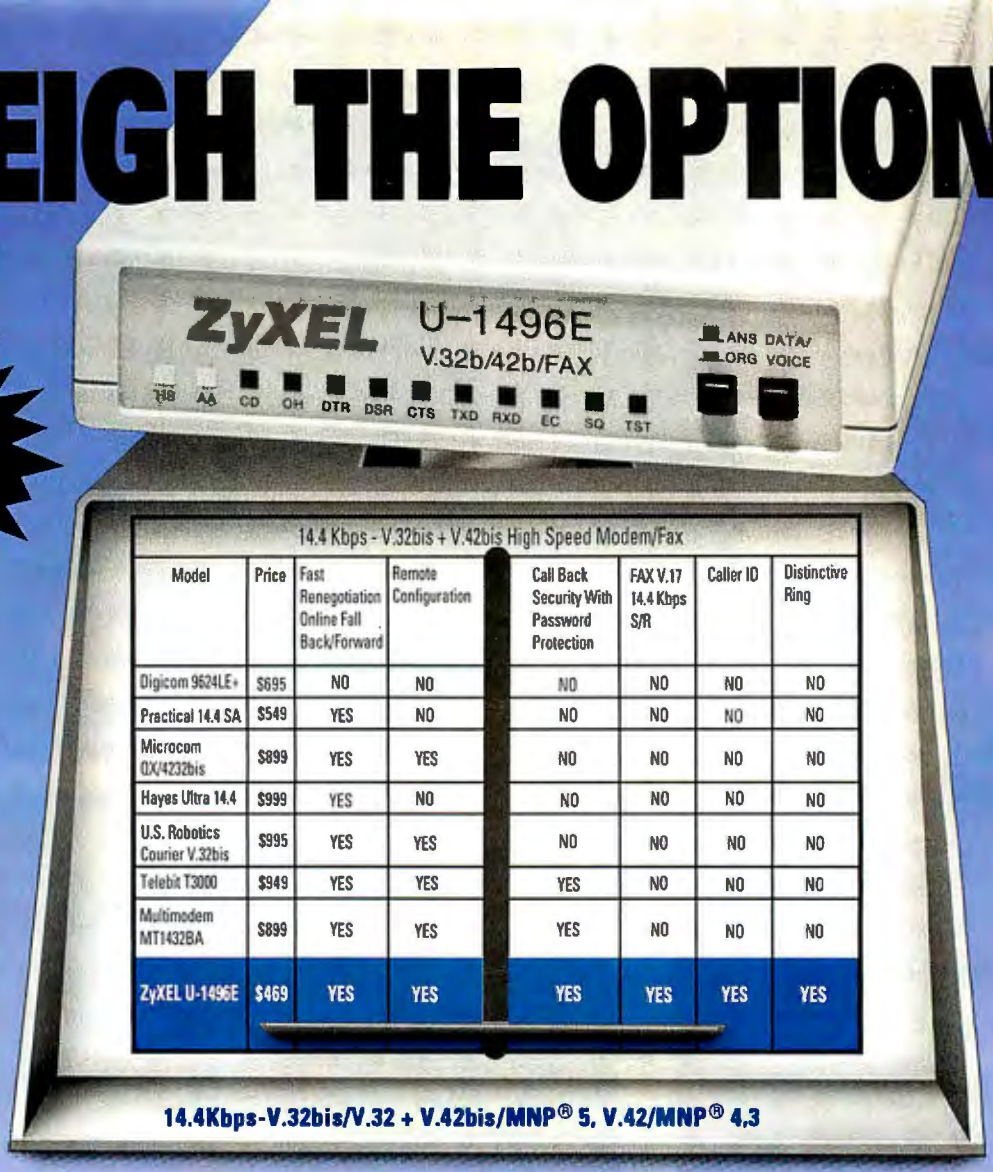
Then watch for notebooks with the Intel SL. Because nothing else is worth looking into.

intel®
The Computer Inside.™

Circle 122 on Inquiry Card.

WEIGH THE OPTIONS

ONLY! $469
Also Available: PC Plug-In Card U-1496 B $449



14.4 Kbps - V.32bis + V.42bis High Speed Modem/Fax

Model	Price	Fast Renegotiation Online Fall Back/Forward	Remote Configuration	Call Back Security With Password Protection	FAX V.17 14.4 Kbps S/R	Caller ID	Distinctive Ring
Digicom 9624LE+	$695	NO	NO	NO	NO	NO	NO
Practical 14.4 SA	$549	YES	NO	NO	NO	NO	NO
Microcom QX/4232bis	$899	YES	YES	NO	NO	NO	NO
Hayes Ultra 14.4	$999	YES	NO	NO	NO	NO	NO
U.S. Robotics Courier V.32bis	$995	YES	YES	NO	NO	NO	NO
Telebit T3000	$949	YES	YES	YES	NO	NO	NO
Multimodem MT1432BA	$899	YES	YES	YES	NO	NO	NO
ZyXEL U-1496E	$469	YES	YES	YES	YES	YES	YES

14.4Kbps-V.32bis/V.32 + V.42bis/MNP® 5, V.42/MNP® 4,3

The features you want in a High Speed-14.4Kbps Modem/Fax. At nearly half the Price!

ZyXEL's U-1496E offers all the standard features available in a 14.4Kbps- V.32bis+V.42bis modem/fax with DTE speeds up to 57.6Kbps. But you'll also find features you'd expect in only the "top-of-the-line" modems. So why pay more for the features you want, when you can get the best value from ZyXEL for less?

Caller ID/Distinctive Ring
Displays the caller's phone number, time and date stamp directly on your screen, and responds to the distinctive rings for incoming fax or modem calls.

Enhanced FAX
14.4Kbps G3 fax with automatic detection of fax or modem calls. Automatically receives, stores and/or prints faxes with our FREE ZFAX software.

Automatic Fast Rate Renegotiation
Online automatic speed fall-back/fall-forward allows the highest throughput achievable during poor line conditions.

Multi-Level Security
Security password protection and automatic call-back features are designed so only authorized callers can access your system.

Nonvolatile Memory Storage
Store up to 4 user configuration profiles in NVRAM, plus up to 10 user phone numbers and their associated passwords.

Software/System Compatible
Supports V.25bis autodial and enhanced AT Command Set, ensuring compatibility with popular communications/fax software. Available with MAC™, Windows™ and DOS fax software packages.

Guarantees
We offer a Full 5 year Parts and Labor Warranty, a 30 day money back guarantee and full BBS technical support line.

Once you've weighed the options, you'll agree: Zyxel's U-1496E offers the best value for less than any other modem/fax in its class. So, don't hesitate. **Call Today.**

ZyXEL USA
(800) 255-4101
Reseller discounts available

TEL (714) 693-0808
FAX (714) 693-0705
BBS/Tech.Support
(714) 693-0762

PC PROFESSIONAL Editor's Choice: ZyXEL U-1496E German Edition, 4/92

ZyXEL USA, 4920 E. LaPalma Ave., Anaheim, CA 92807
All brand names and trademarks are the property of their respective owners.
Comparison chart was completed in May, 1992.

Circle 389 on Inquiry Card (RESELLERS: 390).

SYSTEM

486 Notebooks Double as Desktops

BARRY NANCE

With enough horsepower and sufficient connectivity options, a notebook computer doesn't have to be a second PC that you use just for traveling. A powerful notebook can be a desktop computer as well as a traveling companion, saving the expense of two machines and keeping your projects easily accessible.

I have some strict requirements that a notebook has to fulfill before it can double as my desktop machine. This month, I look at four 486-based notebooks that go a long way toward delivering on the notebook/desktop promise: Compudyne's 4DX/33, Ergo's NoteBrick 486, Gateway 2000's Nomad 420SXL, and Toshiba's T4400SX. I evaluated the machines at odd times and places, indoors and out, in the office and on the road. By the time I finished the review, I had bought one of these notebook PCs (I'll tell you which one, and why, at the end of this article).

All four computers can run OS/2 2.0, DOS, Windows 3.1, and SCO Open Desktop. I used a variety of applications as well: Microsoft's Word for Windows, Excel, and Visual Basic; Borland's Paradox for Windows, ObjectVision, and Borland C++; Watcom's C/386 9.0 compiler; Lotus's Ami Pro and 1-2-3 for OS/2; and Qualitas's 386Max. My son also loaded some games on the notebooks. All of this software ran without incident.

Although slightly bulkier than typical 386SX or 386SL designs, 486 notebooks handle tasks that slower processors can't easily accomplish. Clockwise from left: Gateway 2000's Nomad 420SXL, Toshiba's T4400SX, Ergo's NoteBrick 486, and Compudyne's 4DX/33.

Where to Look, What to Look For

These four notebooks have something to say about the sources of new portable technology. One was made in Texas, one in Japan, and the two fastest in Taiwan; only one (the Toshiba T4400SX) is manufactured and sold by the same company. Gateway's system is based on a Texas Instruments design, Ergo's NoteBrick 486 is built by Nantan, and the Compudyne 4DX/33 is manufactured by Twinhead.

The figure shows benchmark results for performance and battery life. [Editor's note: *For a description of the BYTE battery-life tests, see the text box "A New Thumper" on page 250.*] When you evaluate high-end notebooks, in contrast to 386SX and 386SL systems, I believe that battery life has to take a back seat to performance. At your desk, you'll use an AC charger. Traveling, you'll be ready for a break after 2 or 3 hours. If you buy an additional battery pack, you can slip it into the computer after your break and keep on running.

Each of these computers lasts at least 2 hours on one charged battery. Gateway says the Nomad will last 6 to 7 hours if all its power management features are enabled, but BYTE's battery-life tests rate realistic running time at closer to 4½ hours. The T4400SX had the longest running time on a single battery (at 4 hours, 39 minutes), while the NoteBrick 486 (at 1 hour, 40 minutes) ran the shortest time. In any case, I highly recommend getting an extra battery for any of these computers.

In addition to their speed, compatibility, and sizable hard drives, these notebook computers share one other trait—durability. Notebook PCs are getting more and more rugged. Even the plastic covers over the serial and parallel ports were more difficult to dislodge than they would have been on notebooks made just a year ago. All four computers survived being carried under my arm, being tossed on the seat of my car, and being used by my 16-year-old son.

continued

BYTE ACTION SUMMARY

- **WHAT 486 NOTEBOOKS DO**
  They put the computing power of a 486SX or a 486DX into a small, portable package.
- **LIKES**
  You can realistically expect to complete development projects or other compute-intensive tasks on the road.
- **DISLIKES**
  Keyboard layouts are clumsy, for the most part. The larger systems are also somewhat bulky.
- **RECOMMENDATIONS**
  For the quietest, slimmest notebook, get the Compudyne 4DX/33. The Ergo NoteBrick 486 has the best keyboard.

FEATURES OF 486 NOTEBOOKS

Gateway's Nomad 420SXL, based on a 486SX processor, is far and away the price leader. The Compudyne 4DX/33 and Ergo NoteBrick 486 compete for the high end, but the Compudyne system is considerably smaller and lighter.

	Compudyne 4DX/33	Ergo NoteBrick 486	Gateway 2000 Nomad 420SXL	Toshiba T4400SX
Price[1]	$2999	$2995	$2795	$4349
System unit				
Processor	33-MHz 486DX	33-MHz 486DX	20-MHz 486SX	25-MHz 486SX
RAM (base/ maximum; MB)	4/20	4/16	4/20	2/10
Hard drive capacity (MB)	127	170	80	80
Internal floppy drive (MB)	1.44	1.44	1.44	1.44
Dimensions (D × W × H; inches)	8.7 × 11 × 1.6	10.2 × 11.2 × 2.2	8.5 × 11 × 1.8	8.3 × 11.2 × 2.2
Weight (lbs.)	6.25	8.7	5.8	7.25
Keyboard				
Number of keys	84	82	79	82
External connector	Yes	Yes	No	Optional
Key travel (mm)	2.0	3.0	2.0	2.5
PageUp/PageDown	Yes	Yes	No	Yes
Insert/Delete in lower right	No	Yes	No	Yes
Display				
LCD type[2]	Backlit STN	Backlit STN	Backlit STN	Backlit STN[3]
Resolution	640 × 480	640 × 480	40 × 480	640 × 480
Gray scales	64	32	64	16
Viewing area (H × W; inches)	5.8 × 7.6	5.2 × 6.8	6 × 7.9	7 × 7.7
Super VGA external	Yes	Yes	Yes	Yes
Battery				
Technology	Nickel-cadmium	Nickel-cadmium	Nickel-cadmium	Nickel-cadmium
Recharge time (hrs.)	2	2	2.5	1.5
External power supply/charger				
Dimensions (D × W × H; inches)	6 x 1.5 × 3	6.25 × 2 × 3	6.25 × 1.7 × 2.25	6.25 × 1.7 × 3
Weight (lbs.)	1.5	1.5	1	2
General				
Serial ports	One	Two	One	One
Parallel ports	One	One	One	One
Pointing device	Internal trackball	External mouse	External trackball	None
Internal modem support	Yes	Yes	No	Yes
Expansion chassis port	Yes	Yes	Yes	Yes
Bundled software	DOS 5.0, Windows 3.1, PackRat (PIM)	DOS 5.0, Windows 3.1, AddStor	DOS 5.0, Windows 3.1	DOS 5.0

[1] Unless otherwise noted, price includes 4 MB of RAM, no modem, and features as listed in this table.
[2] All units include VGA-compatible LCD and external VGA port. STN = supertwist nematic; TSTN = triple-supertwist nematic.
[3] Color LCD, gas plasma optional.

These notebook powerhouses aren't without their drawbacks, though. When you're on the road (and even in the office, unless you attach an external keyboard), you're faced with a small keyboard. The keys don't have quite the travel of those on a full-size keyboard, and you'll have to get used to the different layout.

The features table details configurations. In the following sections, I'll give my account of what it's like to use these systems.

Compudyne 4DX/33

Compudyne's 4DX/33 notebook is manufactured by Taiwan-based Twinhead. Compudyne itself is the mail-order division of the CompUSA chain of computer stores. The 4DX/33 is the slimmest and quietest of the four notebooks in this review and quite inexpensive at $2999. It's fast (33 MHz), the standard hard drive is 127 MB, and it comes with a built-in trackball.

The 4DX/33's keyboard doesn't have quite the feel of the T4400SX's or the NoteBrick 486's, but it's more than adequate. The PageUp, PageDown, Home, and End keys are dedicated, and the Control, Caps Lock, and tilde keys are in the same positions as they are on a full-size 101-key keyboard. The Insert and Delete keys are badly placed in the upper right corner of the keyboard.

The built-in trackball is especially handy when you're trying to work while sitting in the cramped coach section of a crowded airline flight. The Cirrus Logic LCD screen features 64 gray scales, quick response, and a clear, brilliant display. The brightness/contrast controls are recessed and stay where you put them.

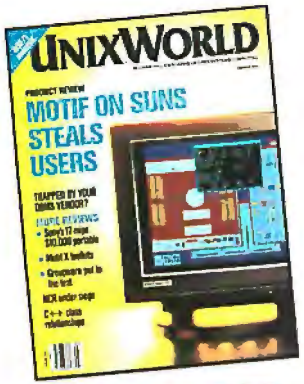
In addition to DOS 5.0 and Windows 3.1, Compudyne gives you a copy of PackRat, a PIM (personal information manager) from Polaris.

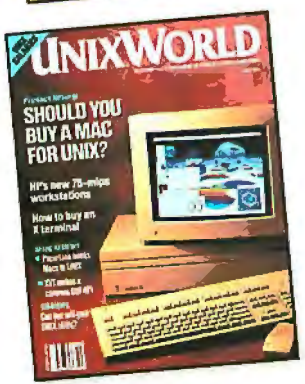
Ergo NoteBrick 486

Nantan manufactures the NoteBrick 486 computer for Ergo Computing. The $2995 NoteBrick 486 is larger, heavier, and noisier than the other notebooks. It is, frankly, a brute. But it is very reasonably priced, comes standard with a carrying case and numeric keypad, and has the nicest keyboard of all four notebooks. The NoteBrick 486 runs at 33 MHz, has a standard 170-MB hard drive, and ships with 4 MB of RAM. The unit Ergo sent for review was a top-end configuration with a full 16 MB of RAM that sells for $3895.

Nantan has manufactured keyboards for years; the company's expertise shows in the NoteBrick 486's. There are dedicated PageUp, PageDown, Home, and End keys. The Insert and Delete keys are in their proper positions in the lower right corner. And the feel of the keyboard is superior, almost as good as that of a full-size true-blue IBM keyboard.

The NoteBrick 486's display is small (5.2 by 6.8 inches), but it's clear and easy to look at. Ergo gives you a Logitech mouse with the NoteBrick 486 and throws in a copy of AddStor. You can use the latter to turn a 170-MB drive into (roughly) a





Explore UNIXWORLD...Risk Free!

Yes! *Start my one-year (12 issues) subscription for only $18.00. That's 50% off the newsstand price.*

NAME (please print)_____ TITLE_____

COMPANY NAME_____

ADDRESS_____ ☐ HOME ☐ OFFICE

CITY_____ STATE_____ ZIP_____

☐ BILL ME AT $18.00* ☐ PAYMENT ENCLOSED PLEASE CHARGE MY ☐ VISA ☐ MASTERCARD ☐ AMEX

CARD #:_____ EXPIRATION DATE_____ SIGNATURE_____

*U.S.A. ONLY. Canadian : 1 yr. $24. Other Foreign : 1 yr. $38. All Foreign orders must be prepaid in U.S. funds.

Please complete all questions to qualify for the rates shown above. Subscriptions at the above rates are limited to persons with active professional, functional and managerial resposibilities in UNIX or XENIX computing. Other subscriptions : $36 a year in U.S., Canada: $48, Other Foreign: $76.

CIRCLE ONE ONLY
My company's primary business

a. Mfg. of Comp./Comp. Equip.
b. Other Manufacturing
c. Systems Integrator/House
d. Software Developer
e. VAR, Dealer or Distributor
f. Communications/Telephone
g. Transportation/Utilities
h. Mining or Construction
i. Fin. /Ins. /Real Estate
j. Whsle or Retail Trade
k. Consulting
l. Government or Military
m. School or University
n. Other:_____
o. Medical/Dental/Legal
p. Research/Development

CIRCLE ONE ONLY
My primary job function

a. Corp. or Financial Mgmt.
b. MIS/DP Mgmt.
c. Office Mgmt. /Administration
d. Network Mgmt./ Telecommunications
e. Systems Integration
f. Design or Dev. Engineering
g. Prog./Software Development
h. Research/Analysis
i. Marketing or Sales
j. Purchasing
k. Mfg./Production
l. Distribution
m. Education/Teaching
n. Consulting
o. Government/Public Admin.
p. Other:_____
q. Technical Staff/Eng. Support

CIRCLE ONE ONLY
The number of employees at all locations of my company

a. Under 10
b. 10 - 49
c. 50 - 249
d. 250 - 999
e. 1,000 - 4,999
f. 5,000 or more

CIRCLE ALL THAT APPLY
I purchase/influence the purchase of the following:

a. Mainframe Computers
b. Minis/Superminis
c. Micros/Supermicros
d. Workstations
e. Board-Level Products
f. Terminals
g. Printers
h. Disk Drives
i. Tape Drives
j. Modems/ Multiplexers
k. LAN Equipment
l. Software

EJ2B502

Save50%

Your No-Risk Guarantee: I may cancel at any time and receive a refund for the balance of my subscription. Please allow 6-8 weeks for processing. California residents, add appropriate state and local sales tax.

UNIX is a registered trademark of UNIX System Laboratories, Inc. UNIXWORLD is not affiliated with AT&T

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT #42 HIGHTSTOWN, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

UNIXWORLD

SUBSCRIPTION SERVICES
P.O. BOX 570
HIGHTSTOWN, NJ 08520-9328

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.

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 biggest high-tech companies. Easy-to-understand programming tips and tutorials that can help your company use UNIX to its fullest. And unbiased hardware and software reviews to help you invest wisely when you buy.

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 strategies that are changing your world. And **UNIXWORLD** consistently offers the freshest, most down-to-earth writing that you'll find in any computer publication.

Subscribe today and recieve the next 12 issues of **UNIXWORLD** for just $18.00 – 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*.

Subscribe now!
Call toll-free:
1-800-257-9402 ext. 29

If you're into UNIX, you need UNIXWORLD

McGraw-Hill's Magazine of **OPEN SYSTEMS COMPUTING**

*UNIXWORLD's no-risk guarantee: If not satisfied, cancel and receive a full refund for the balance of your subscription.

UNIX is a registered trademark of UNIX System Laboratories, Inc.

DH1AUW9

"ALR PACKS POWER INTO NOTEBOOKS"

Info World June 22, 1992

If you think computing on the road means sacrificing the type of power you've become accustomed to, then you need to take a look at the new Ranger M486 from ALR. With a choice of high-powered i486 CPUs, the Ranger M486 is a match for any desktop PC. And, unlike other notebooks, the Ranger M486 is upgradeable. You can advance all the way up to 25-MHz i486DX™ computing by simply plugging in a new CPU module!

Up To Five Hours Of Portable Computing!

With its advanced power management circuitry, the Ranger M486 can keep going long after traditional notebooks have shut down. And its super accurate "Gas Gauge" lets you know just how much power is left.

The Ranger M486 even has three internal ALR expansion slots. Need a FAX/Modem, SCSI adapter, or data compression module? Just plug them in!

And with the addition of our color display notebook, you'll be able to create lively and eye catching presentations.

CALL NOW!
ALR's PrimeLine Direct
1-800-444-4ALR
Ask for ext. B09
For More Information and to order

We've taken the power and advanced 32-bit upgrade technology of our award winning desktop systems and condensed them into a lightweight portable PC. The Ranger M486 Series is the first notebook PC to offer a 32-bit modular upgrade path to full 25-MHz i486DX processing

AND THE

Choice of Upgradeable Processing Power...
25-MHz i486SX or 25-MHz i486DX

ALR Ranger M486 STANDARD FEATURES

- 4-MB RAM; Up to 16-MB on the system board
- 8-KB integrated static cache
- VGA graphics featuring 640 x 480 resolution
- 9" diagonal paperwhite LCD screen
- Hard Drive Options: 60-MB <19ms, 80-MB <16ms or 120-MB <15ms IDE Hard Disk
- 82-key embedded keypad with 10 function keys, inverted "T" cursor, 3mm key travel
- Up to 5 hours possible life with ALR PowerPlus Battery. Recharges in ~ 2 hours with system on or off
- One serial port; one parallel port; one mouse port; external VGA port; external keyboard/keypad and 160 pin docking station port
- Optional SCSI or scanner interface, data compression(2:1)
- Optional internal FAX/Data Modem (9600/2400; V2.2bis)
- ALR MS-DOS 5.0™
- 2.25"H x 11.75"W x 8.5"D, 7.2 lbs. (approximately),
- FCC Class B;
- Limited 12 Months; optional service and support program

ALR®
Advanced Logic Research, Inc.

9401 Jeronimo
Irvine, CA 92718
TEL: (714) 581-6770
FAX: (714) 581-9240
In Canada call 1-800-465-5979

Available at these nationwide locations: ComputerLand, Connecting Point Computer Centers, ENTRE, CBC, ALR Power Partner Resellers

25-MHz i386SX™
THE ALR PowerFlex FLYER 3SX/25
• i386SX microprocessor running at 25-MHz Upgradeable to 20- or 25-MHz i486SX™, 1-MB RAM, integrated Super VGA graphics (1024 x 768), 60, 80 and 120-MB hard drive options

$699

20-MHz i486SX™
THE ALR PowerFlex FLYER 4SX/20
• i486SX microprocessor running at 20-MHz Upgradeable to 25-MHz i486SX, 1-MB RAM, integrated Super VGA graphics (1024 x 768), 60, 80 and 120-MB hard drive options

$995

25-MHz i486SX
THE ALR FLYER 32DT 4SX/25
• i486SX microprocessor running at 25-MHz, Upgradeable to 33-MHz i486DX, and 50-MHz i486DX/2 4-MB RAM, integrated Super VGA graphics (1024 x 768), 80 and 120-MB hard drive options

$1,399

50-MHz i486DX/2™
THE ALR FLYER 32DT 4DX2/50
• i486DX/2 microprocessor running at 50-MHz, Upgradeable to future Intel Overdrive processors, 4-MB RAM, integrated Super VGA graphics (1024 x 768), 120 and 200-MB hard drive options

$1,999

25-MHz i486SX
THE ALR FLYER 32LCT 4SX/25
• i486SX microprocessor running at 25-MHz, Upgradeable to 33-MHz i486DX, 50-MHz i486DX/2 and 50-MHz i486DX, 4-MB RAM, Super VGA graphics (1024 x 768) 120, 340 and 535-MB hard drive options, 5 Security Features, 10 Expansion Slots, 12 Expansion Bays

WINNER
INFO April 23, WORLD 1992
8.5

$2,295

50-MHz i486DX/2
THE ALR FLYER 32LCT 4DX2/50
• i486DX/2 microprocessor running at 50-MHz, Upgradeable to future Intel Overdrive processors, 4-MB RAM, integrated Super VGA graphics (1024 x 768) 120, 340 and 535-MB hard drive options, 5 Security Features, 10 Expansion Slots, 12 Expansion Bays

WINNER
INFO April 23, WORLD 1992
8.5

$3,595

Founded in 1984, ALR is a public company with common stock traded on the NASDAQ National Market System under the symbol "AALR"

DESKTOP, TOO...

ON-SITE SERVICE
Call ALR for complete details

And ALR also offers the convenience and security of on-site service for as little as **$9.95*** a year!

33-MHz i486DX™
THE ALR BusinessVEISA 486/33
• i486DX microprocessor running at 33-MHz, Upgradeable to 50-MHz i486DX/2 and i486DX processors 32-bit high performance EISA bus 1-MB RAM, 120 and 200-MB hard drive options

PC MAGAZINE · PC Computing MVP · ResellerNews

$2,195

33-MHz i486DX
THE ALR POWERPRO VM 486/33
• i486DX microprocessor running at 33-MHz, Upgradeable to 50-MHz i486DX/2 and i486DX processors Dual Processor Ready 32-bit high performance EISA bus 5-MB RAM, 340 and 535-MB SCSI hard drive configurations with 32-bit EISA controllers also available

CRN EDITORS' CHOICE

$4,995

THE ALR Ranger M486
• i486SX microprocessor running at 25-MHz, Upgradeable to 25-MHz i486DX processor, 9" diagonal paperwhite LCD screen, VGA graphics (640 x 480), Up to 5 hours possible life with ALR PowerPlus battery-recharges in ~ 2 hours, 82-key keypad; inverted "T"; 3mm keytravel, 4-MB RAM, 60-, 80- and 120-MB hard drive configurations

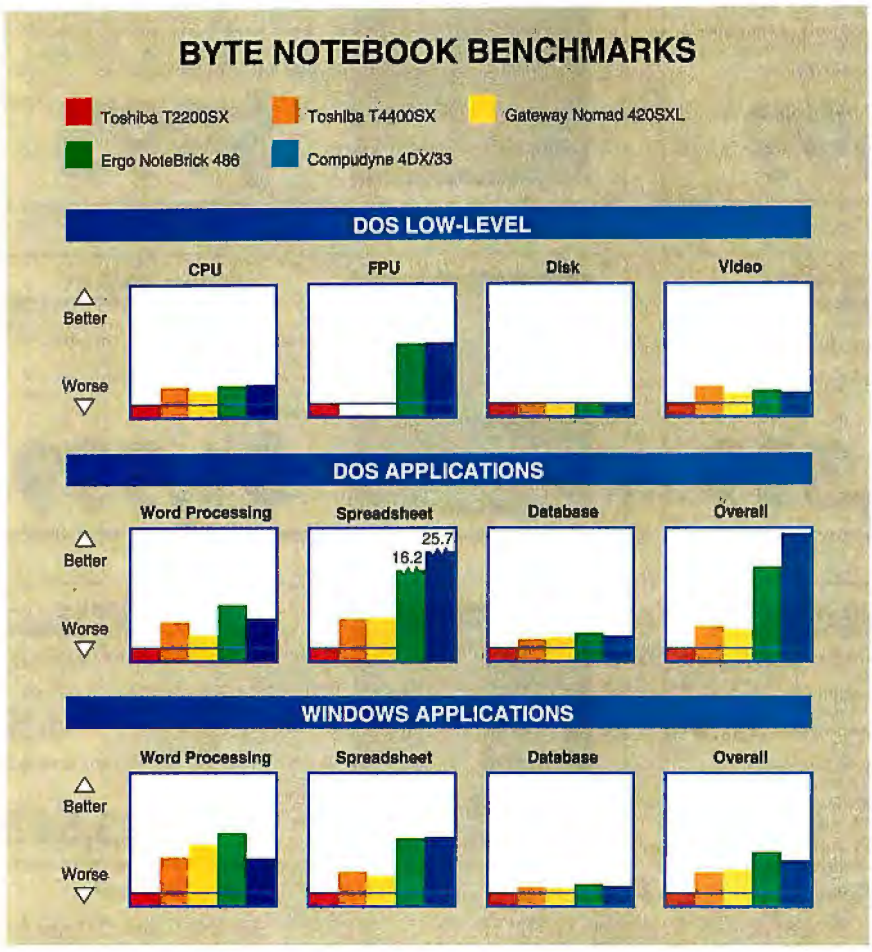
$2,495 Model 60
Color Ranger MC486 starting at $3,495

Novell Labs SuperLab Participant · SCO THE SANTA CRUZ OPERATION · BANYAN · MICROSOFT WINDOWS COMPATIBLE · OS/2™

ALR systems are put through rigorous compatibility testing to insure that whatever operating environment you choose your ALR system will perform above and beyond your expectations.

Prices and configurations subject to change without notice. Systems shown with optional equipment. Verify exact specifications with ALR. Prices based on U.S. Dollars. ALR is a registered trademark and BusinessVEISA is a trademark of Advanced Logic Research, Inc. Intel Inside is a trademark of Intel corp. All other brand and product names are trademarks or registered trademarks of their respective owners. *On-site service available in the U.S. and Canada; call ALR for details.
©1992 by Advanced Logic Research, Inc.

Circle 73 on Inquiry Card (RESELLERS: 74).

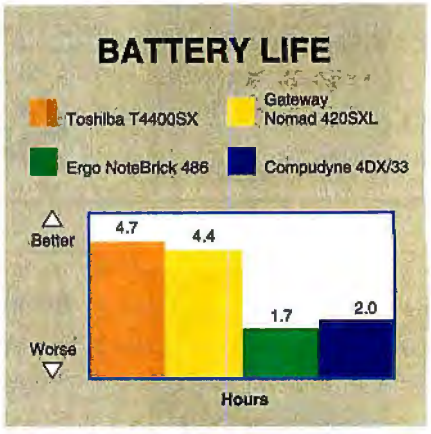


All results are indexed, and higher numbers indicate better performance. For each index, a Toshiba T2200SX running DOS 5.0 and Windows 3.0 = 1.

The BYTE low-level benchmark suite identifies relative performance at the hardware level, breaking down performance by system component. The results of these tests can help you identify the relative performance of a given subsystem and determine where performance bottlenecks may lie. For a complete description of these tests, see "BYTE's New Benchmarks: New Looks, New Numbers," August 1990 BYTE. The BYTE low-level benchmarks, version 2.2, are available in the byte.bmarks conference on BIX, or you can contact BYTE directly.

BYTE's application performance suite measures the performance you can expect to see running a given application category under a given operating environment. We test under two environments: DOS 5.0 and Windows 3.0. We test three application categories for each environment, running test scripts using the following programs: Word Processing: WordPerfect 5.1 and Lotus Ami Pro 2.0; Spreadsheet: Lotus 1-2-3 release 2.3 and Microsoft Excel 3.0a; and Database: Software Publishing Superbase 4 version 1.3 and Borland dBase IV. The data files and test scripts are available from BYTE.

The similarly configured Compudyne 4DX/33 and Ergo NoteBrick 486 (both with a 33-MHz 486DX processor) competed for the top spot on our performance benchmarks, splitting the DOS and Windows application suites. However, the spreadsheet application test is floating-point-intensive, so the DX machines have a strong advantage; low-level CPU benchmarks provide a more accurate performance comparison.



The Toshiba T4400SX and the Gateway 2000 Nomad 420SXL stood out in BYTE's battery-life tests.

340-MB drive through file compression. Ergo also preinstalls DOS 5.0 and Windows 3.1.

Gateway 2000 Nomad 420SXL

The Nomad marks Gateway 2000's entry into the notebook market. The computer is a TI design and looks exactly like a TI TravelMate 3000. Gateway offers a series of 486-based Nomad machines, ranging from the low-end 420SXL ($2795) to the top-of-the-line 425DXL (a 25-MHz 486DX that costs $3495). In its 420SXL configuration, the Nomad is the least expensive of these notebooks; it's also one of the lightest and slimmest, and it's quiet. Not surprising, it's also a little slower than its more fully featured competitors, as you can see from the benchmark results.

While the price/performance trade-off is reasonable, the Nomad's keyboard is its weak point. The PageUp, PageDown, Home, and End keys are also the cursor keys. You hold down an Fn modifier key to choose between these sets. The Insert and Delete keys are in the upper right corner of the keyboard, not the lower right.

The Nomad's screen is the largest of the four (6 by 7.9 inches). The screen is easy to read and has a toggle switch for reverse video. The Nomad has a connector for an external VGA monitor and one for an external keypad. You can also use an external keyboard with an optional adapter.

Nomad's pointing device is a hand-held trackball. Only about 1½ inches square, the Nomad mouse lets you use your thumb to move the mouse cursor. One button on the pointer represents "click and hold," but I found the device unwieldy. Gateway loads DOS 5.0 and Windows 3.1 for you.

Toshiba T4400SX

Toshiba is an old hand at making notebook computers. The T4400SX continues the tradition of good keyboard layout and feel and good display quality that made the T2200SX such a dazzling success. In the past year, however, Toshiba's competitors have created new machines that also have good keyboards and displays. The T4400SX is a solid machine, and it's the only notebook in this collection to offer a color screen as an option, but its high price ($4349) makes it vulnerable to these new competitors.

The T4400SX is heavier and thicker than the Nomad and 4DX/33 but lighter and smaller than the NoteBrick 486. The PageUp, PageDown, Home, and End keys are dedicated. The Insert and Delete keys are in the right place. The Control, Caps Lock, and tilde keys are in unfamiliar locations, however.

The only major problem with the T4400SX is its power switch. Located on the left side of the case, the recessed switch requires a lot of effort to operate. The brightness and contrast controls are also poorly placed; they are in an exposed

TAKE A COUPLE OF GIGABYTES OUT OF YOUR DATA STORAGE PROBLEM

If you're like most PC users, the way your computer devours available storage space resembles... well... a feeding frenzy. You never seem to have enough storage capacity, and when you're mobile, it seems impossible to back up your critical data on the road.

Fortunately, paddling to calmer waters and fail-safe data storage is easy with Parallel Peripherals. All you need is one of our sub-systems and a parallel port (no interface card required). You already have the parallel port, and we have the peripherals—in a format and capacity to satisfy the biggest storage appetite.

Ultra-portable, they simply plug-in to the parallel port on your portable or desktop computer. And each is equipped with an additional printer port pass-through which maintains full printer capability.

Our portable and lightweight drives are true workhorses, providing the most reliable data storage and the most advanced drive features. And with a one-year factory warranty, you can take a bite out of your storage problem without getting bit.

So if your data storage is going down for the third time, let Parallel Peripherals throw you a line. Portable or desktop, we have the right drive in the right capacity. Call (800)222-7240 for more information.

CD-ROM Drive • Dual Floppy Drive • Battery-Powered Hard Drive • Tape Backup • Removable Hard Drive

Parallel PERIPHERALS

©1992 Parallel Peripherals Technology, Inc. • 260 West Arrow Hwy., #E • San Dimas, CA 91773 • (714) 394-7244 • FAX (714) 394-7242

Circle 199 on Inquiry Card.

position, easily bumped, and you'll probably have to readjust them each time you turn on the T4400SX.

The T4400SX offers a resume mode that can be activated through the power switch. When enabled, the resume mode puts you back exactly where you left off when you powered down. This is convenient, unless you use your notebook on a LAN. When you power up, the network software doesn't realize it has lost touch with the file server. And if an application crashes, the power switch resumes back to the same crash. Pressing a special reset button on the back of the T4400SX, or disabling resume mode entirely, solves this problem.

The T4400SX has an expansion bus, one serial and one parallel port, an optional external keyboard connector, and an external VGA port. You can put an internal modem in the machine. Toshiba doesn't supply a mouse or Windows 3.1 with the computer.

Noteworthy Notebook

When I decided to buy one of these notebooks, I picked the Compudyne 4DX/33. For me, the size of the hard drive, the processor speed, the clarity of the screen, and the built-in trackball were deciding factors. Of course, I'll have to put up with the keyboard when I travel, but at my desk I'll use an IBM PS/2 keyboard and VGA monitor.

The new notebook arrived yesterday. I don't expect I'll need to use my PS/2 Model 80 office machine ever again. ■

Barry Nance, a programmer for the past 20 years and a BYTE contributing editor, is the author of Using OS/2 2 *(Que, 1992),* Network Programming in C *(Que, 1990), and* Introduction to Networking *(Que, 1992). He is the editor for the IBM Exchange on BIX, where you can reach him as "barryn."*

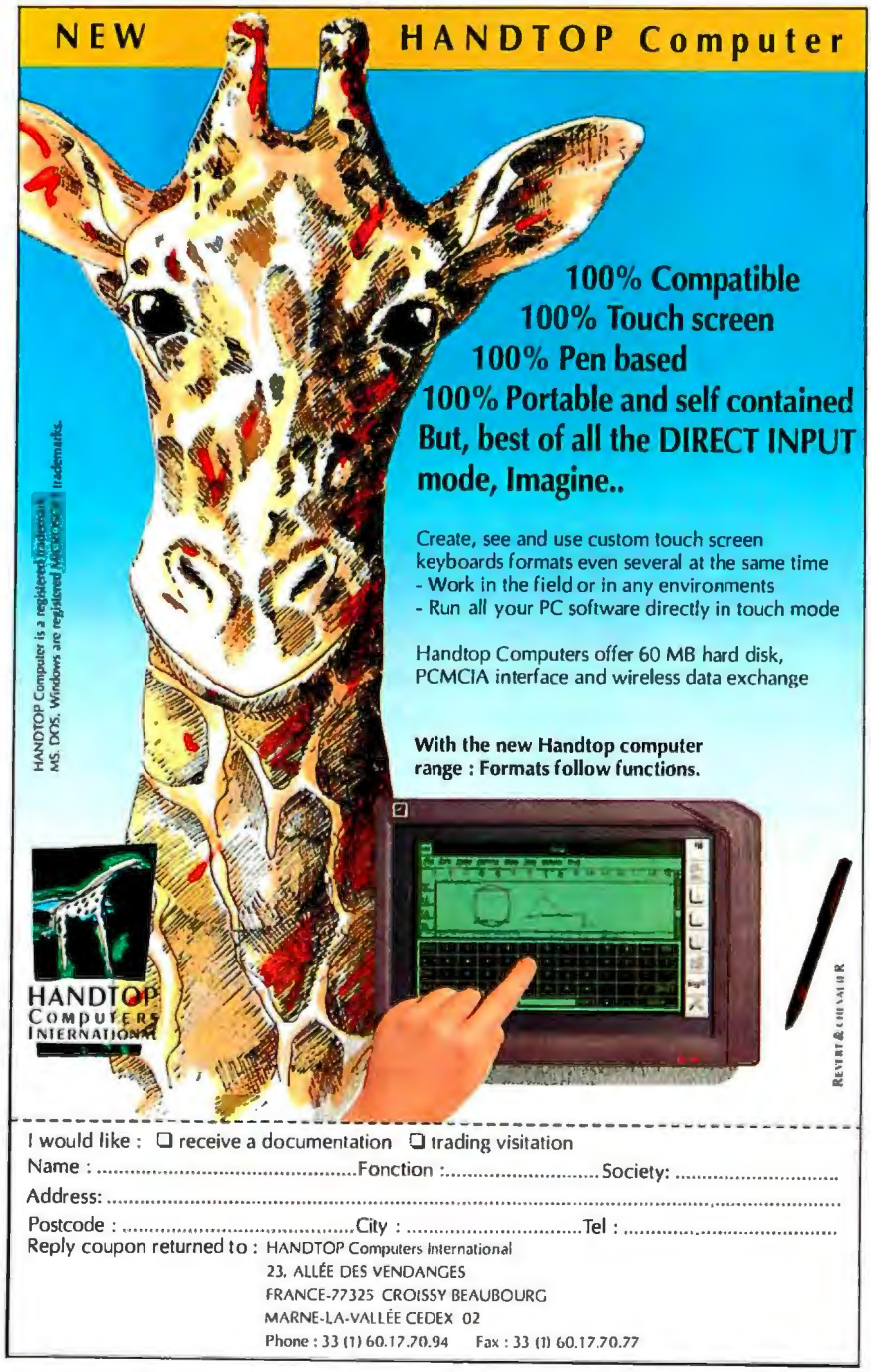
COMPANY INFORMATION

Compudyne Direct
(4DX/33)
15151A Surveyor
Addison, TX 75244
(800) 932-2667
(214) 702-0055
fax: (214) 702-0300
Circle 1234 on Inquiry Card.

Ergo Computing
(NoteBrick 486)
1 Intercontinental Way
Peabody, MA 01960
(800) 633-1925
(508) 535-7510
fax: (508) 535-7512
Circle 1235 on Inquiry Card.

Gateway 2000
(Nomad 420SXL)
610 Gateway Dr.
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
fax: (605) 232-2023
Circle 1236 on Inquiry Card.

Toshiba America Information Systems, Inc.
(T4400SX)
Computer Systems Division
9740 Irvine Blvd.
Irvine, CA 92718
(800) 334-3445
(714) 583-3000
fax: (714) 587-6034
Circle 1237 on Inquiry Card.



Circle 198 on Inquiry Card.

How much longer can you afford to wait?

Create Overlaid Programs-Fast.

BLINKER™, the world's first and fastest dynamic overlay linker, reduces your link time to seconds and reduces program memory requirements. Now you can use one linker for all your software projects.

One Linker, Many Languages.

BLINKER 2.0 links and automatically overlays DOS programs written in Microsoft® C, BASIC, Assembler, QuickBASIC™, Fortran, Pascal, Watcom™ C, Zortech® C++, Clipper®, FORCE® and in Borland® C, C++, Assembler, and more.

Save Time and Memory.

BLINKER removes the need for overlay structures, simplifies program design and reduces memory requirements to save you time, effort and memory.

Memory Swap Function.

BLINKER is the ONLY linker to offer an integrated memory swap function, so you can run other large programs from within your program, with negligible memory overhead.

BLINKER™
High Performance Dynamic Overlay Linker

Don't Settle for Less.

Other major features include full CodeView® support, use of EMS/XMS at program run time, and enhanced execution speed of overlaid code.

Time is Money.

BLINKER offers all this in a fraction of the time it takes to link with your current overlay linker. You know time is money, and link time is no exception.

Free Demo

To try our free demo on your own code

Call: 804-355-4444 or FAX: 804-355-1676

Order now!

If you can't wait any longer, we offer a risk free 30 day money back guarantee. Available in 5.25" or 3.5" diskette format.

Price $299
plus shipping & handling

VISA MasterCard

Blink*inc*
P.O. Box 7154
Richmond VA
23221

© 1991 Blinkinc. Blinker is a trademark of ASM, Inc. Offer only applicable in US and Canada.

Circle 393 on Inquiry Card.

The only notebook with a tilt & swivel display. Great for sharing data or keeping it private. Easily adjusts for perfect viewing.

This fine Italian leather carrying case is an additional option. Loaded with pockets and features everyone wi appreciate.

Digital brightness and contrast buttons make screen adjustment so easy.

ZEOS® Freestyle/SL. More features at a lower cost than any other notebook. Period.

To try and compare the new ZEOS Freestyle/SL to any other notebook is next to impossible. Because nothing else has all its features. And even with all these great features, nobody can match the price. Features and price. It would seem the new ZEOS Freestyle/SL is the best of all worlds. It is.

DESIGNED BY USERS. JUST LIKE YOU!

We asked our customers what it is they want in the perfect notebook. The first thing they told us is that most notebooks look like a cigar box with a lid. They told us they wanted not only good looks, but things like great power *and* great battery life. Lightweight too, like five pounds and change. And the keyboard should be effortless to use. The entire product had to be extremely durable. And that was just for starters.

SL POWER. SL BATTERY LIFE. 64K CACHE!

2MB, 60MB Only $1895!

We listened well. Then we got down to work. For the chipset and CPU we selected the Intel 25MHz SL. We then built in a high-speed 64K SRAM cache as standard. We know this system might well replace a desktop for many users.

And power to your ZEOS Freestyle/SL system is provided by our advanced battery system. The fully enclosed lightweight battery packs easily snap in and out and can be "quick-charged" when the system is not being used or trickle-charged when in use. So what happens when the power is on?

GREAT VIDEO TOO.

You get great video! Because for video control, we chose the amazing new Cirrus Logic VGA controller. It not only consumes less power, it also produces the fast crisp images you're looking for. And with a business machine like this you'll also appreciate our dual display capabilities. You can connect an external VGA color monitor for simultaneous co-display. And that's not all.

A NOTEBOOK KEYBOARD YOU'RE GOING TO LOVE.

We re-designed and re-sculpted every key from scratch. Even the key-switch mechanism was invented anew. And we added the mouse key for easy cursor control. It is the absolute perfect notebook keyboard. What else?

Lots else! Like the best display system of any notebook available anywhere. We listened here too. The screen is big and easy to read. Plus, it's high contrast and it's fast. It's also very easy to adjust. People said contrast and brightness knobs were hard to use. So we replaced them with soft touch buttons that *electronically* adjust screen settings at your command. Then we really got creative.

THE ONLY NOTEBOOK WITH A TILT & SWIVEL DISPLAY.

Can you imagine your desktop PC without a tilt and swivel display? Neither could we. So why not incorporate that feature into a notebook. With the ZEOS Freestyle/SL notebook you can adjust the screen left and right as well as tilt it up and down. Now you can truly adjust your notebook screen to the perfect viewing angle.

IT FLOATS TOO.

And then there is the "floating" screen. When you're facing your new ZEOS Freestyle/SL, the screen actually appears to "float" in the air in front of you. It's the only notebook that can really be used sitting on your lap!

EXTRA, EXTRA, EXTRAS. READ ALL ABOUT 'EM!

We've made more options available than ever before. Like our modem with send/receive fax. And memory up to 20MB, hard drives to 180MB, even an optional Italian leather carrying case! Extra batteries and a charging stand are available too. Call 800-423-5891 for all the details.

Built-in mouse key provides easy cursor control. Leave those bulky mice behind!

This sliding port door won't break off or come loose. Saves your fingers too.

ZEOS. #1 RATED NOTEBOOKS, SERVICE & SUPPORT!

PC Magazine recently surveyed notebook users for their Service and Reliability issue. Their findings? "Only ZEOS portable PCs achieved significantly higher-than-average ratings in all four categories." The categories were reliability, future purchase plans, repair service satisfaction and technical support. And remember, ZEOS technical support is 24 hours a day, 365 days a year, toll free. And we back your new ZEOS Freestyle with our 30-Day Absolute Satisfaction Money-Back Guarantee, One Year Limited Warranty and more.

ORDER YOUR AMAZING ZEOS FREESTYLE/SL NOW.

Ordering your new ZEOS notebook is easy. Simply pick up the phone and give us a call. A friendly ZEOS Systems Consultant is ready to answer any questions you may have. You're going to love your new ZEOS notebook. Give us a call!

CALL NOW TOLL FREE:
800-423-5891

Purchase orders from Fortune 1000 companies, governments and institutions are subject to approval. Leasing programs are available. All prices and specifications are subject to change without notice. Please call to confirm pricing, specifications and warranty details. All products and company names are trademarks or registered trademarks of their respective holders. © 1992, ZEOS International, Ltd., 530 5th Ave. NW, St. Paul, MN 55112 USA. ZEOS is a publicly traded company (NASDAQ symbol: ZEOS). X202-BYT-9209

NEW ZEOS FREESTYLE/SL
ONLY $1895

- Intel 25MHZ 386SL, 64K cache!
- 2MB RAM standard, expandable to 20MB.
- 60MB hard drive, options to 180MB, 3.5" 1.44MB floppy.
- Backlit 9½" VGA display with Tilt/Swivel base. Simultaneous display with external VGA monitor.
- Snap-in and -out battery packs provide for a real 3-4 hours of typical operation or even longer depending on your applications.
- Quick-charge in little over an hour with the small lightweight AC adaptor.
- 8.5" x 11.3", 5.6 pounds, built-in soft carrying handle.
- 81-key keyboard with built-in full-size inverted "T" arrow keys.
- Serial, parallel and VGA ports with standard connectors protected by a durable, easy-to-use sliding door. No more broken doors or broken fingernails!
- 30-Day Money-Back Guarantee One Year Limited Warranty, ZEOS Customer Satisfaction Package.
- Loads of options. Modems, carrying cases and more!
- Designed and built by ZEOS right here in the USA.
- 24-Hour-a-Day Toll-Free Telephone Support, 365 Days a Year.
- Upgrade Packages Too: Call for details about absolutely loaded systems featuring more memory, bigger drives and Windows.

ORDER NOW TOLL FREE:
800-423-5891

Fax Orders: 612-633-1325
Government: 800-245-2449
Hearing Impaired (TDD) Orders: 800-228-5389
Outside US and Canada: 612-633-6131
MasterCard, Visa, Discover, Am Exp, Z-Card.sm
Open 24 Hours a Day, 365 Days a Year!

ZEOS® INTERNATIONAL, LTD.

Circle 190 on Inquiry Card.

BYTE Introduces:

Your Direct Link to Products

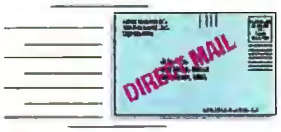
An enhanced service for BYTE readers that gives you free information on products – faster and easier than ever!

BYTE's new, enhanced reader service section, *Your Direct Link*, gives you a direct line to free product information in every issue. And, the newly designed Direct Link Card makes ordering easier than ever!

In the NEW Direct Link section, here's what you'll find:

Alphabetical Index to Advertisers Including Phone Numbers

Dial companies directly to request product information.



Product Category Index to Advertisers

Order information on individual products or complete product categories when you return the postage-paid *Direct Link Card.*

Ordering by product category is a new service of *Your Direct Link.*

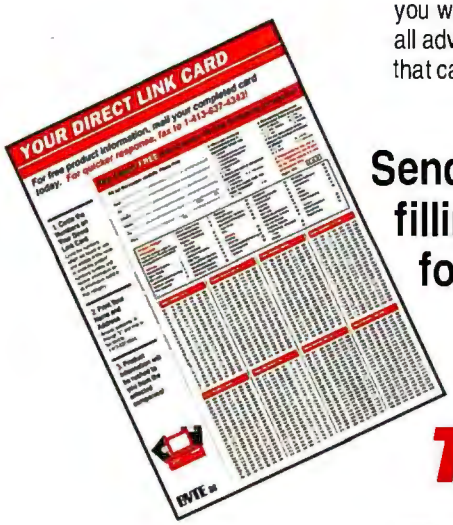
For example:
If you order information under the general category of Printers, you will receive information from all advertisers listed under that category.

New Enhanced Direct Link Card

To receive free information quickly, fill out and mail or fax *Your Direct Link Card* today!

Redesigned Editorial Index

Free information is now easily available from companies covered in articles, columns, or news stories in each issue.



Send for FREE product information by filling out *Your Direct Link Card* found in the back of every issue.

Buy It Through BYTE!

BYTE

APPLICATION

A New Illustrator for Windows

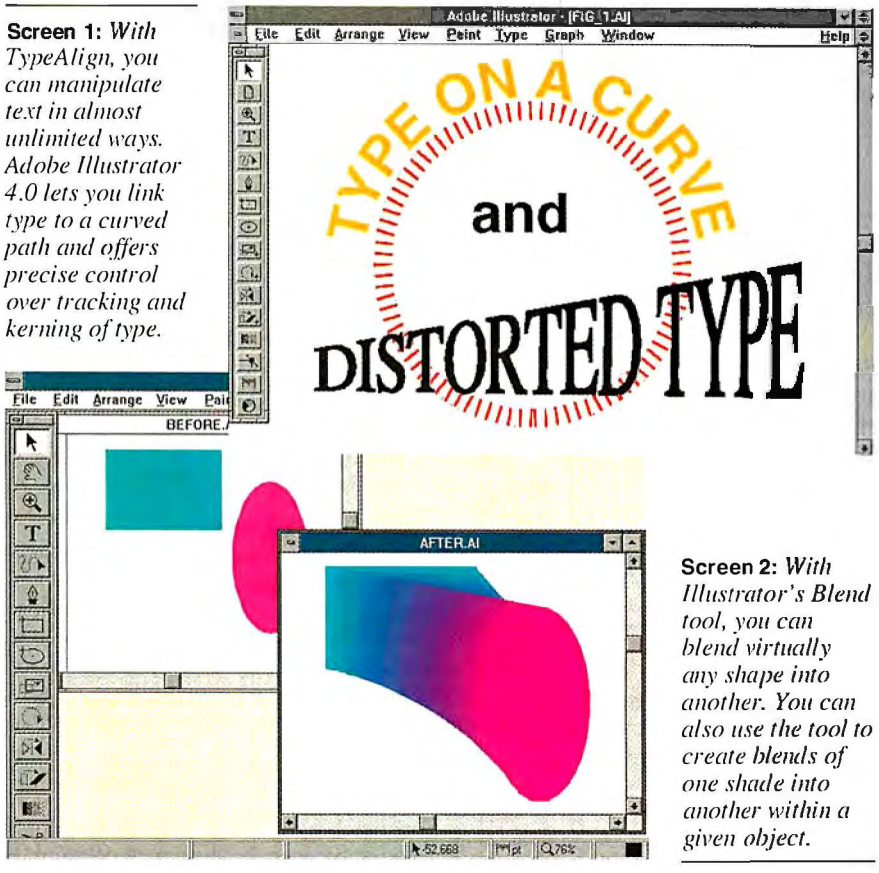
CAL VORNBERGER

Although Adobe Systems' Illustrator 4.0 for Windows is a welcome improvement over the original version for Windows, there are enough missing or poorly implemented features to make this upgrade less than spectacular.

Still, several improvements make the program an important tool for graphic designers and technical illustrators. By bundling Illustrator 4.0 with TypeAlign, Adobe's type-manipulation program, the company addresses some of the missing type-manipulation features found in competitors' programs. Illustrator comes with Adobe Type Manager 2.02 and 40 Type 1 PostScript fonts. Also included are Adobe Separator, a color-separation program, and a version of Adobe Streamline, the bit-mapped graphics tracing program.

Some of Illustrator's new features include the ability to work on illustrations in preview mode, dynamic zooming, better font control, and improved color separation through the Adobe Separator program. Also much improved are the on-line help facility and screen-refresh rates. Another nice new touch to the interface is a floating tool palette that can be resized or made large for high-resolution monitors.

Adobe claims that the program has been optimized for 386 and 486 machines. The program requires a 386 or higher processor, 4 MB of RAM, a hard drive, and a VGA monitor. Experience recommends at least a 33-MHz 386 with 8 MB of memory. Illustrator will not run on an EGA monitor or any other monitor that does not have square pixels (i.e., 640 by 480, 1024 by 768, and so on). If you try to run the program on such a monitor, an error message will warn you of the discrepancy.



Screen 1: *With TypeAlign, you can manipulate text in almost unlimited ways. Adobe Illustrator 4.0 lets you link type to a curved path and offers precise control over tracking and kerning of type.*

Screen 2: *With Illustrator's Blend tool, you can blend virtually any shape into another. You can also use the tool to create blends of one shade into another within a given object.*

Color Preview

One annoying problem with Illustrator in previous Windows and Macintosh versions was the need to toggle back and forth between artwork mode and preview mode. You would draw in artwork mode and view the finished work in color by making a menu selection that toggled the screen into preview mode. This was necessary because of the slowness in screen redrawing rates when the full-color screen had to be refreshed each time an element in the drawing changed. Illustrator 4.0 for Windows lets you manipulate work in preview mode in full color, albeit with slower screen refresh, or continue, as before, to work in artwork mode (with a faster screen refresh) and toggle into preview mode to view the final product. The Mac version still suffers from this toggle boggle.

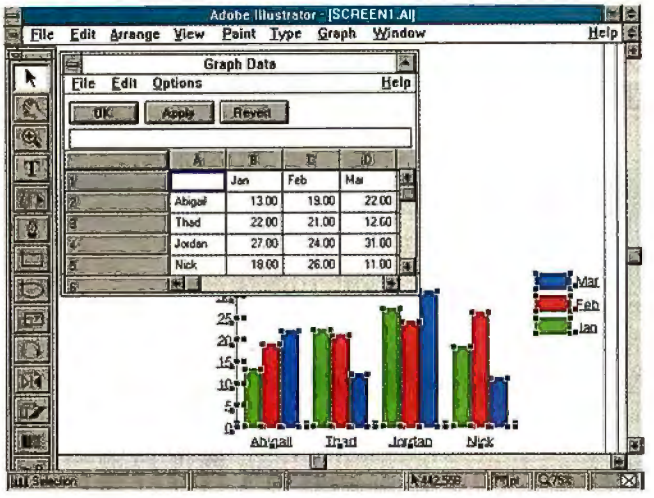
One conspicuous omission, available in rival Aldus FreeHand, is a multiple Undo function. With Illustrator, a single undo is all you get, while FreeHand has up to 99 undos, a valuable feature for the less-than-perfect graphic designer. But beware: Under certain conditions, the Undo function doesn't work at all. This is most noticeable when you go back and forth between preview and artwork modes. If you create a certain effect in artwork mode and then view it in preview and discover you don't like it, you're in for a surprise when you return to artwork mode to try to undo it—you can't. The Undo function is also disabled when you use certain menu items.

Better Type

Illustrator 4.0 and TypeAlign offer much-improved type manipulation and control. Although neither supports TrueType, and both work with only Adobe Type 1 PostScript fonts, the combination of the two programs gives you greater control over type manipulation. With TypeAlign, text can be stretched, pulled, and manipulated in ways limited only by your imagination. Illustrator itself lets you link type to a curved path (see screen 1) and offers precise control over tracking and kerning of type. Type can be stroked with one color and filled with another and can be converted to outlines and filled with an image or gradient. Unfortunately, images must be pasted into text one letter at a time, so the process can get tedious.

Illustrator lacks CorelDraw's ability to create instant 3-D type effects, but you can achieve the same results with a few added steps. If Adobe could see its way clear to support TrueType, Illustrator 4.0 could take advantage of all the TrueType fonts included with Windows 3.1.

The new release of Illustrator introduces dynamic panning and zooming. Although these are much-needed features, there is a



Screen 3: *You can enter data manually into an Illustrator spreadsheet and automatically generate a chart or graph.*

drawback. The screen goes blank during panning, making it difficult to judge how far the page has been moved. Zooming works much better. You select the magnify tool and draw a rectangle around the area you want to zoom in on. Zooming is almost instantaneous.

With Illustrator's Blend tool, you can blend virtually any shape into another, as in the example of the square blended into a circle (see screen 2). You can also use the tool to create blends of one shade into another within a given object.

Working with Color

Adobe has provided a program to create color separations from Illustrator files. Adobe Separator is a stand-alone application that lets you create custom color separations from your Illustrator files for four-color-process output. Illustrator also supports several color-matching systems, albeit in a cumbersome way. Instead of building color matching into the software, Adobe provides several files that have color-matching systems as custom colors. You must open the document containing the color-matching system of choice, make a copy of it, and create your illustration on the copy of that document.

Color-matching systems supported include Pantone, Toyo, Focoltone, and Trumatch. You have the option, as always, of creating your own custom ink colors. Illustrator also has the capacity, in conjunction with printed color swatches in the manual, to let you calibrate your monitor to match printed output. Although crude, the method seems fairly accurate.

Illustrator is Super VGA–compatible in its color picker, but something odd happens when you select custom colors. Since a computer is capable of displaying colors that are unprintable using the standard four-color-process method, color pickers geared for printed output are usually designed to display CMYK equivalents. In this way, users receive an on-screen approximation of what their printed output will look like. Since Adobe's color picker is RGB-based, it is possible to select custom colors that are unprintable. Adobe offers no explanation for this anomaly in the documentation for Illustrator.

Illustrator's simple, elegant interface continues to be its strong suit. All similar structured-drawing programs support Bézier curves, one of the basic constructs of the PostScript PDL (page-description language), but Illustrator's entire interface is based on the creation, linking, manipulation, and control of these curves. There are tools to draw and manipulate freehand curves and combine them with lines and shapes to create complex illustrations. While the Bézier model may prove daunting to the novice, once you've grasped the concept, you'll have a handle on the true power of the program.

An Illustrator's Guide

There is an excellent tutorial that takes you through Bézier-curve fundamentals, and the accompanying examples on disk help beginners grasp Illustrator's unique approach to drawing and shape manipulation. A separate Beyond the Basics manual proceeds step-by-step through more complicated illustration techniques.

Unlike FreeHand, Illustrator lacks any type of layer management or control. In complicated illustrations, this lack of layer management can have serious consequences. Since the order in which layers exist on the page determines their characteristics and whether they obscure a layer underneath them, some kind of approach to layer management is very important in any structured-drawing program. Given Illustrator's lack of layer management, it is at times almost impossible to manipulate certain objects in large, complicated illustrations. Adobe suggests grouping similar objects together, but this is not a solution. Until the problem is addressed, a lack of layer management will remain a serious flaw in Illustrator 4.0.

Another serious problem I encountered with Illustrator 4.0 is its inability to import EPS (Encapsulated PostScript) files from other programs, notably PhotoStyler and CorelPhoto. The images seem to import error-free, but they are not viewable. Adobe's technical support acknowledges this problem and says a bug fix is in the works.

On the matter of technical support, Adobe seems strangled by its own success. It took two separate sessions of over 45 minutes each of auto-dialing Adobe technical support before I was put through. Then it took an additional 10 minutes before an actual technical representative came on the line. The representative was knowledgeable and courteous but admitted that the company can't handle the volume of calls it receives. Although the manuals and tutorials are well written, there are occasions when you'll need to get through to

BYTE

- **WHAT ILLUSTRATOR 4.0 IS**
  A professional design tool for creating precise illustrations and single-page designs.
- **LIKES**
  Lets you view and edit color illustrations directly; has improved type manipulation and control.
- **DISLIKES**
  Lack of layer management.
- **RECOMMENDATIONS**
  Despite several omissions and a few bugs, Illustrator 4.0 is a powerful tool designed for ease of use.
- **PRICE**
  $695
- **FOR MORE INFORMATION**
  Adobe Systems, Inc.
  1585 Charleston Rd.
  P.O. Box 7900
  Mountain View, CA 94039
  (415) 961-4400
  fax: (415) 962-0850
  Circle 1222 on Inquiry Card.

While Our Competitors Are Diligently Trying To Emulate The SummaSketch® II...

We Proudly Announce SummaSketch II *Plus*

The world's best selling, most emulated, most acclaimed desktop tablet just got better. We've taken SummaSketch II, the industry standard, and added several new features to create a tablet that is, unquestionably, the world's best.

Unlike some competitors, we put everything in the box—4-button cursor *and* 2-button stylus (or 16-button cursor), interface cables and a utilities diskette with Windows® 3.0 and ADI® drivers. Plus we've added things like 2000 lines per inch resolution and 10 mil accuracy—standard. Plus the fastest, easiest set-up and configuration procedure. Plus an offer for a free AutoCAD® or CAD KEY® Master Template (a $245 value). Plus software compatibility with over 400 programs, and hardware compatibility with PCs and Macintosh.® Best of all, it's still 100% pure SummaSketch—the editor's choice, winner of every major editorial accolade for graphics tablets. And the people's choice, with well over one-half million sold to demanding computer graphics professionals.

Every decision should be this easy. In fact, the only tough decision is which Plus to choose: 12" x 12" or 18" x 12" Professional. For literature, or the name of your local dealer, call 1-800-729-7866. For technical information call 203-881-5400.

PC MAGAZINE EDITORS' CHOICE November 26, 1989 SummaSketch II

CORPORATE COMPUTING TOP RATED DATAWEEK 1990 SATISFACTION POLL

CADENCE BEST OF 1990

C 1990

Summagraphics®

Every decision should be this easy.™

© 1992 Summagraphics Corporation. Seymour, CT 06483. All rights reserved.

Circle 168 on Inquiry Card.

technical support. The present system is not satisfactory.

Charts and Graphs

An additional feature of Illustrator 4.0, of interest to users of business graphics, is the built-in charting capability. You can import spreadsheets into Illustrator and automatically generate a wide variety of charts and graphs. You can also enter data manually into an Illustrator spreadsheet (see screen 3) and generate a chart or graph that way. Legends are linked to their respective values and change automatically if values are changed. A wide range of different chart and graph types includes bar graphs, pie charts, and scatter graphs. Graphic designers should appreciate the ease with which they can create good-looking charts and graphs.

The program also allows you to import scanned artwork as templates. Templates can be any bit-mapped image in TIFF, PCX, or BMP format. These images can be traced by hand with Illustrator's drawing tools, or they can be auto-traced with the program's built-in Auto Trace tool. The auto-trace function is not very accurate; the traced illustrations require quite a bit of cleaning up to create an accurate rendition of the image. For a limited time, Adobe is offering Streamline, its higher-quality tracing program, free to purchasers of Illustrator. Adobe should have included the capabilities of Streamline in Illustrator in the first place so it wouldn't have had to bundle it as a separate program.

Illustrator drawings cannot be copied, pasted, or viewed in the Windows Clipboard except as special Adobe PostScript objects. These can be passed from TypeAlign and Streamline into Illustrator, but not the other way around. Text blocks that are imported from TypeAlign to Illustrator via the Clipboard come in as outlines. Illustrator 4.0 can read and write Illustrator files from the Mac and from Adobe's Unix and Next versions of the program and can save in Illustrator 88 and Illustrator 1.1 file formats. Tests confirmed that file compatibility is 100 percent across the Mac and PC platforms.

The Whole Bundle

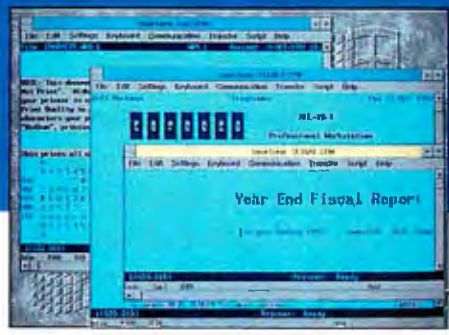
Adobe includes a fair number of borders, symbols, and patterns with the program. These images provide a shortcut from the tedious work of creating these shapes. Some of the borders and patterns are quite imaginative. Noticeably missing from the package is the cornucopia of clip art and fonts distributed with programs like CorelDraw and Professional Draw from Gold Disk, but this is probably not a drawback for most illustrators, as they prefer to create their own work from scratch. What the package lacks in clip art and fonts it makes up in a simple, elegant approach to structured drawing. In fact, Illustrator is much more a tool for creating professional illustrations than for putting together a simple poster or brochure.

Illustrator 4.0 is a welcome addition to the collection of Windows-based structured-drawing programs on the market. While it does not have the wealth of features, clip art, fonts, and ancillary programs offered by CorelDraw 3.0 and several other competitors, it is an excellent illustration tool designed for ease of use. Despite several omissions and a few bugs, the program is a powerful tool for the technical illustrator and professional graphic designer. ■

Cal Vornberger is a graphic designer and software developer who specializes in multimedia applications and presentations. He can be reached on BIX c/o "editors."

Complete, Powerful Connectivity

SmarTerm 420 for Windows version 2.0



Acess multiple host computers, including VAX/VMS and UNIX/Ultrix host systems, simultaneously. SmarTerm 420 for Windows includes LAT, Telnet, and FTP at no extra charge.

New SmarTerm 420 for Windows version 2.0 clearly puts more VT emulation power and ease at your fingertips. New features include scrollback, color selection, font resizing, and ANSI color support. Toolbox, button palettes, trace and remapping utilities, and customizable-help reduce support needs. SmarTerm 420 for Windows still offers error-free file transfer, scripting, and keyboard mapping. Plus, you get LAT, Telnet, and FTP *at no extra cost.* SmarTerm, connecting users worldwide, is also available for VT320 and VT340 emulation using DOS.

Persoft, Inc. 465 Science Dr. P.O. Box 44953
Madison, WI 53744-4953 Call toll-free 1-800-EMULATE
Fax (608) 273-8227

European Headquarters World Trade Ctr. Beursplein 37
Box 30237 3001 DE Rotterdam The Netherlands
Phone +31 10 405.3560 Fax +31 10 405.5073

persoft
CONNECTIVITY SOLUTIONS
DOS • Windows • Ethernet • Token Ring

©1992, Persoft, Inc. All Rights Reserved.
Persoft and SmarTerm are registered trademarks of Persoft, Inc. All other trademarks mentioned are properties of their respective owners.

Circle 144 on Inquiry Card.

APPLICATION

A Power Boost for PowerPoint

SHELLEY CRYAN

With the release of version 3.0, PowerPoint proves you don't need well-honed design skills and a fondness for studying software manuals to create stunning slide presentations on your computer. With a host of new features, including a convenient toolbar, improved drawing and text-handling capabilities, and support for OLE (Object Linking and Embedding), PowerPoint 3.0 represents a sweeping upgrade. Microsoft makes up a lot of ground lost in the two years since PowerPoint's last major upgrade.

PowerPoint 3.0 requires Windows 3.1, and you'll need at minimum a 286 with 2 MB of memory. Microsoft recommends a 386 with 4 MB. Working without a color monitor is possible, because you can select colors by name, but this is akin to buying mail-order dress shoes—you'll be satisfied only if you know exactly what you want or if you're lucky. Make some room on your hard drive; PowerPoint fills 5 to 17 MB, depending on the options you install.

The new version of PowerPoint includes an improved toolbar. The toolbar offers convenient access to commonly used tools and single-click formatting for indentation, text styles, and text sizes.

The Right View

PowerPoint 3.0 helps even the occasional presenter to create professional-looking slides, overheads, or on-screen presentations. You supply the information; PowerPoint eases you through design and production.

PowerPoint offers you four "Views" in which to work. Outline View lets you type your ideas in outline form, which PowerPoint uses to generate slides. In Slide View, you can type directly on the on-screen slides themselves. Here, you customize the look of your slides by applying colors, formatting text, and adding charts, graphs, and drawings. In Slide Sorter View, you can change the order in which the slides appear by dragging slides around with the mouse. Speaker's Notes View lets you jot down things to remember to mention when giving the final presentation. Version 3.0 not only makes all this easier to do than in the previous version, but it offers you a wider variety of options as well.

The most visible change found in each of the Views is the new toolbar. It gives you quick access to frequently used commands, saving you the hassle of using pull-down menus.

Buttons on the toolbar let you format text and toggle easily between magnification levels. An especially helpful set of buttons lets you manipulate relative text placement; for instance, you can move paragraphs around and adjust indent levels. These buttons are much easier to use than the sometimes confusing methods required in top competitor Aldus Persuasion. The toolbar is intelligently designed, although it lacks a text-alignment button.

Master Plan

PowerPoint 3.0's most significant improvements are in its Slide View. As in the previous version, you create and format a single Slide Master, which dictates the format of every slide, but 3.0 offers much more flexibility. The Slide Master now includes both a Master Title and a Master Body that you format separately, and you can alter the Slide Master at any time.

This scheme of a single Slide Master helps to make for a surprisingly short learning curve. It's easy to remember that anything that's on the Slide Master—logos, artwork, and so on—will show up on every slide. However, it's only useful when most of your slides will be formatted the same way, since you'll have to manually set up the slides that vary from the master. This isn't difficult, but it's tedious if you've got more than a handful to adjust.

In contrast, Aldus Persuasion gives you several slide masters, and each one has two parts: a background and a foreground. This scheme offers greater flexibility, especially if several formats will be used more than once. However, it's more complicated, especially if you don't use Persuasion frequently enough to remember how it works.

Other changes in PowerPoint's Slide View include an enhanced set of drawing, text-editing, and graphing tools. Can't draw a perfect shape on demand? Rather not dredge through a clip-art collection to find one? The new Shape Tool is a boon. It's really 24 tools in one: You can use it to create a myriad of stars, arrows, circles, cubes, triangles, and star bursts, and you can change the shape of existing objects with the click of a mouse.

Text editing is now done with a single tool, which is automatically activated when you highlight an object and start typing. The typographic formatting controls include the usual suspects, and using them is straightforward.

Like other programs in this category, PowerPoint does not include high-end text-handling features such as kerning and rotating. You can, however, create embossed text and can use any character of any size or color as a bullet.

The graph tool is not really a tool like the others. When selected, it launches a separate, embedded application called Microsoft Graph. This is the same full-featured graphing program featured in Microsoft Project, Word, and Works. It offers 84 different graphing styles, including all the standard 2-D and 3-D styles and then some. Graphing is probably the hardest aspect of PowerPoint to learn, but the payoff is in the amazing degree of control that you have over the look of your graph. Look no further than PowerPoint if you require sophisticated graphs in your presentation.

continued

Text and Templates

If you've worked with previous versions of PowerPoint, you will be especially pleased with the way it now handles templates. A template serves as a collection of styles to be used throughout a presentation. These styles include background colors and patterns, fonts, text colors, sizes, and styles.

When you "apply" a template, your presentation takes on the style characteristics of that template. The beauty of PowerPoint's implementation is that now you can apply or replace a template anytime. Existing slides, as well as slides you create after you apply a template, will all take on the template's characteristics. This lets you instantaneously change the look of your presentation.

PowerPoint comes with 160 predesigned modifiable templates, which are indispensable if you have neither the time nor the inclination to make your own. It's particularly convenient that templates and presentations are the same type of file, so any presentation can also serve as a template.

Integral to any template is a color scheme. As another example of how PowerPoint caters to nondesigners, the program helps you to select colors that work well together. You can change the color scheme at any time, and PowerPoint will intelligently recolor objects—including graph elements—so that everything still matches. Over 5000 color schemes are available.

Like Persuasion, PowerPoint lets you import outlines in a variety of formats, so you can dump text into Outline View without rekeying or translating it. This gives these two programs a leg up on the other major competitors in the field.

PowerPoint, however, tops Persuasion and the other competitors with its new WYSIWYG Outline View. This lets you format text in either Slide or Outline View, and the different fonts, sizes, and text styles show up in Outline View. Additionally, small icons next to each slide title in Outline View indicate if there are any graphics on the corresponding slide. These visual cues make it significantly easier to edit quickly in Outline View.

Not surprisingly, PowerPoint takes advantage of Windows 3.1 technology. With full OLE capabilities, PowerPoint lets you embed pictures, graphs, and sound from other applications into your presentation. Simply double-clicking on the embedded object automatically loads the external application that created the object. This worked well with compliant applications, including the Sound Recorder and Paintbrush.

Font handling in PowerPoint is also much improved. Unlike with PowerPoint 2.0, you can use TrueType fonts instead of fonts created just for PowerPoint. Additionally, you can save the fonts with your presentation, which is helpful if you need to run your presentation on someone else's computer.

Making the Pitch

In the event that you want to show your presentation on a computer that doesn't have PowerPoint loaded, you can now use the PowerPoint Viewer. A run-time version of PowerPoint's slide-show mode, Viewer can be distributed freely with presentations. With beefed-up slide-show transition effects, like a "flying bullets" feature that makes your bullet points slide into place when a new slide comes on-screen, the opportunity to look good is certainly compelling.

Like Persuasion, PowerPoint only got it half right, though. It should also include a Viewer to run PC presentations on a Macintosh, which would provide real distribution flexibility. Because Microsoft plans to release an upgrade to the Mac version of PowerPoint in the fall and claims cross-platform portability, a Macintosh Viewer for PC presentations should hardly be a stretch.

PowerPoint tops Persuasion and the other competitors with its WYSIWYG Outline View.

While many of its major features have been greatly improved, PowerPoint also shines in the details. A spelling checker, extensive on-screen help, and an automatic Smart Quotes option (to automatically turn straight quotation marks into curly quotes) all help to make the program easy to use. The Print dialog box, however, could be improved to let you print out all parts of a presentation with one command, instead of making you select notes, slides, handouts, and outlines individually.

PowerPoint 3.0 delivers a powerful tool for creating great-looking presentations quickly for people who have little design expertise. The broad flexibility to easily change templates, masters, and colors at any time will be welcomed by businesspeople who select designs by trial and error. Support for OLE is a real time-saver, as is the ability to import text and data in a variety of formats.

PowerPoint 3.0 lets you concentrate on your presentation's content rather than design and production. Is there a presentation in your future? At $495 and with excellent documentation, PowerPoint is a good choice for your software library. ■

Shelley Cryan runs a consulting business that helps companies incorporate computer-based technologies to boost productivity. She holds an M.B.A. in finance and marketing from the University of Chicago. She can be reached on BIX c/o "editors."

BYTE ACTION SUMMARY

- **WHAT POWERPOINT 3.0 IS**
  A Windows 3.1 presentation graphics program geared toward business presenters.
- **LIKES**
  It lets you change text and background formats quickly and easily; it has a convenient toolbar.
- **DISLIKES**
  It cannot create more than one slide master per presentation, so you'll have to manually set up the slides that vary from the master.
- **RECOMMENDATIONS**
  Despite its many features, PowerPoint is extremely easy to learn and use, making it well suited for people who are not professional presentation designers. It will satisfy the needs of almost any business presenter. Highly recommended.
- **PRICE**
  $495
- **FOR MORE INFORMATION**
  Microsoft Corp.
  1 Microsoft Way
  Redmond, WA 98052
  (206) 882-8080
  fax: (206) 936-7329
  Circle 1221 on Inquiry Card.

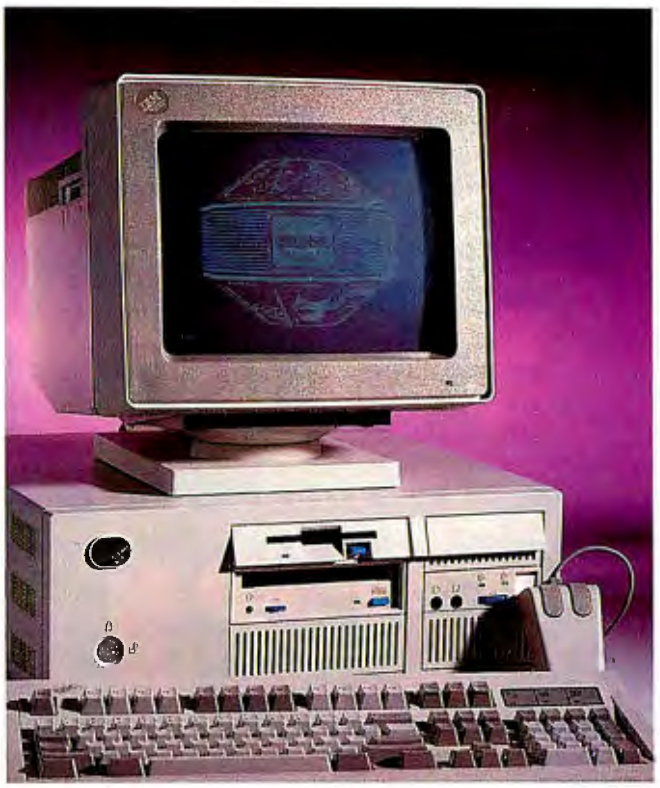
SYSTEM

IBM's New System Speaks for Itself

TOM YAGER

Although responsible for the PC era, IBM has rarely led the market that it created. Now, IBM is hoping to recapture some of the glory of the old days with innovation in a new market: multimedia PCs.

Big Blue's latest PS/2 is the first in a line of unique multimedia-capable systems. Dubbed the PS/2 Ultimedia Model M57 SLC, this new system brings a few surprises to the multimedia PC party. IBM's XGA display adapter, its fine-sounding integrated audio, the fast Micro Channel bus, and its helpful front panel raise the M57 SLC above similar systems. Without better software support, however, the M57 SLC will face stiff competition from the rest of the multimedia PC crowd.



The PS/2 Ultimedia Model M57 SLC features handy front-facing microphone and headphone jacks and a volume control. An internal speaker lets you listen to multimedia presentations without headphones.

Looks Aren't Everything

Like all PS/2s, the M57 SLC is no beauty queen. But behind the Volvo-esque facade sits a solid machine. Its most notable feature (see the photo) is its multimedia front panel. Unlike systems built from MPC upgrade kits, the M57 SLC brings fully mixed audio directly to the front panel through a marvelously accessible quarter-inch headphone jack. A microphone jack and a volume control also share the panel. The CD-ROM drive has its own eighth-inch headphone jack and volume control.

The M57 SLC is designed around a 20-MHz 386SLC, IBM's own implementation of Intel's 386SX that includes an on-chip cache. Processing speed is fair, and a high-speed hard drive contributes to solid overall performance (see the figure). The compact motherboard also holds SCSI and floppy drive controllers and integrated VGA, serial-port, and parallel-port circuitry.

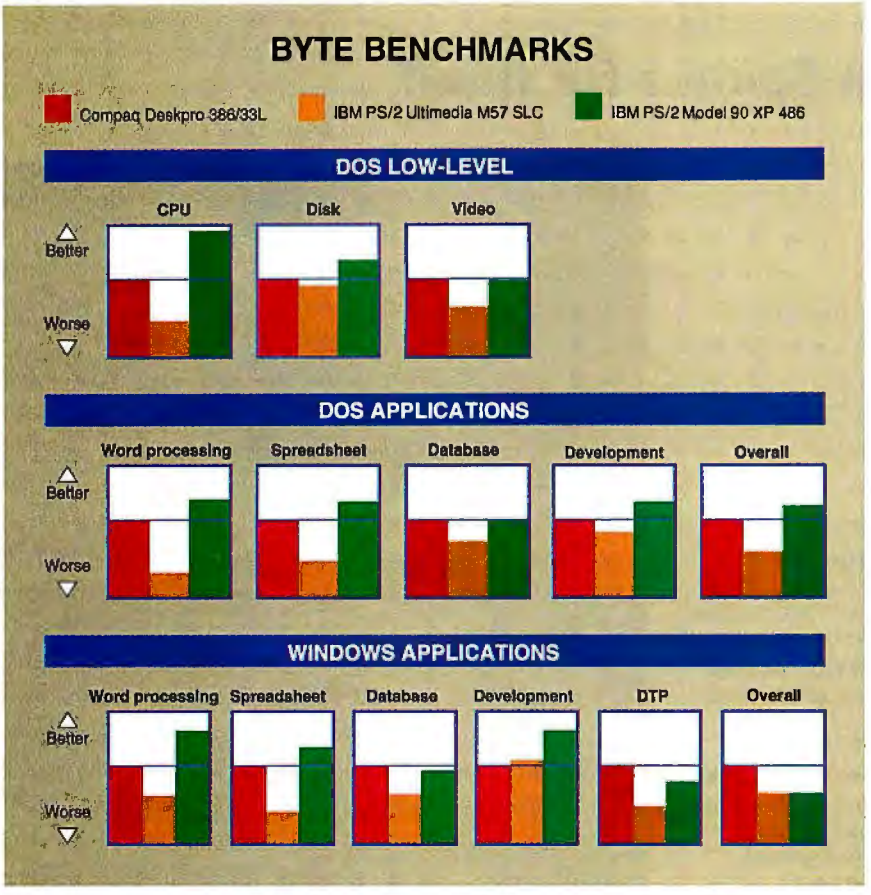
The system's Micro Channel bus rises vertically. Of the six total slots, four are free, one holds an XGA adapter, and the other contains an audio board. The standard sound board is IBM's M-Audio digital-audio capture-and-playback board. A ribbon cable connects this board to the system's front panel, making digital audio feel more like a designed-in feature than an accessory. The board's back panel has a set of eighth-inch connectors labeled only by single letters. This and the somewhat unclear symbols used on the front to signify power and microphone input make the machine a little more confusing to use than it needs to be.

It's in There

The system I reviewed was pretty well decked out. Standard features include the 3½-inch 2.88-MB floppy drive and the 600-MB SCSI CD-ROM drive. The standard configuration ($5995 without monitor) includes 4 MB of RAM and a 160-MB SCSI hard drive, but the system that I reviewed was boosted to one with 16 MB of RAM

BYTE ACTION SUMMARY

- **WHAT THE PS/2 ULTIMEDIA MODEL M57 SLC IS**
  A 386SLC-based PS/2 with integrated digital audio and CD-ROM.
- **LIKES**
  Easily accessible front-panel jacks and controls, dual independent digital-audio channels, and internal speaker.
- **DISLIKES**
  Much of the software is not quite solid; MIDI support is poor.
- **RECOMMENDATIONS**
  Once software is stabilized, this will be a high-quality multimedia system with several advantages over the rest of the crop.
- **PRICE**
  $6945 (includes an 8515 monitor)
- **FOR MORE INFORMATION**
  IBM Corp.
  1133 Westchester Ave.
  White Plains, NY 10604
  (800) 426-9292
  Circle 1233 on Inquiry Card.



All results are indexed, and higher numbers indicate better performance. For each index, a Compaq Deskpro 386/33L running Compaq DOS 5.0 and Windows 3.0 = 1. The overall index is the average index of the individual tests.

The BYTE low-level benchmark suite identifies relative performance at the hardware level, breaking down performance by system component. The results of these tests can help you identify the relative performance of a given subsystem and determine where performance bottlenecks may lie. For a complete description of these tests, see "BYTE's New Benchmarks: New Looks, New Numbers," August 1990 BYTE. The BYTE low-level benchmarks, version 2.2, are available in the byte.bmarks conference on BIX, or you can contact BYTE directly.

BYTE's application performance suite measures the performance you can expect to see running a given application category under a given operating environment. We test under two environments: DOS 5.0 and Windows 3.0. We run test scripts using the following programs: Word Processing: WordPerfect 5.1 and Lotus Ami Pro 2.0; Spreadsheet: Lotus 1-2-3 release 3.1+ and Microsoft Excel 3.0a; Database: Software Publishing Superbase 4 version 1.3 and Borland dBase IV; Development: Borland Turbo Pascal for Windows and Microsoft C 6.0; and Desktop Publishing: Aldus PageMaker 4.0. The data files and test scripts are available from BYTE.

With its cached 386SLC processor and high-speed SCSI disk, the M57 SLC stacks up at about 60 percent the speed of a 33-MHz 386 system on most tests—slightly faster than the typical 20-MHz 386SX.

(which adds another $1240 if you buy SIMMs from IBM). An 8515 monitor costs an additional $950. As an aside, I appreciated IBM's provision of an extra connector on its internal SCSI cable. There are other nice touches, too, like a plastic loop to help lift the SCSI terminating resistor out of its socket and a front-facing oblong speaker that's hooked to the audio board (so it can actually say something besides "beep").

The M-Audio capture-and-playback adapter represents a departure from the audio boards commonly seen in multimedia PCs these days. The difference is the DSP (digital signal processor). Even the MIDI instrument sounds are delivered by the DSP (rather poorly, I'm afraid). Perhaps most valuable are the board's two independent audio tracks. This pair compensates somewhat for the not-so-hot DSP synthesizer by allowing digitized music to play underneath a separate voice track. This feature was frequently highlighted in IBM's demonstrations; the music ran without interruption while the demonstration software loaded and played multiple foreground voice files. The digitized-audio quality is adequate, and I was particularly pleased with the external speaker's delivery of very clear digitized voice. Music is not delivered as well, but when you listen through headphones, the sound is quite clean.

The system I reviewed included DOS 5.0, Windows 3.0, and OS/2 2.0 on CD-ROM. I was pleased to find that IBM had included the Windows Multimedia Extensions, which were tweaked to provide support for M-Audio, XGA, and the CD-ROM drive. The multimedia drivers for OS/2 were still in beta testing at the time of this writing, and the full-fledged Multimedia Presentation Manager wasn't even hinted at. Still, a popular IBM authoring tool, AVC (Audio Visual Connection), ran fine under OS/2 and had support for most of the system's multimedia components. AVC does not support M-Audio's quasi-MIDI synthesizer, but I didn't miss it. Apparently, neither did IBM: The AVC demonstration entitled "MIDI Jukebox" plays *digitized* audio recorded from a real MIDI synthesizer.

Ironically, the best-supported environment for the M57 SLC at the time of my review was Microsoft Windows. It is a credit to IBM that it swallowed some pride and cooked up pretty solid support for its leading operating-system competitor. I loaded a handful of Windows multimedia applications, including Master Trax Pro, Macromind Action, and Brown-Wagh Curtain Call.

The updated Curtain Call, with its support for the Multimedia Extensions, refused to play any of the sample digital-audio files included in the package. I then found out that the standard Windows Media Player program wouldn't play them either but that the Sound Recorder application would. The same files loaded and played fine on an MPC-upgraded PC. Since both Curtain Call and the Windows Media Player communicate with hardware via a high-level interface that the Sound Recorder bypasses, there are apparently some bugs in IBM's implementation.

Listen Up

IBM's first entry into the multimedia PC market is impressive, but not exceptional. The M-Audio board's ability to handle two distinct tracks of digital audio is a huge help to even simple presentations, and the XGA adapter offers improved display performance.

IBM now needs to beef up its Windows Multimedia Extensions support and get Multimedia Presentation Manager out before Microsoft walks away with the entire PC multimedia market. Whatever moves IBM makes in software, the M57 SLC and the Ultimedia PS/2s that follow it should equip IBM to compete effectively in what is fast becoming a crowded market. ■

Tom Yager is the director of the BYTE Multimedia Lab. You can reach him on BIX as "tyager" and on the Internet as "tyager@bytepb.byte.com."

Introducing Video Blaster. Now A Picture Is Worth Just $495.

Here's everything you need for full-motion video, image capture, graphic overlays, even special effects. All the hardware, all the software, all in one box, all for just $495.

It starts with Video Blaster™, an internal video card that lets you display and manipulate full-motion NTSC or PAL video on a standard PC monitor. And it lets you input and mix sound from multiple audio sources.

You also get MacroMind® Action!™ for Windows™ and Tempra™ for DOS. Both combine video with computer graphics and special effects to create interactive presentations and multimedia training applications.

There's also a Windows-based Video Kit with JPEG compression that lets you capture images and use them to spice up your DTP, database and WP applications.

And with over two million colors and video control of hue, saturation, brightness, contrast and RGB, you'll have enough video capability to make even the MTV guys jealous.

So visit your local retailer or call us at 1-800-998-LABS. You'll get the picture on affordable multimedia video.

VIDEO BLASTER™

CREATIVE

CREATIVE LABS, INC.

MICROSOFT WINDOWS COMPATIBLE

Video Blaster is a trademark of Creative Labs, Inc. All other marks are owned by their respective companies. © 1992 Creative Labs, Inc. All rights reserved.
International Inquiries: Creative Technology, Ltd, Singapore Tel 65-773-0233 Fax 65-773-0353

Circle 195 on Inquiry Card.

OS/2 or NT + 50 MHz = Power!

If you are an OS/2 or Windows NT developer and you are porting an application that needs robust 32-bit support, your wait is over. Microway is currently shipping NDP Fortran-386/486 for OS/2 or NT, along with our C|C++ and Pascal. Our products work with the IBM and MS linkers and can directly access their respective APIs, taking full advantage of the 386/486 gigabyte address space. The biggest advantage of these new 32-bit operating systems over DOS is their ability to pre-emptively multitask, which dramatically improves the speed of hard disk I/O and multitasking in general.

Microway has also engineered a complete line of 486 workstations which are ideal platforms for both developers and users who are into number crunching. Using removable hard disks, we can set up a system for you that can be used for DOS, NT, OS/2 and UNIX development! Scientists and engineers will appreciate the fact that our top of the line 486 boxes use industrial strength power and cooling — that's one of the reasons why half of our Number Smasher-860s have gone out in a 50 MHz 486 B^3 workstation. Another important reason is the fact that the 860 can save you thousands of dollars per month in Cray or 3090 rentals. For more information, please call Microway's Technical Support Department at (508) 746-7341.

386, 486 and i860 Compilers

Our NDP family of compilers generate globally optimized, mainframe quality code that runs on the 386, i486, or i860 in protected mode under Windows NT, DESQview, UNIX, OS/2, or extended DOS. The compilers address 4 gigabytes of memory while supporting the 287, 387, Weitek, and Cyrix EMC coprocessors. Applications can mix code from all three compilers and assembly language.To simplify your ports, we offer ClearView, our full-featured, windowing symbolic debugger that works with DOS versions of NDP 386 and 486 compilers.

NDP Fortran™ is a full F77 with F66 and DOD extensions that is 99% VMS compatible. Also contains new F90 features & MS compatibility.

NDP C|C++™ runs in three modes: K&R with Sys V and MS C extensions; 100% ANSI C; and C++ Release 2.1 compatible.

NDP Pascal™ is a full ANSI/IEEE Pascal, with extensions from C and BSD 4.2 Pascal.

NDP Language Pricing

NDP Fortran, C|C++, or Pascal — DOS products include NDP Tools and Extender. 486 DOS version includes Weitek support, royalty-free binder, and ClearView-386. All DOS compilers come with GREX, Microway's library of 160 MS C compatible lower level graphics and hardware interface routines.

OS/2™ or NT $595
386 DOS (includes Tools) $695
486 DOS (includes Tools, Royalty-free DOS Extender and ClearView) $995
386|486 UNIX V. 3 or V. 4 ..... $1195
i860 Compilers $1995

(OS/2 is a trademark of IBM Corporation.)

ClearView-386™—our windowing 32-bit symbolic debugger that runs with our 386 and 486 DOS products $195

NDP IMSL is a Microway port of IMSL mainframe library to the i860, 486 or 386. Math Library, Statistical Library, Special Functions $2000

NDP Plot™ $195
NDP/FFT™ NDP or 80x87 version ... ea. $250
HALO Professional for 386. ..... $595

NDP NAG™ Workstation library is a subset of the NAG mainframe libraries. Has 172 routines for differential equations and eigenvalue problems, matrix operations, fitting curves, statistics, and regression analysis .....386 Version: $895

Number Smasher-860™

Number Smasher-860 is the highest performance coprocessor card ever to run in an ISA or EISA bus or as part of a transputer system. Delivers up to 80 million floating point operations per second at 40 MHz and produces 11.8 double precision Linpack megaflops. The board comes standard with an EISA or ISA interface, 8 meg of high speed memory, and your choice of NDP Fortran, C|C++, or Pascal for the i860 running under MS-DOS, UNIX, OS/2, SunOS, or DESQview .....33 MHz: $5000
40 MHz: $6000 32 MB version: add $2500

i860 Vectorizers and Libraries

NDP NAG/860 is a Microway port of the NAG workstation library to the i860 ..... $1495

NDP HALO-860 includes HALO Professional and an interface library which makes HALO directly callable by the i860 ..... $995

860 Vectorizer includes PSR VAST-2 which converts a C or FORTRAN program into a new program which calls the Intel Vector library. Includes the Intel Vector Library and Microway's i860 Profiler $1495

860 Vector Library — Written for Intel, includes over 400 vector primitives that take advantage of the i860's cache, dual instruction mode, and pipelined multiplier accumulator..... $495

IGL — a 3-D Graphics Pipeline that performs geometry and rendering using routines which use the i860's built-in graphics hardware: $495

Kuck & Associates CLASSPACK — Hand-coded, pipelined libraries for the i860.

- **Basic Math Library** $500
- **DSP** — Over 100 routines including 1 and 2-D correlations and convolutions. Does 1024 Complex FFT in 1 msec..... $750
- **Dense Array** solver package $750

Special! SX Your AT!

FASTCache-SX/Plus™— The "Windows Solution". Converts your 286 into a powerful 25 MHz 386SX. Combines Microway's award-winning FASTCache-SX accelerator with up to 16 meg of extended memory. Features an Intel 486-style 16K internal cache and 387SX coprocessor socket. Uses a 16-bit slot. Outperforms most SX systems! Installs in minutes in over 100 AT systems including AST, Compaq, Epson, HP, IBM, NCR, NEC, Sperry, Tandy, Zenith and more!
FASTCache-SX-20 ..... $295
FASTCache-SX/Plus-25 ..... $495

Since 1982, Microway has been serving the PC community and we wish to thank all of our customers for their continued support.

386/486 Custom Workstations

A Microway Black Tower is the ideal solution for a cost-effective desktop system, personal supercomputer, file or computation server, or industrial PC. Microway workstations are used in corporations, government research labs and university engineering departments on applications ranging from CAD to financial analysis, software development to basic research. They come standard with two or more thermostatically controlled fans, 250 Watt motherboard power connectors, and American-manufactured industrial grade power supplies. Our 386 and 486 motherboards are carefully burned in and tested. Top speeds are 40 MHz for the 386 and 50 MHz for the 486. Choose from a full line of high quality options to customize your workstation. The base system includes a sleek, black tower case, a black tactile response keyboard, four megabytes of memory, a 250 Watt American power supply and one floppy drive. Each system is backed up by a one year warranty and the best technical support in the industry. Our 486B^2T was a recent *Digital Review* Target Award nominee. Our B^3 frequently goes out with three to five i860 cards running NFS on UNIX. With a peak throughput of 400 megaflops, this is the most cost-effective way to boost the power of your Sun network. Microway systems have earned an international reputation for outstanding design, price/performance value and reliability.

386BT^2-40	ISA	64K cache	200W	$1395
486B^{2}T-33	ISA	64K cache	250W	$2495
486B^{2}T-33	EISA	256K cache	250W	$3395
486B^{2}T-50	EISA	256K cache	250W	$3995
486B^3-50	EISA	256K cache	350W	$4495

Math Coprocessors/Overdrive

WEITEK: 4167-25/33 ..... $350/$995
3167-25/-33 ..... $200/$250
mW3167 Micro Channel-25/33: from $700
mW3167/80387 Board $200
INTEL: 287XL $90
387SX: $80 387 16-33: $90
Overdrive 20 MHz: $425 25 MHz: $545
RapidCAD $350
Cyrix:
83S87-25: $79 82S87-20: $85
83D87-33: $99 83D87-40: $129

Microway *Technology You Can Count On*

Research Park, Box 79, Kingston, MA 02364 USA (508) 746-7341
Kingston-Upon-Thames, U.K., 081-541-5466 USA FAX (508) 746-4678
Germany 069-752023 Greece 30 12915672 Japan 047 423 1322 Poland 22-410041

Circle 129 on Inquiry Card.

SOFTWARE

Microsoft's Lucky Number

OTHAR HANSSON

With all the discussion over object-oriented this and that, the only real success story in OOP (object-oriented programming) seems to be C++. With Symantec/Zortech and Borland cleaning up in sales of their Windows-compatible C++ compilers, Microsoft knew its long-standing policy of "C and C alone" would have to go.

After several delays, Microsoft C/C++ 7.0 (or C7 for short) has arrived. Its price and features make it obvious that Microsoft intends to try to recapture the lead it had some years ago when Microsoft C was the only game in town.

C++ Class Library

Arguably the most exciting feature of C7 is the C++ language itself, a topic somewhat beyond the scope of this review. C7 fully supports C++ native compilation, debugging, and profiling. In addition, in the MFC (Microsoft Foundation Classes) library, Microsoft has presented a surprisingly simple and straightforward example of how C++ can be used to simplify development of Windows and MS-DOS applications.

A simple example is provided in listing 1, a sample from Microsoft that consists of the very brief MFC-assisted "Hello, World" program. As you can see, the program relies on a lot of default behavior provided by MFC classes such as `CWinApp` and `CFrameWnd`. The program even uses the `main()` and `winMain()` functions provided by the library, relying simply on the constructor for `CHelloApp()` to initiate the application's interaction with the user.

Microsoft says that the MFC is merely the first in a family of Application Framework Extensions (hence the `afx_` prefix in all library symbols) that will track future Windows developments, including pen-based systems, multimedia, and Windows NT. The future of the library remains to be seen, but it certainly provides a good start. While this is Microsoft C/C++ 7.0 for Windows 3.1, it is important to stress that the library is version 1.00. The initial version of a C++ class library typically suffers from a few oversights, and I would expect changes in future versions of the MFC (luckily, the source is provided for do-or-die modifications).

Keeping Up

One source of future changes is the uncertain state of the C++ ANSI standard, which is still under development. C7 implements the AT&T C++ 2.1 specification, but it deviates from some aspects of later versions. Microsoft claims (correctly) that the upcoming ANSI standard is the only standard worth arguing about, but practically speaking, most other compiler vendors track the AT&T implementations as a de facto standard, and thus the C7 deviations are likely to be a source of aggravation for users.

The first deviation is in the area of templates, which are used to provide a parameterized class facility. For example, with a parameterized list class, it would be easy to define lists of dates, lists of menu items, or lists of any other object type. While the ANSI standard committee argues over possible template specifications and requirements, compiler vendors are simply implementing their own interpretations. Microsoft has chosen a very simple preprocessor that instantiates the template code to use the specific object types.

A similar portability question can be raised over the Microsoft implementation of exceptions. An exception-handling facility can greatly simplify error recovery, which is particularly important in building bulletproof user interfaces. Microsoft provides exception classes and a set of macros that implement a simple exception-handling mechanism, using the C `setjmp` and `longjmp` routines. However, C7 exceptions are not compatible with the implementations chosen by other compiler vendors.

One "extension" that Microsoft did correctly, however, is its implementation of dispatching for Windows message handling. The natural C++ implementation of this is to use virtual functions for each type of message, allowing an object class to override the message handling provided by its parent class. The large number of Windows message types makes this impractical, resulting in large but ridiculously sparse virtual-function tables. Borland C++ works around this problem through a minor but still nonportable language extension. Microsoft found a solution within the language standards by using macros to construct dispatching tables during program initialization.

C++ Documentation

A recent saying has it that while C++ makes it pretty difficult to shoot yourself in the foot (in contrast to C), when it does happen, it blows your whole leg off.

continued

BYTE ACTION SUMMARY

- **WHAT MICROSOFT C/C++ 7.0 IS**
  A C and C++ compiler with tools for creating DOS and Windows applications.
- **LIKES**
  P-code and in-lining for size and speed optimization; Microsoft Foundation Classes library to simplify Windows programming; complete documentation.
- **DISLIKES**
  Still no Windows-hosted tools; deviation from most recent AT&T implementations.
- **RECOMMENDATIONS**
  This is a compiler well worth considering for projects of any size, but you should compare compilers before making a switch.
- **PRICE**
  $499
- **FOR MORE INFORMATION**
  Microsoft Corp.
  1 Microsoft Way
  Redmond, WA 98052
  (206) 882-8080
  fax: (206) 883-8101
  Circle 1232 on Inquiry Card.

Listing 1: *This brief segment is the complete Windows version of the "Hello, World" program, simplified through use of the Microsoft Foundation Classes Windows class library.*

```
// helloapp.cpp : Minimal MFC Windows app.
//
// This is a part of the Microsoft Foundation Classes C++ library.
// Copyright (C) 1992 Microsoft Corp.
// All rights reserved.
//
#include <afxwin.h>

// Define a window class derived from CFrameWnd
class CHelloWindow : public CFrameWnd
{ public:
      CHelloWindow()            { Create(NULL, "Hello World!",
                                WS_OVERLAPPEDWINDOW, rectDefault); }
};

// Define an application class derived from CWinApp
class CHelloApp : public CWinApp
{
public:
      virtual BOOL InitInstance();
};

// Construct the CHelloApp's m_pMainWnd data member
BOOL CHelloApp::InitInstance()
{
      m_pMainWnd = new CHelloWindow();
      m_pMainWnd->ShowWindow(m_nCmdShow);
      m_pMainWnd->UpdateWindow();
      return TRUE;
}

CHelloApp HelloApp;
// HelloApp's constructor initializes and runs the app
```

Folklore also has it that the number of C++ programmers doubles every seven or eight months. C++ enthusiasts take such statistics as evidence of technological Darwinism. On the other hand, such statistics imply that one out of every two C++ programmers has very little experience with the language.

The weighty documentation (2 cubic feet worth) included in the C7 package does an admirable job of preventing serious injury from the powerful features of C++. Included is a C++ tutorial that is a little too short to present the entire language but, on the other hand, is not filled with the usual empty object-oriented propaganda. Despite its length, it presents a glimpse of the implementation where necessary (e.g., in describing virtual functions).

In addition, the tutorial on the MFC library takes care to introduce C++ idioms and style based on the style used in the library itself. If the MFC turns out to be the first large C++ library you work with, you'll be following a good example.

Compiler Improvements

Independent of the C++ capability, C7 includes several extensions to the mature and stable Microsoft C compiler family. Improvements in code size and speed continue with C7's use of p-code (pseudocode) and function in-lining. Microsoft's long-standing problem—long compile times—has been eased somewhat by the addition of a particularly flexible implementation of precompiled headers. In my tests, both Microsoft's product and Borland C++ 3.0 exhibited comparable compilation speed.

P-code is an old technique for reducing the size of executables. Rather than compile from a high-level language to object code, the compiler can optionally generate object code for a virtual machine, together with an interpreter to emulate the virtual machine. C7 packs code into a stack-based language that abstracts many of the details of 80x86 assembly language. P-code is selectable on a per-file basis or even within files using the #pragma compiler directives. For speed-critical sections of an application, standard options can be used to optimize for speed. But for space-inefficient portions of the code, p-code can reduce code size up to 50 percent in some cases, extending traditional code-size optimizations.

Such p-code has apparently been used in the user-interface code of Microsoft Word, Excel, and Project products. For smaller applications, the size of the interpreter may outweigh the code-size reductions. P-code is compatible with the debugger, profiler, and other development tools, but as it is new technology in C7, I would not be surprised to hear of problems with its use.

Function in-lining selects small, frequently called functions and replaces calls to them with "in-line" code for the function, eliminating the overhead of passing arguments and manipulating the call stack. In-line functions are similar to the age-old use of #define macros. However, macros have problems with type safety and unexpected parameter-passing semantics. C7 extends the in-lining implementations of most ANSI C and C++ compilers by allowing the programmer either to specifically request that a function be in-lined or to ask the compiler to search for opportunities for in-lining optimization.

Many compilers will ignore the in-line keyword if the function is too complex. Some compilers will not in-line functions that have even a single conditional or looping statement. In this and many other areas, Microsoft has wisely given the programmer a lot of welcomed flexibility in code optimization.

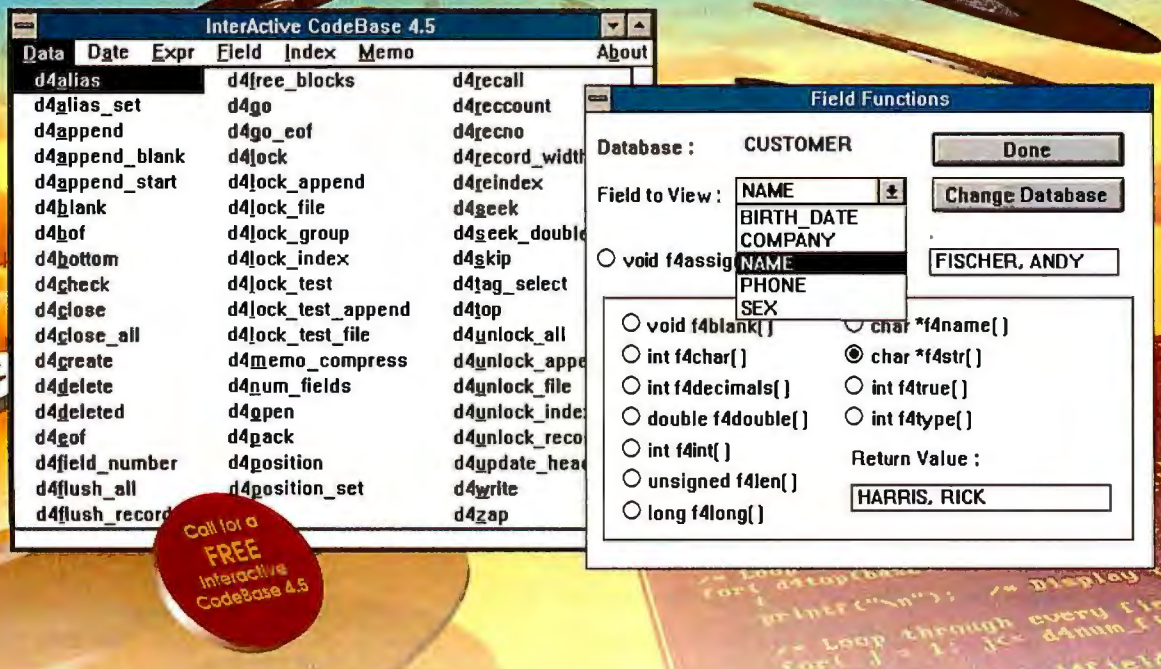
Finally, C7 uses precompiled headers to reduce the overhead of repeatedly parsing header files during compilation. The overhead cost of large or deeply nested header files is a major problem with Windows programs and is particularly frustrating because many header files never change during the course of a development effort.

C7 allows the programmer to "snapshot" the state of the compilation at any point in a source file, typically after the stable header files have been parsed. This saved precompilation can then be used the next time that source file is compiled. In contrast to other compilers, C7 can precompile executable code as well as declarations.

Environment Improvements

C7 introduces several improvements to both the CodeView debugger and the Programmer's Workbench. CodeView now supports remote debugging, overlapping windows, and faster loading of debugging information. The Programmer's Workbench has a new class browser and extended

dBASE, FoxPro and Clipper in C, C++ and Basic



- **Multi-user**
- **DOS, Unix, OS/2 Support**
- **C++ Interface Included**
- **Windows 3 Data Entry**
- **Clipper → C Translator Available**

Complete DBMS for C, C++ and VB programmers - compatible with the data, index and memo files of dBASE III/IV, FoxPro 2 and Clipper. Try the super-fast, super-small FoxPro 2.0 CDX index files!

BYTE AWARD OF MERIT

1991 DATA BASED ADVISOR Readers Choice Award

(Using Visual Basic? Try CodeBasic!)

CodeBase 4.5

The C Library for DataBase Management

SEQUITER SOFTWARE INC.

TEL. 403•437•2410
FAX 403•436•2999
Europe 33.20.24.20.14

#209,9644-54 AVE., EDMONTON, AB, CANADA T6E-5V1

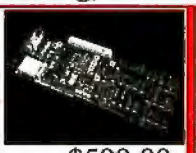
Circle 160 on Inquiry Card.

Circle 95 on Inquiry Card.

Images in your Computer

from Video or full page Scanners. Double your productivity in DeskTop Publishing, OCR and Multimedia applications.

ColorSnap PC



Professional, REAL TIME, video image capture in color (24-bit, 16.7 million colors) and gray scale. Capture from any NTSC/PAL video source, camcorder, live TV, still video etc. VGA, SVGA supported, files saved in standard formats. Superb image quality, Windows support. $599.00

Artiscan 24-bit true 600 or 800 dpi on both axes

Professional, desk-top, fast (SCSI interface included), 24-bit color scanner. True 600 dpi on both axis. Superb picture quality in color and gray scale. **Includes Image Processing software.** Optional X-Ray, Transparency Scanner ($699.00). OCR software options available.Recognita (add $159.00). 800x800 dpi version $1545. Best magazine ratings. $1199.00

PageReader 300

Full Page, 300 dpi Scanner complete **with OCR WordScan software & line-art Imager software!!** HP-ScanJet compatible driver hence compatible with any OCR package. Fast! Reads avg. page in <10 sec. **Incredible introductory price $399.00 complete!!!** With Recognita, add $159.00), with 9600 fax/modem send/rec, add $99.00. Ideal in any office for text, autoCad drawings, presentations etc. $399.00

Color 3000

Full Page, color (24-bit) scanner (16.7 million colors or 256 gray scale). Complete with Color Image Processing Software. Fully HP ScanJet emulation driver. $599.00

Color 3000 .....599.00
WordScan 99.00
Recognita 159.00

Call or write for info on Scanner or Video Based Image Transfer Systems

30-day return guarantee on all products. 1 year warranty. Major credit cards. Resellers Welcome.

Computer Friends, Inc. - 14250 NW Science Park Dr. - Portland OR 97229
Toll Free 1-800-547-3303 - tel. (503)626-2291 - fax (503)643-5379

Video In.

ComputerEyes/RT - affordable 24-bit video frame grabber for IBM computers. Includes everything you need to capture high-resolution 8- or 24-bit color (or 8-bit gray scale) images from any standard composite or S-video source in real time.

Supports VGA and Super-VGA 256-color (or gray-scale), VGA HiColor, and true-color display boards. Saves image files in all common formats - TIFF, Targa TGA, PCX, GIF, ColoRIX, and more. Hundreds of applications!

Also includes new **CineMaker** animation software for capturing motion video clips. Windows and developers software packages also available.

Under $600.

TelevEyes - new VGA-to-TV Converter. External module easily moved from computer to computer - connects between computer's VGA output and VGA monitor.

Outputs standard composite video of whatever is on the VGA screen. Compatible with all TV monitors and VCRs. Works with text, graphics modes (320 and 640), and Windows. Excellent for use with large-screen monitors, video projectors, video networks, etc.

Under $300.

Digital Vision, Inc.
270 Bridge Street
Dedham, MA 02026
(617) 329-5400
To order call (800) 346-0090

COMPUTER EYES

Video Out.

cross-referencing facilities. In addition, thanks to the Workbench, it has never been easier for novices to start a new project and get the make-file and compiler options correct.

Microsoft has by no means abandoned MS-DOS development and/or users. All the programming tools are MS-DOS applications. The majority of the MFC library is independent of Windows. This includes all the expected data structures—such as lists, arrays, strings, and "maps"—as well as well-designed support for persistent objects, debugging, tracing, and exception handling.

There are aspects of the development environment that could benefit greatly from a GUI, however. It is somewhat ironic that very few of the tools for developing Windows applications are actually Windows applications themselves. Cynics would say that Windows development must be much more difficult than compiler vendors claim or that the Windows environment is simply not as useful as Microsoft says. Many programmers still want lean and mean tools, not pull-down menus and what they perceive to be sluggish response. I for one eagerly await the advent of Windows class browsers, debuggers, and profilers.

Big and Beefy

As someone who has been using Microsoft C since 1986, when the best that could be said about it was that there was nothing better available, I'm gratified to see C7 up the ante in the C and C++ development tools–feature war. Microsoft's C7 is the classic "power tool," thanks in large measure to its 10,000 pages of documentation and the alphabet soup of options that it provides.

Although its thorough and readable documentation (particularly for C++) and its simple and well-designed class library make it an option for small projects, C7's appeal is clearly to the serious, large-scale development project. I would suggest a head-to-head comparison of different compilers on your application before switching. The applicability of the supplied classes and tools to your particular needs should be the most important factor, and the current price wars make such a comparison feasible. ■

Othar Hansson is vice president of Heuristicrats Research, Inc., a software R&D firm in Berkeley, California. He received his Ph.D. in computer science from the University of California–Berkeley, and he has been a C++ user since 1986. He can be reached on BIX c/o "editors" and on the Internet as "othar@heuristicrat.com."

Circle 103 on Inquiry Card.

Delivering the Power: WATCOM C9.0/386

- **The Widest Range of 32-bit Intel x86 Platforms**
  32-bit DOS, 32-bit Windows, OS/2 2.0, AutoCAD ADS
- **The Industry's Leading Code Optimizer**
  Advanced global optimizer with new 486 optimizations
- **The Most Comprehensive Toolset**
  Debugger, profiler, protected-mode compiler and linker, 32-bit DOS extender with royalty-free run-time, licensed components from Microsoft SDK, and more
- **The Best Value in 32-Bit Tools: $895***

Unleash 32-bit Power!

WATCOM C9.0/386 lets you exploit the two key 32-bit performance benefits. The 32-bit flat memory model simplifies memory management and lets applications address beyond the 640K limit. Powerful 32-bit instruction processing delivers a significant speed advantage: typically at least a 2x speedup.

You Get:

- **100% ANSI and SAA compatible:** C9.0/386 passes all Plum Hall Validation Suite tests
- **Extensive Microsoft compatibility** simplifies porting of 16-bit code
- **Royalty-free** run-time for 32-bit DOS, Windows and OS/2 apps
- **Comprehensive toolset** includes debugger, linker, profiler and more
- **DOS extender** support for Rational, Phar Lap and Ergo
- **Run-time compatible with WATCOM FORTRAN 77/386**

32-bit DOS support includes the DOS/4GW 32-bit DOS extender by Rational Systems with royalty-free runtime license

- Virtual Memory support up to 32Mb

32-bit Windows support enables development and debugging of true 32-bit GUI applications and DLL's.

- Includes licensed Microsoft SDK components

32-bit OS/2 2.0 support includes development for multiple target environments including OS/2 2.0, 32-bit DOS and 32-bit Windows

- Access to full OS/2 2.0 API including Presentation Manager
- Integrated with IBM Workframe/2 Environment

AutoCAD ADS and **ADI** Development: Everything you need to develop and debug ADS and ADI applications for AutoCAD Release 11

Novell's *Network C for NLM's SDK* includes C/386

The Industry's Choice.

Autodesk, *Robert Wenig, Manager, AutoCAD for Windows:* "At Autodesk, we're using WATCOM C/386 in the development of strategic new products since it gives us a competitive edge through early access to new technologies. We also highly recommend WATCOM C/386 to third party AutoCAD add-on (ADS and ADI) developers."

Fox Software, *David Fulton, President:* "FoxPro 2.0 itself is written in WATCOM C, and takes advantage of its many superior features. Optimizing for either speed or compactness is not uncommon, but to accomplish both was quite remarkable."

GO, *Robert Carr, Vice President of Software:* "After looking at the 32-bit Intel 80x86 tools available in the industry, WATCOM C was the best choice. Key factors in our decision were performance, functionality, reliability and technical support."

IBM, *John Soyring, Director of OS/2 Software Developer Programs:* "IBM and WATCOM are working together closely to integrate these compilers with the OS/2 2.0 Programmer's Workbench."

Lotus, *David Reed, Chief Scientist and Vice President, Pen-Based Applications:* "In new product development we're working with WATCOM C because of superior code optimization, responsive support, and timely delivery of technologies important to us like p-code and support for GO Corp's. PenPoint."

Novell, *Nancy Woodward, V.P. and G.M., Development Products:* "We searched the industry for the best 386 C compiler technology to incorporate with our developer toolkits. Our choice was WATCOM."

MICROSOFT WINDOWS

PC MAGAZINE EDITORS' CHOICE September 10, 1985

INFO WORLD BEST IN ITS CLASS WATCOM C/C++ 1989

COMPUTER LANGUAGE PRODUCTIVITY AWARD 1990

COMPUTER LANGUAGE PRODUCT EXCELLENCE AWARD 1990 COLA

WATCOM **1-800-265-4555**

The Leader in 32-bit Development Tools

415 Phillip Street, Waterloo, Ontario, Canada. Telephone: (519) 886-3700, Fax: (519) 747-4971. *Price does not include freight and taxes where applicable. Authorized dealers may sell for less. WATCOM C and Lightning Device are trademarks of WATCOM Systems Inc. DOS/4G and DOS/16M are trademarks of Rational Systems Inc. Other trademarks are the properties of their respective owners.
Copyright 1992 WATCOM Products Inc.

Circle 185 on Inquiry Card.

IF YOU READ THIS AD, THEN YOU'RE ONE OF BYTE'S 500,000 READERS WHO IS:

- **INFLUENTIAL**
- **AUTHORITATIVE**
- **TECHNICALLY-ADVANCED**
- **KNOWLEDGEABLE**
- **INNOVATIVE**

AND MOST OF ALL . . . BUSY!

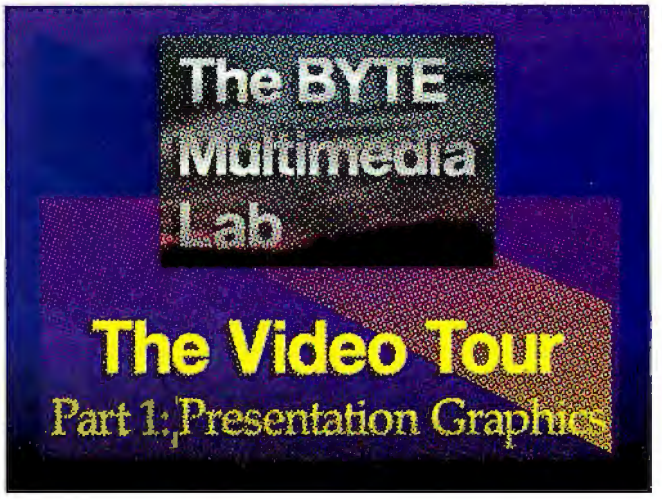
When you want to buy, turn to the **BYTE Buyer's Guide** in the back for fast access to buying direct from reputable suppliers. From computers to CAD, notebooks to networks, memory to mathematics, you'll find it in the **BYTE Buyer's Guide.**

Tell 'em you saw it in BYTE!

APPLICATION

Animation Energizes Rio's World-Class Graphics

TOM YAGER



Gradients, transparency, shadows, image mapping, antialiasing, and scalable kerned text, all shown here, are standard in Rio. Rio's unique interface speeds the creation of even complex scenes like this one.

If the current excitement over multimedia has done anything, it's helped open the eyes of potential users to the value of using technology to present information. Sometimes overlooked amid all the hoopla is one of the simplest ways to attract attention: 2-D color graphics. AT&T Graphics Software Labs offers an impressive way to create 2-D presentation graphics. It's called Rio, and its latest incarnation, version 5.20, adds the allure of animation to what was already a world-class tool.

Hanging a Tag

Rio uses 2-D shapes—polygons, ellipses, and text—to represent images of any complexity. You draw, color, and place these shapes as if you were working with shards of construction paper. When viewed together, they can become a convincing vision of anything, real or imagined.

Rio makes no distinction between drawing and preview modes. Everything you draw in Rio typically appears on the screen as it will appear in the finished image. Each element of a drawing—each shape or text phrase—maintains its own identity and carries with it a set of attributes that you can view or change at any time. Rio lets you declare default attributes for the major object types; all circles, for example, can start out yellow and with a shadow. Rio will apply solid colors, gradients, and image maps. Objects can be transparent to any degree and can cast shadows of variable depth, color, and transparency.

Rio includes a small (but expandable) assortment of proprietary scalable fonts. The entire drawing, called a *scene*, is stored on disk in a resolution- and device-independent format. A drawing can be rendered to the screen, to an external device such as a printer or a film recorder, or to a file for later processing. Rio optimizes its output according to the target device, applying antialiasing and dithering to produce smooth, high-quality images.

Finally, with the Animator option installed, you can set your Rio scenes in motion. Animations can be either recorded directly to videotape for the best-quality results or written to a file.

Ticket to Rio

Installing Rio isn't difficult, but it does take some thought. The latest revision of the package includes support for VGA (VESA [Video Electronics Standards Association] compatibility is needed for 256 colors and higher resolutions) and the full line of Truevision 16-, 24-, and 32-bit color display cards. The Truevision cards offer the highest-quality immediately viewable results, but a VGA and a secondary output device (e.g., a color printer or film recorder) are just as effective for hard-copy or slide presentations.

I chose to focus on Rio's strength when used with Truevision cards. I used the BYTE Multimedia Lab's PC system with an ATVista, a 32-bit color card with 4 MB of memory. The destination for much of my work in the lab is video, so the ATVista was aided by Truevision's VidI/O Box, a two-way RGB–to–recordable video converter. This not only paved the way to record my Rio still scenes and animations, but also allowed me to use Rio's image-capture capabilities (more on that later).

Rio runs under DOS but uses Phar Lap's DOS Extender to gain access to extended memory. GSL recommends at least 6 MB of RAM, and a 386 or 486 processor is required (a math coprocessor is strongly recommended for 386-based systems). Input-device support covers popular mice and graphics tablets. Rio will also converse with an amazing number of scanners, printers, film recorders, and VCR controllers, with all the device support internal to Rio.

The rest of the Multmedia Lab's test setup for Rio included a Panasonic AG-7750 Super-VHS video recorder, a Diaquest DQ-422 VCR controller card, and a Videomedia V-LAN VCR controller. The ATVista's output was connected to a Panasonic 13-inch professional video monitor. These things are valuable for video and animation work; a VGA system is all that's needed for basic graphics work.

The Smart Canvas

Rio's interface is a delight. It takes over the entire screen, putting up a pull-down menu bar that extends across the screen's top. You'll find, however, that the most common operations don't require you to go to the menus. Rio makes sublime use of quickly learned mouse/tablet shortcuts for the things you do most often.

If you're accustomed to working with a monochrome line-art representation and switching to a special preview mode to see colors and object stacking, Rio's real-time viewing may take some getting used to. I immediately took to it, and I found myself far more productive than with the two-step drawing tools I was used to. Performance is affected: Colored polygons take longer to appear on the screen than lines do. Rio performs reasonably well, though, and the benefit of seeing what I was drawing was worth the trade-off.

As a polygon drawing tool, Rio more than holds its own. There is no toolbox of shapes and actions. Instead, the pull-down menus use words to describe the object types and the actions available. To draw a square, you select Square from the Build menu and then drag out the square's dimensions with the mouse or pointer. To move, rotate, resize, flip, copy, or delete the square, you need only click with the mouse to select it and place the cursor inside the selection box that appears around it. As you move the cursor around the

perimeter of the selection box, the cursor changes shape to show the action that will take place if you click again.

The object-attribute dialog boxes are also quick to access. They pop up with a mouse-click for selected objects and offer control of color (including gradients), shadows, transparency, and image mapping. Selecting a color in the attribute dialog box brings up a palette. You can rotate through several default palettes or add your own entries at will. Rio supports RGB, HLS (hue, luminance, saturation), CMY (cyan, magenta, yellow), and HSV (hue, saturation, value) color models.

Gradient patterns are a special case. They can be rendered at any angle and can include up to eight color stops. Rio creates a smooth transition between the colors selected to produce the gradient.

Image mapping is one of Rio's most powerful features. A scanned or captured image---or any graphics file in one of the many supported formats---can be used as an object's foreground color. You can interactively crop and shape the image to produce all kinds of effects. Rio scales and smooths the imported image to match the shape and cropping you select. Rio will import images directly from a scanner or Truevision video card. In the latter case, Rio handles all the image-capture functions internally. A particularly nice touch is Rio's field average function; this very effectively removes motion artifacts (i.e., jitter) from captured video frames.

Rio's background can also take on a flat color, a gradient, or an image map. If you are using a Truevision video card, you also have the option of making the background "live"—that is, the video coming into the Truevision card becomes your background. With this, you can use Rio to create video-overlay graphics and titles. A scene rendered with a live background can be reloaded and displayed on top of live video, using either Rio or GSL's Panorama presentation software.

Getting a Look

While Rio shows you something very close to the finished output as you draw, it does cut a few corners for speed's sake. When you select the Render, Print to File, or Print to Device menu options, Rio renders the scene, delivering the best possible quality for the type of output device being used. With VGA, this is only as good as a 256-color palette can deliver. But with the Multimedia Lab's ATVista, Rio takes full advantage of the card's 16.7 million colors. Everything is antialiased to smooth diagonals and curves and improve the image's apparent resolution. Image maps are smoothed to hide the artifacts of scaling. Text is automatically kerned, and the completed drawing is either displayed on the screen, saved in a file, or sent to an external device, as you request. Rio will apply a number of image effects at your request, including emboss, contrast shift, negative, black and white, mosaic, posterize, and soften.

Rio's Print to File option lets you save an optimized render directly to disk in one of a number of popular graphics file formats. You can then import these files into other programs and for use as presentation slides (see the screen), backgrounds, or what-have-you.

Rio's Animator add-on attaches a powerful key-frame animation system to Rio's 2-D graphics facility. Each object's position, size, visibility, transparency, and color, as well as many other attributes, can be smoothly animated between key frames. With Rio, animation is as simple as drawing objects as you'd like them to appear at the start of the animation, setting a key frame, and then changing the objects to reflect the way you want them to look at the end of the animation. Rio will create smooth transitions between those two key frames. You can set any number of key frames, and a key can be applied to an object, a group, or the entire scene. Rio includes a sophisticated time-line editor that lets you alter the speed, direction, and other elements of your objects' animation.

You can render finished animations to videotape, consecutive image files, or animation files. Once again, Rio's animation capability is fully self-contained. It includes the ability to automatically render and record individual frames to videotape using supported VCR control devices, allowing completely unattended operation. It will also save animations, one frame at a time, to consecutively numbered image files, for spooling to video, film, or some other medium.

Finally, Rio will create Autodesk Animator–compatible FLI (low-resolution) and FLC (high-resolution) files that contain a compressed copy of all the animated frames. You can then use a player (from Autodesk or numerous other third-party sources) to quickly play back the images in sequence to reproduce the animation on your computer's display.

Return from the Islands

For the past two years, in the face of a steady parade of graphics packages, Rio has remained my hands-down favorite for 2-D graphics and animation, because I can quickly create professional-looking images. I might have written that off to familiarity, except that I was productive from the first day it arrived. Nothing I've tried since has got me through the learning curve so fast, provided so many built-in services (like video capture and animation), or produced such beautiful output on so many kinds of devices.

Rio has a quirk or two, to be sure, but they're minor. I put Rio through some positively grueling paces for this review, and I was always impressed with its performance, stability, and quality of output. Whether your medium is 35mm slides, color overhead transparencies, hard copy, or video, Rio makes it easy to create graphics that will impress your audience. ■

Tom Yager is director of the BYTE Multimedia Lab and author of the forthcoming book The Multimedia Producer's Handbook *(Academic Press). He can be reached on BIX as "tyager" or on the Internet at tyager@bytepb.byte.com.*

BYTE ACTION SUMMARY

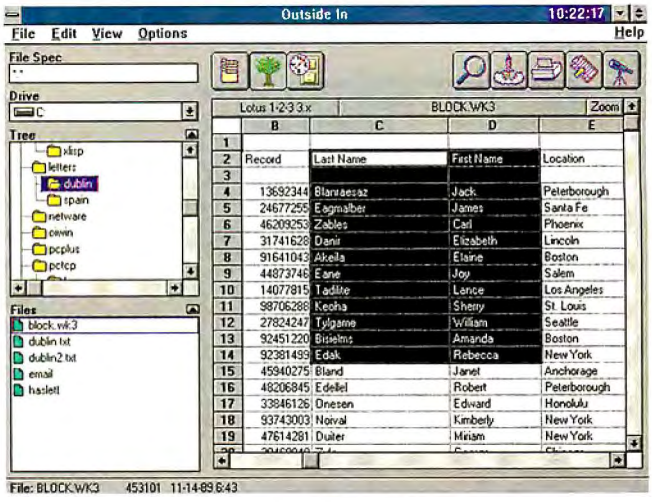
- **WHAT RIO ANIMATOR IS**
  A professional 2-D presentation graphics tool with key-frame animation.
- **LIKES**
  Quick access to common operations; complex gradients; image mapping; internal support for input and output devices; stunning results.
- **DISLIKES**
  Too high-priced; fixed viewpoint for animation (no movable "camera").
- **RECOMMENDATIONS**
  This is a fast, easy-to-learn presentation graphics system geared toward professional-quality output; I recommend it very highly as a step up from traditional PC presentation graphics programs.
- **PRICE**
  $1795; Animator option, $1495
- **FOR MORE INFORMATION**
  AT&T Graphics Software Labs
  3520 Commerce Crossing,
  Suite 300
  Indianapolis, IN 46240
  (317) 844-4364
  fax: (317) 575-0649
  Circle 1075 on Inquiry Card.

APPLICATION

Bringing the Outside into Windows

STEVE APIKI

Outside In for Windows is a document utility that aims to make it easier for those of us who live inside Windows to work with documents generated by those in the outside world. Outside In lets you view documents, complete with formatting (e.g., tabs and spacing), from DOS and Macintosh applications. Outside In blends viewing capability with cut-and-paste data transfer, printing, and file-finding and navigation tools to create a working environment that's ideal for handling multiple document types.



Outside In's viewer lets you copy and paste between DOS document formats (in this case, a file from Lotus 1-2-3) and Windows applications. You can also search for files by document type and content and print formatted documents.

Viewing Documents

File viewing is the central task of Outside In for Windows. Loading a document into the viewer requires only double-clicking on the filename in one of the navigation boxes or hitting the magnifying-glass button with the proper file highlighted (see the screen). Outside In displays the file complete with font styles, margins, and other formatting features.

Outside In handles a raft of file formats. There are too many to enumerate here, but Outside In covers just about every popular word processor designed for DOS, Windows, and the Mac, and most DOS spreadsheets and databases. I ran Outside In with documents from several versions of Lotus 1-2-3, Quattro and Quattro Pro, FoxPro, Microsoft Word (DOS, Mac, and Windows versions), WordPerfect, XyWrite, and Ami Pro. The viewer worked flawlessly most of the time, but I had some problems with two 1-2-3 documents (Outside In reported that the documents were empty when they weren't). Systems Compatibility was working on a fix as we went to press.

Don't Just Watch

Outside In for Windows is more than a viewer; in fact, its most useful capability is its transferring of formatted data between DOS and Windows applications through simple cutting and pasting. To transfer data between, say, a Quattro spreadsheet and Ami Pro, you load the spreadsheet into the viewer, select the part you need, copy your selection to the Clipboard, and paste it into Ami Pro.

This mechanism makes it extremely easy to combine information from various formats. Outside In defaults to placing the data on the Clipboard in every format that it supports (i.e., Text, Rich Text Format, and several Windows applications), but you can customize the copy operation to choose only formats you select.

Outside In's integration with these and other elements of Windows is very solid. It installs itself as a menu item in the Windows File Manager, allowing you to launch the utility directly from the File Manager menu. You can also drag and drop documents between the 3.1 File Manager and Outside In. Finally, Outside In will replace the file viewers in Norton Desktop.

Navigation and search tools make Outside In for Windows a full working environment. You can search for documents based on type, location, or even by contents. The navigation window is generally well designed, but it lacks a collapsible hierarchy; with a complex directory structure like the one on my disk, you can easily lose yourself in directories nested several levels deep.

Overall, Outside In for Windows is an outstanding tool if you need to work in a shop where many document formats are common. One of Windows' strongest selling points is that it provides a consistent mechanism for opening and printing documents and for transferring data between applications; Outside In extends this environment to include documents born outside of Windows. ■

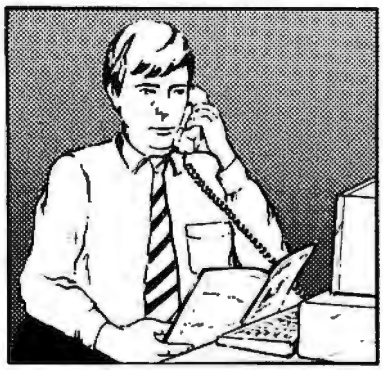
Steve Apiki is a BYTE technical editor with a B.S.E.E. from Rensselaer Polytechnic Institute. You can reach him on BIX as "apiki."

BYTE ACTION SUMMARY

- **WHAT OUTSIDE IN FOR WINDOWS DOES**
  It lets you view documents from DOS applications within Windows and lets you copy and paste between those documents and Windows applications.
- **LIKES**
  Easy cutting and pasting between DOS and Windows applications; wide variety of file formats.
- **DISLIKES**
  Errors with supported document types; directory tools are lacking.
- **RECOMMENDATIONS**
  If you work in Windows but need access to other documents, Outside In is outstanding.
- **PRICE**
  $89
- **FOR MORE INFORMATION**
  Systems Compatibility Corp.
  401 North Wabash, Suite 600
  Chicago, IL 60611
  (800) 333-1395
  (312) 329-0700
  fax: (312) 670-0820
  Circle 1231 on Inquiry 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

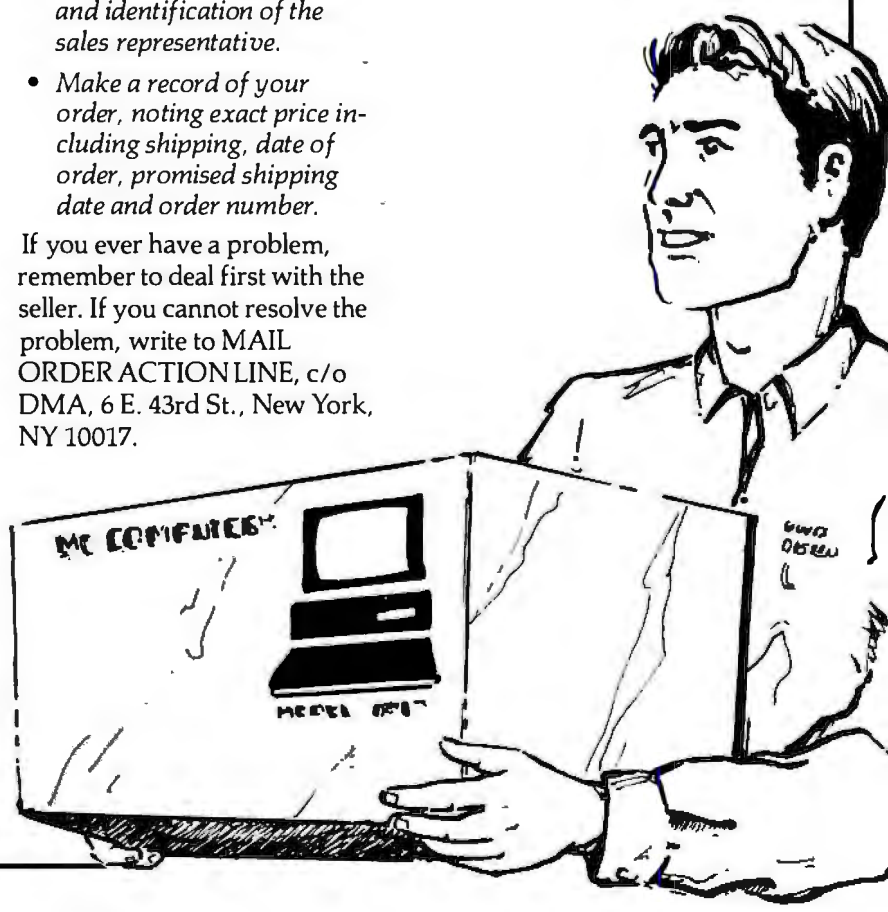
- *State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.*
- *Establish that the item is in stock and confirm shipping date.*
- *Confirm that the price is as advertised.*
- *Obtain an order number and identification of the sales representative.*
- *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

SOFTWARE

A/UX 3.0: The Mac's Odd Couple

TOM THOMPSON

What could be stranger than the Mac OS, renowned for its friendly user interface, working in tandem with Unix, whose user-hostile attitude is legendary? Nevertheless, that's exactly what Apple's implementation of Unix—known as A/UX—accomplishes.

A/UX allows the Mac OS and applications to operate on the traditional Mac Desktop beside Unix programs and tools running in console windows. A/UX 2.0 managed this Jekyll-and-Hyde duality decently (see "A Workstation in a Mac's Clothing," January 1991 BYTE). It combined features from both AT&T System V release 2 and BSD 4.2 Unix, and it used System 6.0's MultiFinder to run Mac applications. However, some Unix tools were missing or out of date, support of third-party peripherals was spotty, and not all Mac OS facilities were available. The latest release, A/UX 3.0, eliminates many of these shortcomings.

A/UX 3.0 uses System 7.0 for Mac application support. This is crucial for providing access to the high-powered Mac Quadras, which require System 7.0 to operate. Most Mac OS facilities, including the Sound Manager, multiple monitors, and even the QuickTime multimedia facilities, are supported. A/UX still uses AT&T System V release 2 version 2 (the latest release is SVR4), but the BSD portions are the up-to-date 4.3 version. Supplied with A/UX 3.0 is a boatload of network, text-processing, and development tools. A/UX 3.0 also supports Apple's SCSI scanners and some third-party hard drives, tape units, and CD-ROM drives.

Improved Installation

These enhancements have upped the hardware requirements for A/UX: You need an FPU (Mac IIsi users, take note), a minimum of 8 MB of RAM, and an 80-MB hard drive, although a 160-MB drive is preferable. The software comes either preinstalled on a Mac or on a CD-ROM.

Installation from the CD-ROM now requires only the CD-ROM itself and one floppy disk. You start the Mac and insert the installation disk and the CD-ROM in their respective drives. After several minutes, the disk ejects and code execution transfers to the CD-ROM, which functions as a slow hard drive. The A/UX installation application closely resembles the Mac OS software Installer application. You can install all or a subset of the software.

The CD-ROM comes packed with core Unix software; development tools such as an assembler and C and ANSI FORTRAN compilers; source-control utilities; X Window System support (both MacX and X11 2.1.1), and X development tools. There's also a grab bag of networking software: NFS (Network File System) 4.1 for file sharing, UUCP (AT&T V.4 version), CSL/IP, and TCP/IP utilities. Once you've made your selections, you let the CD-ROM and computer chug away for a while, and you're done. On a Mac Quadra 950 with a 160-MB hard drive, the complete A/UX software installation took an hour and 15 minutes, and it occupied 72 MB on the hard drive.

Prior to A/UX 3.0, those using third-party hard drives had to hope the vendor's software could create the Unix partitions required by A/UX. In a great show of faith by Apple, its HD SC Setup 3.0 application, which formats and partitions Apple hard drives for A/UX, now recognizes and works with third-party hard drives.

Setup and Performance

I tried A/UX 3.0 on two systems. One was a Mac IIci equipped with an 80-MB hard drive, 8 MB of RAM, a SuperMac 17-inch monitor with a Spectrum/8•24 PDQ display board, and a SuperMac 19-inch monitor with a Thunder/24 display board. The other was a Mac Quadra 950 with 8 MB of RAM, a 160-MB hard drive, and a Mac 16-inch monitor that used the Quadra's built-in video. To eliminate the storage-space problem on the IIci, I successfully installed and ran A/UX 3.0 on a Storage Dimensions 1-GB hard drive using only the A/UX installation software.

The IIci was connected to the BYTE network via an Apple Ethernet NB board. At first, I couldn't get the Ethernet services to work, although the LocalTalk services worked fine. I had to locate an oblique reference on the A/UX Read Me floppy disk and scan several manuals before I deduced that I had to install an Ethernet software module using `newconfig`. After `newconfig` modified the A/UX kernel, the Ethernet board began operating. I'd recommend that the first thing you do when you get A/UX up and running is print out the on-line manual pages for `newconfig`, because many of the network services (e.g., NFS, TCP/IP, and CSL/IP) have to be added through this program.

With contact to BYTE's Ethernet network established, I used `ftp` to copy the BYTE Unix benchmarks to both computers for performance testing. As you can see in the table, the 33-MHz 68040-based Quadra 950 weighs in with an average index of 2.5, making it more than twice as fast as a Sun Sparcstation IPC. The Mac

BYTE ACTION SUMMARY

- **WHAT A/UX IS**
  A combination of AT&T System V and BSD Unix that allows Mac applications to run concurrently.
- **LIKES**
  It offers access to Mac applications for graphics and imaging, point-and-click network and virtual memory control, and lots of Unix utilities.
- **DISLIKES**
  It still needs work on documenting Unix kernel configuration.
- **RECOMMENDATIONS**
  A/UX is valuable for Mac users who need ready access to Unix and for Unix wizards who need ready access to quality graphics or imaging applications.
- **PRICE**
  CD-ROM, $709
  CD-ROM and AppleCD 150 CD-ROM drive, $1208
  Upgrade from A/UX 2.0, $245
- **FOR MORE INFORMATION**
  Apple Computer, Inc.
  20525 Mariani Ave.
  Cupertino, CA 95014
  (408) 996-1010
  Circle 1313 on Inquiry Card.

BYTE LAB BENCHMARKS

A/UX running on a Quadra 950 makes it more than twice as fast as a Sun Sparcstation IPC. For each index, a Sparcstation IPC = 1.

Test	Baseline	Result	Index
Arithmetic (type = double)	2541.7	2743.3	1.1
Dhrystone 2 (without register variables)	22,366.3	21,533.3	1.0
Execl Throughput	16.5	157.5	9.5
File Copy Throughput (30 seconds)	179.0	315.0	1.8
Pipe-Based Context Switching	1318.5	957.1	0.7
Shell Scripts (eight concurrent)	4.0	3.0	0.8
Sum of six items			14.8
Average			2.5

IIci results (not shown in the table) give A/UX 3.0 an index of 1. The A/UX 2.0 review summed up the situation, still true today: Compared to new Unix workstations, the Quadra is neither a barnburner nor a lumbering cow in performance.

On the Mac side, System 7.0 features such as File Sharing and TrueType worked, as did all the Mac applications. I could move scanned images displayed by Adobe Photoshop from one monitor to another on the Mac IIci without problems. When copied to the `/mac/system/System Folder`, Control Panels and Extensions such as Now Utilities' Super Boomerang 3.0.2, Adobe's Type Manager 2.0.3, and Rock Ridge's VideoBeep 1.02 (a QuickTime player) ran flawlessly. This came as no surprise, since most Mac applications and utilities are System 7.0 compatible, which automatically makes them compliant with A/UX.

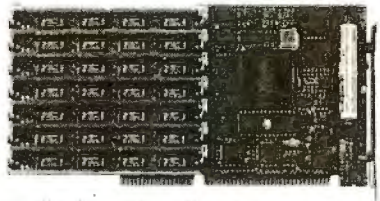
A Real Improvement

How does a Mac running A/UX stack up against other workstations? A Quadra 950 with 8 MB of RAM, a 230-MB hard drive, a 16-inch Apple monitor, and a keyboard costs about $10,300. This appears a tad pricey compared to some workstations, but the Mac brings important features to the Unix party. First, the Quadra's price includes 24-bit color. Second, to expand your view, you just add another display board and monitor. If you do huge layouts or extensive CAD work, the ability to span two or more monitors is a big win.

Finally, A/UX gives Unix wizards access to a raft of Mac desktop publishing, color prepress, image-editing, and multimedia applications. A/UX 3.0 is an improvement worth looking into. ■

Tom Thompson is a BYTE senior technical editor at large with a B.S.E.E. from Memphis State University. He is also an associate Apple developer. You can contact him on BIX as "tom_thompson" or on AppleLink as "T.THOMPSON."

ROMDISK™



High Performance Multimegabyte Disk Emulators

NEW MODELS / LOWER PRICES

- Floppy Drive and multimegabyte emulators for ISA bus computers
- 180K to 14 MB capacities
- EPROM, Flash or SRAM technologies
- Autobooting, Single or Dual disk emulation under PC or MS DOS
- List prices from $195

CURTIS, INC.

418 West County Road D • St. Paul, MN 55112
612/631-9512 FAX 612/631-9508
PC DOS is a trademark of IBM; MS DOS is a trademark of Microsoft

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).

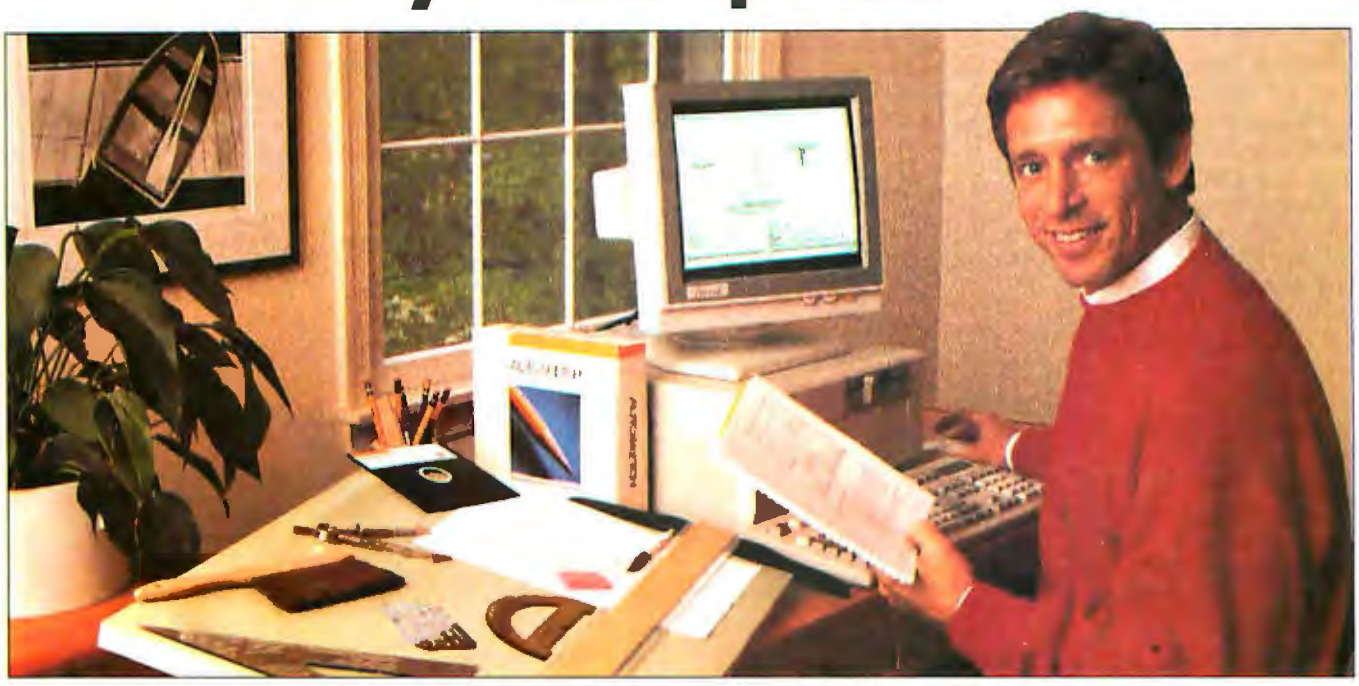
While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to the following address.

BYTE Magazine
Attn: Subscriber Service
P.O. Box 555
Hightstown, NJ 08520

 Circle 97 on Inquiry Card.

Training includes AT-compatible computer system with hard drive and AutoSketch® CAD software!

Be today's complete drafter.



Now, with NRI at-home training, you can get the hands-on skills and equipment you need for a fast start as today's complete drafter, equally comfortable with both manual and computer-aided drafting techniques.

Transforming rough sketches and calculations into accurate, working drawings, drafters have always been the key link in the chain of creative people who envision, design, and build the world's products. And today, thanks to the computer revolution, a career in drafting offers more job security — and opportunity — than ever before.

It's true! People with computer-aided drafting (CAD) skills are achieving breakthrough success on design teams in all areas of business and industry. In fact, employment experts predict that manufacturers will hire some 300,000 of these computer-savvy drafters over the next decade! And now — whether you want to work for someone else or even be your own boss — NRI hands-on training can help you can get in on the ground floor of this big-opportunity field.

You learn by doing

Working with a full array of drafting tools — drawing board, templates, T-square, compass, protractor, triangles, scales, and much more — you first master the techniques required to create detailed drawings by hand. Then, with a firm foundation in traditional methods, you move on to do the same kinds of drawings with greater speed and accuracy — using the high-powered PC and software also included with your course.

Train with and keep a computer and CAD software

Only NRI gives you this priceless, practical experience ... with a complete computer system that's yours to train with and keep! You learn to create precision drawings using a fully IBM PC/AT-compatible system that includes a full meg of RAM, hard disk drive, high-density floppy drive, mouse, 14" monitor, and AutoSketch CAD software.

With these state-of-the-art tools at your fingertips and a few simple commands, you'll be able to create precise, professional-quality drawings in a fraction of the time it takes to do them by hand.

Find out how NRI helps you turn your computer into a high-tech drafting tool! See other side.

SEND TODAY FOR YOUR FREE NRI CATALOG!

NRI Schools
McGraw-Hill Continuing Education Center
4401 Connecticut Avenue, NW, Washington, DC 20008

YES! Send me the FREE catalog I've checked and show me how NRI can give me the state-of-the-art training I need for success.

- ☑ Check one FREE catalog only
- ❑ **COMPUTER-AIDED DRAFTING**
- ❑ Computer Programming
- ❑ Microcomputer Servicing
- ❑ Desktop Publishing and Design
- ❑ Home Inspection
- ❑ Programming in C++ with Windows

NAME *(please print)* AGE

ADDRESS

CITY STATE ZIP 169-092

Accredited Member, National Home Study Council

Only NRI gives you the hands-on skills and equipment you need to succeed in drafting today!

There's no doubt about it: Drafting with a computer and software will save you time, increase your accuracy, boost your creativity ... and open the door to a brand new world of money-making opportunity!

Using your AutoSketch® CAD software, you learn to draft objects with a variety of computer-generated drawing tools - from lines, arcs, and circles to fillets, ellipses, and pattern fill areas. And, once you've discovered how to draw an object, you learn how to quickly stretch it, scale it, copy it, rotate it at any angle, or change its dimensions.

You find out how fast and easy it is to manipulate your work with a single keystroke — moving or adding features such as wheels, doorways, and circuitry on your mechanical, architectural, and electrical drawings.

NRI Discovery Learning Method means no experience necessary

NRI's unique at-home training method helps you learn by doing as you build a complete understanding of today's revolutionary drafting techniques.

Bite-size lessons expand your knowledge step by step while hands-on Discovery Learning projects give you practical drafting experience with actual tools of the trade. You learn at home, at your own pace, guided by your personal NRI instructor from the basics of manual drafting to more advanced computer techniques.

Soon you have the skills and confidence you need to draft detailed renderings of sprockets, homes, circuit boards — indeed, virtually anything you'll be called on to produce on the job — at the drafting table or your computer terminal.

Send today for your FREE NRI catalog

Whether you want to change careers, advance on the job, or make good money in a business of your own, you can count on NRI hands-on training to give you the fast start you need to succeed. Send today for your free catalog describing NRI's new course in Computer-Aided Drafting.

If the coupon is missing, write to NRI Schools, McGraw-Hill Continuing Education Center, 4401 Connecticut Avenue, NW, Washington, DC 20008.

AutoSketch is a registered trademark of Autodesk, Inc., makers of AutoCAD®. IBM, PC, and AT are registered trademarks of IBM Corp.

CARD 362

SEND TODAY FOR YOUR FREE NRI CATALOG!

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL

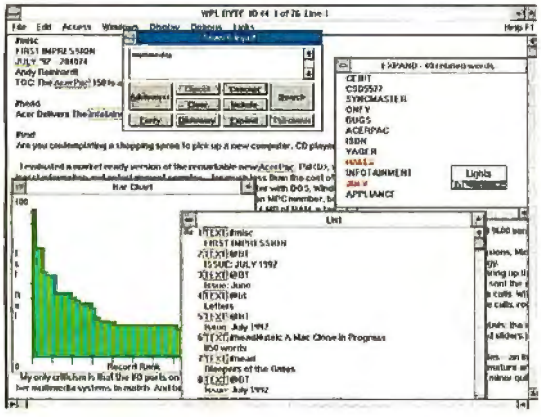
FIRST CLASS MAIL PERMIT NO. 10008 WASHINGTON, D.C.

POSTAGE WILL BE PAID BY ADDRESSEE

NRI Schools

McGraw-Hill Continuing Education Center
4401 Connecticut Avenue, NW
Washington, DC 20078-3543

A New Personal Librarian



The result of a Windows Personal Librarian concept search on the term multimedia *shows related terms, a list of documents, a bar graph outlining the relevancy of each hit, and the highest-ranking document.*

Personal Librarian, one of the most powerful text managers on the market, was in the midst of a major upgrade as we wrote June's Solutions Focus on text management. Here is a quick review of the new Windows Personal Librarian 3.0.

Personal Librarian indexes files on your hard disk, leaving those files in place and storing only index and related database information. The latest version supports WordPerfect and Word for Windows files as well as text.

You can use Personal Librarian as a stand-alone document retrieval system, but the package is clearly designed for network operation. The user module allows you to search indexes and view documents, while the administration unit lets you add and remove files, create hypertext links, and perform other maintenance.

Personal Librarian supports the usual repertoire of Boolean search expressions and fuzzy searches, but its *concept search* capability is by far its most powerful feature. Concept searching is not the typical grouping of related search clauses found in other packages: Instead, the Personal Librarian program builds a concept from a single search expression by finding related words on its own.

For example, you might search an index of BYTE for the term *multimedia*, but you'd miss documents you might want to find on CD players and the like if those documents didn't contain the term itself. If you run a concept search on *multimedia*, however, Personal Librarian first expands the search list by searching through its index for related words. Then it searches for those related words in each document (see the screen). Naturally, this generates a lot of hits for each search, but Personal Librarian uses a proprietary relevancy-ranking algorithm to determine which documents most closely match your request.

Personal Librarian searches almost instantaneously and indexes very quickly: We added 3 MB of BYTE article data to an index in under 15 minutes on a fast 486. But for most people, the power of Personal Librarian's concept searching will provide the strongest draw. If you have complex text documents where the proper search term isn't always obvious, Personal Librarian is the way to go.

Good but Not GreatWorks

Before we could do a review of GreatWorks 1.0, Symantec brought out a new version of its integrated software program for the Mac. This package gives you a word processor, database, spreadsheet, chartmaker, drawing program, painting program, outliner, and telecommunications program all in one box. Additions include 50 new features, the ability to paint in color, and support for System 7.0 features like Publish/Subscribe. While you can easily bring, say, a pie chart into a word processing document by cutting and pasting, Publish/Subscribe maintains hot links between such elements. So, if you make a change to the original pie chart or graphic or worksheet, or whatever, the version embedded in the word processing document is automatically updated.

Handy as this can be, there's one problem with the implementation of Publish/Subscribe. GreatWorks doesn't just make the change in the object you've put into the document; it replaces the object with a copy of the revised version. Much of the time, this is not a problem. But say you've drawn something with the drawing or painting modules, placed that graphic in a text document, and then scaled it down to fit into a particular space. The changed drawing comes in at the size of the original, so you then have to go into the word processing module and resize the graphic again to make it fit.

The applications themselves do a good job handling typical chores. You can't assemble a fancy newsletter with the word processor, the spreadsheet doesn't do autosumming, and the communications package will perform only XMODEM and text transfers. But for most run-of-the-mill operations, these modules are more than sufficient. More significant for some users, the whole kit and caboodle takes up only 2.5 MB of hard disk space and will run in 1 MB of RAM. GreatWorks 2.0 certainly likes more memory than that, though.

While each of the modules can stand on its own as a competent application, the integration of these modules could be more elegant. Sharing data between them is simple enough, but going from module to module could be a little easier. It would be great if you could, for example, click on a chart in a document and have the charting program fire up.

Regardless of our few quibbles with implementation, GreatWorks 2.0 is a mighty fine bargain. Eight capable programs for $299 is a real deal. ■

—The BYTE Lab

Reviewer's Notebook provides new information—including version updates, new test data, and long-term usage reports—on products and product categories.

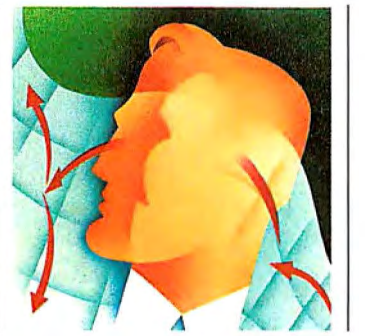
ITEMS DISCUSSED

Windows Personal Librarian 3.0
(stand-alone version).....$995
Personal Library Software
2400 Research Blvd., Suite 350
Rockville, MD 20850
(301) 990-1155
fax: (301) 963-9738
Circle 1076 on Inquiry Card.

GreatWorks 2.0.....$299
Symantec Corp.
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600
fax: (408) 252-4694
Circle 1077 on Inquiry Card.

BOOK AND CD-ROM REVIEWS

HUGH KENNER



THE ORIGINS OF HYPERTEXT

From Memex to Hypertext: Vannevar Bush and the Mind's Machine
James M. Nyce and Paul Kahn, eds.
Academic Press, 1992, $39.95,
ISBN 0-12-523270-5

Vannevar Bush—does that name ring, perhaps, a faint bell in your mind? A nearby dictionary says "1890–1974; U.S. electrical engineer & administrator."

"Administrator," indeed; how fame does fade! During World War II he was head of the Office of Scientific Research and Development—U.S. Science Czar—and one of many claimants to A-bomb fatherhood. He'd been a dean and vice president at MIT; later he headed the Carnegie Institution.

And "electrical engineer" is a futile stab. Bush was a computing pioneer at a time, 60 years ago, when it still wasn't clear (except to Alan Turing) whether the useful future was analog or digital. I don't know if Bush ever heard of Turing, who by the 1930s had proved that all digital computers are essentially the same computer: versions of what we now call the Turing machine.

But while Turing started from logic, Bush started from problems, such as how to get the data for contour lines on maps (normally, "several men, careful fieldwork, and tedious data reduction afterwards"). It occurred to Bush that if you pushed a wheeled box over hilly ground, gears inside the box could record changes in elevation. His profile tracer got him a patent and a master's degree (Tufts University, 1912).

The idea, you see, was to have gears act out the problem. That's analog thinking. Later, differential equations helped generalize it, and by 1942 the differential analyzer—gears plus relays, motors, and vacuum tubes—on which Bush had spent nearly two decades was helping win the war. But by 1950 its upkeep was merely "a burden on MIT." That anticlimax reflects the dawn of digital.

Something else that occupied Bush from at least 1932 was how on earth we'd ever find anything amid the sheer proliferation of print. As long ago as 1866, Mendel's crucial paper on genetics had vanished unread into "the literature," not to emerge for decades. A library should be a memory machine. So how does human memory work?

Well, it works by blazing trails of association between details that catch our fancy. Never mind those authorized headings: author, title, subject. Again, analog to the rescue! For decades, Bush described and redescribed Memex, your own personal associative memory machine that lets you tag microfilm frames you want linked. Thus, you form "an associative trail through the material...closely analogous to the trails formed in the cells of the brain."

Hypertext, you're thinking? Yes, more or less. Memex would have been desk-size and clumsy, space and speed alike dictated by microfilm's constraints. Hypertext emerged from a digital revolution that Bush seemed to feel was too abstract for comfort.

In 1945 he published his seminal Memex essay "As We May Think," both in the *Atlantic Monthly* and (somewhat condensed) in the old *Life*, with its multimillion circulation. *From Memex to Hypertext: Vannevar Bush and the Mind's Machine*, edited by James M. Nyce and Paul Kahn, now offers all the pertinent Bush writings plus pertinent commentary, not omitting a lively 1989 lecture by Norman Meyrowitz: "Hypertext—Does It Reduce Cholesterol Too?"

No one mentions a prime glitch in the analogy that underlies Memex, those paired tags for linking. Some paragraphs above, you saw Alan Turing pop into my head as I pondered Bush's fixation on analogs. I now have, yes, a link between Turing and Bush. But what did today's reading of Bush really link back to? Not to any tag I'd placed in my Turing trail in 1965, long before analog versus digital had meaning for me, and certainly long prior to any notion that I'd some day want a link from Vannevar Bush. By what process, then, did I fish up Turing this morning? By no process Memex ever thought to mimic. ■

Hugh Kenner is Franklin and Callaway Professor of English at the University of Georgia. His recent books include Mazes *and* Historical Fictions. *You can contact him on BIX as "hkenner."*

UNIX FOR THE UNINITIATED

Unix has changed during the past few years; it's no longer just a language of cryptic commands and arcane syntax. Yes, those "features" are still there, but they have been complemented by sophisticated windowing GUIs that can run Unix versions of Lotus 1-2-3 and WordPerfect or even DOS software. With these and other changes has come a need for new Unix documentation and "how-to" books.

As intuitive as some of the new Unix GUIs are, however, much of the real power and usefulness of Unix come from understanding concepts like redirection and pipes and from using commands like `sed`, `grep`, and `awk`. I perused four books that all offer good descriptions of the essential Unix commands. All four emphasize AT&T Unix System V release 4.0. They also deal with networking issues and with accessing and exchanging information from remote computers with programs like `ftp`, `telnet`, and `mail`. Beyond coverage of the most common Unix commands and programs, the contents of the books vary considerably.

Unix for the Impatient appears to target readers who are comfortable with somewhat terse technical material. It presents its subject matter concisely, rather than in a tutorial manner. It covers both Unix SVR4 and BSD 4.3. This book has the most detailed descriptions of the various Unix editors and has the best presentation of the `emacs` editor. *Unix for the Impatient* is written for the person who is computer-knowledgeable and doesn't need much hand-holding. This book is the only one of the four to describe using Unix with

ILLUSTRATION: BOB SCOTT © 1992

an X Window System GUI. It, along with *The Waite Group's Unix System V Primer*, includes an index-like listing of all the common Unix commands with short descriptions and, more important, a page reference of where a command is discussed in detail in the book.

Introduction to Unix is the one most like traditional Unix texts. It groups many common Unix commands and presents relatively abbreviated examples of their use. It would be a good book to use in conjunction with a more tutorial-type book. Although the book lacks the lengthier descriptions of `emacs` and `vi` found in the other three books, it is the only one of the four to include a detailed discussion of Unix system administration and details of the basic structure of the Unix operating system.

Unix Step-by-Step introduces you to this operating system as its title states. The book's tutorial-style approach includes a summary, review questions and answers, and exercises at the end of each chapter. It has detailed descriptions of how to write Bourne, C, and Korn shell scripts.

The Waite Group's Unix System V Primer also uses a tutorial approach with review questions and answers and exercises at the end of each chapter. The book makes good use of contrasting blue-type and blue-background sidebars to highlight important topics and examples. It also makes more effective use of graphics than the other books. The authors' easygoing style makes the reading pleasurable, and Bob Johnson's cartoons add some light entertainment and serve to introduce you to "Unix humor." The book has a particularly complete coverage of the `vi` editor.

Because the approach used in *Unix for the Impatient* fits my learning style, I found it suited me best. The concise style lets its authors cover more subject matter than the others without sacrificing clarity or assuming too much from the reader. This book also seems to have the best balance between the "old" and "new" aspects of Unix. It covers traditional Unix material like the file system structure and setting up a terminal as well as using the X interface and applications.

If you are more comfortable with a book that uses a tutorial approach, *The Waite Group's Unix System V Primer* is my recommendation. I give it a slight edge over *Unix Step-by-Step* for its easy-to-read layout and use of color and graphics to highlight important concepts. Many times, the best way to learn operating-system syntax is to find a specific example that is close to what you need to do and make slight revisions until you finally get it correct. This book provides ample examples of using Unix commands with their various options.

—John Unger

Unix for the Impatient, Paul W. Abrahams and Bruce R. Larson, Addison-Wesley, 1992, $26.95, ISBN 0-201-55703-7.
Introduction to Unix, Mark Schulman, Que, 1992, $24.95, ISBN 0-88022-745-1.
Unix Step-by-Step, Ben Smith, Howard W. Sams, 1990, $29.95, ISBN 0-672-48469-2.
The Waite Group's Unix System V Primer, 2nd ed., Mitchell Waite, Don Martin, and Stephen Prata, Howard W. Sams, 1992, $29.95, ISBN 0-672-30194-6.

John Unger is a scientist who works for the U.S. government in the Washington, D.C., area. He can be reached on BIX as "junger."

ROAD MAPS ON CD-ROM

Street Atlas USA, $169 from DeLorme Mapping (Main Street, P.O. Box 298, Freeport, ME 04032, (207) 865-1234; fax (207) 865-9628).

Street Atlas USA, DeLorme Mapping's CD-ROM for Windows, contains over 1 million maps of U.S. streets. It installs directly from the CD-ROM drive. The program has the familiar look and feel of a Windows application, but it has no pull-down menus. All functions are accessible through push-button icons on the right side of the screen. The main screen displays the active map. When you start up Street Atlas USA, the main area displays a color map of the U.S. When you draw a box on this map using the mouse, you zoom in on your selected area. You scroll around the map by clicking on different compass points. To move faster, you simply slide a selection box across a thumbnail map at the bottom of the icon palette.

One click on a push button triggers rapid searches using the criteria you select. For example, enter ZIP code 30319, and you'll see a detailed map of northeast Atlanta. Type in area code 603, exchange 673, and up pops a map of Milford, New Hampshire. Or you can enter any state or town name in the U.S. to pull up a local map. From there, you search for the specific street name you want. The software then displays its location, highlighting the street on the map. At any magnification level, you can continue to scroll about using the compass controls. Push buttons let you zoom in or out at any time and copy the active map to the Windows Clipboard. The interface is fast, well designed, and efficient.

What's truly impressive is the detail of the maps. DeLorme started with the Census Bureau's TIGER (Topologically Integrated Geographic Encoding and Reference) maps and embellished them with other contracted and in-house data sources.

BYTE editors searched out old haunts, from Kailua, Hawaii, to Kasilof, Alaska. Some road names were missing from the truly backwater spots, but we found it hard to stump the program with an unknown street reference. The current maps are two years old, but DeLorme plans to update the disc annually.

If you're always getting lost, buy DeLorme's GPS MapKit. You get a CD-ROM drive, mapping software, device driver software, and an antenna and receiver to link to the Global Positioning Satellite System, a network of 24 orbiting government satellites. The GPS package lets you keep a constantly updated display of your current location on the electronic map. Hook it up to a notebook computer in your car, and tour the country with confidence. All you need is money—$10,000 versus $169 for the CD-ROM alone. But you may never take a wrong turn again.

—Stanford Diehl

THE PROGRAMMER'S SHOP

Development tools of every type...

New 286 | DOS-Extender™ 2.5
by Phar Lap Software

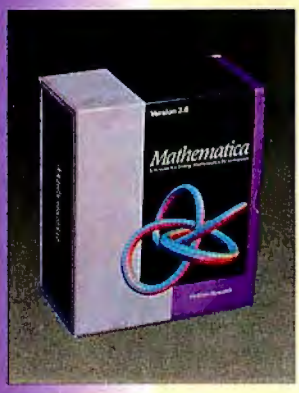
New Version 2.5 of 286 | DOS-Extender™ adds support for Microsoft C/C++ 7.0 and Borland C++ 3.1! With 286 | DOS-Extender, you can build multi-megabyte DOS applications with your familiar Microsoft C/C++, Borland C++ or Microsoft Fortran compiler. You can even debug with CodeView or Turbo Debugger. Extended applications run under DOS, DESQview and Windows.

LIST: $495 **PS Price: $459**
FastFaxts 420-045

F77L- EM/32 Version 5.0
by Lahey Computer Systems

Industry leading 32-bit Fortran Language System includes Phar Lap's 386/ DOS Extender. This VCPI, XMS, and DPMI compliant extender enables users to access up to 4GB and operate in the MS Windows DOS box. The extender is royalty free and includes virtual memory support. New withVersion 5.0: 32-bit debugger, arrays beyond 16MB, compression linker, and 486 optimizations. Support for popular VAX, IBM VS, and 90 features.

LIST: $1195 **PS Price: $1049**
FastFaxts 334-052



Mathematica 2.0® for Windows
by Wolfram Research

A system for doing numerical, symbolic, and graphical computation used both as an interactive calculation tool and a programming language. Numerical capabilities include arbitrary precision arithmetic and matrix manipulation. On systems with a sophisticated graphical user interface, users can create "Notebooks" that mix input, graphics, text, and sound. Generates graphics in PostScript form.

LIST: $995 **PS Price: $975**
FastFaxts 1394-006

Q+E DataBase Library 1.1
by Pioneer Software

Write one application that works multiple databases! Don't rewrite code just to use a different database! With Q+E Database Library (QELIB), your applications can simultaneously and identically access, query and edit DB2, Oracle, SQL Server, Sybase, Netware SQL, Ingres, XDB, SQL Base, Btrieve, OS/2 EE DBM, Paradox, dBase, Excel .XLS files, and text files. If your favorite tool can call a DLL, you can use QELIB!

LIST: $399 **PS Price: $379**
FastFaxts 2137-012

Visual Basic
Competitive Upgrade!
by Microsoft

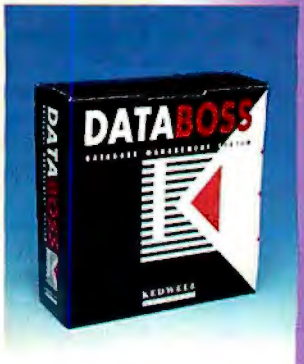
The fastest, easiest way to build real Windows applications. Windows-hosted programming system combines graphical interface design tools and general purpose programming language. Automatic creation of empty procedures to handle events associated with objects placed on screen. Incremental compilation, automatic syntax checking, integrated debugging, more. Access API, DLLs, and DDE. ***Now only $99.***

LIST: $199 **PS Price: $99**
FastFaxts 502-189

DataBoss 3.5
by Kedwell Software

Works with your compiler to generate complete, working relational database applications in error-free C, C++ or Pascal. DataBoss cuts your development time in half, but still gives you the flexibility of traditional methods. You quickly create entry screens, menus and reports and build single-user and networked multi-user systems. Customizable source code is included, and you pay no run-time royalties. Ever.

LIST: $695 **PS Price: $415**
FastFaxts 5277-001



Distinct TCP/IP for Windows
by Distinct Corporation

Distinct TCP/IP for Windows SDK extends the TCP/IP and RPC/XDR networking capabilities to Microsoft Windows. Includes the smallest and fastest DLLs today available for Berkeley Sockets, RPC, Telnet, and FTP. Coexists on the same board with Lan Manager, Novell and Banyan. Supports Packets, NDIS and ODI drivers. Only 5KB of DOS memory required.

(SDK) LIST: $495 **PS Price: $439**
(Applications) LIST: $395 **PS Price: $379**
FastFaxts 1951-003

SQA:ROBOT for Windows
by Software Quality Automation

Fully-automated test development and unattended test execution for any Windows application. SQA:ROBOT generates scripts that can be maintained by non-programmers. Other unique features include: standalone or networked operation; run-time only option: easy to use, intuitive user-interface; user-selectable recording level generates Visual Basic scripts or low-level mouse and keystroke journal; and integrated test reporting using SQA: Manager, winner of Computer Lanugage's 1992 Productivity Award.

LIST: $495 **PS Price: $469**
FastFaxts 5305-001

To Order Call THE PROGRAMMER'S SHOP *1-800-421-8006*

...Good prices, great service, no useless hype. Shop the Shop!

WATCOM C/386
by WATCOM

Develop and debug 32-bit applications for extended DOS, Windows and OS/2 2.0. Includes royalty-free 32-bit DOS extender, true 32-bit Windows GUI Application Kit, our fast, tight, and reliable 32-bit Code Optimizer, licensed Microsoft Windows SDK Components, an interactive Source-Level Debugger, an Execution Profiler and More! Now includes OS/2 2.0 Support.

LIST: $895 **PS Price: $739**
FastFaxts 1044-020

Janus/Ada x86 Compiler
by R. R. Software

Janus/Ada for DOS: the power and reliability of Ada, priced for everybody! You get a full implementation of the Ada standard - compiler, linker, royalty-free runtime libraries, multiple memory models, environment, tools, even an Ada tutorial. And R.R. Software supports you with 11 years of Ada experience and know-how. Now's the time for you to use Janus/Ada.

LIST: $129 **PS Price: $99**
FastFaxts 586-002

The PKWARE Data Compression Library
by PKWARE

The PKWARE Data Compression Library allows software developers to add data compression technology to applications. The application program controls all data I/O, allowing data to be compressed or extracted to any device or area of memory. Only 35K of memory is needed to compress data, and only 12K is needed to extract data. Compatible with MSC, BC++, TC, TP 6.0, Clipper, Basic 4.5,7.1, ASM.

LIST: $295 **PS Price: $275**
FastFaxts 3043-011

SVS C3 ANSI C, Pascal, or FORTRAN-77
by Silicon Valley Software

Only from the Programmer's Shop! ANSI compliant, optimizing, 32-bit compilers; DPMI-compliant, royalty-free DOS extender; source level debugger; utilities. Supports "flat model" code. Linker, librarian, make, i387 emulation, W31/4167 support. Interoperable languages!

	LIST	PS Price
ANSI C	$325	**$315**
Pascal	$325	**$315**
FORTRAN	$395	**$375**

FastFaxts 1958-048: (C), 1958-050: (Pascal), 1958-049: (FORTRAN)

WindowsMAKER™ Professional 4.0
by Blue Sky Software™

Considered the easiest and fastest way to create MS-Windows applications in C/C++. Generate the Windows .EXE w/complete source & production files (no royalties). Just Point & Click to define the Windows user interface. Lets you animate your design to instantly test look & feel and make changes on the fly without needing to compile. Custom code is preserved during code regeneration. The leading development tool for Microsoft Windows. Highly Recommended.

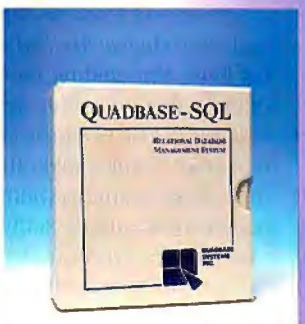
LIST: $995 **PS Price: $895**
FastFaxts 2001-006

Quadbase-SQL/Win
by Quadbase Systems Inc.

FULL-FEATURED, FAST SQL ENGINE FOR WINDOWS.

Quadbase-SQL/Win is a SQL DBMS that allows developers to build Laptop, Pen-based and multi-user apps using Windows languages such as Visual Basic, C, C++, etc. Fully supports ANSI SQL level 2. Features include referential integrity, concurrency control, crash recovery, commit/roll-back, scroll cursor, outer join, multiple instances BLOB, custom controls for VB, Embedded SQL for C and VB.

(single user) LIST: $595 **PS Price: $565**
(multi-user) LIST: $995 **PS Price: $949**
FastFaxts 1259-007



But wait, there's more: Bargains galore!

	LIST	PS		LIST	PS		LIST	PS
• **Norton Desktop for Windows**	149	**109**	• **Microsoft C/C++**	495	**339**	• **Carbon Copy Plus 6.0**	199	**129**
• **Lotus 1-2-3 v3.**	595	**429**	• **Borland C++**	495	**329**	• **ProComm Plus**	129	**99**
• **QuattroPro**	495	**349**	• **Clipper**	795	**Call**	• **xtree gold 2.5**	149	**109**
• **WordPerfect**	495	**279**	• **dBASE IV 1.5**	795	**529**	• **BTrieve**	595	**399**
• **WordPerfect (Windows)**	495	**299**	• **FoxPro 2.0**	795	**Call**	• **QEMM**	100	**69**
• **Microsoft Word**	450	**239**	• **Windows 3.1 upgrade**	99	**Call**	• **Pro-C Lite w/Pro dbx**	795	**99**
• **Microsoft Word (Windows)**	495	**339**	• **Norton Utilities**	179	**129**	• **DesqView**	220	**99**
• **MS Dos 5.0 upgrade**	100	**65**	• **Visual Basic 1.0**	199	**149**	• **DR DOS**	99	**59**

Call the Programmer's Shop today: 1-800-421-8006

Call FastFaxts for product information any time, day or night. 617-740-0025.
Get free information on all of our more than 10,000 products any time you like • Dial from a fax machine or fax-board equipped PC • Follow the voice computer's instructions • Receive literature instantly via fax

THE PROGRAMMER'S SHOP

Canada 800-446-3846
MA 617-740-2510
FAX: 617-749-2018
90 Industrial Park Road, Hingham, MA 02043

• Credit card orders processed only when product is shipped • All prices subject to change • International prices will vary

At last...using more than one PC is as easy as you always thought it should be!

Save 20%

Introducing FILERUNNER.™

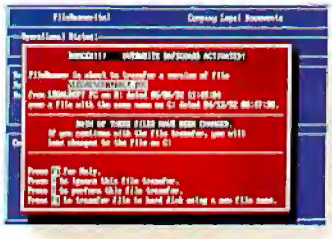
The most convenient way to keep the latest versions of your files in synch on every personal computer you use!

No cables. No modems. No confusion. Now, your Notebooks/Laptops, Networks, your Home and your Office PCs will work together the way you've always wanted them to.

With the push of a button, the new FILERUNNER program provides:

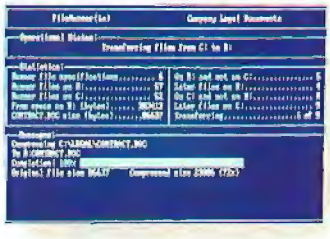
- Synchronized Files on All Your PCs
- Exclusive ***Overwrite Safeguard*** to protect valuable data when a file has been changed on more than one PC
- Virus Detection using **Virex®**
- Automatic File Compression during transfer to fit your files easily onto your Runner diskettes
- Time Zone compensation and correction for inexact PC Clocks to keep your update sequence completely accurate
- Ease of Use...with Context-Sensitive Hypertext and On-Screen Help throughout
- An automatic "bonus" backup of your critical files

At last, your computers will get with the program: FILERUNNER!



Overwrite Safeguard™

Protects valuable data when the same file is changed on more than one PC.



Automatic Transfers and Updates

FILERUNNER shows analysis and synchronization of files, file transfer and compression.

PROGRAMMER'S SHOP EXCLUSIVE: SAVE 20%

$79.00

Suggested Retail Price: $99.95

FREE BONUS!
4-Diskette Travel Wallet

The Reviews Are In. Here's What The Experts Say About FILERUNNER:

"...FILERUNNER can save you plenty of time and aggravation when you need the right file in the right place at the right time."
PC Magazine, July, 1992

"FILERUNNER makes life easier for busy professionals whose work goes where they do...so simple that PC Week Labs did not have to open the manual."
PC Week, May 11, 1992

"FILERUNNER can put those files in synch...Data compression techniques help FILERUNNER cram more than the usual amount of information onto its floppies."
Business Week, April 13, 1992

FILE RUNNER™

As easy as you always thought it should be.℠

Call the Programmer's Shop Now To Order FILERUNNER: 1-800-421-8006.

THE PROGRAMMER'S SHOP 1-800-421-8006
90 Industrial Park Road, Hingham, MA 02043 • Canada
800-446-3846 • MA 617-740-2510 • FAX: 617-749-2018
Credit card orders processed only when product is shipped.
All prices subject to change. International prices will vary.

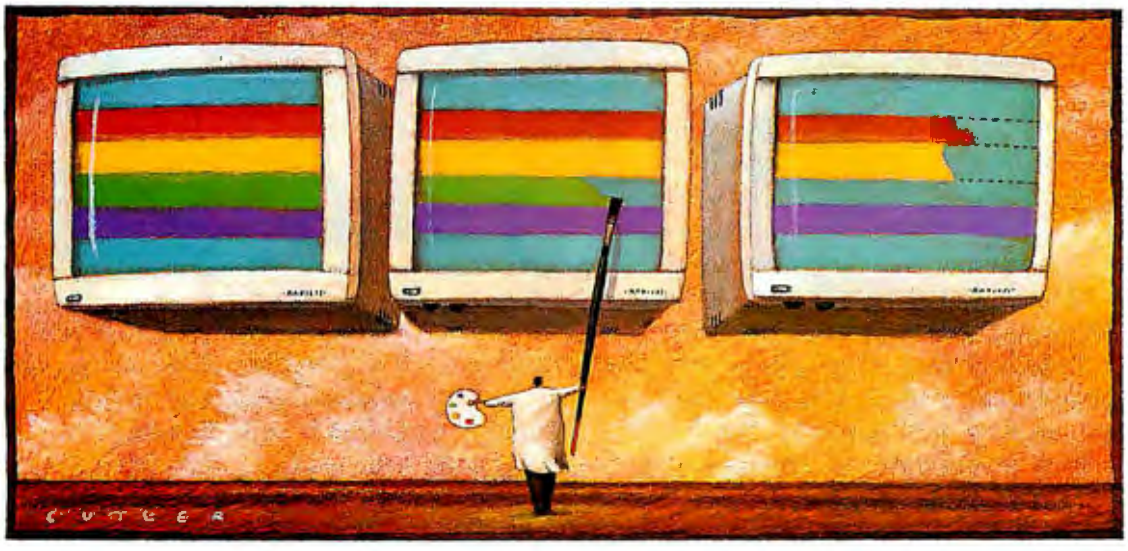
MBS TECHNOLOGIES, INC.
800-860-8700

IBM® PC, XT, AT®, PS/1®, PS/2®, Tandy or other 100% compatible, DOS® 3.1 or higher. Compatible with Windows® 3.0 or higher. Requires hard disk and floppy drive on each PC used for file transfer. Floppy drives must use diskettes with the same size and density. All other product names are trademarks of their respective owners.

BY992

KONSTANTIN
OTHMER

INSIDE QUICKDRAW



Here's how the Macintosh's graphics engine operates to produce optimum visual results, regardless of the display's limitations

One of the Macintosh's most renowned features is its graphics. This capability is provided by a powerful yet flexible graphics engine known as QuickDraw. QuickDraw is built into every Mac's firmware and is responsible for everything that appears on the Mac's screen, whether it's the Mac's own GUI, a newsletter page in a desktop publishing application, or a 24-bit-color scanned picture in an image-editing application.

To handle this broad range of graphics operations, QuickDraw provides a rich set of drawing and imaging functions for the programmer's use. These graphics functions add a layer of abstraction between the drawing that an application performs and what appears on the screen.

What does that last sentence mean? Put another way, QuickDraw resolves an application's drawing commands into actions that affect the frame buffer and display hardware of the Mac on which the application runs. QuickDraw accomplishes these drawing operations effectively, regardless of the output device's dimensions and pixel depth. I use the term *device* here because QuickDraw can be used to draw to printers and film recorders as well as monitors.

Because QuickDraw manages every aspect of the Mac's display, you shouldn't bypass QuickDraw to draw something on the screen. If you somehow directly jam graphics data into a Mac's frame buffer, two things will happen—both of them bad. First, another application using QuickDraw will stomp on your drawing. Because you didn't use QuickDraw, QuickDraw doesn't know you put something on-screen, so it freely draws over your portion of the screen. Second, this ties your application to one specific set of hardware, which might not be compatible with different combinations of existing hardware, and certainly not with future hardware.

Another, less touted feature of QuickDraw can be found on modular Macs with NuBus slots: You can easily expand your screen real estate by adding another monitor and display board. You can create a Desktop that consists of up to six different displays of varying sizes and pixel depths this way, and all Mac applications automatically make use of all the screens.

Having multiple monitors is extremely useful for working with several applications at once. Another benefit of such a setup is that you can configure each monitor for the operations that take place on it. When I write articles that use color artwork (like this one), I set the monitor on which I'm constructing the art to use 32-bit color and the monitor on which I'm writing the text to use 1-bit black and white. This allows me to see my artwork in full color while editing the text at top speed, because 1-bit black-and-white graphics (which includes text) are

ILLUSTRATION: DAVE CUTLER © 1992

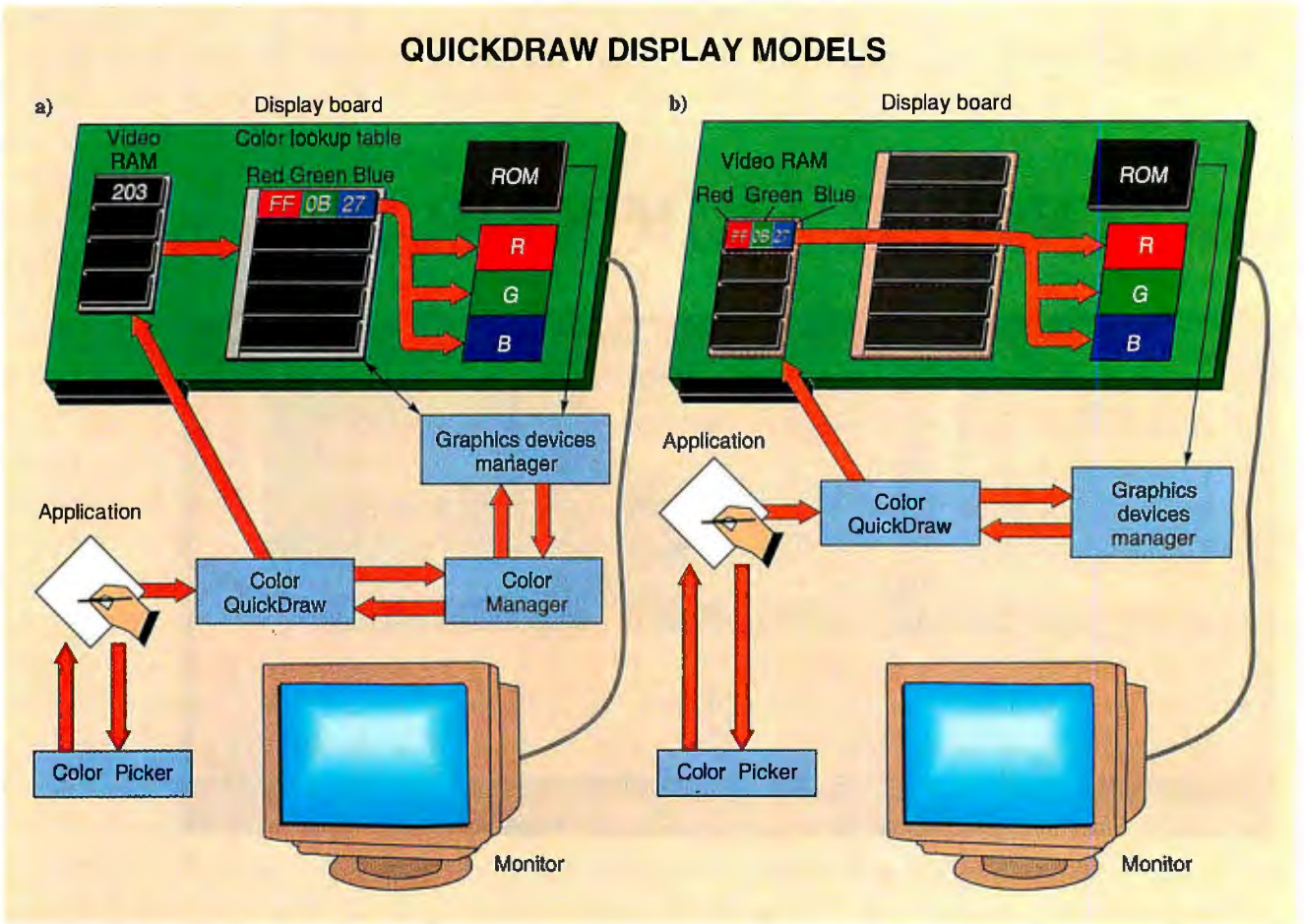


Figure 1: *The QuickDraw models for displaying* **(a)** *indexed pixels and* **(b)** *direct pixels. In the indexed model, each pixel contains a value that is an index into a color table on the display hardware. In the direct model, each pixel contains the actual color information used by the display hardware.*

significantly faster than those that are in 32-bit color.

QuickDraw Basics

How does all this work? Low-level parts of the Mac OS provide QuickDraw with the address of the target device's frame buffer. Again, the target device might be a printer or a piece of imaging hardware other than a monitor. For NuBus boards, low-level routines that are part of the Slot Manager obtain the display board's frame-buffer address, image dimensions, and pixel depth. The Slot Manager also loads the driver that QuickDraw uses to control the board's hardware. (For more information, see "Macintosh Video Revealed," April 1991 BYTE.) QuickDraw uses this gathered information to render the best possible graphics on the given Mac display.

Through QuickDraw and the Window Manager, an application works in the local coordinates of a rectangular drawing area called a `GrafPort` (i.e., the window). The `GrafPort` contains state information about how QuickDraw should perform drawing in that window. With the `GrafPort` state information in hand, QuickDraw can manage the accurate presentation of a window that straddles two monitors of different pixel depths.

QuickDraw can draw two basic kinds of objects: *geometric objects*, such as lines, rectangles, and text; and *pixel images*, which are arrays of color pixels termed a *pixel map* (as opposed to a black-and-white bit map). These two objects get their color information from different sources.

When a geometric object is drawn, its color is stored in the `GrafPort` as a 48-bit RGB value (16 bits for each of the three color components—red, green, and blue). Given the color, location, and geometry of an object, QuickDraw renders the object on each physical device the object intersects. Since individual devices have varying color capabilities, QuickDraw must determine how best to represent the source (48-bit RGB data) on each device. How QuickDraw performs this color mapping is explained below.

A pixel map (or pixmap for short) is a 2-D grid with a color value at each integer grid point; the color information is stored within the pixmap itself. Pixmaps can be scanned images, or they can represent the image that appears on the Mac's monitor(s). Currently, QuickDraw supports pixmaps that are 1, 2, 4, 8, 16, and 32 bits deep.

Pixmaps can be the source of a drawing operation, as when a scanning application takes 32-bit-color image data and places it into a pixmap in memory. Pixmaps can also be the destination of a drawing operation, as when the same scanning application takes the 32-bit-deep pixel image and draws it onto an 8-bit-deep Mac screen. Thus, QuickDraw must be able to map colors from source depths of 1, 2, 4, 8, 16, and 32 bits per pixel (for pixmaps) and 48 bits per pixel (for geometric objects) to destination depths of 1, 2, 4, 8, 16, and 32 bits per pixel.

1 YEAR FOR ~~$42.00~~!

Special offer $24.95!

Save over 40% off the single copy price by subscribing now to BYTE! Your paid subscription will include BYTE's Annual Special Issue.

☐ Payment enclosed ☐ Bill me later

NAME _____

COMPANY _____

ADDRESS _____

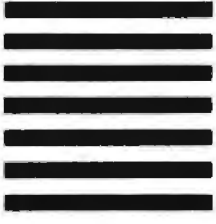
CITY _____ STATE _____ ZIP _____

Please allow 6-8 weeks for delivery. Basic subscription rate, including Special Issue is $29.95. (Mexico, $29.95 payable in U.S. Funds). Your subscription is GUARANTEED! If you are ever dissatisfied, cancel for a full refund on all unmailed issues. A ove rates are for U.S. delivery only. Please see table of contents for international subscription rates.

BYTE

IW29015

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 42 HIGHTSTOWN, NJ

POSTAGE WILL BE PAID BY ADDRESSEE:

BYTE

Subscription Department
P.O. Box 558
Hightstown, N.J. 08520-9409

How QuickDraw Maps Colors

To understand how QuickDraw actually maps colors, first consider the two color models QuickDraw uses: *indexed* and *direct*.

Indexed color (1, 2, 4, or 8 bits) is limited to displaying one, four, 16, or 256 colors simultaneously, but the accuracy, or resolution, of each of those colors is very high (48 bits, even though most hardware is capable of reproducing only about 10 to 12 bits per color component accurately). In the indexed color model, each pixel's value in the pixmap represents an index into a color table. The entries in the color table contain the actual digital values the display hardware uses to present the color (see figure 1). Although the depth of the pixmap is only 1, 2, 4, or 8 bits, the resolution of the color information as provided by the color table is 48 bits.

The direct color model is fundamentally different. Direct pixmaps store the digital values in each image pixel rather than in a color table. The advantage of the direct model is that it can accommodate larger pixel values than the indexed color model, so many more colors can be displayed simultaneously. Direct pixmaps are generally easier to manipulate, since they remove the overhead required by color-table searches. The disadvantages of the direct color model are that the larger pixels require much more memory to store an image, image manipulation is slower because there is more color data to work with, and pixels are accurate to only 8 bits per color component (but this is plenty for most applications).

Thus, a source pixmap has three levels of resolution: 16 or 32 bits (direct) or 48 bits (indexed). However, life gets interesting when a source pixmap must be drawn to a destination device such as a display board. When the destination is a direct pixmap, mapping colors is easy. If the destination's pixel depth is smaller than the depth of the source, the low bits are thrown away so the color values are truncated to the size of the destination. When the source's depth is smaller than the destination, the pixel's color-table value (not its index) is copied into the destination pixmap. A special case occurs when the source is a direct pixmap that's 16 bits deep and the destination is 32 bits deep. Here, the 5 high bits of the source are taken as the top 5 bits of the destination, and the top 3 bits of the source are taken for the bottom 3 bits of the destination.

When an indexed pixmap is used as the destination, the color mapping process becomes more complicated, since QuickDraw must find the index of the closest color in the color table. Rather than search the color table each time an index is needed, QuickDraw builds a structure called an *inverse table*. It's commonly called an inverse color table since it maps a color to an index, rather than an index to a color as a standard color table does.

Depending on the resolution of the inverse table, QuickDraw takes the high 3, 4 (the default), or 5 bits of the red, green, and blue color components of the color in question and constructs an index that's 9, 12, or 15 bits in size. This index is used to find the relevant entry in the inverse table. That entry corresponds to the index of the closest color in the color table.

But there's a problem here: Since the inverse color table uses only several bits from each of the source color components, multiple entries in the source color table could map to the same position in the inverse color table. Thus, the inverse table by itself is not adequate for finding the closest color match.

QuickDraw solves this problem by using a *hidden color list*, which keeps track of colors that map to the same location in the inverse table. If the inverse table lookup reveals a position to which multiple colors map, QuickDraw searches the hidden color list for the closest match. To find the closest match, QuickDraw finds the difference between the color's red, green, and blue components and those of each color in the hidden color list. The maximum difference of the three channels is kept for each color. The closest—and desired—color is the one that minimizes this difference.

Unfortunately, searching the hidden color list takes time. The time is negligible for objects (since usually only one color lookup is needed) and for indexed pixmaps (since at most only 256 color lookups are needed). However, with a direct pixmap as the source, searching the hidden color list for every pixel in the source takes a prohibitively long time, so QuickDraw doesn't do it. This results in QuickDraw's not using the best available color in some cases when the source is a direct pixmap and the destination is an indexed pixmap.

A color image overlapping an 8-bit monitor and a 1-bit monitor can create problems. Because the resulting color image is light, QuickDraw's algorithm for mapping colors produces mainly white, resulting in an image that is hard to recognize. There are two basic ways to overcome this problem: The first is to put smarter color translation in QuickDraw

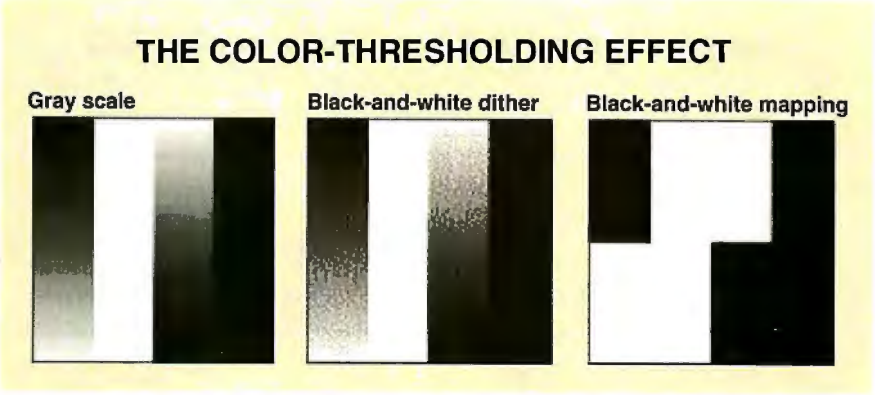


Figure 2: *The use of color thresholding helps to preserve the luminance of an image.*

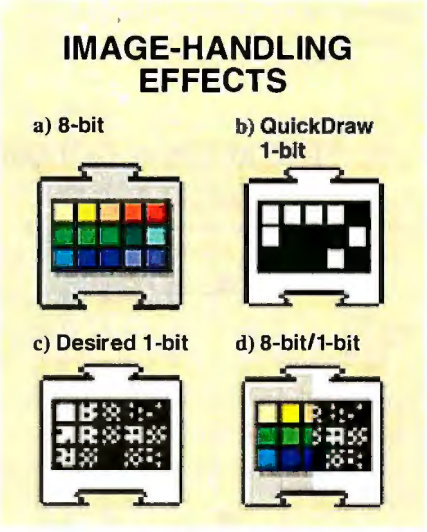


Figure 3: *Handling imaging under a variety of conditions.* (**a**) *A full-color image.* (**b**) *An image drawn to a 1-bit screen. Colors map to either black or white, which produces ambiguous results.* (**c**) *The desired appearance at 1-bit resolution.* (**d**) *The desired results when the image straddles an 8-bit-color monitor and a black-and-white monitor. Various QuickDraw color-mapping routines can resolve this situation.*

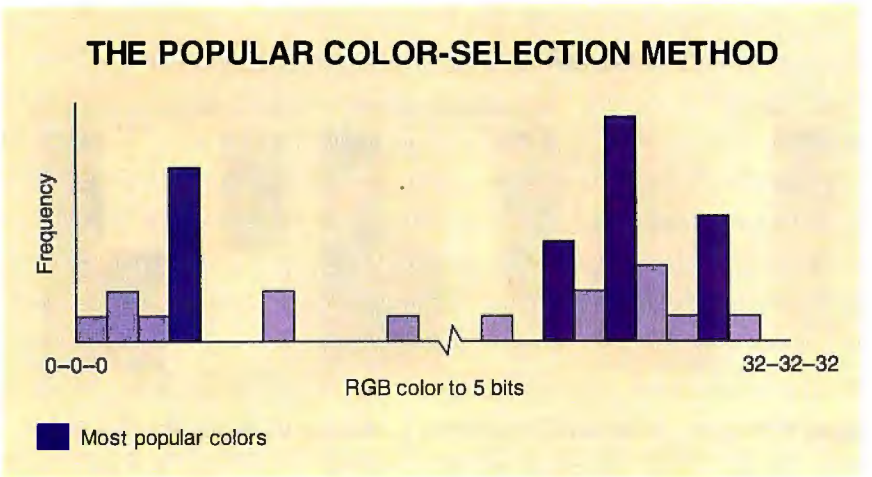


Figure 4: *In the popular method of color selection, the most frequently used colors, as tallied in the histogram, are used for the display.*

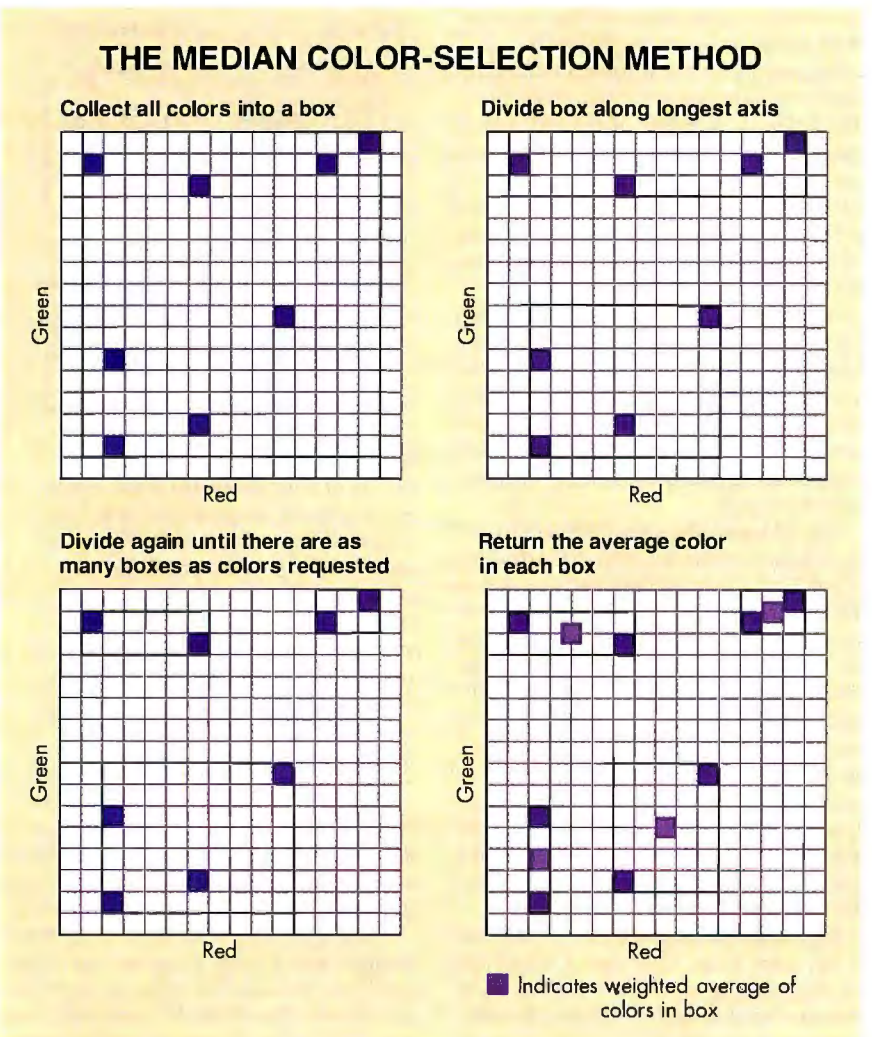


Figure 5: *The median method of color selection. The image's colors are grouped into a box that is divided until there are as many boxes as there are colors requested. The median colors within each box (marked with red) are used for the display.*

(which happened with 32-Bit QuickDraw 1.0); the second is to allow an application to draw independently to monitors with varying screen characteristics (which is possible with System 7.0 and higher).

Smart Color

QuickDraw's ability to map colors for geometric objects is limited to the algorithms I have already described. For drawing pixmaps, however, QuickDraw has the ability to perform an *error-diffusion dither*. Normally, the closest match available on the destination device is chosen to represent each color requested in the source. With dithering, the difference between the closest matching color and the requested color is kept as an error and added to the surrounding pixels. This ensures that the overall color (or, in the case of a monochrome image, the overall luminance) of the image is preserved. Figure 2 shows a gray ramp drawn using the 50 percent thresholding algorithm in dither mode.

Setting the dither flag results in substantially higher quality images, but the results may still be less than optimal. For example, a set of blue lines on a red background might simply look gray (with dithering) or black (without dithering) on a 1-bit display. Clearly, you can do better if you know what the characteristics of the destination device are.

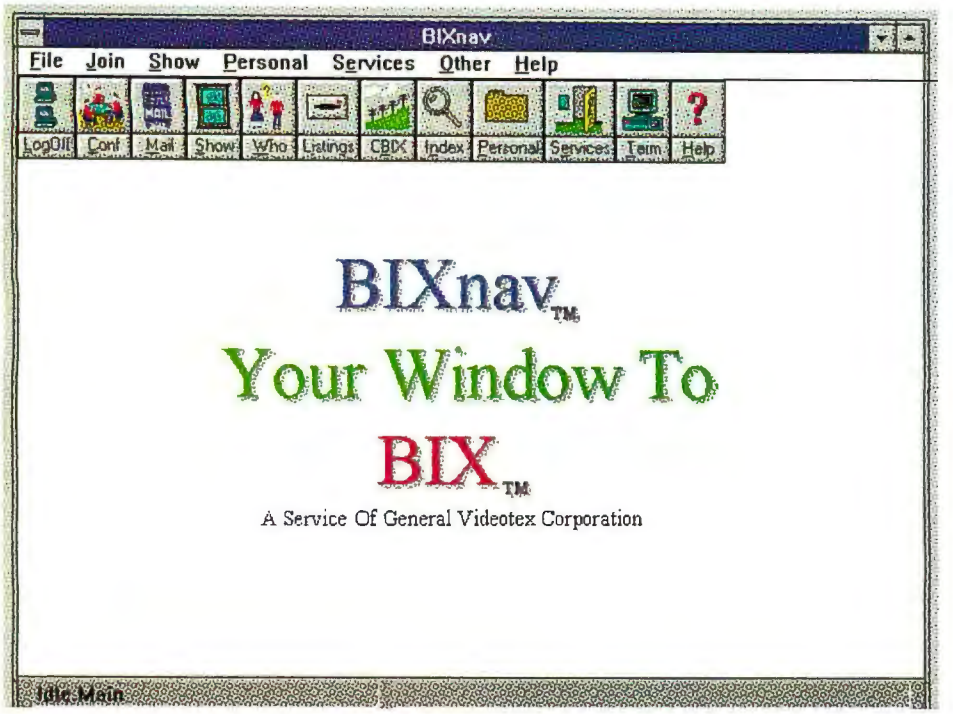
QuickDraw gives an application the ability to perform drawing updates on a device-by-device basis rather than simply drawing within QuickDraw's abstract model. At first glance, it might seem that examining the destination device's characteristics to determine how to draw a given image would contradict QuickDraw's device-independent model and would be frowned upon by Apple's Developer Technical Support, its "programming police." But it turns out that device-specific drawing integrates seamlessly with the rest of QuickDraw because QuickDraw supplies a Toolbox call for your use.

The call that permits device-by-device updates is called `DeviceLoop`. You call `DeviceLoop` with a region to update and a drawing procedure, and then `DeviceLoop` calls the drawing procedure once for every screen that the update region intersects. The drawing procedure is passed the characteristics of the device it is drawing to, and it performs the appropriate drawing for that device.

Figure 3 shows the type of problem that can be solved using the `DeviceLoop` call. Figure 3a shows the desired pixmap image in full color. Figure 3b shows this image as QuickDraw draws it to a 1-bit screen. The intent of the image is gone, however. Figure 3c shows the desired 1-bit image.

continued

Introducing BIXnav



- Software Libraries
- Background Downloading
- Powerful Search Feature
- Hypertext to file downloads, mail addressing, and user information

A WINDOWS NAVIGATOR FOR BIX

BIX Covers Computing Right!

Not only does BIX have great information, now it has a great user interface.

When you are up against a brick wall and need answers to tough programming questions fast, BIX has the solutions you need! Other online services cater to end users and computer neophytes. BIX serves computer pros like you! On BIX, you don't have to pan through mountains of trash to find the golden nuggets. You get fast answers from people who know computing.

BIX's Exchanges cover all aspects of computing in all platforms and computer languages. And BIXnav makes using BIX as easy as your other Windows applications.

Lots of New Files

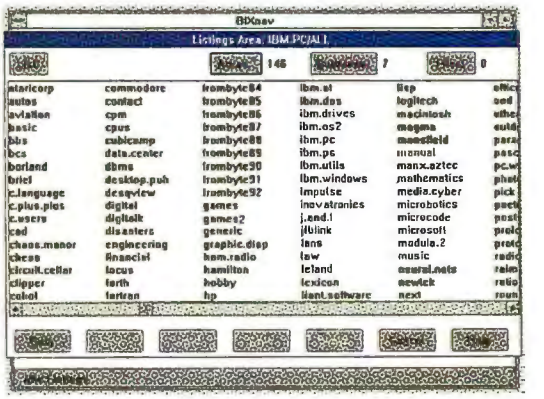
BIX publishes hundreds of new files each month. You can find files by date or keyword, and you can even download them in the background with a simple click.

BIX is Affordable

Subscribe to BIX for only $13 per month. Connect to BIX locally via Tymnet for only $3 per hour.* Or, choose the 20/20 Plan, where $20 per month covers your first 20 hours of evening or weekend access. Additional time is only $1.80 per hour on the 20/20 Plan.* Once online, you can download BIXnav for only $9.95.

Join BIX Now!

Using any communications program, dial 1-800-695-4882. Enter "bix" at the prompt. When you are prompted for



"Name?" enter "bix.navigator" and complete the online registration. Pay by credit card for immediate access.

For additional information call
1-800-695-4775 or 617-354-4137.

BIX is a service of
General Videotex Corporation,
1030 Massachusetts Avenue, 4th Floor,
Cambridge, MA 02138.
617-491-3342.

*Rates listed apply for evening and weekend access from within the contiguous 48 states. Daytime access from within the contiguous 48 states is billed at $9 per hour.

Circle 450 on Inquiry Card.

Figure 6: *An example of the image results you can expect when using several color-selection mechanisms.* **(a)** *is the original image,* **(b)** *uses the colors in the standard 4-bit system palette,* **(c)** *uses the 16 most popular colors, and* **(d)** *uses 16 colors as calculated by the median-cut algorithm.*

Finally, figure 3d shows the image as it should be drawn when it crosses a full-color screen and a monochrome screen.

Palettes and the Picture Utilities

QuickDraw provides applications with an additional level of color control for indexed devices of 2, 4, and 8 bits (1-bit devices are generally set to black and white). While you have control over the screen depth and its mode (i.e., grays or colors), the application controls each window's colors via a part of QuickDraw called the Palette Manager. For example, if you select a pixel depth of 4 bits for the display, the application decides which 16 colors (actually only 14, since black and white are always present) to use for each window.

QuickDraw acts as the referee that ensures that the color requests of the frontmost window (i.e., the window you're working with, which thus requires the most accurate color representation) are met. Thus, the problem the application faces is finding the best palette to use. For example, a scanning application might want to determine what the best 256 colors are for displaying a given scanned image. Fortunately, QuickDraw has the facility for solving this problem. A set of routines called the Picture Utilities returns a palette of best-fit colors for use in displaying the PICT file or pixmap.

The application can select one of two available algorithms for choosing the best colors. The first is the *popular method*, which simply returns the colors that occur most frequently in the image. The second is called *median cut*; it returns colors that cover the range of colors used in the image. You can also implement your own algorithm for color selection that the Picture Utilities can use. For more information on finding the optimal color palette, see issue 10 of *develop*, Apple's magazine for programming techniques and tips.

Figure 4 shows the operation of the popular method. A histogram accurate to 5 bits for red, green, and blue is constructed. The Picture Utilities returns the most frequently occurring colors. With the median-cut method of color selection, all the colors are first grouped into one box. This box is divided along its longest edge (the green axis, in this case), and the colors are sorted by their green components. This produces two boxes. The box that has the longest edge is divided along that edge. This produces three boxes. This operation continues until there are as many boxes as there are colors requested. The average color in each box is returned as one of the median colors. Figure 5 shows how the median method works. This figure shows only the red-green axis.

To understand why there are several color-selection algorithms, look at figure 6, which shows four versions of the same image. Figure 6a is the original, 6b is drawn using only the colors in the standard 4-bit color table, 6c is drawn using the 16 most popular colors, and 6d uses 16 colors returned by the median-cut algorithm.

A Visual Tool

I've covered a lot of ground in this article, but the most important point to remember is that QuickDraw has a lot of power and flexibility. QuickDraw provides a common base on which programmers can build their applications. Its device-independent design allows Mac applications to run on a variety of Macs with widely different processors and video circuitry—even Macs using multiple monitors.

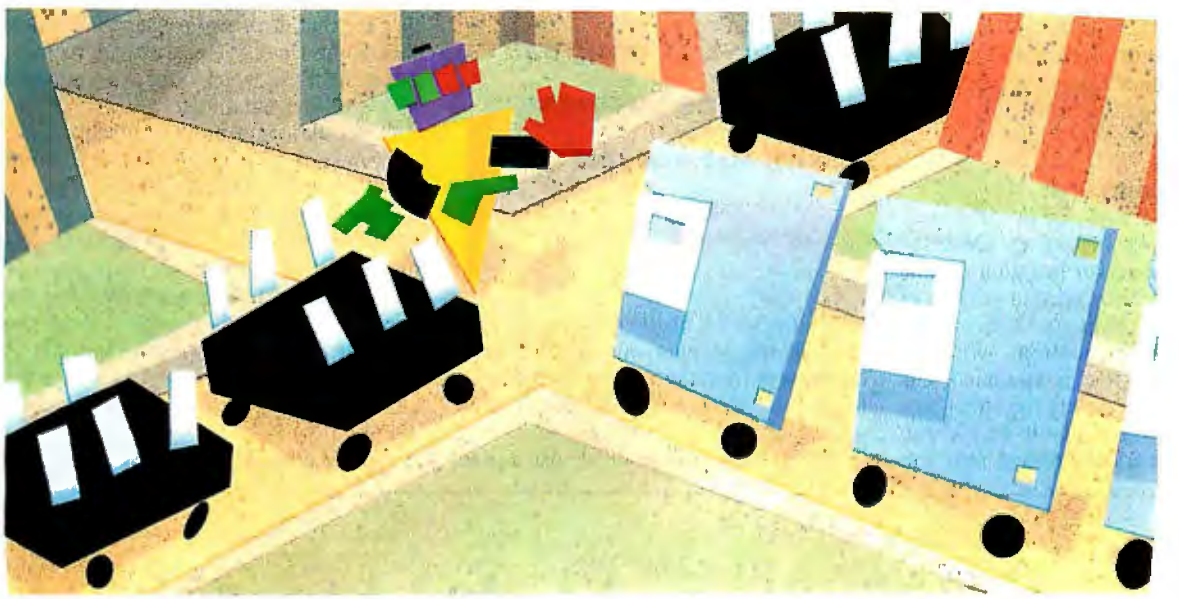
Furthermore, QuickDraw uses color mapping to produce visually optimal results, regardless of a display's size and depth. In those instances where you have a specialized application that needs precise color control, you can use the Picture Utilities or well-defined operating-system calls such as `DeviceLoop`. These functions allow you to choose the best colors with which to display a given image, without forsaking application compatibility.

QuickDraw is a versatile tool that lets programmers concentrate on obtaining powerful imagery while it handles the intricate details of making the results look their best no matter what screen is used. Thanks to these capabilities, the Mac is still regarded as the best microcomputer for color graphics and imaging work. Better still, QuickDraw is evolving to provide even better color control and to deal with complex problems, such as color matching, that users will demand solutions for in the near future. ■

Konstantin Othmer works at Apple Computer. He has worked on kanji TrueType, QuickDraw, and ColorSync and is the author of two books on computer software: Debugging Macintosh Software with MacsBug *and* Programming with QuickDraw, *both published by Addison-Wesley. You can contact him on BIX c/o "editors."*

RICK GREHAN

A SHARED RESOURCE ACCESS MANAGER, PART 2



Last month, I opened a discussion on resource access management and explored several ways to coordinate multiple programs requesting control of system resources. Resources can be any asset that your programs use in a multitasking or multiuser environment. Examples include *physical* resources, such as a network printer, and *logical* resources, such as database records.

This month, I conclude the discussion by looking more closely at the access manager I briefly described at the end of Part 1. The access manager is written for BSD Unix and is composed of two main pieces: a server program and a library of client routines. (I tried to isolate the network interface routines sufficiently that the access manager could be ported to other systems, such as NetWare.)

The server is a stand-alone program that runs as a background process, maintaining a list of available resources as well as handling the chore of determining whether an access request should be granted or denied. These access requests are transmitted to the server from one or more *clients*—separate programs running locally or on other workstations networked to the machine on which the server executes.

The client routines are a collection of C functions that you link into your application program. They take care of the dirty work of finding the server, establishing a connection, and so on. When it's time for your application program to, for example, obtain exclusive access to a printer or lock a record in a database, your program calls a routine in the library that does all the communicating with the server. Most of the action within this access management system revolves around both server and client routines manipulating a list of data objects. These objects carry descriptive information for resources, clients, connections, and access requests. I'll refer to such objects as *definition blocks*.

The network resource access manager is a true client-server application for BSD Unix systems

Handles and Blocks

Most of the important data structures that the server controls are dynamic: They come and go. Both the server and client library routines make use of a squad of such definition blocks; there is one for each entity handled by the system. Thus, any resource managed by the server is described by a definition block, any lock is described by a definition block, and so on.

The system makes heavy use of handles as shorthand identifiers of all data structures that a client program manipulates. If you've done any file-system programming, you're already familiar with how handles operate. Initially, your program provides a symbolic name of the entity on which it intends to work—in the file-system example, your program issues a call to the `open()` function, with the file's path name as an argument. The `open()` function returns a 16-bit handle that is bound to a data structure internal to the operating system.

continued

ILLUSTRATION: ROGER BOEHM © 1992

This structure carries everything the operating system needs to manipulate the file. Whenever your program wants to perform file I/O, it calls the appropriate function and passes only the handle. The operating system uses the handle as a pointer to the appropriate data function, so your program needn't use the file's path name over and over.

The resource manager uses this same principle. All definition blocks are ultimately referenced by their handles. This keeps information exchange across the network to a minimum (all handles are 16 bits long), and since a handle is an instant pointer to its definition block, it saves the server from lengthy searching.

Clients and Connections

A client is any process or program that does business with the server. Once the client locates the server program (via its network address in the current version of the software), the client establishes a digital dialogue—a connection—with the server by issuing a `login` command. The `login` command is simply the client process saying, "Hello. I want to be a client. Here's my network address where you should send all correspondence."

In response, the server builds a client definition block in which it stores the client's network address, and it sends the handle of the block back to the client. This handle becomes a kind of ID badge by which the server distinguishes that client from all other clients, since any future requests sent from that client will carry the handle (the client routines insert the handle automatically).

A client is any process or program that does business with the server.

The client definition block also carries two counters. These counters indicate the number of active and waiting lock requests issued by that client. The server can use these counters to determine whether any cleanup has to be done in case the client unexpectedly issues a `log_out` command (which terminates the connection between client and server). For example, suppose a client process issues an exclusive lock on a printer queue and then logs out without releasing the lock. The server will examine the counters in the client definition block and see that the client has an outstanding lock somewhere. The server can then remove this lock, which otherwise might tie up the printer indefinitely.

From the client process's perspective, a connection with a server (often referred to as a *session*) is identified by a connection definition block. The connection definition block is analogous to the client definition block that the server maintains; that is, it contains all the information that the client process needs to maintain contact with the server. Specifically, it contains the server's network address as well as the handle that the server has assigned to the client.

Since a connection on the client side is

Not since Jimmy Stewart has there been such a combination of character and good looks.

C-scape® lets you easily create handsome and completely portable character-based applications with integrated graphics.

C++/Views™ lets you easily create handsome and completely portable applications for MS Windows and other GUI environments.

We offer a complete line of user interface toolkits to make your applications become stars.

Even better, our toolkits let your applications appear on screens everywhere — from DOS to Windows to UNIX and more — without modification.

C-scape. The most flexible user interface package

C-scape provides you with a library of powerful windowing functions such as scrolling windows, mouse support, and graphics.

Look & Feel®, C-scape's interactive screen designer, makes prototyping and code generation almost effortless.

C-scape supports both text and graphics mode.

C++/Views. The leading C++ class library.

C++/Views has over 100 proven and portable C++ object classes for GUI development.

These classes shield you from the underlying GUI environment and API — slashing development time on GUI programming up to 75%.

C++/Browse™, a powerful source code browser comes *free* with C++/Views as does a sophisticated documentor.

Call 800-662-9866. FAX 508-992-6936.

Call for a free demo today. Both products come with source code — FREE

LIANT

All trademarks belong to their respective companies. Copyright © 1992 by Liant Software Corporation, 959 Concord St., Framingham, MA 01701. 508-997-5801. C-scape for DOS $495. C++/Views for MS Windows

Circle 191 on Inquiry Card (RESELLERS: 192).

HI JetPro®. A day's work in under an hour.

9:00 AM
A- to C-Size CAD Plots

No more waiting for pen plotter check plots. HI JetPro Series V100 and V50 plotters create HP-GL™/2, HP-GL and DM/PL™ CAD "review plots" at 360 dpi in under five minutes! No options needed. Includes real and protected mode ADI® drivers.

9:05 AM
FAX Output

HI JetPro V100 outputs FAX/modem files directly for high-resolution A- to C-size plain paper copies. Optional sheet feeder for A- and B-size output.

9:10 AM
Spreadsheets

C-size and rollfeed capability allow you to create large, readable spreadsheets. Drivers are available for Windows™ 3.0 and 3.1 compatibility.

9:15 AM
Multiple Review Copies

For meetings create A-size review copies in one minute; high-quality, C-size review copies in under five minutes.

9:30 AM
Documents

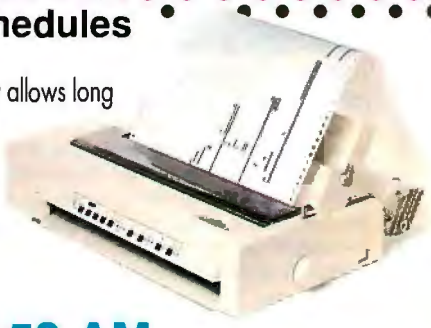
HI JetPro Series emulates the IBM® Proprinter™ XL24 to create high quality reports and letters from a wide range of word processing packages.

9:35 AM
Scanner Output

HI JetPro V100 automatically reads and outputs high-resolution, scanned, raster images from hand-held (PCX), desktop (TIFF) and large-format scanners (RLC and CALS). At a fraction of the cost of electrostatic plotters.

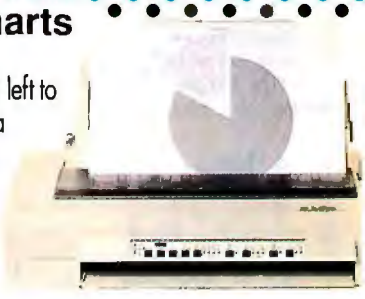
9:40 AM
Project Schedules

The rollfeed accessory allows long project management charts to be plotted from rolls of opaque or translucent bond paper.



9:50 AM
Presentation Charts

There's even time left to do large-scale charts for a 10:00 AM presentation. For information on HI JetPro Series plotters, or the name of your local dealer, call 1-800-444-3425.



New HI JetPro® Series Plotters.

HOUSTON INSTRUMENT®

Every decision should be this easy.™

© 1992 Summagraphics Corporation. Seymour, CT 06483. All rights reserved.

Circle 116 on Inquiry Card.

1	Exxon	25	Standard Oil (Ohio)	49	Consolidated Foods
2	General Motors	26	AT&T Technologies	50	Lockheed
3	Mobil	27	Boeing	51	Georgia-Pacific
4	Ford Motor	28	Dow Chemical	52	Monsanto
5	IBM	29	Allied	53	W.R. Grace
6	Texaco	30	Eastman Kodak	54	Signal Companies
7	E.I. du Pont	31	Unocal	55	Anheuser-Busch
8	Standard Oil (Ind.)	32	Goodyear	56	Nabisco Brands
9	Standard Oil of Cal.	33	Dart & Kraft	57	Johnson & Johnson
10	General Electric	34	Westinghouse Elec.	58	Coastal
11	Gulf Oil	35	Philip Morris	59	Raytheon
12	Atlantic Richfield	36	Beatrice Foods	60	Honeywe
13	Shell Oil	37	Union Carbide	61	Charte
14	Occidental Petroleum	38	Xerox	62	General Mills
15	U.S. Steel	39	Amerada Hess	63	TRW
16	Phillips Petroleum	40	Union Pacific	64	Caterpillar Tractor
17	Sun	41	General Foods	65	Aluminum Co. of Amer.
18	United Technologies	42	McDonnell Douglas	66	Sperry
19	Tenneco	43	Rockwell Int.	67	Gulf & Western Ind
20	ITT	44	PepsiCo		
21	Chrysler	45	Ashland Oil		
22	Procter & Gamble	46	General Dynamics	70	Weyerhaeuser
23	R.J. Reynolds Ind.	47	3M	71	Ralston Purina
		48	Coca-Cola	72	Colgate-Palmolive

While American business is trying to stay competitive with foreign companies, it's paying an added penalty. The penalty of double-digit illiteracy.

Believe it or not, 27 million American adults can't read and write. Another 47 million are literate on only the most minimal level. That adds up to almost one third of our entire population. . . and probably a disturbing number of *your* employees.

What does illiteracy cost you? Get out your calculator. Illiterate adults make up 50%–75% of our unemployed. Every year they cost us an estimated $237 billion in lost earnings. They swell our welfare costs by $6 billion annually and diminish our tax revenues by $8 billion.

Illiteracy costs you through your community, too. It robs the place where you work and live of its resources. It undermines the potential of the people who make your products and the people who buy them. No dollar figure can be assigned to this. But over the years, this may be the costliest loss of all.

What can your company do about this? It can join in local efforts to fight illiteracy. It can volunteer company dollars and facilities for better school and tutorial programs. It can invest in a more literate community.

The first step is to call the Coalition for Literacy at **1-800-228-8813** or fill out the coupon below. Do it today. You may find it's the greatest cost-saving measure your company has ever taken.

A literate America is a good investment.

Ad Council

Coalition for Literacy

☐ I want my company to join the fight against illiteracy. Please send brochure with additional information

☐ We want to discuss funding the Coalition for Literacy Please have a representative contact me

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

Phone _____

Please return to Coalition for Literacy
Business Division
PO Box 81826
Lincoln, NE 68501 1826

defined by a connection definition block, a single program can log into the server more than once and appear as more than one client. For example, you might have a multithreaded program, each process of which accesses a single data file for different purposes. It's perfectly reasonable for each process to log into the server independently.

Maintaining the data that describes a resource is the server's job.

Resources

Maintaining the data that describes a resource—its name, the locking levels it permits, the number of active locks on the resource, and so on—is the server's job. All the data defining a particular resource is held in a resource definition block.

Each resource definition block is uniquely identified by two entities: its name (a string field of up to 32 characters) and a handle. The handle is implicit; it's simply the offset to the particular resource block in the memory region that holds all resource definition blocks. The name field is an explicit symbolic identifier that clients use to initially reference the resource. This string can contain arbitrary characters (except for a NULL character, which acts as a terminator), so your programs are free to establish any naming convention you consider appropriate. For example, network printers can be named NWPRT:LASER1 and NWPRT:JET2 and can be handled by the resource manager right alongside database records with names like DBF:GENLEDGER:00103 and DBF:GENLEDGER:02344.

When a client requests a lock on a resource for the first time, that client only knows the resource by name. Consequently, the server must respond to the request by searching the name fields of all active resource blocks. To facilitate this search, all the active resource blocks are chained together on a doubly linked list.

Why did I choose a linked list rather than some other structure with quicker

YES!

Enter my one-year (12 issues) subscription to BYTE for only $24.95. **I'll save 40% off the single copy price.** Plus, I'll also receive BYTE's Annual Special Issue FREE with my paid subscription. If at any time I'm not satisfied with BYTE, I may cancel for a full refund on all unmailed copies.

❑ Payment enclosed ❑ Bill me

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Please allow 6-8 weeks for delivery. Basic subscription rate is $29.95. (Mexico, $29.95 payable in U.S. funds.) Above rates are for U.S. delivery only. Please see table of contents for international subscription rates.

PRINTED WITH SOY INK

SAVE 40%

BYTE

IB29014

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 42 HIGHTSTOWN, NJ

POSTAGE WILL BE PAID BY ADDRESSEE:

BYTE

Subscription Department
P.O. Box 558
Hightstown, N.J. 08520-9409

search times, like a binary tree or a hash table? I had two reasons.

First, the only time the server must search the list is when a client makes an initial request for resource access. After that, the client uses only the handle to reference the resource definition block, so locating the block is instantaneous.

Second, there are two resource types—permanent and transient. The definition block for a permanent resource, such as a printer queue, remains active even if no locks are present on the resource. However, the definition block for a transient resource, such as a single record in a database file, is discarded after all active and waiting locks on the resource have been released. Using a doubly linked list simplifies the task of disconnecting blocks from the list.

Each resource definition block also has a pair of lists attached (see the figure). One is the list of all active locks currently enforced on the resource; the other is the list of all locks that have been forced to wait because they conflict with one or more of the active locks. (I'll go into detail about the members of these lists later.)

When a client issues a lock request for a resource, the server must decide whether that request should be granted (in which case the request goes on the active list) or denied (in which case the request goes on the waiting list). Rather than force the server to search the active list each time it has to make this decision, each resource definition block carries an array `curr_locks[]`, such that the value of `curr_locks[i]` is the number of locks currently active at lock level *i*. Also, the resource block carries an array called `lock_comp_tab[]` (short for *lock compatibility table*), whose contents show which lock levels are compatible with each other. The server can examine these two arrays and rapidly decide the fate of a lock request.

The code the server must execute to make a lock grant/deny decision is actually quite simple. First, given that a lock level is stored in variable `lockl`, the server builds a bit mask that has the bit corresponding to that lock level set to 1. You can do this with the following code:

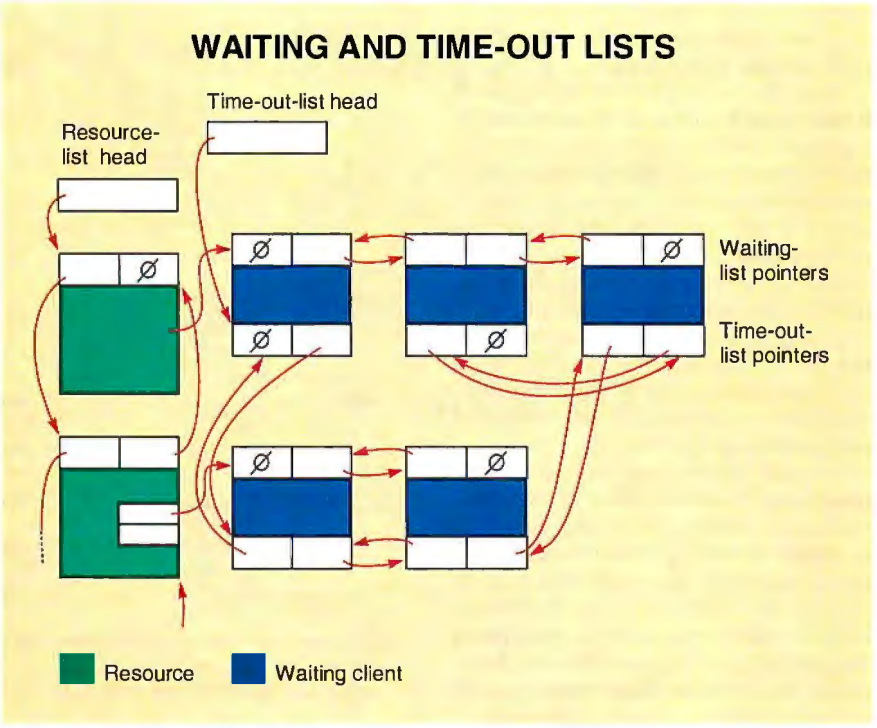
```
lockm=(uchar)(1<<lockl);
```

where `uchar` is a `typedef` that is shorthand for `unsigned char`. Now the resource manager can simply examine each member of the lock compatibility table. For any member in the table that has a bit set corresponding to lock level `lockl`, the manager checks the associated value in the `curr_locks[]` array. If that value is nonzero, then a lock already exists on the resource that is incompatible with the request being made. The code looks like this:

```
for(i=0;i<4;i++)
 if((lockl & lock_comp_tab[i])!
      =(uchar)0)
   if(curr_locks[i]!=0)
     return(FAIL);
```

If execution makes it out of the above loop, the lock can proceed. (I've taken some liberties with the code to preserve clarity; although I haven't shown it here, the two arrays are actually components of the structure that defines a resource definition block.) Note that the number of lock levels is easy to expand by simply increasing the size of the `lock_comp_tab[]` and `curr_locks[]` arrays and increasing the limit of the above `for` loop accordingly. The lock comparison table is currently defined as an array of `unsigned char`, which means that the current program can support up to eight lock levels with those minor modifications.

As I mentioned above, the server carries all the detailed information about a resource. Initially, a client program knows only the resource's name; it loads that name into the first lock request for the resource. The server will return the resource's handle in response to this request, and thereafter the client program uses that handle to identify the resource.



Attached to each resource is a list of lock definition blocks representing pending lock requests. Lock requests enter the lists in order of arrival; pending requests are also connected to a systemwide time-out list. Requests are attached to the time-out list based on the length of time each associated client will wait for lock request service.

Locks: The Server View

A lock definition block serves to record a lock request that a client posts. You recall that all lock definition blocks live on one of two lists and that these lists are anchored to a resource definition block associated with the resource being locked. The most important component of a lock definition block is the lock level. It guides the server's decision on whether the lock can proceed or must wait. The server also uses it to update the contents of the resource definition block's `curr_locks[]` array.

Regardless of what list it's on, a lock definition block also holds the handle of the resource to which it's attached, as well as the handle of the client making the lock request. The resource handle lets the server rapidly locate a lock's target resource in case the resource definition block must be modified to reflect a change in the lock. The client handle is necessary if a client issues a log-out and still has lock requests active or on waiting lists. When this happens, the server must scan all resource active and waiting lists and remove those lock definition blocks associated with the client (a time-consuming job, to be sure, but one that should happen infrequently;

it's most likely to happen if a client's program terminates abnormally and is trying to at least die with dignity).

Typically, a lock request will arrive at the server and end up at the tail of a waiting list. As locks are released, the server removes their lock definition blocks from the active list, updates the state of the resource definition block, and then examines the head of the waiting list to see if that lock request can move to the active list. The server continues moving locks from the waiting list to the active list as long as the lock requests can be granted. This is the mechanism by which the FIFO (first-in/first-out) waiting list I described last month is implemented.

Locks on the waiting-list items are actually members of two doubly linked lists. Once again, I chose the doubly linked list structure because it is easy to rapidly attach items to and, most important, remove items from random locations within the list. My description of these overlapping lists gets complicated, so refer to the figure during this discussion. Remember that each resource possesses a waiting list. Lock-request definition blocks are attached to the end of this list as they arrive at the server. This is a FIFO queue.

However, each lock request also carries an associated time-out value. This value tells the server how long the client is willing to wait for the associated request to be serviced. The resource manager maintains yet another list to which all waiting lock requests are attached in order of ascending time-out values. This list, the *time-out list*, crisscrosses the waiting lists of every resource in the system (see the figure).

At the head of the time-out list is the first request due to time-out; next is the second request due to time-out; and so on. When a lock request arrives that the server determines must go on a waiting list, the server "wires" the request into the time-out list. At regular intervals, the server examines the first request on the list to see if that request has timed out. If so, the server removes the request from the system and sends a "request timed out" response to the client. The server repeats this process, removing the new first request if it has timed out, until it encounters a request that has not timed out. Since all requests in the system are on the time-out list, this saves the server considerable time; the server doesn't have to repeatedly examine all requests on all the waiting lists to see which ones have timed out.

Listing 1: *Definitions for the primary structures used on the client side.*

```
/*************************
** Connection definition **
*************************/
typedef struct {
   short client_hand;     /* Client handle */
   int socket;         /* Server socket */
} connect_def;

/****************************
** Access definition block **
****************************/
typedef struct {
short result;              /* Result code of request */
    char name[32];         /* Resource name */
    char template_id[4];   /* Template ID string */
    short resource_hand;   /* Resource handle assigned by server */
    short lock_hand;       /* Lock handle assigned by server */
    short lock_level;      /* Lock-level request */
    ulong wait_timeout;    /* Maximum time to wait for request */
    ulong quantity;        /* Used for multi-instance resources */
} access_def;              /* Access handle */

/*********************************
** Resource definition structure **
*********************************/
typedef struct {
    char name[32];                  /* Name */
    short flags;                    /* Definition flags */
    uchar lock_comp_tab[4];         /* Lock compatibility table */
    short act_clients_allowed;      /* Active clients allowed */
    short wait_clients_allowed;     /* Waiting clients allowed */
} resource_def;
```

Locks: The Client View

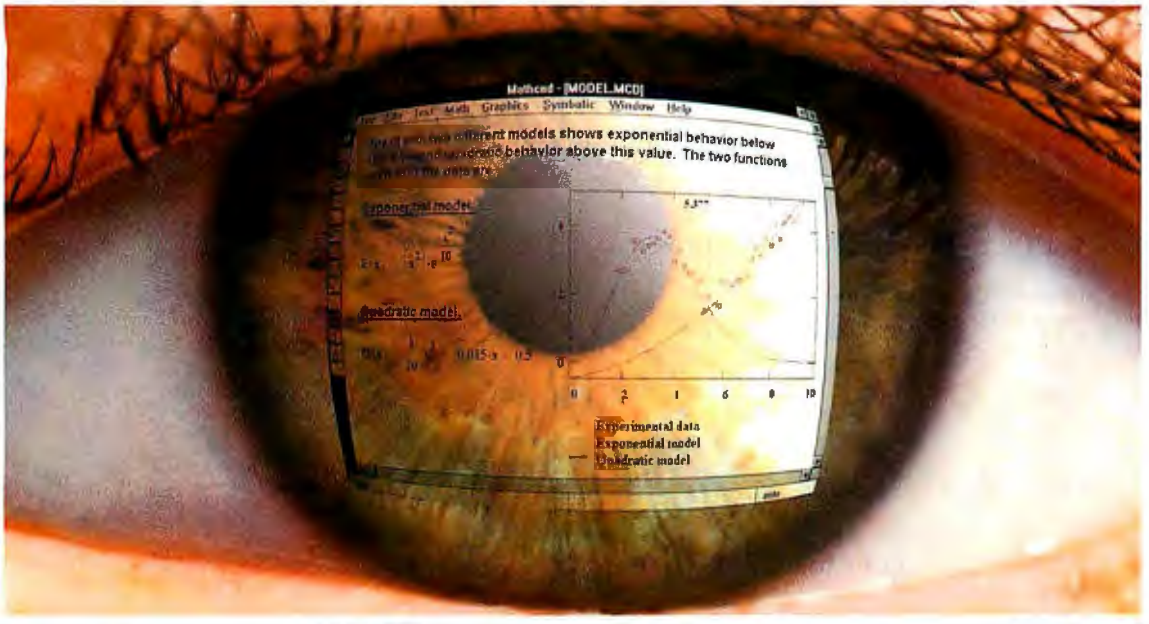
For every lock request that a client submits to the server, the client program creates a data structure similar to the lock definition block. This structure is known as an access definition block, and the act of issuing a lock request to the server actually amounts to the client sending a copy of the access definition block to the server. The server attempts to satisfy the request, modifies the contents of the access definition block depending on whether or not the request succeeded, and transmits the results back to the client.

Inside an access definition block, you will find not only a resource name field, but also a resource handle field. When the server receives an access request block, it examines both fields. If the resource handle field contains a negative number, the server assumes that this is the client's first access request. So, the server must look up the resource by name and uses the contents of the resource name field to guide its search. Otherwise, the server can use the resource handle field to locate the resource directly. The access definition block also carries lock-level and time-out fields that the server must move into the corresponding fields of the lock request block.

In most cases, a client will request access to a resource that is already active in the server (i.e., has an active resource definition block). However, a client may make an access request to a resource that is not currently active; then the server will have to build a resource definition block on the fly. An example is when a client submits a request to lock a particular record in a database. The server certainly doesn't want to keep an active resource entry for every possible record in that database—there could be millions. This is an example of a temporary resource: one whose definition block is created only when a client issues a lock request and is deleted when all requests on that resource have been released.

To facilitate the rapid creation of temporary resource definition blocks, a client's access request also carries a four-character template ID string. When the access request arrives at the server, if the server finds neither the resource's name nor its handle, it uses the template ID to read a resource definition block template—a kind of fill-in-the-blanks form that the server can copy into a new resource definition block. The template defines such things as lock levels permitted, number of active clients permitted, the lock compatibility table, and so on—everything the server needs to rapidly construct the new resource definition block. (The server builds its in-memory library of templates by reading a

Think of it as a mathematical playground for your mind.



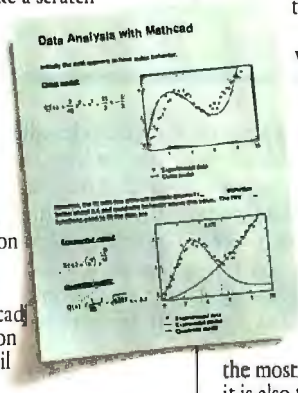
Open up a whole new world of scientific and engineering problem solving with Mathcad 3.1.

Between the challenge of new problems and the reward of new solutions there is math. Often, a lot of math.

Which is why we make Mathcad.

It's the remarkable software that gives you the power to perform everything from simple arithmetic to advanced computational gymnastics more quickly, easily and naturally than with calculators, spreadsheets or programming alone.

You use Mathcad just like a scratch pad. Simply type your work anywhere in the live screen and Mathcad does the calculating. Change variables and Mathcad automatically updates the answers. It plots in 2-D and 3-D. And prints your results, complete with text and graphics, in presentation quality documents.



Plus you see your work more clearly because Mathcad uses the same math notation you would use with a pencil and paper.

It's the complete math system.

Mathcad comes with more than 200 commonly used functions that let you quickly build even complex equations and formulas with exponentials, differentials, cubic splines, FFTs and more.

Full symbolic calculation capabilities are available with a menu pick. So you can evaluate any integral, Taylor series or infinite sum just by clicking.

NOW UNIX 3.1 AVAILABLE

Optional Electronic Handbooks* give you instant access to data, formulas and diagrams once found only in reference books. They're fully interactive. Just click and paste them right into your document and work with them like any other text, value, table or formula. Or work with them right in the handbook itself.

Plus optional Applications Packs with modifiable templates are available for all major engineering and science fields.

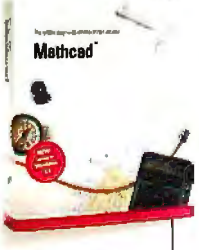
Over 200,000 satisfied users.

Each day, more engineers, scientists and other technical professionals discover that Mathcad opens up a whole new world of freedom in problem solving, and helps them manage their time more efficiently. Which is why in addition to being the most popular math software you can buy, it is also the most productive.

- Microsoft® Windows,™ Motif and Open Look interfaces make Mathcad easy to learn and use
- Optional Electronic Handbooks include The CRC Materials Science and Engineering Handbook, Machine Design and Analysis from the *Standard Handbook of Engineering Calculations* (McGraw-Hill), and the Mathcad Treasury of Methods and Formulas
- Optional Signal Processing Function Pack contains over 60 functions including FIR and IIR filter coefficients and power spectrum
- Optional Applications Packs with adaptable templates for Electrical, Mechanical, Civil and Chemical Engineering, Statistics, Advanced Math, and Numerical Methods
- PC Windows, PC DOS, UNIX® and Macintosh® versions available

Free demo disk.

For a free Mathcad demo disk, or upgrade information, call 1-800-628-4223, (or 617-577-1017, Fax: 617-577-8829). Or see your software dealer.



*Electronic Handbooks require Mathcad 3.1.

© 1992 MathSoft, Inc. ™ and ® signify manufacturer's trademark or registered trademark respectively.

1-800-MATHCAD

The answer is Mathcad®

MathSoft, Inc. 201 Broadway, Cambridge, MA 02139 USA • Phone: 1-800-628-4223 • 617-577-1017 • Fax: 617-577-8829

Australia: Hearne (03)866 1766; Belgium: SCIA 013/55 1775; Denmark: Engberg 042-231777; Finland: Zenex 0-692-7677; France: Uniware 01-45-272061; Germany: Softline (0 78 02) 4036; Italy: Channel 02-90091773; Japan: SMI 03-5476-9816; Sweden: AkademiData (018)2400 35; Switzerland: Redacom 032 41 01 11; UK: Adept Scientific (0462) 480055. In other locations, contact MathSoft, USA.

Circle 126 on Inquiry Card.

Listing 2: *In this simple example, a client application logs into the server and then requests exclusive access to a printer queue named PQUEUE:LASER1. After the client has completed use of the queue, the client releases the lock and logs out from the server.*

```
/*
** We presume that the server port has been
** decided on and is globally defined as
** S_PORT. We also presume that s_name points
** to the server name string.
*/

/*
** Login to server given by s_name.
*/
rval=rs_login(s_name,S_PORT,&connection_block);
if(rval!=0)
{       printf("Connection failed, error:
           %d\n",rval); exit(0);
}

/*
** Request exclusive access to a printer queue
** This is our first request, so we request it
** by name. Also, this is a permanent
** resource, so there is no template ID
** string.
*/
memset((void *)&access_block,0,
        sizeof(access_block));
   /* Name */
memmove(access_block.name, "PQUEUE:LASER1",13);
   /* Don't know handle */
access_block.lock_hand=-1;
   /* Exclusive lock */
access_block.lock_level=RS_LOCK_EXCL;
   /* Wait 100 secs */
access_block.wait_timeout=(unsigned long)100;

rval=rs_req_access(&connection_block,
   &access_block);

/*
** The code in rval indicates whether
** communication with the server somehow
** failed. The result code of the request is in
** the access block.
*/
if(rval!=0)
{       printf("Server communication failure:
           %d\n",rval); exit(SERVER_COMMERR);
}
if(access_block.result!=0)
{       printf("Request failed: %d\n",
           access_block.result);
        /*
        ** Code to handle request failure goes
        ** here....
        */
}

/*
** At this point, the client has exclusive
** access to the print queue.
*/

/*
** Release access to the queue.
*/

rval=rs_rel_access(&connection_block,
   &access_block)

/*
** Again, the code in rval indicates whether
** communication with the server failed.
*/

if(rval!=0)
{       printf("Server failure: %d\n",
           rval); exit(SERVER_COMMERR);
}

/*
** Log out. We'll ignore any errors at this
** point, but go ahead and wait for a server
** response.
*/

rs_logout(&connect_block,RS_LOGOUT_WAIT);
```

predefined file at start-up time. You can load as many templates as your applications require, up to your memory limits.)

Show and Tell

Listings 1 and 2 present a short example of how a client application would call the access manager to gain an exclusive lock on a print queue. Listing 1 is a collection of the structure definitions used by the client application; refer to it as you look over listing 2, where the real action occurs.

The code in listing 2 shows how a client would log into the server (i.e., set up a connection) and issue a lock request. Presumably, if the request is granted, the application will proceed to access the resource (in this example, copy printer data into a file). Once finished with the resource, the client issues a release command and then logs out from the server.

As usual, there are numerous additions you can make to tailor the system to your particular needs. For example, you may want clients to log in with an associated name, so if something goes wrong, you can create some auditing information and determine which client messed things up.

Another addition would be to add a monitoring screen that you can call up in case the system appears to be exhibiting difficulties. This screen would let you peek into the server and see which clients hold locks on which resources.

My requirements, however, are modest. I need only a systemwide lock manager that can handle record locking as easily as file locking, and file locking as easily as queue management. Perhaps the best attribute of this system is its extensibility; a variety of management functions can be brought under the control of a single program. Simplification is always welcome in the programming world. ■

Editor's note: *The listings in this article are available from BYTE in electronic format; see page 5 for details.*

Rick Grehan is technical director of the BYTE Lab. He holds a B.S. in physics and applied mathematics and an M.S. in mathematics/computer science. You can reach him on BIX as "rick_g."

BARRY NANCE

SOFTWARE WITH CURVES

Bézier curves, inside and outside Windows, and keeping Windows menus alive

If you want to draw curves in a Windows program, you can use the Bézier library routines in the Windows 3.1 SDK (Software Development Kit) or you can roll your own. With the latter approach, you have more control over the behavior of your program. You can also use the same basic routines in non-Windows graphics programs; you'll just have to remove the references to a Windows device context and substitute whatever is appropriate for the other graphics environment.

This month's software, CDRAW, is a Windows program that interprets an EPS (Encapsulated PostScript) file and displays the result in a window. I've also included a sample EPS file, created with Arts & Letters from Computer Support (Dallas, TX). The file contains dozens of curve-drawing commands. Even the text displayed on-screen exists in the file as sets of draw curve and draw line commands.

CDRAW is a C program that you can compile into a Windows executable file with a Windows-capable C compiler from Microsoft, Borland, or Watcom. The listings disk also contains the associated resource files (i.e., .RC and .ICO) for building the Windows application. The icon for CDRAW shows "EPS" and a picture of an eye—it also shows I'm not much of an artist!

When you pick the Draw menu item, CDRAW reads and interprets the EPS data. CDRAW processes move to, line, and curve commands embedded in the file. To draw a curve, CDRAW recursively invokes logic that uses the de Casteljau algorithm for Bézier curves. I wrote the de Casteljau routine as a separate C function, so you can scavenge the code and insert it into your own programs whenever you want to draw curves, whether inside or outside Windows.

Bézier curves and quadratic b-splines are both methods of approximating smooth curves, and both have applications in font technology. TrueType fonts are based on quadratic b-splines; Adobe Type 1 fonts are based on Bézier curves (4-point Bézier curves, to be specific). You need to store more data points to represent a TrueType font than an Adobe Type 1 font, but TrueType fonts require less computation. Nevertheless, Bézier-curve drawing, especially with the de Casteljau algorithm, is fast. So fast, in fact, that it's generally faster to convert quadratic b-splines to Bézier curves before drawing them.

If you find that CDRAW runs too fast to follow, you can slow it down by selecting the Slow Speed menu option. In this mode, CDRAW pauses for a second after each drawing command.

CDRAW doesn't turn the cursor into an hourglass while it draws. Instead, the program strategically calls the `PeekMessage()` Windows function to ensure that the message queue is emptied on a timely basis. If you click on the left mouse button, CDRAW sets a flag that tells the drawing function to stop. Because the `PeekMessage()` technique keeps the menus "alive" while the program draws, you can pick Slow Speed or Fast Speed while the drawing is in progress. ■

MAC/Tom Thompson

Zync Syncs Macs

Nothing creates more havoc than being out on the road, PowerBook in hand, and discovering that you left an essential file or application behind on your office Mac. You can head off trouble by simply checking that your PowerBook files match, or are "in sync" with, those on your desktop Mac. This seems easy enough, but it's easy to overlook some obscure folder or file buried deep in a collection of folders.

Fortunately, Ricardo Batista's Zync comes to the rescue. Zync, a freeware utility, compares the files of two networked Macs and makes both of the file systems match. It copies missing files to the machine that is lacking them and makes sure that the most recent copy of each file is on both computers. You can select an entire drive or just a single folder for the synchronization process. Zync requires System 7.0's file-sharing feature.

UNIX/Ben Smith

The Bit-Map Translators

Few subjects more resemble the post-Tower biblical community of Babel than image file formats. Different applications use a wide variety of formats (e.g., TIFF, GIF, and PCX), and translating between formats is a common problem.

Several sets of public domain translation utilities have grown up around the idea of translating all these formats to a common base format. From the base format, you can convert to whatever format you need. The least of these base formats (and the seed from which all these utilities sprang) is PBM (Portable Bit Map), developed by Jef Poskanzer. Now there are also PGM (for gray scale), PPM (portable pix map, for full color), and Michael Mauldin's FBM (Fuzzy Bit Map). This month's listings include utilities by these authors for working with all four of these formats, with features including sizing, scaling, retoning, halftoning, and quantizing, as well as translating.

Editor's note: *Software Corner highlights public domain, freeware, and shareware programs. The programs are available in electronic format. See "Program Listings" on page 5 for details. We solicit your contributions. We pay $50 for any program we use. Write to: Software Corner, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

C++ ... in Action

with Object-Oriented Analysis & Design

CONFERENCE & EXPOSITION
SANTA CLARA, CALIFORNIA

SEPTEMBER 21-25, 1992

PUTTING OBJECT-ORIENTED TECHNOLOGY TO WORK

PRESENTED BY

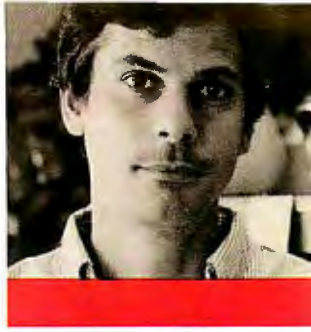
BOSTON UNIVERSITY

CORPORATE EDUCATION CENTER

To register for C++ *in Action*, or to receive a **FREE** brochure, call
508/649-4200,
or fax your inquiry to
508/649-2162.

■

For more information on exhibiting, call
800-733-3593, ext. 261,
or fax your inquiry to
508/649-6926.
Circle 388 on Inquiry Card.



JON UDELL

IN SEARCH OF AN OBJECT-ORIENTED FILE SYSTEM

Windows, like the Roman god Janus, has two faces. Program Manager surveys an abstract landscape of groups and items, and File Manager presides over a set of real tree-structured disk volumes. No such logical/physical duality confronts Mac users because Finder's nested-folders-and-icons view of the contents of a disk maps directly to actual directories and files. To reorganize your view of programs and documents, you have to literally haul them around on the disk. Deep within the Mac OS, the windowing and file systems conspire closely to make this approach fast and effective.

Windows 3.0, unable to emulate the Mac in this regard, charted a new direction. You saw programs and documents primarily as collections of Program Manager objects. In principle, this was a great thing. You could create pseudodocuments as program items configured to load data files. Thus, the group "Weekly reports" might contain the item "Week of February 12." This would launch WRITE.EXE and feed it the file C:\JON\WEEKLY\FEB1292.WRI.

Unhappily, the item "Week of February 12" didn't have all the properties a document should have. You could launch it, but you couldn't search for it. For that, you went to File Manager and hunted for, say, "FEB*.WRI"—*not* "Week of Feb*." Worse, you had two sets of copy/move/delete semantics to contend with. Are you copying/moving/deleting a Program Manager object—merely a pointer to a file? Or are you working with a File Manager object—the file itself?

Windows 3.1's new drag-and-drop features drove Windows' two faces even farther apart. In version 3.1, you can drop a file onto Print Manager to print it or onto the icon of a running program to load it into that program. But only File Manager can act as a drag-and-drop donor. So your effort to hide FEB1292.WRI behind a Program Manager abstraction comes to naught if you want to use version 3.1's direct-manipulation printing feature. You have to reveal the object's physical location, by File Manager navigation, to be able to drag it to the printer.

New Windows and OS/2 Desktops

Three new Program Manager replacements—Norton Desktop 2.0, WinTools, and NewWave 4.0—wrestle with the duality of the Windows desktop. There's also the OS/2 2.0 Workplace Shell, IBM's effort to smooth out a similar division that had plagued the Presentation Manager desktop. All four products add something that the original Windows and PM desktops lacked—a fully hierarchical logical view.

Only an object-oriented file system can resolve the File Manager/Program Manager duality

At first blush, the nested folders, groups, or objects seem to make these environments more Mac-like. But there's always a separate file manager hanging around, because none of these shells can free you completely from the need to navigate the file system. Further, as the logical view grows more ambitious, the logical/physical duality worsens.

While Norton Desktop and WinTools do allow nested objects, they don't really push these as the preferred method of document organization. The tip-off is that neither product can search its respective object name space. To find a "Weekly report" object, you have to remember where you put it or bypass the logical view and use a file manager to track down its data file directly. Clearly, you're not expected to build a logical view that rivals the complexity of the physical one, which for typical users can involve thousands of files and many levels of nested directories.

NewWave and the Workplace Shell, on the other hand, do want you to build elaborate logical views, and they include tools for searching the logical namespace. Both enable you to pull existing material into their logical views (when installed onto a DOS partition already full of programs and documents) and to capture newly created material as well.

The Workplace Shell's migration tool automatically captures DOS, Windows, and OS/2 applications as Workplace Shell *program-file objects*, but it's up to you to create *data-file objects* by dragging data file icons from the Templates folder and specifying the applications that created them. NewWave goes further, automatically migrating both programs and documents into its environment.

Because NewWave's list of document types is richer than OS/2's and more closely coupled to program-launch behavior, things integrate much more smoothly. NewWave takes great pains to capture

ILLUSTRATION: JAMIE HOGAN © 1992

your work in its object database. That's a given if you run NewWave-aware applications like TextNote, the Notepad-like text editor included with the package. The desktop's Create a New dialog box offers TextNote as an object type.

When you create a TextNote, you get an appropriately typed document object that you can drag from folder to folder and that launches the TextNote editor when you double-click on it. Unlike Notepad, TextNote's Save As menu option doesn't invoke Windows 3.1's Common File dialog box. You can rename the *object* using Save As, but NewWave won't let you get at the file.

It does have a real DOS identity—out of perverse curiosity, I found that "Memo to Anne re: PC EXPO" was stored as C:\HP-NWDATA\HPOMF002\0000006B.SRD—but you don't need to know that to search for, edit, delete, or print the document. You do, however, have to reconstitute a DOS identity for the file if you want to, say, copy it to drive A. NewWave provides the admittedly awkward Detach DOS File from Object function for this purpose.

Alternatively, you can register non-NewWave-aware applications as object types. Because real NewWave applications are scarce, this is the usual arrangement. If you add Notepad to the set of types known to the Create a New dialog box, things appear to work just as with a TextNote.

There are subtle differences, however. You can have a Notepad object refer to a normal DOS text file "in place," or you can choose to have NewWave move the data into its object database. If shift-clicking on the object's name reveals a DOS path name, NewWave doesn't own its storage; otherwise, NewWave does. The distinction matters. If you dump a DOS-managed object into the Waste Basket, you'll just delete the object; if you trash a NewWave-managed object, you'll delete its data as well. With two file systems coexisting, conflicts are inevitable.

Ultimately, neither NewWave nor the Workplace Shell can guarantee that you'll be able to find a given document by searching the logical namespace rather than the physical one. Users must constantly decide whether to commit a newly created document to one environment or the other. Even if you're a true believer in the value of a logical scheme, applications (NewWave-aware ones excepted) are constantly working to subvert that belief.

They happily offer File Save dialog boxes that invite you to write straight to the file system without the knowledge or consent of the desktop environment. For today's applications, the ability to name and use files is a sacred and inalienable right. Until that changes, the marriage of Program Manager and File Manager can never be truly consummated.

Farewell to Filenames

Imagine how an OOFS (object-oriented file system) would help solve this dilemma. Suppose the operating system doled out to applications not named chunks of disk space but opaque handles to storage objects. These objects would be registered in a class hierarchy. A text editor might request an object of class Text, subclass ASCII; an image editor might ask for an object of class Image, subclass GIF. And they'd have long descriptive names completely unrelated to their storage location, which the operating system would determine based on their handles.

The key change in OLE 2.0 will be in-situ interaction.

You'd search for storage objects by descriptive name—which wouldn't need to be overloaded with type information—or by type. Thanks to the class hierarchy, you could conduct general searches (e.g., all images) or specific ones (e.g., all GIF images). Object linking would be simplified enormously. Links wouldn't break when users renamed storage objects, because the underlying handles would persist. Object embedding, as implemented today in OLE (Object Linking and Embedding), would not even be needed. Its raison d'être—the anonymity of embedded objects—would evaporate if regular storage objects became handle-based.

Ironically, OLE's embedding technology may offer the best practical migration path. Suppose Windows 4.0 or NT 2.0 provides an OOFS API supporting the features I've described and an OOFS-aware shell. These systems won't be allowed to break every application in the world, so they'll have to support the old file-system APIs and the new object-oriented ones.

During the long transitional period, how can applications that use the older APIs be kept from violating the abstract view imposed by the OOFS-aware shell? The Hewlett-Packard folks showed me an experimental version of NewWave 4.0 that solved this problem in an intriguing way. They demonstrated NewWave launching Paintbrush in embedding mode—just as if you'd started the application from an OLE client like Write using Insert Object. HP had Paintbrush thinking that NewWave was an OLE client while it slyly redirected the bit-map data that Paintbrush pumped through the OLE pipe into NewWave's object database.

In normal OLE, the anonymous chunk of data that is an embedded object resides within the client-created document, accessible only to the client. HP's clever hack exposed the name and type of that data to systemwide access while hiding its location. Unfortunately, this feature didn't make the final cut, so it's now slated for the next release of NewWave. Still, hats off to HP for championing the object-oriented file system we all know we need and for blazing a trail that could take us from here to there.

Meanwhile, Microsoft is busily nailing down the specification for OLE 2.0. For users, the key enhancement will be *in-situ interaction*. In OLE 1.0, when you activate a Paintbrush object that's embedded in or linked to a Write document, an instance of Paintbrush launches in a separate window. Once these applications comply with OLE 2.0, Paintbrush will simply take over Write's window, so Write "becomes" Paintbrush while the embedded/linked object is active.

Under the covers, the client (e.g., Write) and the server (e.g., Paintbrush) will exploit a vastly improved method of communication. OLE 1.0 requires the client to pump all of an embedded object's data through a DDE pipe to the server, which does its editing and then pumps everything back. OLE 2.0 introduces a new object storage system, the "Docfile," which gives servers direct read/write access to objects embedded in client-owned documents. (Optionally that access may be transactional, so a user could choose to commit or roll back edits performed during in-situ interaction.)

A Docfile, contained within an ordinary DOS file, can itself contain a mixture of embedded or linked objects and subsidiary Docfiles. When you link to an object in a Docfile, you're no longer using a DOS filename, but rather an OLE 2.0 "Moniker"—that is, an opaque object handle. Here's another evolutionary path that will, hopefully, lead someday to a full-blown OOFS. ■

Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell."

ASK BYTE

Weather by PC

I am looking for a system to receive and store weather maps on my computer. I have a shortwave radio and an IBM AT. Where can I find a radio-to-PC interface?

Pascal Gilles
Frascati, Italy

Going to a commercial service is probably your best solution. Global weather maps and reports are currently available to members of CompuServe (5000 Arlington Centre Blvd., Columbus, OH 43220, (800) 848-8990 or (614) 457-8600) who use the optional CIM (CompuServe Information Manager) software. You need CIM 1.3 or higher for DOS machines and version 1.5 for the Mac.

CIM lets you access current conditions and a 72-hour forecast for the U.S., Canada, and 85 additional cities worldwide, with hourly updates. You can also receive current conditions, a 24-hour forecast, and satellite maps for the U.K./Ireland, continental Europe, the Pacific Rim, and Australia/New Zealand in 16-color or black-and-white graphical representations.

For Mac users in the U.S., Mainstream Data (420 Chipeta Way, Suite 200, Salt Lake City, UT 84108, (801) 584-2800; fax (801) 584-2831) has released Mainstream Newscast, a broadcast information service that delivers news to users in the U.S. and Canada via FM radio or satellite.

Mainstream does not yet have a weather service, but you can monitor business and general news from such sources as Associated Press, Reuters, Knight-Ridder, Market News Service, Newsnet, PR Newswire, Business Wire, Sports Network, and others. Along with software, you need an FM antenna or satellite dish, coaxial cable, and the Mainstream Intelligent Data receiver, which receives the FM or satellite signal and formats it for use by the computer.

Prices for news delivery to a stand-alone Mac start at about $50 per month. The software and hardware prices range from $495 for FM service (in 12 U.S. cities only) to $990 for a small-dish satellite connection (U.S. and southern Canada only).

I'm not aware of any such services in Europe. Perhaps some of our readers can offer suggestions.—Stan Wszola

Column Conundrum

I am looking for an editor that I can use to draw up a seven-column chart. I want something that will let me edit font size, line spacing, and page breaks easily. Do you know of anything that would meet my needs?

Sara Little
Amherst, NH

The BYTE Lab has had to assemble many tables for comparative reviews. Many of the newer high-end word processing programs will work. Microsoft Word for Windows 2.0 has built-in table creation and editing functions, and it supports a table with up to 31 columns and an almost unlimited number of rows. Word can convert ASCII text to a table, where table cells can be sized, copied, and moved. You can insert the table directly into an article's text and retain the correct formatting.

Alternately, you can use a spreadsheet program like Borland's Quattro Pro or Microsoft Excel. They can't manipulate text as well as a word processor does, but you get the advantage of built-in calculation functions. Many spreadsheet programs let you rotate cell locations to change the table's format.

If you want the best of both worlds and have two applications that support OLE (Object Linking and Embedding), you can embed a table created in a spreadsheet program directly into your word processing file. Excel and Word offer this feature. Without OLE, you would have to convert the spreadsheet file into a text file before importing it into your word processor. In the process, you'd lose all your formatting.—Stan Wszola

Which Unix?

I plan to buy a 33-MHz 486 and run DOS and Unix on it. I will use this machine as a single-user multitasking system, typically for `xterm`. Which Unix should I use? Are the X Window System versions from The Santa Cruz Operation and Interactive fully compatible with the MIT version? How should I configure the system?

Claudio Fornaro
Turin, Italy

The BYTE Lab has tested the most recent releases of SCO and Interactive Unix. Both are good. When Interactive comes out as Solaris, it should be even better. SCO is more popular and is well known in the VAR world, but it is not a typical Unix environment. It will be a long time before it becomes System V release 4.0—if ever. SCO Unix is available from The Santa Cruz Operation (400 Encinal St., P.O. Box 1900, Santa Cruz, CA 95061, (800) 726-8649 or (408) 425-7222; fax (408) 425-4222). For Interactive Unix, contact Sunsoft (2550 Garcia Ave., Mountain View, CA 94043, (415) 960-3200; fax (415) 960-9131).

BSDI Unix from Berkeley Software Design (3110 Fairview, Suite 580, Falls Church, VA 22042, (703) 876-5040; fax (703) 876-5059) includes full source code. Judging by the beta copy we received recently, BSDI Unix looks like the best choice for anyone who plans to do any serious system hacking.

You can install these operating systems on 30-MB drives, but you won't have enough room for the compiler, libraries, and other niceties (e.g., the man pages, networking, and X). I run SCO Unix with the developer's tools and X on a system with a 150-MB hard drive and 8 MB of RAM. Interactive Unix is about the same. SCO Open Desktop will hog all 150 MB if you install everything, including the database server.

The MIT sources are raw source code. Thus, they require considerable work to install on any system. The most recent versions of X servers for Intel-based Unix support only through version 11 release 4.

If you don't plan to run X, a 9-inch monitor is fine. I find that Super VGA and a noninterlaced 17-inch display

are preferable for X. If you aren't working with graphics, however, you can get by with much less. My SCO system, which I use primarily for writing books, has a VGA card with a noninterlaced 13-inch screen.

Get a system that has maintained a reputation for dependability for at least a few years. Don't get the motherboard with the newest technology; there may not be drivers or utilities for installing Unix or Unix drivers for its devices. The same goes for device controller boards.

As for memory, 8 MB is tight, but sufficient. You will need to do some system tuning to be sure that the process tables don't overflow. At less than US$100 per megabyte of RAM, it is worth going to 16 MB. Be sure to install the memory before you configure your disk, or at least set aside a swap space for the amount of memory that you intend to install. Reconfiguring your disk for a bigger swap space after the fact is a lot of work on Intel-based systems, because you have to repartition it.—Ben Smith

Pixels, Pixels Everywhere

I found "Monitors: Beyond VGA" (May BYTE) helpful, but I am puzzled about the relationship between resolution and screen size. On page 210 you say, "Screen characters shrink each time you boost screen resolution." Does this mean that increasing screen resolution merely crams more of the "page" on the screen? How can I increase the resolution of the characters and images on the page?

Donald V. Etz
Kettering, OH

For a given monitor of any size, character (and picture) size decreases as screen resolution increases. The reason is simple: A character defined as 9 pixels wide by 12 pixels high will always display as a 9- by 12-pixel matrix. Increasing resolution simply packs the pixels together more closely. That's why buying a 13-inch monitor for use as a 1024- by 768-pixel display doesn't make a lot of sense; the text and images will be too small to read easily. If you want to upgrade to a higher resolution, you need a bigger monitor to keep the image readable.—Raymond GA Côté

What's in a Name?

The March BYTE has a Microbytes item about the standard programming interface for electronic image processing, CLASP (Connecting Link for Applications and Source Peripherals). Because I am currently conducting a study about image acquisition and restitution, I am very interested in CLASP. However, I cannot find any information about it. Can you help me?

Michel Bories
Valbonne, France

Currently, there is no standard format for exchanging data between computers and peripherals that create or capture graphics images. Such a standard would make it far easier for programmers to write applications that would accept this graphical data rather than dealing with an alphabet soup of graphics image file formats (e.g., GIFF, TIFF, PCX, PICT, and BMP) on a variety of platforms.

CLASP's name has changed to TWAIN (Toolkit Without An Important Name). It provides a consistent, easy integration of image data between input devices and software applications. The specification has several goals. It must work with System 7.0 and Windows, but it should also be able to extend to Unix, OS/2, and other environments. It should support multiple devices, including handheld scanners, flatbed scanners, slide scanners, image-capture boards or frame grabbers, digital cameras, and image databases.

It should provide a well-defined interface that lets hardware and software developers provide drivers for their devices or include support through their applications. It should be extensible, and revisions should be backward-compatible with code written to earlier versions of the specification.

The interface and its documentation should be clear, well structured, well written, and intuitively designed. It should provide a single solution for the industry that will last for several years, or until such time as a facility like this might be supported at the operating-system level. This general data-interchange mechanism must be able to transmit data in existing standard formats and native file formats (e.g., TIFF, PICT, and DIB).

Several companies have got together to define TWAIN. The principal companies are Aldus, Caere, Eastman Kodak, Hewlett-Packard, and Logitech. Adobe, Howtek, and Software Architects are among the more than 160 other contributors. You can order the TWAIN programmer's toolkit and disk by calling the TWAIN distribution center at (800) 722-0379. You can send a fax to (303) 352-6152. Ask for document 9154. The cost is US$30.—Stan Wszola

VGA Interrupts

My Super VGA card (which uses a Tseng ET4000 chip set) has a jumper that lets me enable and disable IRQ2 (interrupt request). I have COM3 configured with IRQ2 and have the interrupt on the Super VGA card disabled. What exactly do I gain or lose by enabling or disabling IRQ2 on the Super VGA card, and would it be worth my time to reconfigure my COM port and enable the interrupt on my video card?

Gary Foster
Wichita, KS

You are quite safe in leaving the interrupt disabled. The IRQ was originally introduced by IBM on the EGA video card. It triggers during every vertical retrace, thus letting you perform smooth animation by changing the screen contents while the data is not being drawn to the screen. Unfortunately, early IBM EGA adapters did not properly implement this interrupt. Because of that, there is little, if any, software that requires its presence.

—Raymond GA Côté ■

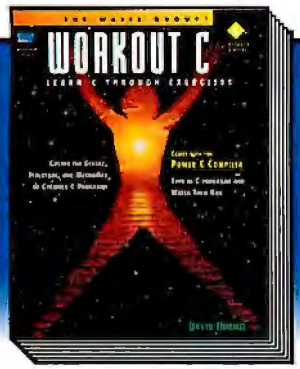
The BYTE Lab welcomes your questions. Address correspondence to Ask BYTE, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. You can also send BIX mail c/o "editors."

We read every letter, but due to the volume of mail received, we cannot guarantee a response. We edit all letters for clarity and brevity. Letters appear in BYTE about four months after we receive them.

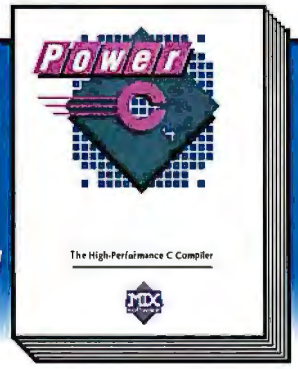
Struggling With Microsoft® or Borland® C? Shape Up With Our Easy3 Step Solution

For a Limited Time
$49.95
($30.00 Off List Price!)

1



2



3

START WITH THE WAITE GROUP'S NEW WORKOUT C.
This balanced training program covers all topics and concepts of C programming, from simple to complex. Throughout more than 800 pages of illuminating text, hundreds of hands-on exercises illustrate everything from arrays to unions and bit fields.

Workout C includes special versions of our Power C compiler and split-screen text editor, so you can compile and execute the example programs at the press of a key. There is no substitute for practice, and you get plenty of it with useful and interesting programs such as a calculator, card playing game, file dumping utility, and animated graphics.

By the time you finish Workout C, you'll have a very solid foundation on which to build a successful C programming career.

AFTER PUMPING UP WITH WORKOUT C, YOU'LL BE READY TO DO SOME HEAVY DUTY PROGRAMMING WITH POWER C.
This ANSI standard C compiler is now used by over 100,000 programmers worldwide. PC magazine calls it "a heavy-weight contender at a bantom-weight price," and Power C is a three time winner of Computer Shopper's Best Buy award.

Even though it's powerful, Power C is very easy to use. That's why The Waite Group chose it over all other compilers for Workout C. And unlike some compilers that hog 30 or 40 megabytes of disk space, Power C requires only 1 megabyte.

FEATURES INCLUDE:
- ☑ Over 450 Library Functions
- ☑ Small, Medium, & Large Models
- ☑ Mixed model with near/far/huge
- ☑ Supports 8088/286/386/486
- ☑ Supports 8087/287/387
- ☑ CGA, EGA,VGA, Hercules Graphics
- ☑ 650 page manual

AS YOU DEVELOP YOUR OWN C APPLICATIONS, POWER CTRACE PLAYS A CRUCIAL ROLE IN THE PROCESS.
This state-of-the-art debugger helps find your programming errors fast. Describing Power Ctrace in a word, Computer Shopper simply calls it "magnificent."

No other debugger shows you the internal working of your program the way Power Ctrace does. Watch your C source code executing not just line by line, but statement by statement. While viewing source code in one window, simultaneously view variable values and program output in other windows. Break and watch points stop execution at suspected trouble spots.

Like Power C, Power Ctrace is very simple to use. Combined with Workout C, this trio of products will end your struggles and put you in great C programming shape.

Order Now and Save $30 Off List Price

❑ **Please Send FREE Brochures**
Disk Size: ❑ 5.25" ❑ 3.5"
(Requires DOS 2.0 or higher)
Name _____
Company _____
Street _____
City _____
State _____ Zip _____
Country _____
Telephone _____

❑ **Workout Pack** $49.95
Includes: ☑ Workout C
☑ Power C
☑ Power Ctrace

Shipping & Handling ..... _____
($5 USA, $10 Canada, $40 Foreign)
Sales Tax (Texas Only) $4.53
Total Amount of Order ..... _____
Paying By: ❑ Check or Money Order
❑ Visa ❑ MC ❑ Amex ❑ Discover
Card# _____
Exp. Date _____

B

60 DAY MONEY-BACK GUARANTEE

To Order Please Call:
1-800-333-0330

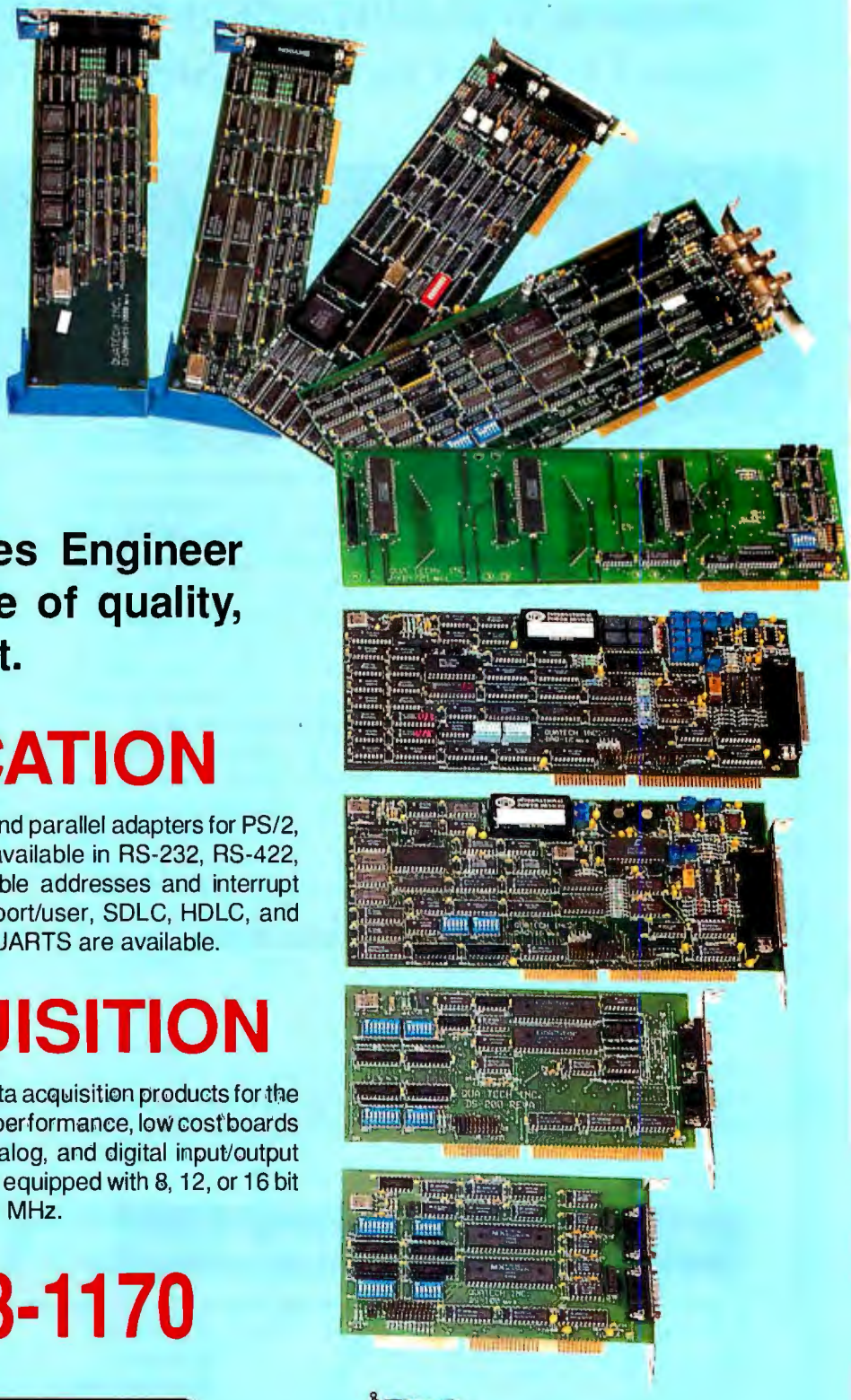
For Technical Questions:
Tel: 1-214-783-6001
Fax: 1-214-783-1404

MIX software

Mix Software
1132 Commerce Dr.
Richardson, TX
75081

Circle 130 on Inquiry Card.

WHEN YOU NEED SOLUTIONS, NOT JUST ANOTHER BOARD!



Let a Quatech Sales Engineer show you the value of quality, service and support.

COMMUNICATION

Quatech produces a full line of serial and parallel adapters for PS/2, PC-XT, AT and compatible systems available in RS-232, RS-422, RS-485 and Current Loop. Selectable addresses and interrupt capabilities are featured in our multi-port/user, SDLC, HDLC, and X.25 adapters. Software and 16550 UARTS are available.

DATA ACQUISITION

Quatech has developed a full line of data acquisition products for the IBM AT and compatibles. These high performance, low cost boards provide analog-to-digital, digital-to-analog, and digital input/output functions. A/D and D/A converters are equipped with 8, 12, or 16 bit resolution, and sampling rates up to 1 MHz.

1-800-553-1170

QUATECH

Made in U.S.A.

Corporate office: (216) 434-3154, FAX (216) 434-1409, 662 Wolf Ledges Pkwy, Akron, OH 44311 U.S.A. International: Australia/Interworld Electronics 03-563-7066, Canada (Western)/Interworld VCR 604-984-4171, England/Diamond Point International 634-722-390, Finland/Lab Hitech OY 358-0-804-2522, France/Elexo 33-1-69302880, Germany/Jupiter Electronic Systems 06181/75041, Israel/RCM Ltd. 972-03-5447885, Italy/N.C.S. Computer Italia 0331/ 770-016, Netherlands/ACAL Auriema 040-816565 Korea/Sam Boo Enterprise Co. 02-678-7457. IBM PC-XT, AT and PS/2 are registered trademarks of IBM Corp.

Circle 153 on Inquiry Card.

Buy it Through BYTE

BUYER'S GUIDE

Mail Order

The latest offerings from vendors supplying products of all leading manufacturers at extremely competitive prices.

314

Hardware/Software Showcase

This *categorized* four-color display section makes it easy to find Hardware and Software products from a wide variety of manufacturers and suppliers.

354

Buyer's Mart

From Accessories to Laptops to Word Processors, you can easily find the dealers you are looking for in this directory of products and services.

364

Get A Lode Of This.

Our Three-Way Guarantee Just Got Better.

The LodeStar Three-Way Personal Guarantee has always been one of the industry's most comprehensive. But now it just got better. Introducing The LodeStar Five-Way Personal Guarantee. Now, every LodeStar system is covered five ways to insure your complete satisfaction. And that should take a lode off you mind.

1. MONEY BACK GUARANTEE.
If you change your mind for any reason simply return your LodeStar system to us in original condition within 30 days of your receipt and we'll refund your money.

2. FREE LIFETIME TECHNICAL SUPPORT.
For as long as you own your system, we'll give you FAST, FREE unlimited technical advice and guidance from our expert staff. This includes any support needed to upgrade or modify your system.

3. FREE LIFETIME LABOR SUPPORT.
Although you will probably never need it, for as long as you own your system, it will be protected by our 100% labor warranty.

4. FREE 2-YEAR PARTS WARRANTY.
For a full two years after purchase, your LodeStar computer will be covered by our 100% parts warranty with fast turn around on any replacements.

5. FREE 1-YEAR ON-SITE SERVICE..
For a full one year after purchase, you'll have the added security of our coast-to-coast FREE on-site service.

Moduless Upgradeables

Carry A Greater Lode In The Future

Easy and inexpensive upgrades are built right into your LodeStar Starflex computer. Unlike conventional modular upgradeable systems from other Companies, you can upgrade your LodeStar Starflex system at a fraction of the cost-all the way from 386DX to 486SX or 486DX, at any clock speed.
Thanks to our unique non-proprietary Moduless Upgrade design, LodeStar Starflex systems can be upgraded by simply plugging in the new chip and oscillator that comes in their inexpensive upgrade kit. Another bright idea from LodeStar-It's just that simple !

Every LodeStar computer is fully loaded with value. This includes unsurpassed quality throughout. To make certain of this, every system is individually pre-tested and burned-in for 72 hours prior to shipment. And of course, we stand behind our quality with our comprehensive Five-Way Personal Guarantee. You will see this quality all the way from our StarView SVGA Non-Interlaced Monitors with flicker-free image, to our own StarKey extended keyboards. And we pack in even extra value by pre-loading MS DOS 5.0 & Windows 3.0, as well as a Hi-Res 400 DPI serial mouse on every system. And our systems can be upgraded to include optional cache, RAM, more hard disk capacity, larger monitor, and a host of other enhancements you may require. Add it all together - stellar performance, brilliant quality, and guarantee that outshines all others - and you've got LodeStar.

486-DX Local Bus Plus

486-DX/33 $1889

- ☐ 2 32-bit Local Bus expansion slots for more 32-bit power expandability
- ☐ 64K ultrafast write-back cache SRAM
- ☐ Built-in 487 math coprocessor & 8k cache in the CPU
- ☐ 4MB RAM expandable to 32MB
- ☐ 130MB 15ms IDE hard drive w/64K cache
- ☐ 1:1 interleave 2H/2F IDE controller
- ☐ Teac 1.2MB 5.25" & 1.44MB 3.5" drives
- ☐ 32-bit Local Bus SVGA card w/1MB RAM. Six times faster than ISA SVGA, 1280x1024 resolution & 32,768 colors
- ☐ 14" StarView 1024 non-interlaced 0.28mm dot pitch SVGA monitor. VESA 72Hz flicker-free display
- ☐ 2 serial, 1 parallel & 1 game port
- ☐ MS DOS 5.0 & MS Windows 3.1
- ☐ Enhanced 101-key keyboard
- ☐ High resolution serial mouse
- ☐ Desktop or mid-vertical case

486-DX2/50 $2059

486-DX/50 $2179

StarFlex 3/486C

386-DX/25 $1529

- ☐ CPU Upgradable to 386DX, 486SX, 486DX, 486DX2. Up to 66MHz
- ☐ 64K ultrafast write-back cache SRAM expandable to 256K
- ☐ 4mb RAM expandable to 32MB
- ☐ 130MB 15ms IDE hard drive w/64K cache
- ☐ 1.2MB 5.25" & 1.44MB 3.5" drives
- ☐ 1MB SVGA non-interlaced 0.28mm card
- ☐ 14"StarView 1024 non-interlaced 0.28mm dot pitch SVGA monitor, VESA 72Hz flicker-free display
- ☐ 2 serial, 1 parallel & 1 game port
- ☐ MS DOS 5.0 & MS Windows 3.1
- ☐ Enhanced 101-key keyboard
- ☐ High resolution serial mouse
- ☐ Desktop or mini-vertical case

386-DX/33 $1559

386-DX/40 $1589

486-DX/33 $1869

486-DX2/50 $2039

486-DX/50 $2159

486LB WINstation

486-DX/33 $2139

- ☐ 2 32-bit Local Bus expansion slots for more 32-bit power expandability
- ☐ 64K ultrafast write-back cache SRAM
- ☐ Built-in 487 math coprocessor & 8k cache in the CPU
- ☐ 4MB RAM expandable to 32MB
- ☐ 130MB 15ms IDE drive w/64K cache
- ☐ High throughput Super IDE Caching Controller. Reduces average disk seek time to 0.2ms
- ☐ Teac 1.2MB 5.25" & 1.44MB 3.5" drives
- ☐ 32-bit Local Bus S3 Graphics Engine w/1MB VRAM. Up to 1280x1024 resolution & 32,768 colors
- ☐ 14" StarView 1024 non-interlaced 0.28mm dot pitch SVGA monitor. VESA 72Hz flicker-free dsisplay
- ☐ 2 serial, 1 parallel & 1 game port
- ☐ MS DOS 5.0 & MS Windows 3.1
- ☐ Enhanced 101-key keyboard
- ☐ High resolution serial mouse
- ☐ Desktop or mid-vertical case

486-DX2/50 $2309

486-DX/50 $2429

486 EISA Datamaster

486-DX/33 $2099

- ☐ 256K ultrafast write-back cache SRAM. Provides better Hit-rate
- ☐ Built-in 487 math coprocessor & 8K cache in CPU
- ☐ 4MB fast RAM 60ns
- ☐ 130MB 15ms IDE hard-drive w/64K cache
- ☐ Teac 1.2MB 5.25" & 1.44MB 3.5" drives
- ☐ 16-bit 1024x768 SVGA card w/1MB RAM
- ☐ 14" StarView 1024 non-interlaced 0.28mm dot pitch SVGA monitor. VESA 72 Hz flicker-free display
- ☐ 2 serial, 1 parallel & 1 game port
- ☐ MS DOS 5.0 & MS Windows 3.1
- ☐ Enhanced 101-key keyboard
- ☐ High resolution serial mouse
- ☐ Desktop or mini-vertical case

486-DX2/50 $2269

486-DX/50 $2389

486-LB CADstation

486-DX/33 $2799

- ☐ 2 32-bit Local Bus expansion slots for more 32-bit power expandability
- ☐ 256K ultrafast write-back cache SRAM
- ☐ Built-in 487 math coprocessor & 8k cache in the CPU
- ☐ 8MB RAM expandable to 32MB
- ☐ 213MB 13ms IDE drive w/64K cache
- ☐ High throughput Super IDE Caching Controller. Reduces average disk seek time to 0.2ms
- ☐ Teac 1.2MB 5.25" & 1.44MB 3.5" drives
- ☐ 32-bit Local Bus S3 Graphics Engine w/1MB VRAM. Up to 1280x1024 resolution & 32,768 colors
- ☐ Award winning Mag 15" flat screen non-interlaced SVGA color monitor. Up to 1280x1024 resolution w/digital controls
- ☐ 2 serial, 1 parallel & 1 game port
- ☐ MS DOS 5.0 & MS Windows 3.1
- ☐ Enhanced 101-key keyboard
- ☐ High resoluiton serial mouse
- ☐ Desktop or mid-vertical case

486-DX2/50 $2969

486-DX/50 $3089

486 EISA Network Server

486-DX/33 $2899

- ☐ 256K ultrafast write-back cache SRAM. Provides better Hit-rate
- ☐ Built-in 487 math coprocessor & 8K cache in CPU
- ☐ 8MB fast RAM, 60ns
- ☐ 340MB 15ms IDE hard drive w/cache
- ☐ High throughput Super IDE Caching Controller. Reduces average disk seek time to 0.2ms
- ☐ Teac 1.2MB 5.25" & 1.44MB 3.5" drives
- ☐ 16-bit 1024x768 SVGA card w/1MB RAM
- ☐ 14" StarView 1024 non-interlaced 0.28mm dot pitch SVGA monitor VESA 72 Hz flicker-free display
- ☐ 2 serial, 1 parallel & 1 game port
- ☐ MS DOS 5.0 & MS Window 3.1
- ☐ Enhanced 101-key keyboard
- ☐ High resolution serial mouse
- ☐ Desktop or mid-tower case

486-DX2/50 $3069

486-DX/50 $3189

1.800.875.7568

"Please call for 386DX and 386SX Systems Pricing"

Circle 232 on Inquiry Card.

PC Sources

- Warranty -
"One of the most conspicuous things that differentiate LodeStar from its competitors is extensive warranty support."

- Craftsmanship -
Layout is excellent..... Wonderfully uncramped sight that greets you when you open the case with LodeStar's tower, you don't have to fight a mass of tangled cables and jagged edges."

- Technical Support -
"As a further test of technical support, I deliberately destroyed..... I then gave the system and a phone to an inexperienced friend. A LodeStar technician competently took her through the process....."

- Prompt Response -
"When I called with a question....., I was immediately connected to a knowledgeable technician."

- Summary -
"The combination of high performance, low price, and one year of free on-site services makes LodeStar 486 an attractive buy." - PC Sources 1992

LodeStar COMPUTER

18539 East Gale Ave.
City of Industry,
California, 91748
Tel: 1.818.810.3818
Tech Support:
1.800.875.7569
Fax: 1.818.810.5928

GOVERNMENT, SCHOOLS AND CORPORATE PURCHASE ORDERS WELCOME. All prices and specifications subject to change without notice. 2-Year Parts Warranty applies to LodeStar products only. Money Back Guarantee does not include shipping & handing, and all returns must be shipped pre-paid & in resalable condition. Please call to confirm all warranty details. Photography is for illustration only. No surcharge on VISA, MasterCard, & Discover. 2% cash discount on all Pre-Paid systems. Purchase orders are accepted on approved credit. California orders add 8 1/4% sales tax. All product names, trademarks and registered trademarks are the property of their respective companies. For more written information, please call for our FREE product catalog.

SAVE 50% TO 70%

SATISFACTION GUARANTEED

386SX 30 Meg NOTEBOOK

800-635-0300

949.

Famous Manufacturer

- 386SX 20
- 1 MB RAM Expandable to 2 or 5 MB
- 60 MB High Speed Hard Drive
- 1.44 3-1/2" Floppy Drive
- VGA Screen High Resolution Backlit 640 × 480 Grey Scales
- Removeable NiCad Battery, 2.5 hour
- 110/220 AC Adapter/Charger
- 86 Key Keyboard, True 101 Key Emulation
- Serial, Parallel & External VGA Port
- 10" × 12" × 2"

60 Meg **1199.**

OPTIONS:

- Carry Case 39.
- 1 MB Memory CALL
- 2400 Baud Internal Modem 79.
- 4 Meg CALL

NEC 386SX 100 Meg

999.

Factory Renewed

Factory Warranty

- 16 MHz 386SX
- 1 Meg RAM
- VGA Backlit Screen
- 100 Meg Hard Disk
- 3-1/2" 1.44 Meg Floppy
- Serial & Parallel Ports
- 110/220 Volt Charger
- External VGA Port
- Battery
- 15 lbs.
- 12.9" W × 3.4" H × 14.9" L

OPTIONS:

- Carry Case 59.
- 2400 Baud Modem 99.
- 1 Meg Memory 99.
- 4 Meg Memory CALL
- Expansion Station CALL

Famous Manufacturer 386SX/16 Laptop

- 16 MHz 386SX
- 1 Meg RAM
- VGA Backlit Screen
- 40 Meg Hard Disk
- 3-1/2" 1.44 Meg Floppy
- Serial & Parallel Ports
- 110/220 Volt Charger
- External VGA Port
- Battery
- 11.8 lbs.
- 13.4" W × 3.4" H × 10.4" L

~~949.~~

EVEN LESS

OPTIONS:

- Carry Case 59.
- 2400 Baud Modem 99.
- 1 Meg Memory 119.
- 4 Meg Memory CALL

NEC 386SX *Color* Laptop

- 16 MHz 80386SX
- 2 MB Memory
- 42 MB Hard Drive
- 3-1/2" 1.44 Floppy
- Display 64 Color Palette
- 640 × 400 EGA/CGA and VGA Mode Support

~~1599.~~

EVEN LESS

Palm Top

- 128K
- 58 Keys
- 8 Lines, 40 Characters Screen

Word Processor- Compatible with Microsoft Word.

Agenda - Master Scheduler organizing with monthly, weekly & daily calendars.

Data Base - Holds names, addresses, phone numbers. Can call through acoustic coupler.

Calculator - Contains trig functions square and square roots.

World - Supplies current times & phone numbers for 400 cities worldwide.

299.

NEC Panasonic TI
Sanyo Toshiba Bondwell
More!

Famous Manufacturers LAPTOPS/NOTEBOOKS!!

286/386SX/386SL
CGA/EGA/VGA
20/40/60/80 Meg Hard Drives

Options: Case, Extra Memory Modems...

Starting at **799.**

Portable Hard Drive

- 6" × 1-3/8" × 8-1/2"
- 2 lbs.
- 20 Meg
- Includes AC Charger & Battery
- Connects to any printer port
- Great for laptops & notebooks

Other sizes also available... CALL

249.

- 486SX 25 MHz Processor
- 1 Meg RAM
- 1.2 or 1.44 Meg Floppy
- 105 Meg Drive 19 MS
- 16 Bit VGA Card with 1 Meg
- 14" 1024 × 768 Color VGA Monitor .28 DP
- 1 Parallel + 2 Serial Ports, 1 Game
- 101 Key Keyboard
- Battery Backed Clock
- Math Co-processor Socket
- MS DOS + GW Basic
- 3 Button Mouse

1199.

CD ROM's

STARTING AT

299.

9 Years Since 1983

TrueData PRODUCTS, INC.

775 Quaker Highway, Rte. 146A, P.O. Box 347, Uxbridge, MA 01569

to order:
1-800-635-0300
In MA 508-278-6555

All packages shipped UPS and A.P.O.'s. C.O.D.'s add $4.00. **ALL RETURNS** must have RMA# (call 508-278-6555). You may be subject to a restocking fee. Shipping/handling charges non-refundable. 1 year warranty unless otherwise noted. Prices/terms/conditions subject to change without notice. **Corporate P.O.'s welcomed. International orders also accepted.**

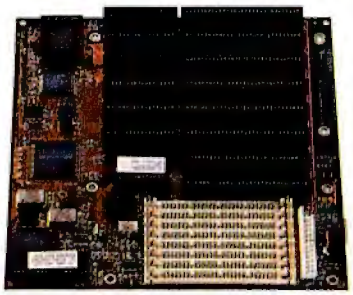
MC, VISA, Amex, Discover
All prices are cash discounted prices.

386 & SX are trademarks of Intel Corporation

Circle 229 on Inquiry Card.

Stay Out Of The Red...

RMB Motherboards



386SX-25 MHz $169

25MHz processor speed
Headland HT18 80386sx chip set
IBM™ AT-bus compatible
AMI BIOS (64 Kb)
AMD CPU
Up to 16 Meg on-board RAM memory

Buy any RMB motherboard with SIMM memory and we'll install the memory FREE. And we won't stop there...Ralin will also run a full diagnostic and burn-in your memory onto the motherboard at no charge.

It's service like this that sets Ralin apart from our competition and makes our 1st time customer a customer for life.

Model	No Memory	2 Mb	4 Mb	8 Mb	16 Mb	32 Mb
386 SX-25	$149	$239	$329	$509	$809	NA
386 SX-33	$199	$289	$379	$559	$859	NA
*386 DX-33	$275	NA	$455	$635	$935	$1595
*386 DX-40	$285	NA	$465	$645	$945	$1605
*486 DX-33	$599	NA	$779	$959	$1259	$1919
**486 DX-33 *Upgradable*	$675	NA	$855	$1035	$1335	$1995
**486 DX-33 *Local Bus Slot*	$685	NA	$865	$1045	$1345	$2005
**486 DX-50 *Upgradable*	$995	NA	$1191	$1387	$1695	$2395

*128k Cache Memory Standard **256k Cache Memory

Future Upgradability: 486 DX-33 to → DX-2/66 MHz
486 DX-50 to → DX-2/100 MHz

Buy Smart...Buy RMB Upgradable Motherboards

Upgrade!

Case Upgrades

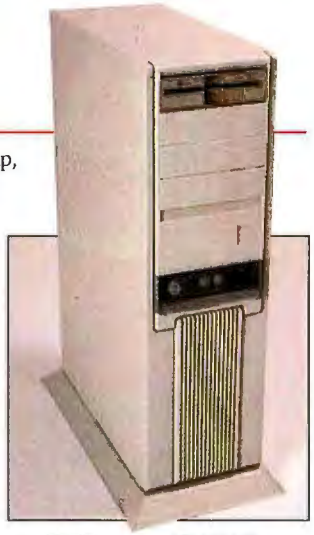
If your computer case doesn't have room for more floppies or tape back-up, consider upgrading to a new Ralin case. Our cases offer the flexibility you require at a price that can't be beat.

Desktop Case $87.00

5-bay Desktop Case
200 watt Power Supply
(3)- 5.25 inch bays
(2)- 3.5 inch bays
16.3 inch, 16 inch & 7 inch

Mini Tower $75.00

4-bay Mini Tower Case
200 watt Power Supply
(2) - 5.25 inch bays
(2) - 3.5 inch bays
7 inch, 16 inch & 13.6 inch



Full Tower $149.00

8-bay Full Tower Case
230 watt Power Supply
(4) - Internal 5.25 inch bays
(4) - External 5.25 inch bays
Digital Display

Why go broke replacing your PC's? Talk to the upgrade specialists at Ralin and see how modifying your existing equipment could save you hundreds or even thousands of dollars. Our highly trained representatives sell thousands of motherboards and upgrade components every month. And our volume purchasing helps us, help you...Stay out of the red.

Ralin offers a complete line of brand name products to complete your upgrade. Use this check list of key

w/Power

returned

Ralin Policies

- Prices and availability subject to change.
- Purchase orders are accepted, subject to approval.
- We do not charge your card until order is processed.
- Incomplete returns are subject to a service charge.
- All returns other than exchanged items incur a 10% re-stocking fee.
- Not responsible for compatibility problems and typos.
- 30 day guarantee does not apply to software. Defective software exchanged only.
- APO and FPO's please call for shipping charges or for credit card orders leave blank when mailing order and applicable charges will be added.

To insure your shipment arrives when you need it, Ralin uses only the most reputable modes of transportation available:

DHL WORLDWIDE EXPRESS UPS

Circle 240 on Inquiry Card.

MPC Upgrades

Creative Labs MPC Upgrade Kit $585.00

Creative Labs has combined a Panasonic MPC internal CD-ROM (works off the Sound Blaster SCSI port) and their own Sound Blaster Pro MPC sound card with a bundle of the most popular CD software for an unbeatable upgrade value.

Includes:

- sonic MPC
  OM drive
  d Blaster Pro
  sound card
  soft™ Windows 3.1
  5 inch disks
  CD-ROM software:
  Microsoft™ Bookshelf,
  Creative Sounds,
  The Selectware System,
  ock Holmes -
  ulting Detective
- Sound Blaster Software:
  - The Talking Parrot
  - Text to Speech & Dr. Sbaitso
  - Voice Editor II
  - MultiMedia & MM Play
  - CD Play
  - FM Intelligent Organ

Sound Blaster Pro Package $195.00

- Sound Blaster Pro sound card
- Sound Blaster Pro software bundle (6 titles)
- CD-ROM software: ChessMaster 3000 (MPC) and Wing Commander with Ultima VI

Communications Upgrades

Zoom Telephonics

Zoom modems rate at the top of their class for compatibility and performance. The recipient of numerous Editors' Choice awards, Zoom modems offer the quality and dependability that you require at a price that makes them a true value. All Zoom modems are backed by a 7 Year Warranty and are made in the USA.

2400 bps w/ v.42bis and MNP 2-5	(AMC) (AMX)	internal external	$ 57.00 $ 65.00
2400 bps w/ v.42bis and MNP 2-5 9600 send & 4800 receive Fax	(AFC) (AFX)	internal external	$ 69.00 $ 82.00
2400 bps w/ 9600 bps send/receive Fax	(FC 9624) (FX 9624)	internal external	$105.00 $105.00
9600 bps modem w/ v.32, v.42bis, MNP2-5 and 9600 bps send/receive Fax	(VFP-V32) (VFX-V32)	internal external	$249.00 $269.00
14,400 bps modem w/ v.32bis, v.32, v.42bis, MNP 2-5 and 9600 bps send/receive Fax	(VFP-V32bis) (VFX-V32bis)	internal external	$269.00 $299.00

Printer Upgrades

If your printer is behind the times and can't keep up with your workload, consider an upgrade to the latest Star Micronics has to offer. Star's award winning NX-2420 Rainbow 24-pin color printer can supply the letter quality, crispness and speed you need, plus seven vibrant colors to make your print outs come alive. If it's laser quality you require, the StarJet ink jet printer can produce professional laser quality at a fraction of the cost of a true laser printer.

NX-2420 Rainbow $279.00

- 250 cps draft speed
- 83 cps letter quality
- 5 fonts
- 7 color output
- 10 Enhancement modes
- User switchable push/pull tractor

StarJet SJ-48 ink jet $289.00

- 100 cps near laser quality speed
- 360 x 360 dpi high resolution available
- 4 near laser quality fonts
- 13 scalable fonts with windows
- 2 paper paths
- IBM™, Epson™ and NEC™ 24-pin graphics compatible

Upgrade Specialists.

Hours: 8:00 am to 7:00 pm Monday – Friday
Customer Service: 716-674-6267 • Fax: 716-674-2108

Relisys WHOLESALERS, INC.
P.O. Box 450
Orchard Park, New York 14127

TOWER POWER!

EISA II 486DX-50MHz System:

- INTEL 486DX-50 HMHz CPU with 8K Internal Cache & 487 Math Co-processor
- 256K of External High-speed Cache RAM
- Super Tower Case with 11 Disk Drive Bays, Swivel Door, 300 Watt UL Power Supply & 2 Cooling Fans
- 8MB of High Speed RAM
- 32-bit EISA SCSI-2 Caching Controller with 2MB Cache expandable to 4MB
- 667MB 15ms SCSI-2 Hard Disk
- 1.2 MB & 1.44MB Floppy Disk Drives
- True 32-bit EISA SVGA Adapter w/ Hi-color (32,000+ color capability) & 1MB RAM
- 14" Non-interlaced VESA 72Hz Super VGA Monitor, 0.28dp
- 2 Serial Ports & 1 Parallel Port
- 101-key Mechanical Click Enhanced Keyboard
- 1,600dpi High Resolution 3-button Mouse
- MS DOS 5.0 & Windows3.1
- One Year On-site Service Included Free

$4,695

Also Available:

486DX-50MHz Local Bus CAD System:

- INTEL 486DX-50MHz CPU
- 8MB RAM, 256K External Cache
- Caching IDE Controller w/2MB Cache
- 210MB 15ms IDE Hard Disk
- 17" Digital 1280 x 1024 SVGA Monitor, 0.26dp
- True 32-bit Local Bus SVGA Adapter w/True color (16.7 million color capability) & 1MB RAM
- Full Tower Case with 300 Watt Power Supply
- 1.2 MB & 1.44MB Floppy Drives
- 2 Serial Ports & 1 Parallel Port
- 101-key Mechanical Click Enhanced Keyboard
- 1,600dpi High Resolution 3-button Mouse
- MS DOS 5.0 & Windows 3.1
- One Year On-site Service Included Free

$3,495

The ATLAS Commitment:

• 100% Customer satisfaction GUARANTEE • Highest quality products
• Most competitive prices
• Most knowledgeable sales staff • Most responsive technical staff

ATLAS INDUSTRIES, INC.

1-800-ATLAS-11 (285-2711)

(310)478-6920 FAX (310)479-2334

11601 Wilshire Blvd., Suite 1820, L.A., CA 90025

Circle 242 on Inquiry Card.

Serving you since 1979

JDR Microdevices®

2233 Samaritan Drive, San Jose, CA 95124

BUY WITH CONFIDENCE FROM JDR!
- 30-DAY MONEY BACK GUARANTEE
- 1 YEAR WARRANTY
- TOLL-FREE TECH SUPPORT

MMC

UPRIGHT CASE $99.95

- Mounts 3 floppy and 4 hard drives
- Accommodates std. & mini motherboards
- 2 digit LED display

CASE-100A $99.95
PS-250TW 250W p. supply $129.95
PS-300TW 300W p. supply $149.95
CASE-50 Mini 286-style case $59.95
CASE-70 Std. 286-style case $89.95
CASE-120 ..... $199.95
Mini-upright case w/200W power supply

POWER SUPPLIES

- U/L approved
- 110/220VAC, 50/60Hz

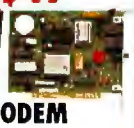
PS-150 8088 150 watt $69.95
PS-200X 8088 200 watt $89.95
PS-200 286/386/486 200 watt $89.95
PS-250 286/386/486 250 watt $129.95
PS-300 286/386/486 300 watt $149.95

1024 X 768 NON-INTERLACED VGA PACKAGE $499.95

- 0.28mm dot pitch monitor & high-resolution VGA card
- Resolution up to 1024 x 768 in 256 colors*
- 512Kb video RAM expandable to 1Mb

VGA-PKG-1024N $499.95
VGA-PKG-1024+ 1024x768 interlaced VGA pkg. $469.95
VGA-PKG 640x480 interlaced VGA pkg. $349.95
VGA-MON-1024 1024x768 interlaced monitor ... $349.95
VGA-MON-1024N 1024x768 non-interlaced mon. $389.95
* Note: Requires 1Mb RAM for 1024 x 768 in 256 colors

2400 BAUD MODEM $49.95



- Internal data modem
- Hayes AT compatibility
- Incl. ProComm software

MCT-241 ..... $49.95

9600 BAUD EXTERNAL MODEM

- CCITT V.42bis/V.32/V.22bis/Bell 212A & Hayes AT compatible • Asynchronous / synchronous

VIVA-96E $349.95

FAX/MODEM/PHONE SWITCH

- Savephone line charges! • Supports fax, modem, phone and answering machine from 1 phone line

FAXM-SWITCH $119.95
FAX-SWITCH Without modem connection $89.95

BREADBOARD ON-A-CARD

- Solderless breadboard with I/O, decode & timing circuitry

PDS-601 8-bit card $79.95
PDS-611 16-bit version $89.95

WIRE-WRAP PROTOTYPE CARDS

JDR-PR2 8-bit with I/O decode layout $29.95
JDR-PR10 16-bit with I/O decode layout $34.95

PORTABLE IC TESTER

- Tests the following 14 to 20-pin devices: 74 series TTL, 40 & 45 series CMOS & 41/44 series DRAM up to 1Mb
- Identifies unknown part numbers

MOD-HIC $129.95

MOTHERBOARDS

NEW LOWER PRICE!

25MHZ CACHE 486SX $499.95

- 25 MHz Intel 80486SX CPU • 64Kb cache memory on board (expandable to 256Kb) • Expandable to 32Mb on-board using 256Kb, 1Mb or 4Mb SIMMs (0Kb installed) • Includes Intel's "Vacancy" socket

MCT-M486SX-25 ..... $499.95
MCT-M486-50 Mini-size 50MHz cache 486 .... $1295.00
MCT-M486-33 Mini-size 33MHz cache 486 ..... $895.00
MCT-C386-40 Mini-size 40MHz cache 386 ..... $379.95
MCT-C386-33 Mini-size 33MHz cache 386 ..... $349.95
MCT-M386SX-25 Mini-size 25MHz 386SX $199.95
MCT-M286-16 Mini-size 16MHz 286 ..... $149.95
MCT-M286-12 Mini-size 12MHz 286 ..... $129.95
MCT-TURBO-10 Mini-size 10/4.77MHz 8088 ..... $69.95

16-BIT VGA CARD $49.95

- 8/16-bit 8088 and 286/386/486 compatible
- 640 x 480 in 16 colors 320 x 200 in 256 colors
- 256Kb video RAM

MCT-VGA-16 ..... $49.95
MCT-VGA-1024+ 1024x768, 512 Kb VGA card $149.95
MCT-FDC-HD 1.44Mb floppy controller $49.95
MCT-FDC-ED 2.88Mb intelligent floppy controller $79.95
MCT-IDEFH 16-bit IDE hard/floppy controller $29.95
MCT-IDEIO 16-bit IDE floppy/hard multi I/O $69.95
MCT-CIDEFH 16-bit IDE CACHE controller $299.95
MCT-IDE-8 8-bit IDE controller $99.95
MCT-AIO Serial/parallel/game port card $49.95
MCT-AIO+ Two NS16550 seriol/par/game port . $89.95
DFINET-400 16-bit Ethernet card $149.95
GATEKEEPER PC security card $49.95
PCODE Diagnostic display card $49.95

UNIVERSAL PROGRAMMER

- Programs EPROMs, EEPROMs, microprocessors, PROMs, PAL/GALs and other PLDs; tests logic & memory devices
- Optional adaptors available for PLCC, PGA, QFP and multiple DIP devices
- Includes host adaptor card and cable

MOD-EMUP $699.00

EPROM PROGRAMMER $119.95

- Programs 24-32 pin EPROMs & EEPROMs from 16K-1024K
- Hex to OBJ converter
- Vpp 5, 12.5, 12.75, 13, 21 & 25V

MOD-MEP* $119.95
MOD-MEP-4* 4-EPROM programmer unit $169.95
MOD-MAC Host adaptor card & cable $29.95
*Note: Requires host adaptor card

EPROM ERASER $39.95

- Quickly and simultaneously erases up to 4 standard EPROMs

DATARASE II $39.95

CONNER 84Mb DRIVE PACKAGE $319

- CP-30084 84Mb, 19ms IDE hard drive, 16-bit floppy/ hard disk controller, cables and instructions

HDKIT80 ..... $319.00

IDE HARD DRIVES

PART #	BRAND	CAP.	SPD.	TYPE	PRICE
CP-3000	Conner	42Mb	28ms	3.5" IDE	$199
ST-351A	Seagate	42Mb	28ms	3.5" IDE	$209
CP-30084	Conner	84Mb	19ms	3.5" IDE	$299
ST-3096A	Seagate	88Mb	16ms	3.5" IDE	$319
CP-30104	Conner	120Mb	19ms	3.5" IDE	$379
ST-3144A	Seagate	131Mb	16ms	3.5" IDE	$399
CP-3204F	Conner	212Mb	16ms	5.25" IDE	$599

FLOPPY DRIVES

FDD-1.44A 1.44Mb, 3.5", Beige $79.95
FDD-1.44X 1.44Mb, 3.5", Black . $79.95
FDD-1.2 1.2Mb, 5.25", Beige..... $89.95
FDD-360 360Kb, 5.25", Black $79.95
FDD-2.88A 2.88Mb 3.5" drive, Beige .. $149.95
FD-505 5.25" & 3.5" combo drive $199.95

DYNAMIC RAM

PART #	SIZE	SPEED	TYPE	PRICE
41256-80	256K x 1	80ns	DIP	1.69
41256-60	256K x 1	60ns	DIP	2.39
414256-80	256K x 4	80ns	DIP	5.95
1MB-80	1M x 1	80ns	DIP	5.99
1MB-60	1M x 1	60ns	DIP	6.49
41256A98-80	256K x 9	80ns	SIMM	14.95
41256A98-60	256K x 9	60ns	SIMM	16.95
421000A9B-10	1M x 9	100ns	SIMM	39.95
421000A98-80	1M x 9	80ns	SIMM	45.95
421000A9B-60	1M x 9	60ns	SIMM	49.95
424000A98-80	4M x 9	80ns	SIMM	169.95
424000A9B-60	4M x 9	60ns	SIMM	174.95

MATH CO-PROCESSORS intel

Each co-processor includes a manual, software guide and Intel's lifetime warranty.

PART #	SPEED	PRICE	PART #	SPEED	PRICE
8087-2	8MHz	129.95	80387-SXP	≤25MHz	119.95
8087	5MHz	89.95	80387-DXP	33MHz	199.95
80287-XL	12MHz	94.95	80487-SX	20MHz	499.95

ENHANCED KEYBOARD $49.95

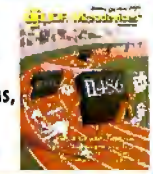
BTC-5339 101/102-key enhanced layout $49.95

3-BUTTON MOUSE $14.95

- Accuracy 290 -1450 DPI
- Opto-mechanical design
- Windows 3.1 compatible

JDR-MOUSE-3 ..... $14.95
MOUSE-PAD $4.95

CALL FOR YOUR FREE JDR CATALOG TODAY!



FOR PC'S, SOFTWARE, MONITORS, DISK DRIVES, KEYBOARDS, MODEMS, CABLES, CONNECTORS, ICS, COMPONENTS, PROGRAMMERS, TEST EQUIPMENT, TOOLS & MORE!

VISA MasterCard

NOW ORDER 24 HOURS A DAY!

800-538-5000

Toll-free Fax ordering 800-538-5005

Local 408-559-1200
BBS 408-559-0253

TERMS: For shipping & handling include $5.00 for ground & $7.50 for air. Orders over 1 lb. and foreign orders may require additional shipping charges—contact our Sales Dept. for the amount. CA residents must include applicable sales tax. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities 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. JDR, the JDR logo, JDR Microdevices, and the MCT logo are registered trademarks of JDR Microdevices, Inc. Modular Circuit Technology is a trademark of JDR Microdevices, Inc. Copyright 1992 JDR MICRODEVICES.

KEY CODE 1033

How Can I Have

SYSTEMS

ALL SYSTEMS INCLUDE:

- 4MB RAM on 32MB Motherboard
- 2 Serial, 1 Parallel, 1 Game Port
- 2 Floppies, 1.44 & 1.2 MB (3-1/2" & 5-1/4")
- DynamicScan, Super VGA Monitor .28 DOT, 1024x768, Tilt & Swivel
- 1MB, Super VGA Card
- 101 Keyboard, Non-Click or Click
- Min. 200W Noiseless Power Supply
- 8 Expansion Slot
- Windows 3.1 and Mouse (2600DPI), DOS 5.0

Synchronous 32Bit Super VGA Card
50 MHZ or 33MHZ

- 486-50MHZ, 256K Cache, w/Local Bus $1,589.00
- 486-50MHZ, 256K Cache, w/ISA.....$1,499.00
- 486-33MHZ, 256K Cache, w/ISA Bus.....$1,259.00
- 386-40MHZ, 256K Cache, AMI BIOS Upgradeable to 486-50MHZ $998.00

OPTION:
Non Interlaced DynamicScan 72 SPVGA Monitor.
1024 x 768, .28 DOT, 72HZ, Add.....$49.00

HARD DRIVES: – Call For Best Price

80MB	100MB	120MB	200MB	300MB	600MB	1.2GB
14MS	16MS	14MS	14MS	14MS	15MS	14MS

The Fastest P.C. Configurations:

486-50MHZ Motherboard 512k external Cache 16MB RAM Installed Dual Local Buses → 32Bit Synchronous SuperVGA Card 1MB Accelerating Windows and AutoCAD → IDE 32BIT Synchronous Local Bus 50MHZ w/4MB Cache Card Less than .3MS → "DynamicScan" 486

32Bit VGA Card and 32Bit IDE Local Buses/4MB Caching!

- 300MB IDE Hard Drive plus 32Bit Local Bus
- Comes with 4MB RAM Write Back Cache
- Speed Up Windows or AutoCAD
- 32Bit Local Bus 16115CHR/MS
- 16MB RAM with 512K Write Back S.RAM Cache
- Dual Local Buses

- 15" Flat Screen Flicker Free
- .28 DOT, 1024 x 768
- Low Emission

The Best Application for File Server, CAD Station, Graphic Art, Data Base

- Click or Soft Touch 101 Keyboard

30 Days Money Back Guarantee

The Fastest PC?

MOTHERBOARD

486-50MHZ, 256K
AMI Bios $749.00
486-50MHZ, 256K
Local Bus.....$859.00
486-EISA
Please CALL
386-40MHZ, 64K
AMI Bios $229.00
Upgradable to 486-50
386-40MHZ $279.00
386-SX25MHZ .$139.00
386-SX16MHZ .$119.00

GRAPHIC CARDS

Trident, 1MB.....$69.00
SpeedStar Stealth,
1MB $249.00
Renoir Hi Color,
1MB $189.00
Tseng Lab, 1MB RAM,
32K Colors.....$119.00

FLOPPY DRIVES

Teac 1.44MB.....$52.00
Teac 1.2MB.....$58.00
JPN 1.44MB.....$51.00
JPN 1.2MB.....$57.00

HARD DRIVES

Maxtor .....CALL
Seagate .....CALL
Conner .....CALL
Western Digital ....CALL

CASES & POWER SUPPLIES

AT Mini Tower
w/200W P.S. $59.00
AT Medium Tower
w/200W P.S. $89.00
AT Big Tower Case
w/230W P.S. $129.00

MONITORS

Sunshine DOT .28,
1024 x 768.....$269.00
Sunshine N.I. SPVGA
Monitor $339.00
DynamicScan .28DOT,
1024 x 768.....$289.00
DynamicScan N.I.
SPVGA Monitor..$389.00
NEC 3FGX $659.00
NEC 4FG $769.00

MODEMS & FAX

Int. 2400 MNP $49.00
Int. FAX & Modem
9600/FAX S/R.....$79.00
Int. 9600
Modem.....$299.00
Ext. 9600
Modem $329.00

DYNAMICSCAN 486-33MHZ DX NOTEBOOK

- Complete Set $2,299.00
- HardDrive...$1,889.00
- No Hidden Price!

MISCELLANEOUS

Memory.....CALL
Printers.....CALL
Autoswitch–
FAX/Modem/Voice...CALL

We Offer Any Custom Configuration.
Lanstic. Novell Lan System.

All Systems Include The Following Software Package That Even The Novice Can Use.

- Easy Menu
- Lotus Tutor
- Bible
- Accounting
- DOS Tutor
- Word Processing
- Data Base
- Real Estate
- Variety of Games and Educational Programs

Test a DynamicScan System yourself with a 30-day money back guarantee.

With the purchase of any DynamicScan System, you will have access to unlimited technical support with our "800" DynamicScan Users Number.

Warranty–1 Year On-Site Service to most locations.

DynamicScan
10824 Page Avenue
St. Louis, Missouri 63132

SALES/ORDERS.....314-423-0044
FAX 314-426-4014
EXPORTING.....314-428-7734
TECH SUPPORT AND RMA
800-852-3273

DynamicScan®

Business days:
Mon thru Fri
Central Time
9AM to 7PM
Saturday
9AM to 5PM

We Honor:
Major Credit Cards
Company & School P.O.
C.O.D. or net 30 days

MEMORY...
YOU JUST CAN'T DO WITHOUT IT.

Picture this:

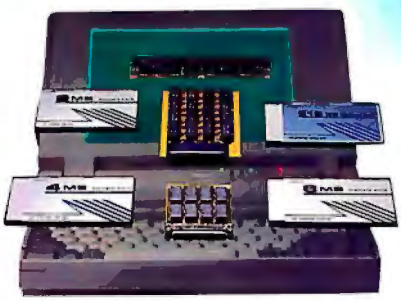
You bought a new software package. You try it out on your computer and soon find yourself working for hours on a sophisticated graphic design. While scrolling through your worksheet, it feels like you are moving through pudding. Your hard disk has a tough time trying to catch up. You then try to print, but the laser printer's buffer is full. You reset it, try again, and find that it spits out only part of your beautiful graphic....

No problem!

We'll take it from here. With our **JetRam™** line that supports the leading brands of laser printers and the **PcRam™** line that upgrades your notebook, laptop or desktop computers, *Transcend* can help solve your memory problems.

What you get from our memory upgrades

- *Life time warranty on all our products*
- *Full memory lines support a variety of brand names of laser printers and PCs*
- *High quality at a reasonable price*
- *Easy-to-install*



Office hours: 6:00 a.m to 6:00 p.m

Transcend

Your Supplier, Your Partner, Your Friend.

Transcend Information Inc.

104 Exchange Place,
Pomona, CA 91768 U.S.A.
TEL: (714) 598-5500
FAX: (714) 598-5050, (714) 598-6050

HEWLETT PACKARD · IBM · EPSON · NEC
TOSHIBA · QMS · COMPAQ
KYOCERA · brother · Apple®
Panasonic · OKIDATA
SHARP · star · TEXAS INSTRUMENTS

Circle 245 on Inquiry Card.

All brand names are registed trademarks of their respective owners.

APS Technologies
The SCSI Drive Specialists

Why Choose SCSI?
5 Good Reasons

- Handles up to 7 devices (& floppy) w/one controller
- Supports CD-ROMs, Tape, DATs, Scanners and more
- Bus Mastering I/O
- Use "Workstation" Quality (and Performance) Peripherals
- Works with ST-506, ESDI Drive Controllers and IDE Controllers

Quantum

MB	INTL	EXTL
120	399	479
240	659	729
425	999	1069

Maxtor

MB	INTL	EXTL
120	$359	$439
213	499	569
340	859	959
535	1249	1349
760	1399	1549
1.2G	1899	1999

Fujitsu

MB	INTL	EXTL
330	$1099	$1199
520	1249	1349

Toshiba

MB	INTL	EXTL
830	$1499	$1599

WREN

MB	INTL	EXTL
630	1649	1749
1.2G	1899	1999
1.6G	2799	2949

SyQuest

Model	Bare
SQ-555	$379
SQ-5110	499

Additional SyQuest Cartridges
44MB - $75 88MB - $109

DAT

Model	INTL	EXTL
APSDAT	$1599	$1699
2.6 - 5 GB Compression DAT		
APSDAT	1349	1499
Desktop and Portable Units		
DATs Archive-based Mechanisms		
All Tape Drives Include Sytos Plus		

Micronics

386SX	ISA 25	$259
386DX	ISA 25	399
386DX	ISA/33/Cache	449
486DX	ISA/33/Cache	859
486DX	EISA/33/Cache	1199
486DX	ISA/50/Cache	1449

Toshiba

CD-ROM	Bare
3301B	$579

Why Buy from APS?

- Helpful, knowledgeable sales associates.
- Toll-free Technical Support—call as often or for as long as you need. See why APS has won 2 MACWORLD Service Hero awards!
- 30-Day, No-Questions-Asked, Money-Back Guarantee.*
- Helpful, informative 160-page manual.
- Disk-for-Disk Replacement Warranty—you'll probably never need it, but if you do, 90% of our warranty service is performed within 48 hours (most within 24 hours). Return shipping via FEDEX Standard Overnight Service—no charge.
- 24-hour BBS with the latest version of our software.

* Your Risk in the Transaction is the Cost of Shipping

Prices & Specifications Subject to Change Without Notice

APS TECHNOLOGIES

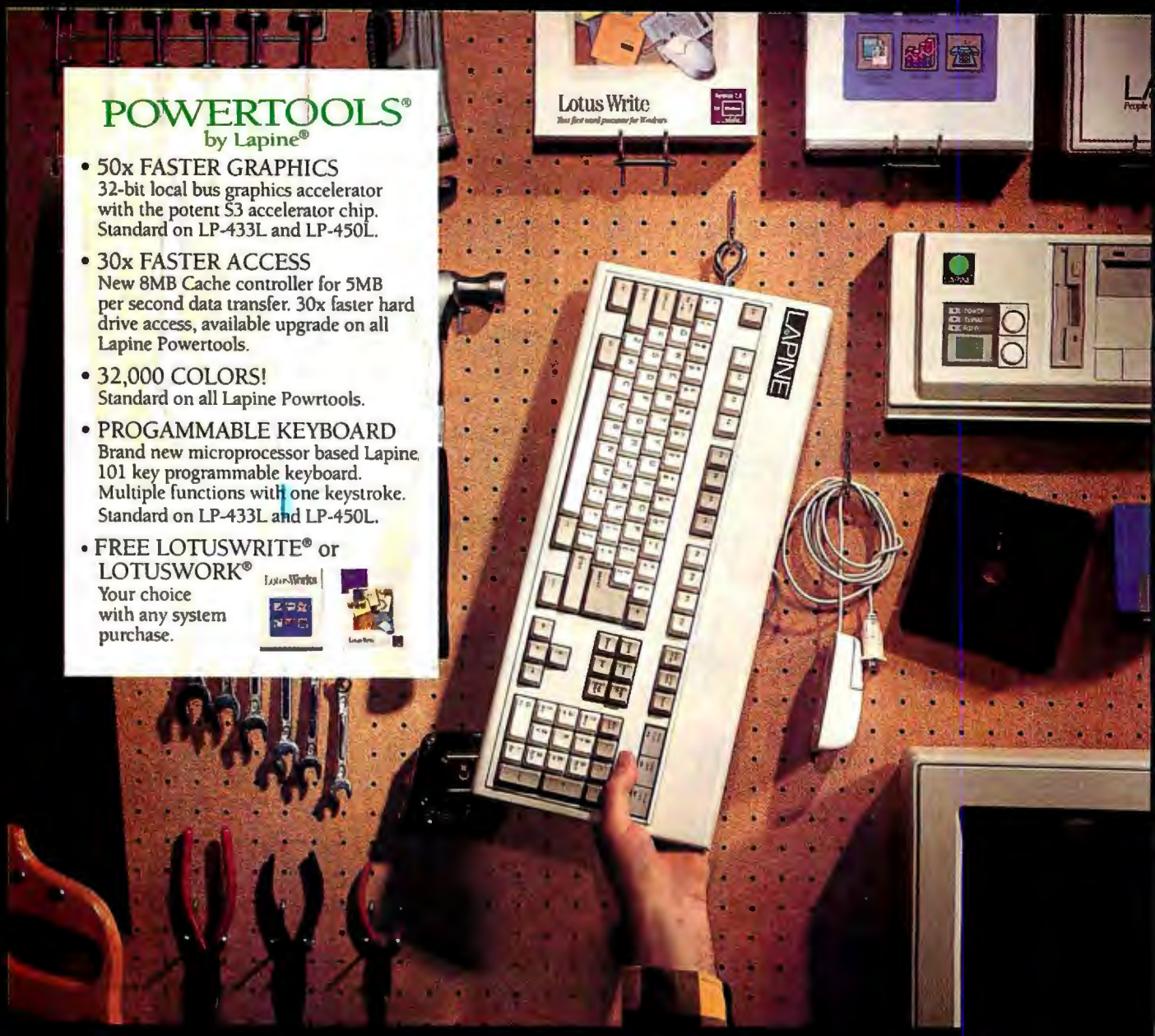
M—F 7AM—9PM CST SAT 10AM—4PM CST

Visa/MC, Discover, AMEX—No Surcharge

International: 1-816 478-8300 FAX: 1-816 478-4596 (24 Hrs) Toll Free UK: 0800-897-545 Toll Free Australia: 0014-800-125-875

APS Technologies, 2900 S. 291 Hwy., Independence, MO 64057

1-800 235-3707


POWERTOOLS®
by Lapine®
• 50x FASTER GRAPHICS
32-bit local bus graphics accelerator with the potent S3 accelerator chip. Standard on LP-433L and LP-450L.
• 30x FASTER ACCESS
New 8MB Cache controller for 5MB per second data transfer. 30x faster hard drive access, available upgrade on all Lapine Powertools.
• 32,000 COLORS!
Standard on all Lapine Powrtools.
• PROGAMMABLE KEYBOARD
Brand new microprocessor based Lapine 101 key programmable keyboard. Multiple functions with one keystroke. Standard on LP-433L and LP-450L.
• FREE LOTUSWRITE® or LOTUSWORK®
Your choice with any system purchase.

Power Is Within Your Reach.

Powertools by Lapine are the office machines that make all the difference for all kinds of businesses.

Lapine is the first computer manufacturer to offer local bus computing with the S3 graphic accelerator chip for 32-bit, 33 and 50mhz processing of graphics. This means graphics that are 50x faster than standard 16-bit processing. The local bus feature is standard on LP-433L and LP-450L models.

Powertools are designed right. Whether it be our true tactile programmable and non-programmable keyboards, ergonomic stylings or crystal clear monitors; we invite comparison. You'll find Lapine's superior quality is evident.

For 5 years Lapine has been committed to bringing corporate America the absolute latest technology faster than any other name brand computer manufacturer. And Lapine's service and support team is dedicated to keeping your office running at maximum efficiency.

Owning a Lapine Powertool puts a great computer and a great company in your hands.

Mini Upright Standard Upright Desktop

POWERTOOLS®

by Lapine®

386-33/40Mhz
LP-333/40

- 4MB (70ns) RAM 64K Cache
- 125MB fast IDE hard drive with Cache
- TEAC® 1.2 and 1.44MB floppies
- ★16-bit 1MB SVGA card with 32,000 color Sierra® DAC chip
- 14" non-interlaced .28 1024x768 SVGA monitor
- 2 serial/1 parallel/1 game port
- LAPINE 101 key tactile keyboard
- MS-DOS 5.0 and WINDOWS™ 3.1 with hi-resolution mouse
- 280 watt power supply
- FREE LOTUSWORKS® or LOTUSWRITE® for WINDOWS FREE!

$1392

Your choice of desktop or mini upright

- Same system as above with 8MB RAM, 256K Cache and 200MB hard drive — $1742
- 17"flat screen SVGA digital mon. — add $520

486-33Mhz
LP-433

- 4MB (70ns) RAM 64K Cache
- 125MB fast IDE hard drive with Cache
- TEAC® 1.2 and 1.44MB floppies
- ★16-bit 1MB SVGA card with 32,000 color Sierra® DAC chip
- 14" non-interlaced .28 1024x768 SVGA monitor
- 2 serial/1 parallel/1 game port
- LAPINE 101 key tactile keyboard
- MS-DOS 5.0 and WINDOWS™ 3.1 with hi-resolution mouse
- 280 watt power supply
- FREE LOTUSWORKS® or LOTUSWRITE® for WINDOWS FREE

$1742

Your choice of desktop or standard upright

- Same system as above with 8MB RAM, 256K Cache, and 200MB hard drive — $2092
- 17"flat screen SVGA digital mon. — add $520

486-50Mhz
LP-450

- 4MB (60ns) RAM 64K Cache
- 125MB fast IDE hard drive with Cache
- TEAC® 1.2 and 1.44MB floppies
- ★16-bit 1MB SVGA card with 32,000 color Sierra® DAC chip
- 14" non-interlaced .28 1024x768 SVGA monitor
- 2 serial/1 parallel/1 game port
- LAPINE 101 key tactile keyboard
- MS-DOS 5.0 and WINDOWS™ 3.1 with hi-resolution mouse
- 280 watt power supply
- FREE LOTUSWORKS® or LOTUSWRITE® for WINDOWS FREE!

$2042

Your choice of desktop or standard upright

- Same system as above with 8MB RAM, 256K Cache, and 200MB hard drive — $2392
- 17"flat screen SVGA digital mon. — add $520

486-33 local bus
LP-433L

- 4MB (70ns) RAM 64K Cache
- 125MB fast IDE hard drive with Cache
- TEAC® 1.2 and 1.44MB floppies
- ★32-bit local bus S3 graphics accelerator for 50x faster graphics with up to 1280x1024 resolution and 32,000 colors
- 14" non-interlaced .28 1024x768 SVGA monitor
- 2 serial/1 parallel/1 game port
- ★Programmable 101 key LAPINE keyboard
- MS-DOS 5.0 and WINDOWS™ 3.1 with hi-resolution mouse
- 280 watt power supply
- FREE LOTUSWORKS® or LOTUSWRITE® for WINDOWS FREE!

$1942

Your choice of desktop or standard upright

- Same system as above with 8MB RAM, 256K Cache, and 200MB hard drive — $2292
- 17"flat screen SVGA digital mon. — add $520

486-50 local bus
LP-450L

- 4MB (60ns) RAM 64K Cache
- 125MB fast IDE hard drive with Cache
- TEAC® 1.2 and 1.44MB floppies
- ★32-bit local bus S3 graphics accelerator for 50x faster graphics with up to 1280x1024 resolution and 32,000 colors
- 14" non-interlaced .28 1024x768 SVGA monitor
- 2 serial/1 parallel/1 game port
- ★Programmable 101 key LAPINE keyboard
- MS-DOS 5.0 and WINDOWS™ 3.1 with hi-resolution mouse
- 280 watt power supply
- FREE LOTUSWORKS® or LOTUSWRITE® for WINDOWS FREE!

$2342

Your choice of desktop or standard upright

- Same system as above with 8MB RAM, 256K Cache, and 200MB hard drive — $2692
- 17"flat screen SVGA digital mon. — add $520

GRAND POWERTOOL 486-33 local bus
GP-433L

- 16MB (60ns) RAM 256K Cache
- 1.2 Gigabyte fast SCSI hard drive
- TEAC® 1.2 and 1.44MB floppies
- ★32-bit local bus S3 graphics accelerator for 50x faster graphics with up to 1280x1024 resolution and 32,000 colors
- 17" non-interlaced 1280x1024 SVGA flat screen monitor w/digital control readout.
- ★ SCSI fast drive controller
- 2 serial/1 parallel/1 game port
- ★Programmable 101 key LAPINE keyboard
- MS-DOS 5.0 and WINDOWS™ 3.1 with hi-resolution mouse
- 280 watt power supply
- FREE LOTUSWORKS® or LOTUSWRITE® for WINDOWS FREE!

$4992

Your choice of desktop or standard upright

- 486-50 local bus (GP-450L) — $5292

LAPINE SERVICE

- 1 year on-site service to most locations
- 1 year parts and 5 years labor
- Toll free technical support unlimited
- 30-day money back guarantee
- Federal Express replacement parts
- Intensive 72-hr. burn-in & test
- Se habla espanol

LAPINE OPTIONS

- Add additional megabytes of memory
- Greater capacity hard drives
- 15",17",20" monitors
- Low radiation monitors
- Tape backups
- CD ROM and multi-media
- And MORE!

All major credit cards accepted. Net 30 day credit terms to qualified government, educational & commercial accounts. All prices subject to change. Prices do not include shipping.

1992 LAPINE Computers

Business Hours:
Mon-Fri. 7am-7pm (PST)
Saturday. 9am-3pm (PST)

8025 Deering Avenue, Canoga Park,
California 91304
818/884-3685 FAX 818/884-3670

1-800-927-3772

LAPINE

Business Compatible Computers.

Circle 237 on Inquiry Card (RESELLERS: 238).

NEVADA COMPUTER — ALL PRICES SLASHED 20-40% OFF

SOFTWARE

WORDSTAR 6.0 or 2000 REL. 3.5

This is not a misprint! These are the exact some ones selling for over $300.00 from our competitors. We have thousands in stock FOR SALE BELOW DISTRIBUTOR COST! LIST $495.00 ea *DEALERS WELCOME*

$99 **$99**

Fast Trax Disk Optimizer	$14.00
Lotus Metro	9.00
Dos 5.0	49.00
PFS Proof	5.00
PFS Graph	5.00
Windows 3.1	59.00

MONITORS

14" MONO/TTL AMBER FLAT SCREEN			$109.00
14" VGA	640X480	(.41 Dot)	$229.00
14" VGA	1024X768	(.28 Dot)	$278.00
14" VGA	1024X768	(Non Interlaced)	$349.00
VGA CARD	w/1MEG		$99.00

NEC MONITORS

NEC NEC NEC

NEC 3FGX	$649.00
NEC 4FG	$749.00
NEC 4D	$799.00
NEC 5FG	$1379.00

TAPE BACKUPS

WANGTEK Wangtec 5099EN24 drive, 6.5MB per minute, PC 36 Controller, Menu Driven Software, Easy installation, DC 600 cartridge. List $999.00 YOUR COST $299

3M DC 2000 (40MB) 13.00 DC 300XLP (45MB) 14.00 DC 6150 22.00

HARD DRIVES

Seagate MICROPOLIS CONNER

PART#	SIZE	ACCESS TIME	INTERFACE	YOUR COST
ST351A	42MB (3.5"/1"H)	28MSec	IDE	199.00
CP3000	40MB (3.5"/1"H)	25MSec	IDE	199.00
ST251-1	40MB (5.25"/HH)	28MSec	MFM	219.00
ST3120A	106MB (3.5"/1"H)	18MSec	IDE	299.00
CP30104	120MB (3.5"/1"H)	16MSec	IDE	359.00
ST3144A	130MB (3.5"/1"H)	16MSec	IDE	349.00
CP30174A	170MB (3.5"/1"H)	17MSec	IDE	459.00
CP3204	209MB (3.5"/HH)	16MSec	IDE	599.00
ST1239A	210MB (3.5"/HH)	15MSec	IDE	599.00
MC1664	340MB (5.25"/HH)	15MSec	ESDI	1,099.00
MC1624	660MB (5.25"/FH)	16MSec	SCSI	1499.00
MC1598	1034MB (5.25"/FH)	14MSec	SCSI	2199.00
MC1528	1354MB (5.25"/FH)	14MSec	SCSI	2699.00
MAXTOR	210MB (3.5 1"H)	15MSec	IDE	549.00

All Hard Drives have a 1 Year Warranty

COPROCESSORS

intel

8088BASED MACHINES:
8087-5MHz, **54.00**
8087-2 8MHz **79.00**
8087-1 10MHz **129.00**

80286BASED MACHINES:
80287-6MHz **39.00**
80287-8MHz **49.00**
80287-10 10MHz **89.00**
80287-XL **99.00**

80386BASED MACHINES:
80387-16 16MHz **89.00**
80387-20 20MHz **94.00**
80387-25 25MHz **99.00**
80387-33 33MHz **109.00**
80387-SX16 **89.00**
80387-SX20 **99.00**
80487-SX20 **539.00**

CONTROLLERS

IDE HD/Floppy **39.00**, 16 Bit HD & FLOPPY 1:1 **39.00**, 8 Bit HD only **49.00** PCXT Controller **9.00** 16Bit Hardonly **19.00**
Super Floppy (controls four drives) 1.2, 360K, 720K & 1.44 **49.00**

FLOPPY DRIVES

MITSUBISHI
EPSON

1 year warranty

360K ½ HT 5¼ "	$39
720K 3½ "	$29
1.2MB 5¼ "	$58
1.44MB 3½ "	$59
5¼ " Brackets	$5
Compaq 360K	$49

SYSTEMS

8088 XT 10MHZ W/640K MEMORY
Hard drive, 360K floppy, Par-Ser-Clock, 12" Amber Monitor, 101 Key Keyboard. 6 month warranty.
COMPLETE HARD DRIVE SYSTEMS:
30MB-$379 40MB-$399

POWER SUPPY

150 WATT XT (DIRECT REPLACEMENT)	39.00
200 WATT AT (DIRECT REPLACEMENT)	39.00

MODEMS

2400 Baud Modem
Hayes compatible; supports extended AT Command Set. Comm 1-4 & IRQ 3-5 & 7. On board speaker, software & telephone cord.
Internal $49 External $79
1200 baud internal $29
V.42 BIS MNP5 Hardware add $30

FAXES

Send & receive 9600 BPS fax & 2400 BPS Modem. Hayes compatible. On board speaker.
Mirror fax software. Port address Com 1-4. **$88**
14.4 Baud V.32 Bis Add $200

COMPUTER PERIPHERALS, INC MEMORY BOARD 2MEG exp 4MEG

16 Bit. 2MB expandable to 4MB. (Uses 1MB x 1Dips) Works with IBM AT, 386 and compatibles. Expanded, Extended, 4.0 Lim compatible **2MEG $79 4MEG $159**

FIND YOUR BEST PRICE, WE'LL BEAT IT!

COMPAQ MEMORY

MODEL	MEMORY ADDED	COMPAQ EQUIV. PART#	YOUR COST
DESKPRO 286	512K KIT	113012-001	59.00
DESKPRO 286N, 386N, 386SX/20 M SYSTEMS	1MB MODULE	118688-001	89.00
	2MB MODULE	118689-001	99.00
	OK BOARD	118700-001	98.00
	4MB MODULE	118690-001	179.00
	8MB	128877-001	399.00
DESKPRO 386/16	1MB-2MB BOARD	108069-001	299.00
	2MB BOARD	108069W71	348.00
	1MB KIT	108071-001	114.00
	4MB-8MB BOARD	108070-001	545.00
	4MB KIT	108072-001	259.00
DESKPRO 386S	1MB BOARD	113633-001	109.00
	4MB BOARD	113634-001	239.00
	1MB MODULE	113646-001	75.00
	4MB MODULE	112534-001	209.00
DESKPRO 386/20, 25, 286E	1MB MODULE	113131-001	69.00
	4MB MODULE	113132-001	184.00
	4MB BOARD	113190-001	799.00
DESKPRO 386/20E/25E	1MB BOARD	113644-001	119.00
	4MB BOARD	113645-001	239.00
DESKPRO 386/33, 486/25/33/33I	2MB MODULE	115144-001	119.00
	8MB MODULE	116561-001	349.00
SYSTEMPRO	32MB MODULE	116568-001	1850.00
PORTABLE III	512K KIT	107331-001	38.00
	INTFC BD	107808-001	149.00
	EXPBD	107811-001	249.00
	2MB KIT	107332-001	119.00
SLT/286	1MB MODULE	110235-001	119.00
	4MB MODULE	110237-001	369.00
LTE	512K KIT	117077-001	149.00
LTE/386S20	1MB	121125-001	99.00
	4MB	121125-002	249.00
LTE/286	1MB BOARD	117081-001	69.00
	4MB BOARD	117081-003	299.00
PORTABLE 386	1MB KIT	107651-001	149.00
	INTFC BD	107707-001	129.00
	4MB BOARD	107653-001	469.00
	4MB EXT BRD	107654-001	469.00
SLT/386S	1MB MODULE	118303-001	89.00
	2MB MODULE	118304-001	139.00
	4MB MODULE	118305-001	249.00
LITE 20&25	2MEG	129769-001	189.00
	4MEG	129769-002	319.00
	8MEG	129769-003	695.00

TOSHIBA MEMORY

In Touch with Tomorrow

TOSHIBA MODEL	MEMORY ADDED	TOSHIBA EQUIV. PART #	YOUR COST
T1000SE & XE/1E	1MEG	PC14-PA8311U	119.00
T1000SE & XE/1E	2MEG	PC14-PA8312U	169.00
T2000SX/T2000	1MEG	PC18-PA8316U	89.00
T2000SX/T2000	2MEG	PC18-PA8317U	119.00
T2000SX/T1000LE	4MEG	PC-PA8314U	219.00
T2000SX/T1000LE	8MEG	PC-PA8315U	399.00
T2000SXE/2200SX	2MEG	PC-PA2000U	119.00
T2000SXE/2200SX	4MEG	PC-PA2001U	219.00
T2000SXE/2200SX	8MEG	PC-PA2002U	399.00
T1200XE	2MEG	PC13-PA8306U	99.00
T1600	2MEG	PC8-PA8302U	99.00
T3100E	2MEG	PC9-PA8341U	99.00
T3100SX	2MEG	PC15-PA8308U	99.00
T3100SX	4MEG	PC15-PA8310U	174.00
T3200	3MEG	PC6-PA7137U	159.00
T3200SX	2MEG	PC12-PA8307U	104.00
T3200SX	4MEG	PC12-PA8309U	174.00
T3200SXC	2MEG	PC19-PA8318U	109.00
T3200SXC	4MEG	PC19-PA8319U	184.00
T4400SX, T6400 & C	2MEG	PC-PA2003U	199.00
T4400SX, T6400 & C	4MEG	PC-PA2004U	399.00
T4400SX, T6400 & C	8MEG	PC-PA2005U	699.00
T5100	2MEG	PC7-PA8301U	99.00
T8500 or	2MEG	PC10-PA8304U	109.00
T5200 & T5200C	8MEG	PC10-PA8313U	369.00

LASER PRINTER MEMORY

	1MEG	2MEG	4MEG
HP2, 20, 3, 3D, 3P, 2P, 2P+		109	169
HP IIISI	59		179
IBM LASER A019, 4019E	89	135	189
IBM LASER A029			189
PANASONIC 4410/4430	129	209	319
PANASONIC 4420/4450I	89	129	209
PANASONIC 4450	119		
PANASONIC 4455		134	

	1MEG	2MEG	4MEG
NEC 90, 290		134	
QMS 410	114	154	244
TIXL/PS17/PS35	59		
CANON LBP4	154	214	
STARLS04	129	179	269
EPSON 6000, ACTION 1SR		125	189
TOSHIBA PAGELASER6		125	199
PACKARD BELL PB9500		125	199
DEI 400	99	149	

RAM CHIPS (DIPS)

DESCRIPTION	150NS	120NS	100NS	80NS	70NS	60NS
64X4	1.95	2.25	2.45	2.95		
256X1 STATIC				1.95	2.25	
256X1	.95	1.05	1.10	1.15	1.45	2.20
256X4		3.95	4.45	4.95	5.45	5.95
1MEGX1		3.50	3.85	4.10	4.45	4.95
1MEGX1 STATIC				4.95	5.25	
1MEGX4				22.00		

IBM PS/2 MEMORY

IBM PS/2 MODEL#	MEMORY ADDED	IBM EQUIV. PART#	YOUR COST
PS/1, 386SX	2MB	92F9935	119.00
30-286	512KKIT	30F5348	36.00
	2MBKIT	30F5360	94.00
140SX&N33SXLAPTOP	2MEG	79F0999	89.00
	4MEG	79F1000	159.00
	8MEG	79F1001	339.00
50Z&55SX,65SX	1MBSIMM	6450603	39.00
	2MBSIMM	6450604	85.00
40SX, 55SX, 65SX, 35SX, 35LS	4MBMODULE	34F2933/87F9977	159.00
50,50Z,55SX&60,65SX	2-8MBBOARD	1497259/6450609	349.00
35SX,LS,40SX	1MBSIMM	6450603	39.00
70-E61,061,121,P70	2MBSIMM	6450604	85.00
70-A21 A61,B21,B61	2MBSIMM	6450608	94.00
80-041	1MBMODULE	6450375	98.00
80-111, 121, 311, 321	2MBMODULE	6450379	189.00
80-A21, A31	4MBMODULE	6451060	199.00
35SX-LS&40SX	8MB	6450129	359.00
ALL 70s&80s	2-8MBBOARD	6450605	299.00
	2-16MBBOARD	34F3077	358.00
	4-16MBBOARD	34F3011	488.00
57SX, 90, 95, P75	2MB	6450902	99.00
	4MB	6450128	169.00
	8MB	6450130	359.00

SIPP ADD $4 SIMM MODULES SIPP ADD $4

DESCRIPTION	150NS	120NS	100NS	80NS	70NS	60NS
256X8	3.00	4.00	6.00	8.00	14.00	
256X9		9.00	14.00	17.00	26.00	29.00
1MEG X 9			33.00	36.00	38.00	41.00
4MEG X 9				134.00	134.00	134.00
512X36 2MEG (72PIN)				99.00		
1X36 4MEG (72PIN)				169.00		
2X36 8MEG (72PIN)				339.00		
4X36 16MEG (72PIN)				649.00		

BOCA MEMORY BOARDS 5 YEAR WARRANTY

80286 & 386 AT MACHINES - BOCA AT PLUS (BRAT 90) OK-8MEG BD. 4.0 LIM COMPATIBLE. CONVENTIONAL, EXPANDED & EXTENDED MEMORY. SUPPORTS DOS, OS/2, LIM/EMS & EEMS. USES 1MEG SIMMS. OK-99.00 2MEG-169.00 4MEG-249.00 8MEG-389.00

BOCARAM/2 PLUS
16 BIT MEMORY FOR ALL IBM MCA SYSTEMS. DOS & OS/2 LIM EMS 4.0 SUPPORT. 2-8 MB USES 1 MB SIMMS. 2MB $194 4MB $279 8MB $449

ORDERS ONLY

800-982-2925

You can Fax orders over also
TECHNICAL/CUSTOMER SERVICE/ORDER STATUS:
(702) 294-0204 FAX (702) 294-1168
HOURS: M-F 7:00-6:00 PST, SAT 10:00-3:00 PST

Mfg. part #'s for convenience only. Most memory products 3rd party.
WE ACCEPT INTERNATIONAL ORDERS
International orders shipped DHL or Air Mail
WE ALSO PURCHASE EXCESS INVENTORY! FAX OR CALL.
ALL PRICES FINAL. Trademarks are registered with their respective Co.'s. 386, 387, 287, SX, are trademarks of Intel Corp.

NEVADA COMPUTER

TERMS:
NO SURCHARGE FOR MC/VISA/AE
MC, VISA, AE, COD CASH, NET
Purchase orders from Universities Fortune 1000 & Government Agencies
Personal Checks, COD add $5.00
20% Restocking Fee on refunds within 30 days
No refunds or exchanges after 30 days - WARRANTY REPLACEMENT ONLY

AD # B-992

*Under same terms in magazine.
PRICES SUBJECT TO CHANGE.
SHIPPING: UPS (Min. $8.25)

684 Wells Road, Boulder City, Nevada 89005

Circle 219 on Inquiry Card.

BUY HDI

A RECOGNIZED LEADER!

PC MAGAZINE EDITORS' CHOICE June 27, 1989 Mass Storage Mail Order

HARD DRIVES AND PERIPHERALS

NEW LOWER PRICES

WORRY-FREE 30 Day ONE YEAR REPLACEMENT GUARANTEE

FOR THE BEST PRICE, SERVICE & SUPPORT CALL:

800/998-8040

HDI SALES: 602/350-1128
FAX 602/350-1150

NATIONAL ACCOUNTS
Purchase Orders
800/998-8014
FAX 602/350-1180

International: 602/350-1144
FAX 602/350-1188

APO/FPO: 602/350-1145

Order Status: 800/729-4490

TOLL-FREE TECHNICAL SUPPORT

WE SHIP VIA FEDERAL EXPRESS
80% OF ORDERS DELIVERED NEXT DAY!

INTRODUCING THE INSIGHT CREDIT CARD
CALL FOR DETAILS
800/755-0822

NEVER A SURCHARGE FOR CREDIT CARDS

VISA* MasterCard Card DISCOVER

Prices and availability subject to change without notice. All items NEW. PO's accepted from qualified buyers-Net 20. APO/FPO orders add $16 shipping. 30 Day Guarantee & 1-Year Replacement Policy may have some restrictions. Shipping is not refundable. All trademarks are the properties of their respective owners. 9.92

Hard Drives International
1912 W. 4th St., Dept. HAQ
Tempe, AZ 85281

ORDER 24 HOURS EVERY DAY

Quantum

52MB QULPS52A IDE
17ms 3.5" 1"H
Bare Drive Kit $209
8 Bit $249
16 Bit Kit $229

120MB QULPS120A IDE
15ms 3.5" 1"H
Bare Drive Kit $359
8 Bit $399
16 Bit Kit $379

240MB QULPS240A IDE
16ms 3.5" 1"H
Bare Drive Kit $649
8 Bit $689
16 Bit Kit $669

Seagate

42MB ST351A IDE
28ms 3.5" 1"H
Bare Drive Kit $189
8 Bit Kit $219
16 Bit Kit $199

60MB ST277R-1 RLL
28ms 5.25" HH
Bare Drive Kit $219
8 Bit Kit $279
16 Bit Kit $299

106MB ST3120A IDE
18ms 3.5" 1"H
Bare Drive Kit $299
8 Bit Kit $339
16 Bit Kit $319

130MB ST3144A IDE
16ms 3.5" 1"H
Bare Drive Kit $349
8 Bit $389
16 Bit Kit $369

245MB ST3283A IDE
12ms 3.5" 1"H
Bare Drive Kit $599
16 Bit Kit $619

1050MB ST41200N SCSI
15ms 5.25" FH
Bare Drive Kit $1999
16 Bit Kit $2199

ALWAYS LOW PRICES SOFTWARE! SUPER LOW WITH PURCHASE OF HARDWARE Call for details

Talon

120MB TA3020A IDE
15ms 3.5" 1"H
Bare Drive Kit $299
8 Bit $329
16 Bit Kit $319

Maxtor

120MB MX7120A IDE
15ms 3.5" 1"H
Bare Drive Kit $349
16 Bit Kit $369

210MB MX7213A IDE
15ms 3.5" 1"H
Bare Drive Kit $499
16 Bit Kit $519

FUJITSU

425MB FJ2623S SCSI
12ms 3.5" HH
Bare Drive Kit $1049
16 Bit Kit $1199

510MB FJ2624A IDE
12ms 3.5" HH
Bare Drive Kit $1149
16 Bit Kit $1169

520MB FJ2624S SCSI
12ms 3.5" 1"H
Bare Drive Kit $1149
16 Bit Kit $1299

CONNER

40MB CP3000 IDE
25ms 3.5" 1"H
Bare Drive Kit $189
8 Bit Kit $229
16 Bit Kit $209

170MB CP30174 IDE
17ms 3.5" 1"H
Bare Drive Kit $399
16 Bit Kit $419

209MB CP3204 IDE
16ms 3.5" HH
Bare Drive Kit $609
16 Bit Kit $629

MICROPOLIS

340MB MC1684-7 ESDI
15ms 5.25" HH
Bare Drive Kit $1099
16 Bit Kit $1249

660MB MC1624 SCSI
15ms 5.25" FH
Bare Drive Kit $1399
16 Bit Kit $1549

1049MB HS MC1598 SCSI
14ms 5.25" FH
Bare Drive Kit $1949
16 Bit Kit $2099

1354MB HS MC1528-15 SCSI
14ms 5.25" FH
Bare Drive Kit $2179
16 Bit Kit $2329

SIMM

ADD 1MB RAM AS LOW AS $39

1MB	x9	80ns	$38
1MB	x8	80ns	$39

MEMORY FOR EVERY SYSTEM!

CD-ROM DRIVES

SONY

	INTERNAL	EXTERNAL
DOS	$419	$699

ALL BARE DRIVE KITS INCLUDE
All mounting hardware, "Disk Manager" formatting/partitioning software if necessary, and HDI's Hard Drive Reference Manual with complete installation instructions.

ALL 8 & 16 BIT KITS INCLUDE
16-Bit host adaptor hard/floppy "1 to 1" controller or interface card, mounting kit (3.5" kit inc. beige & black bezels), rails, cables, all mounting hardware, "Disk Manager" software (if applicable) and manual.

COMPLETE INSTRUCTIONS - EVERYTHING YOU NEED!

Insight

HARD DRIVES International

800/998-8040

PURCHASE ORDERS/NATIONAL ACCOUNTS 800/998-8014

HARD DRIVES International

HAQ

MONITOR COMBO'S

Now's the time to add a Monitor Combo to your computer system. The VGA Combo's come with a 2 year warranty, and work AT, 386 and 486 computer systems.

COMBO-MONO $99
12" Monographics Monitor with controller card.

COMBO-VGA $289
640 x 480 VGA monitor with controller card and 256K video RAM. Works with AT or 386 computers.

COMBO-SVGA $439
1024 x 768 Super VGA monitor with controller card and 1 MEG video RAM.

HARD DRIVE COMBO'S

Now's the time to upgrade your computer system with our hard drive combo's. Change your outdated MFM drive to a faster more reliable IDE hard drive. Works with AT, 386 and 486 computers.

COMBO-40 $225
40 MEG IDE 28ms hard drive with controller card.

COMBO-105 $335
105 MEG IDE 15ms hard drive with controller card.

COMBO-130 $375
120 MEG IDE 19ms hard drive with controller card.

COMBO-210 $649
210 MEG IDE 15ms hard drive with controller card.

GREAT NEW PRICES!

BOCA 14.4K MODEM

M1440I BOCA V.32BIS, 14.4K Modem Internal $239
M1440E BOCA V.32 BIS, 14.4K Modem External $319
BOCA Research FAX Send/Receive Modem. Uses Rockwell chip set, transmits and receives FAXES up to 9600 BAUD. Modem transmits and receives data up to 14.4K BAUD. Includes Quicklink II Software. Made in the U.S.A. and comes with BOCA 5-year warranty.

ZOOM MODEMS

AMC-2400 Internal 2400 BAUD Modem $59
AMX-2400 External 2400 BAUD Modem $69

MONITORS

RM9502	14" Monochrome VGA Monitor (800 x 350, 400, 480)	$139
RE1420	14" Super VGA Monitor (1024 x 768) Unlimited Colors - 2-year manufacturers' warranty	$359
MON-05	Monochrome TTL Amber (720 x 348) 12"	$89
MON-06	Paper White TTL 14"	$112
MON-10	CGA/RGB (640x240) 14"	$219
MON-07	VGA .41 Dot Pitch 640 x 480 14" - One-year manufacturers' warranty	$239

TRIPP LITE POWER PRODUCTS

Back-Up Systems

Part#	Each
BC-250	$105
BC-400	$169
BC-500	$194
BC-500LAN	$199
BC-600LAN	$269
BC-900LAN	$379
BC-1250LAN	$529
BC-4000LAN	$2549

OMNI Back-Up Systems

Part#	Each
OMNI-450LAN	$299
OMNI-600LAN	$399
OMNI-900LAN	$549
OMNI-1250LAN	$679
OMNI-2000LAN	$1149

TRIPP LITE EST 1922 "THE POWER PEOPLE"

Line Stabilizer/Conditioners

UL listed and 2 year warranty.

Part#	Description	Each
LS-504	500 Watts, 230 Volt, 4 Outlets	$98
LS-600	600 Watts, 2 Outlets	77
LS-604	LS-600 with HI voltage regulation	98
LC-1200	1200 Watts, 4 Outlets	139
LC-1800	1800 Watts, 6 Outlets	188
LC-2000	2000 Watts, 208/220/240 Volt	243
LC-2000X	220/240 V, 2000 watts,6 Outlets	243
LC-2400	2400 watts,110 V, 6 outlets	243
LCR-2400	2400 watt rack mt., 110 V, 14 outlets	287

Modem Fax Protectors

2 year warranty.

Part#	Description	Each
ISOTEL	Lifetime warranty. 4 outlet, 6 ft. cord and modem protector (*Gold Seal)	$59
ISOFAX	ISOBLOK w/ Modem protector	36
TSB	3 stage Modem/Fax protector	38
MP	Economy Modem/Fax protector	14
SMP	1 AC outlet w/modem/fax protector	29
SMP-GS	Lifetime guarantee. (*Gold Seal)	35

TrippLite Isobars

All Isobars come with a lifetime warranty and UL listing.

Part#	Description	Each
IB2-0	2 outlet direct plug-in	$23
IB2-0/20	2 outlet, 20 amp, direct plug-in	39
IB2-6	2 outlet, 6 ft. cord (*Gold Seal)	32
IB4	4 outlet, 6 ft. cord (*Gold Seal)	43
IB4/220	4 outlet, 6 ft. cord, 220 Volt	49
IB6	6 outlet, 6 ft. cord (*Gold Seal)	51
IB8	8 outlet, 12 ft. cord (*Gold Seal)	61
IB-8RM	8 outlet, 12 ft. cord w/remote power switch	69
EUROBAR	4 outlet, 6 ft. cord, 220/240 Volt Euro connectors	52
IBR-12	12 outlet, 19" rack mountable	89

3M DATA CARTRIDGES

DC2000-3M	40 Megabyte	$14.99
DC2000T-3M	Thetamat for Colo. Mem.	17.99
DC2060T-3M	Thetamat for Colo. Mem.	22.99
DC2080R-3M	Rhomat for Irwin 80	15.99
DC2120-3M	120 Megabyte	18.49
DC2120R-3M	Rhomat for Irwin 80	22.99
DC300XL/P	45 Megabyte	18.29
DC600A-3M	60 Megabyte	19.99
DC6150-3M	150 Megabyte	20.99
DC6250-3M	250 Megabyte	24.99
D8-112-3M	8MM up to 5.0 GB	12.39

3M DISKETTES

3-1/2" Diskettes

Part#	Description	Per Box/10
3.5DS	DSDD	$6.99
3.5DS/F	DSDD Formatted	7.49
3.5DSHD	DSHD	13.39
3.5DSHD/F	DSHD Formatted	13.99

5-1/4" Diskettes

Part#	Description	Per Box/10
5.25DS	DSDD	$4.89
5.25DS/F	DSDD Formatted	5.39
5.25DSHD	DSHD	8.49
5.25DSHD/F	DSHD Formatted	9.19

IIT MATH CO-PROCESSORS

100% Compatibility Guaranteed: 386DX, 386SX and 286 systems & software. Lower-Power for Portables • IIT Lifetime Warranty

2C87-12	For 286 up to 12.5 MHz	$56
2C87-20	For 286 up to 20 MHz	64
3C87-16SX	For 386SX up to 16 MHz	72
3C87-20SX	For 386SX up to 20 MHz	72
3C87-25SX	For 386SX up to 25 MHz	75
3C87-25	For 386 up to 25 MHz	92
3C87-33	For 386 up to 33 MHz	95
3C87-40	For 386 up to 40 MHz	123

NEW LOWER PRICES!

MEMORY MODULES

256KX9-80	256K x 9-80 NS SIMM	$13.00
256KX9-80SP	256K x 9-80 NS SIPP	15.00
256KX9-70	256K x 9-70 NS SIMM	14.00
1MEGX9-80	1MB x 9-80 NS SIMM	44.00
1MEGX9-80SP	1MB x 9-80 NS SIPP	46.00
1MEGX9-70	1MB x 9-70 NS SIMM	46.00
1MEGX9-70SP	1MB x 9-70 NS SIPP	48.00
1MEGX9-60	1MB x 9-60 NS SIMM	48.00
4MEGX9-60	4MB x 60 NS SIMM	Call

DISK DRIVES

DDD-04	5 1/4 inch DSDD 360K black faceplate	$59
DDD-05	5 1/4 inch DSDD 360K beige faceplate	59
DDH-06	5 1/4 inch DSHD 1.2MB beige faceplate	59
DDH-09	3 1/2 inch 720K beige w/bracket	59
DDH-10	3 1/2 inch 1.44MB beige w/bracket	59
DDH-11	Same as DDH-10 without 5-1/4" Mounting bracket. Fits in 3-1/2" bay	55

3-1/2" Drive Mounting Kits $9.95

5.25KITFD Mounts 3-1/2" Floppy drive in 5-1/4" Bay
5.25KITHD Mounts 3-1/2" Hard drive in 5-1/4" Bay

HARD DRIVES

ST-351A	40MB, 28MS IDE, 3-1/2"	$209
ST-3120A	105MB, 15MS IDE, 3-1/2"	$319
ST-3144A	120MB, 19MS IDE, 3-1/2"	$359
ST-1239A	210MB, 15MS IDE, 3-1/2"	$639

SCSI Hard Drives

ST-1239N	Seagate 204MEG, SCSI, 15MS,3-1/2"	$649
ST1480N	Seagate 426MEG, SCSI, 14MS,3-1/2"	$1399
ST-41650N	Seagate 1.4GB, SCSI, 15MS, FH	$2479

MFM Hard Drive

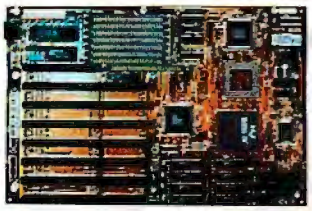
ST-251	40MEG Fixed Disk without Controller ST-251, 5-1/4"	$259

Locations in San Antonio • Austin • Dallas

1 (800) 531-5369

11342 IH 35 NORTH • SAN ANTONIO, TEXAS 78233 (512) 637-3200
Hours: 7am—8pm Monday-Friday • 9am-5pm Saturday CST • FAX: (512) 637-3264

MOTHERBOARDS



Part#	Description	Each
MB286-16	16 MHz 286 Motherboard	$85
MB286-20	20 MHz 286 Motherboard	$95
MB386SX-25	25MHz 286 Motherboard	$159
MB386-33C	33MHz 386 Motherboard	$299
MB486-33	33MHz 486 Motherboard	$659

Descriptions and Prices on Mother Boards Subject to Change.

EXPANSION BOARDS

Part#	Description	Each
IFC-12	Serial Board PC/XT	$11
IFC-25	2 Serial, Parallel, Game Board XT/AT	$16
IFC-13	Parallel Board XT/AT	$9
IFC-20	Game Board XT/AT 2 Ports	$9
IFC-70	BOCA 2 Serial, 2 Parallel I/O Board	$49

DISK CONTROLLER BOARDS

Part#	Description	Each
IFC-14	2 Floppy Controller Board PC/XT	$13
IFC-15	Disk I/O Board Serial, Parallel, Clock, Game PC/XT	$25
IFC-24	Fixed Disk MFM/ 2 Floppy Controller AT	$69
IFC-27-2	AT 2/IDE 2/Floppy Controller	$19
IFC-28	Fixed Disk Controller Board PC/XT XT MFM hard drive controller board.	$47
ST-01	8-Bit SCSI Controller Board	$29
ST-02	8-Bit SCSI/Floppy Controller Board	$47
IN-2000	16-Bit SCSI Hard/Floppy Controller Board	$189

POWER SUPPLIES

Part#	Description	Each
PS-150	150 watt XT Power Supply	$39
PS-200M	200 watt XT power Supply	49
PS-200	200 watt AT Power Supply	59
PS-230	230 watt Large Vertical Case	79
PS-200MINI	200 watt Baby Vertical Case	59

KEYBOARDS

KBY-60 AT Style - LIMITED QUANTITIES $19
AT style, 10 function keys. XT or AT

K-156 Enhanced Style Keyboard (XT,AT) $35
101 keys with regular footprint for XT or AT. Size: 20 1/2"L x 7 7/8"W x 1 13/16"H.

K-160 Enhanced Style Narrow Footprint $36
Small footprint keyboard with 101 keys and three cable position connection to computer (left, center, right) for XT or AT. Size: 18 1/2"L x 6 1/2"W x 1 5/16"H.

K-158 Enhanced Style Small Footprint $43
Compact keyboards with 101/102 keys. 22 percent smaller than regular footprint. Size: 15 3/4"L x 7 7/8"W x 1 13/16"H.

K-158-1 Small Footprint Spanish Language $47

KBY-39 Enhanced Style, 12 Function Keys, XT or AT $49

KBY-TRACK Keyboard/Trackball $79
Keyboard with 12 Function Keys and Trackball. Microsoft compatible driver on a 5.25" disk. User selectable XT or AT, 386 or compatible.

VISA MasterCard DISCOVER AMERICAN EXPRESS

SOUND BLASTER PRO WITH CD-ROM SOFTWARE!

Includes Chess Master 3000 • Ultima VI • Wing Commander

Features:
- Stereo DACs and ADCs
- Stereo Digital/Analog Mixer (Six input sources include FM, CD audio, microphone, etc.)
- Stereo FM music synthesizers
- MIDI interface
- CD-ROM interface and Joystick Port
- All cables and operating manuals

We Also Have CD-ROM Software

SBPRO-CD Sound Blaster Pro With CD-ROM Software $199

CD ROM DRIVE AND SOFTWARE

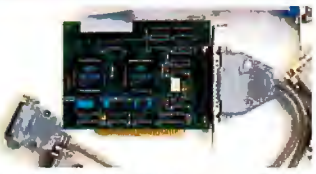
91-011 Sony 535, 340MS Internal CD ROM Drive with a 1-year warranty. $490

Bundled with:
Reference Library Version 2.0
Book of Mammals
Groliers' Illustrated Encyclopedia 1991 with Audio
US/World Atlas
CD Game Pack 2 (12 Games)
CD SetGo Version 1.9

BOCA I/O 2 BY 4

A High-Performance Interface Solution
- Supports 4 serial ports and 2 parallel ports. Parallel Port: LPT1, LPT2, Selectable interrupts: IRQ 5 and 7. Serial Port: COM 1-4. Selectable interrupts: IRQ 2, 3, 4 and 5
- Comes with two DB-37 to DB-25 cable adapters and one DB-37 connector/bracket assembly with ribbon cable
- Made in the USA
- 5-year warranty
- Free technical support
- FIFO Buffering

BOCA RESEARCH INC



IO2BY4 BOCA I/O 2 by 4 $109

BOCA MULTI PORT 1004/1008

A cost-effective interface solution for serial devices.
A high-speed, non-intelligent, multi-port enhancement board. Available in two versions, the board provides either 4 or 8 ports on a single board.
- Choose 4 or 8 ports on a single board
- Install multiple boards into one system
- Utilizes ST16C554 UART technology - each ST16C554 chip is equivalent to four NS16C550s with FIFO buffering
- 8/16 bit interface
- Compatible with ISA & EISA systems
- One 6' RJ-11 cable with DB-25 adapter for each port and software drivers
- Software Drivers on 5.25" diskette for SCO XENIX system V & SCO INIX system V. Software driver not required for PC-MOS/386

BB1004 BOCA 4 Port Board $119
BB1008 BOCA 8 Port Board $169

CALL NOW FOR THE NEW 1992 CATALOG! 1 (800) 531-5369

TERMS: No surcharge on credit cards. For C.O.D. orders add $5. C.O.D. orders are cash or cashiers check only. Minimum C.O.D. order is $25. PO's accepted from approved accounts. Government, Institutional and Corporate Purchase Orders welcome. FAX your order for faster service. All orders under $99 will be assessed a $3 handling fee. Orders of $99 or more, no handling charges. All shipping is FOB San Antonio, Texas and will be added to invoice. Texas residents add 8-1/4% sales tax. All returns require an RMA number and we ask that all returns are sent back in the condition in which you received them. A 15% restocking fee will be assessed on product that is returned in non-resaleable condition. Prices are subject to change, please call for current pricing. We are not responsible for typographical errors. In a hurry? Federal Express your order. 2nd Day Economy: $6.75 up to 20 lbs.. Overnight Priority: $15.50 up to 20 lbs.

VOLUME DISCOUNT PRICES!

FEDERAL EXPRESS

Circle 204 on Inquiry Card.

Altex Electronics

11342 IH 35 NORTH • SAN ANTONIO, TEXAS 78233 (512) 637-3200
Hours: 7am—8pm Monday-Friday • 9am-5pm Saturday CST • FAX: (512) 637-3264

1 (800) 531-5369

16MB TECHNOLOGY NOW!!

ACER 486sx - 16MB SIMM (4M X 36)	$ 599.00
32MB SIMM (8M X 36)	$ 1,999.00
COMPAQ SystemPro - 32MB MODULE	$ 1,599.00
DELL 486's - 16MB KIT (2 SIMMS)	$ 598.00
32MB KIT (2 SIMMS)	$ 1,198.00
MAC IIfx - 64MB KIT (4 SIMMS)	$ 2,116.00
MAC QUADRA 950 - 64MB KIT (4 SIMMS)	$ 2,076.00
MAC IIci,IIcx,QUADRA 900 - 64MB KIT (4 SIMMS)	$ 2,076.00
MAC QUADRA 700 - 64MB KIT (4 SIMMS)	$ 2,276.00
SUN IPX,ELC - 16MB SIMM	$ 499.00

OTHER MEMORIES AVAILABLE...

IBM

PS/1 - 2MB	$ 68
4MB	$ 149
M30 - 2MB	$ 92
M50Z,55sx,65sx,70 - 1MB	*$ 45*
2MB	*$ 89*
M55sx,65sx,70 - 4MB	*$ 149*
M70-A21,A61,121 - 2MB	$ 90
M40sx,35sx - 8MB	$ 299
M57sx,90,95 - 4MB	$ 155
8MB	$ 309
M80-041 - 1MB	$ 65
M80-111,121,311 - 2MB	$ 99
M80-A21,A31 - 4MB	$ 195
16-BIT 0K Exp Board	$ 128
32-BIT 0K Exp Board	$ 155

AST

PREM. 386/20C - 1MB KIT	$ 65
PREM. 386/25 - 1MB	$ 45
PREM. 486/25 - 1MB	$ 45
PREM. II 486 - 1MB	*$ 45*
4MB	*$ 155*
8MB KIT	*$ 310*
PREM. II 1MB Exp Board	$ 469

COMPAQ

DP 386/20,20E,25 - 1MB	$ 66
4MB	$ 168
DP 386S/16 - 1MB	$ 66
4MB	$ 168
DP 286N,386N,S/20 - 4MB	$ 149
M-SYSTEMS - 2MB	*$ 89*
4MB	*$ 149*
8MB	*$ 299*
DP 386/33,486/25 - 2MB	$ 96
SystemPro - 8MB	$ 315
0K Exp Brd	$ 335
DP 386S/16 1MB Exp Brd	$ 105
DP 386/20,20E,25,25E 1MB Exp. Board	$ 105

DELL

325D,P;333D,P - 1MB	$ 45
4MB	$ 149
420,425,433 - 2MB KIT	$ 90
4MB KIT	$ 178
8MB KIT	$ 298
450DE,450SE - 2MB KIT	$ 90
4MB KIT	$ 178
8MB KIT	$ 298

HP

Vectra QS-16 - 2MB KIT	$ 129
4MB KIT	$ 229
Vectra 486 - 2MB	$ 89
4MB	$ 149
8MB	$ 299
X-Station 700 Ser. - 2MB	$ 89
4MB	$ 149
8MB	$ 299
9000/400t,425t - 8MB KIT	$ 495
16MB KIT	$ 999
32MB KIT	$1869
9000/425e - 8MB KIT	$ 428
16MB KIT	$ 828

APPLE

II,SE,SE/30 - 1MB	$ 32
Classic - 1MB Exp. Board	$ 54
SE/30,IIci,IIcx,IIsi,LC & Quad. 700,900 - 4MB	$ 115
Quad. 700,900 - 32MB KIT	$1120
IIfx - 16MB KIT	*$ 499*
IIfx - 32MB KIT	$1156
Quadra 256K V-RAM	$ 30
LC 512K V-RAM	$ 47

LAPTOPS

AST EXEC. NB - 4MB	$ 135
COMPAQ LTE386 - 4MB	$ 229
SLT386 - 4MB	$ 168
DELL 316,320 LT - 2MB	$ 99
EVEREX TEMPO - 2MB	$ 78
IBM L40sx - 4MB	$ 160
MAC POWERBOOK - 2MB	*$ 104*
NEC P.S. 286,386sx - 4MB	$ 200
P.S. 386 - 8MB	$ 429
P.S. SX/20 - 4MB	$ 200
PANASONIC CF170 - 1MB	$ 55
T.I. TRVL-MT 3000 - 2MB	$ 80
TOSHIBA 1000 - 2MB	$ 108
2000SXE - 8MB	$ 388
3200SXC - 4MB	$ 160
5200 - 8MB	$ 315

PRINTERS

EPSON 6000 - 4MB	$ 229
HP IIP,III,IIID,P - 2MB	*$ 108*
IIIsi - 4MB	*$ 135*
IBM 4019,4029e - 3.5MB	$ 140
4029 - 4MB	$ 135
OKIDATA 400 - 2MB	$ 129

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

OTHER MEMORIES FOR:
ACER, ALTIMA, APPLE, AST, CHAPLET, COMPAQ, DELL, EPSON, EVEREX, HP, LEADING EDGE, IBM, NEC, NCR, OKIDATA, PACKARD-BELL, PANASONIC, PHILIP, SAMPO, SHARP, SILICON GRAPHICS, SUN MICROSYSTEMS, TANDON, TI, TOSHIBA, TULIP AND ZENITH.

CALL FOR OUR COMPLETE CATALOG

CitiTronics Inc.

TERMS: C.O.D. CASH, VISA OR MASTERCARD.
COMPANY AND UNIVERSITY P.O.'S ACCEPTED UPON CREDIT APPROVAL.

414 CLOVERLEAF DR., UNIT B, BALDWIN PARK, CA 91706

TEL. (818)855-5688 FAX (818)855-5687

ALL PRODUCT NAMES, TRADEMARKS AND REGISTERED TRADEMARKS ARE THE PROPERTY OF THEIR REPSECTIVE COMPANIES.

Circle 234 on Inquiry Card.

THIS IS ONE FLIGHT YOU DEFINITELY WON'T BE SLEEPING THROUGH.

So the novelty of flying wore off a long time ago. Cancel those reservations and strap yourself into the cockpit of the *F-15 Strike Eagle® III* jet fighter computer game. This is flying as it should be. Slicing through war theaters around the world. Blasting enemy fighters to smithereens with high-tech missiles.

Devastating strategic targets in dangerous bombing runs. Performing fantastic aerial aerobics. And dogfighting against a friend via modem. All brought to life by dazzling, state-of-the-art graphics. Sure, it's not like flying first class.

But when's the last time you had fun flying first class? *F-15 Strike Eagle III* from MicroProse. To get your copy, visit your favorite computer game retailer today.

MICROPROSE™
ENTERTAINMENT • SOFTWARE
SERIOUSLY FUN SOFTWARE

To get our free catalog, call **1-800-879-PLAY**
(Mon. - Fri., 8:30 am - 5:00 pm EST) or fill out the coupon and mail it to: MicroProse Software, Inc. 180 Lakefront Drive Dept. D10 • Hunt Valley, MD 21030-2245

Name _____
Address _____
City _____ State _____ Zip _____
Telephone ( ) _____
NAA

© 1992 MicroProse Software, Inc. ALL RIGHTS RESERVED.
Available for IBM-PC/Compatibles.

Circle 220 on Inquiry Card.

SAVE BIG ON COMPUTER PRODUCTS

NO EXTRA CHARGE for credit cards

DRIVES AND BACKUPS

Conner Hard Drives

3000	42MB	3.5" IDE 28ms	$199
30104H	120MB	3.5" IDE 19ms	375
30174E	170MB	3.5" IDE 17ms	449
3204F	212MB	3.5" IDE 16ms	599

Seagate Hard Drives

ST351AX	40MB	IDE 3.5"	209
ST251-1	40MB	MFM 28ms	249
ST3096A	89MB	IDE 3.5" 14ms	319
ST3120A	100MB	3.5" IDE	349
ST3144A	130MB	IDE 3.5" 16ms	399

Micropolis

1654	161MB	ESDI HH 16ms	749
1664	345MB	ESDI HH 18ms	999

Plus Development Hard Drive Cords
Hard Cord IIXL 50MB / 105MB . . CALL

Mountain Tape Backups
FS4000 40/120MB AT Int. . . . . CALL
FS8500 80/304MB AT IDE Int. . . . CALL

Irwin Tape Back-Up
Accutrak 120MB Internal Drive 179
Accutrak+ 250MB Internal Drive 299

FLOPPY DRIVES

Toshiba Disk Drive Kits
ND 04D 5.25" 1/2 HT 360K (PC/XT) $59
ND 08DEG 5.25" 1.2MB (PC/AT) . . . 69
ND 356T 3.5" 1.44MB AT Kit 69

Sony Disk Drives
3.5" 720K (PC/XT/AT) 59
3.5" 1.44MB Slimline Bare 59
3.5" 1.44MB 59

MONITORS

Packard Bell Color Monitors
8551VG 14" 640 x 480 (.51mm) . . $199
8538SVGL 14" 1024 x 768 Low Radiation(.39mm) 279
8548SVGL 14" 1024 x 768 Low Radiation Non-Interlaced (.28mm) 369

Panasonic Color Monitors
C-1381i 14" 1024 x 768 (.28mm) . $349
C-1395 14" 1024 x 768 (.28mm) . . . 449

Leading Edge 14" Monitors
Mono VGA Monochrome 129
C39AD 1024 x 768 (.39mm) 245
C28AD 1024 x 768 (.28mm) 299
C28M 1024 x 768 Multisync (.28mm) 350

NEC Multisync Color
3FGX 15" 1024 x 768 659
4FG 15" 1024 x 768 755
5FG 17" 1280 x 1024 1450
5D 20" 1280 x 1024 1699

Sony 14" Color
1304HG 1024 x 768 Multiscan 599
1320 640 x 480 VGA 349

BOARDS & VIDEO CARDS

Intel Aboveboard
Above Board ISA w/2MB/4MB . . . . . CALL
Above Board MC for PS/2 249

Boca Boards
Boca I/O 2 Ser., 1Par. 45
Boca I/O MCA 2 Ser., 1 Par. 89
Boca I/O 4 Ser., 2 Par. 99
Boca AT Plus 0K/2MB 109/209
Boca VGA Basic 640 x 480 49
Boca VGA Basic 800 x 600 59
Boca SVGA 1024 x 768 119
Boca SVGA 1024 x 768 high resolution color 129

JOYSTICKS

Etronics Super Shooter Joystick . . $10.99
Gravis Analog Joystick 31.99
Gravis Eliminator Game Card 24.99
Gravis PC Game Pad 19.99

MICE

Etronics Smartee Mouse $25.00
IMSI Pet Mouse 19.99
Logitech Mousemon Combo 69.99
Logitech First Mouse Serial 39.99
Logitech Portable Trackman 99.00
Microsoft Ballpoint for Laptops . . 119.99
Microsoft Serial Mouse w/Wind. 149.99
Microsoft Mouse Serial/Bus 79.99
Mouse System Omnimouse II w/Point Bus/Seriol 49.99/35.99

Feather Light & Priced Right!

AST Authorized Systems Reseller

AST Premium® Exec™ Notebook Series

AST's Premium Exec Notebook computers pack the highest performance, processing, and more standard features, into a convenient compact package weighing only 7 lbs.

The Premium Exec 386SX/20 and 386SX/25 include the latest flat panel display technology, providing high-resolution VGA on a "paper white" screen, capable of supporting 32 shades of gray.

The New Premium Exec 386SX/25C offers passive matrix color, 16 colors at 640 x 480 resolution and 256 colors at 320 x 200. And, at a price other manufacturers charge for slower speed monochrome systems.

3865X/20 40MB 43V
3865X/20 60MB 63V
3865X/25 60MB 63V/4
3865X/25 80MB 83V/4
3865X/25 120MB 123V/4

COLOR
3865X/25C 60MB 63V/4
3865X/25C 80MB 83V/4
3865X/25C 120MB 123V/4

CALL FOR NEW LOWER PRICES

Premium Exec 386SX/20 Features:
- 386SX/20MHz processor
- 40MB or 60MB fast-access, 2.5" lightweight HD
- 2MB RAM exp. to 8MB
- 3.5" 1.44MB FDD
- Ports: 1S, 1P, 1Video 1KB or mouse
- MS-DOS 5.0 from AST
- Free carrying case with handle

Premium Exec 386SX/25 & 386SX/25C Features:
- 386SX/25MHz processor
- 60MB,80MB or 120MB fast access, 2.5" lightweight HD
- 4MB RAM exp. to 8MB
- 3.5" 1,44MB FDD
- Ports: 1S, 1P, 1Video, 1KB or mouse
- MS-DOS 5.0 from AST
- Free carrying case with handle

AST, AST logo and Premium are registered and Exec is a trademark of AST Research, Inc.
All other product or brand names are trademarks or registered trademarks of their respective companies.

MATH COPROCESSORS

Intel Math CoProcessors

80287XL	(6,8,10MHz)	CALL
and 80C287	(12MHz)	FOR
80387SL	(16/20/25MHz)	NEW
80387SX	(16/20/25MHz)	LOWER
80387	(16/20/25/33MHz)	PRICES!
80487SX	(20/25MHz)	
Ropidcod	(16/20/25/33MHz)	
Overdrive (New)	486SX/20	CALL
Overdrive (New)	486SX/25	CALL

Cyrix Math CoProcessors

82S87	(8-20MHz 80286)	CALL
83S87	(16/20/25MHz SX)	FOR
83D87	(16/20/25/33MHz)	LOWER
83D87-40	(40MHz 80386)	PRICES!

MEMORY UPGRADES FOR IBM

Legend IBM™ Compatible PS/2 Memory Upgrades

529802	2MB 30-286	$109
529828	2MB 70-E61, 70-121	109
529836	2MB 70-A21	109
551029	2MB Exp. Bd 50Z, 60, 55SX	299

Legend Memory available for Toshiba Laptops, AST, HP, Mac & Others. CALL

CHIPS AND SIMMS

All speeds . . . . . CALL

MULTIMEDIA

SoundBlaster Pro $199.99
SoundBlaster Pro Basic 159.99
SoundBlaster PC 99.99
Multimedia Int. CD ROM Drive w/SoundBlaster Pro 579.00
LABTEC SS-100 Amplified Speaker 19.99
LABTEC SS-700 Amplified Spoeker 29.99
Sony CD-ROM 7205 Ext. XT/AT w/Laser Library 549.99
Includes: Compton's Family Encyclopedia. Languages of the World/ Toolworks, World Atlas and more.

CD-ROM Software
Audobon's Birds of America 29.99
Chessmoster 3000 . . . . . 59.99
Greatest Book Collection 32.99
King's Quest V 39.99
Library of the Future 134.99
Microsoft Multimedia Beethoven . . 52.99
New Bosics Electronic Cookbook . 64.99
Shokespeore on Disk 19.99
Sherlock Holmes 39.99
Spirit of Excalibur 32.99
Stellor 7 . . . . . 39.99
Where in the World is Carmen Son Diego Deluxe 64.99

TRONICS MODEMS

▲ 100% Hayes Compotible
▲ 2 Year Warranty

2400 Baud Internal w/software	$49
2400 Baud External no software	69
2400 Baud Internal w/V.42 & software	95
2400 Baud External w/V.42 no software	119
9600 Baud Internal w/V.42 & software	249
9600 Baud External w/V.42 no software	259

DISKETTES

	ELEK-TEK	maxell.	SONY	3M	Verbatim
3 1/2" DSDD	$5.99	$7.99	$7.99	$8.50	$7.99
3 1/2" DSHD	10.99	12.99	12.99	13.99	11.99
5 1/4" DSDD	3.99	5.50	4.99	5.99	5.50
5 1/4" DSHD (IBM AT)	6.99	8.99	8.99	9.50	8.99

In addition to the above, we stock pre-formatted & color diskettes.

3M DATA CARTRIDGES

Regular

DC100A(Mini)	$14.99
DC300XL/P	20.00
DC600A	21.00
DC6150	22.00
DC6250	26.99
DC6320	29.00
DC6525	34.00
DC1000(Mini)	$14.50
DC2000(Mini)	14.99
DC2080 (Mini)	19.50
DC2120 (Mini)	20.99
DC1 .35G Magnus 2000 Tape Drive Cleaner	36.99
	19.99

Pre-formatted

DC600HC/Iatamat™	$25.50
DC6150/Zetamat™	28.00
DC2000/Koppamat™	19.00
DC2000/Thetamat™	19.00
DC2080/Rhomat™	20.99
DC2120/Rhomat™	25.50
DC2120/Ximat™	25.50

Call for large quantity pricing. Call for wholesale pricing on 3M computer tape.

SOFTWARE

Quicken Windows	$17.99	LetterPerfect	94.99
386 Max	54.99	Orbits	29.99
Bodyworks	39.99	PFS: Job Search & Resume Pro	36.99
Cathy Doily Planner	34.99	Presentation Task Force	124.99
Central Point Antivirus	57.99	ProCom Plus	65.99
Central Point Backup V7.1	59.99	ProCom Plus Windows	84.99
Chemistry Works	34.99	Speedstor	59.99
Fastback for Windows	89.99	Quatro Pro V4.0	309.99
Fox Grobber	104.99	QEMM 386 V6	58.99
Kid Pix	34.99	Stacker V2.0	84.99
		WinFox Pro	74.99
		XTREE Gold	99.99

We Stock 2500 Other Software Titles

"Complete Line Of EPSON Panasonic & OKIDATA Dot Matrix & Laser Printers Call For Our Low, Low Prices."

Genuine Supplies HEWLETT PACKARD

Laser Toner Cartridges

HP92275 - LaserJet IIP/IIP+/IIIP	$59.99†
HP92285 - LJ/LJ+/LJ 500+	81.99†
HP92295 - LaserJet II/IID/III/IIID	79.99†
HP92291 - LaserJet IIISi	107.99†

Ink Cartridges

DeskJet/DeskJet Plus Ink Cartridges	15.99†
DeskJet High Capacity Cartridge	23.99†
DeskJet Color Ink Cartridge	25.99†

†Quantity Discounts Available

Trays

Lower Cassette IIP/IIP+/IIIP	135
Letter†† / Legal Size†† IIP/IIP+/IIIP	49/59
Envelope Troy †† IIP/IIP+/IIIP	65
Letter / Legal Size II/IID/III/IIID	52/60
Envelope Troy II/IID/III/IIID	70
Letter Size IIISi / Legal Size IIISi	95/95
Executive Size IIISi	95

†† Requires Lower Cassette

Memory Boards

1MB Memory LJ IIP/IIP+/IIIP/III/IIID	149.00
2MB Memory LJ IIP/IIP+/IIIP/III/IIID	249.00
1MB Memory LaserJet IIISi	115.00
4MB Memory LaserJet IIISi	325.00

HP LASERJET ENHANCEMENTS

PACIFIC Data Products

25-IN-1 Font Cart. II/IIP/IIP+/IIIP/IIICALL	
25-IN-1 Font Cart. DeskJet 500/Plus	$99
1MB Memory Board IIP/IIP+/III/IIID	89
2MB Memory Board IIP/IIP+/III/IIID	129
Postscript Cart. for IIP/IIP+/IID/III/IIID	299

MODEMS AND FAX BOARDS

***Internal* Hayes**	
2400 Baud with Software	$239
External Hayes (with software)	
2400 Baud Smartmodem	279
Ultra 96	599
Hayes Optima 2400/9600 Ext.	125/339
Internal Hayes Compatibles (with software)	
Practical Peripherals	
2400 / 2400 V.42	75/115
2400 IBM PS/2	199
9600 V.42	269
External Hayes Compatibles	
Practical Peripherals	
2400SA / 2400SA V.42	99/125
9600SA V.42 bis	279.99
2400V.42 Pocket Modem w/Send Fax	159
Other Hayes Compatibles	
Intel 9600 V.32bis with Software	CALL
All U.S. Robotics Models	CALL
Intel SatisFAXtion	
2400 mod,FAX:96/48 Send/Recv.	99
2400V.42 mod, FAX: 96 Send/Recv.	299
14.4 mod, FAX 14.4 Send/Recv.	399
Practical Peripherals Fax Modems	
2400 Baud Int. w/9600 Send/Recv. Fax	99
2400 Baud Ext. w/9600 Send/Recv. Fax	109
14400 V.32 Int. w/9600 Send/Recv. Fax	375
14400 V.32 Ext. w/9600 Send/Recv. Fax	399
Etronics Fax Modems	
2400 Baud Int. w/9600 Send/Recv. Fax	85
2400 Baud Ext. w/9600 Send/Recv. Fax	99

CORPORATE CUSTOMERS INVITED
We offer large bid opportunities. DUNS # 09-718-0517

OPEN ACCOUNTS--Net 30 terms available to D&B accounts rated 2A1 or better. Actual freight charges FOB Skokie, IL. Phone (as indicated) or fax orders to: Corporate Accounts, 708-677-7168. Mail P.O.'s (as indicated) to Dept. C1132.

PREPAID ACCOUNTS--Use Visa, MasterCard, check or money order (no cash or c.o.d.'s please). When ordering by mail please call in advance for shipping and handling charges. Shipments to IL add 7.75% tax. Minimum order $15.00. 9/92 Write for FREE catalog.

ET VALUELINE
WHERE MORE THAN JUST THE PRICE IS RIGHT

7350 North Linder Avenue, Skokie, Illinois 60077

800-395-1000 In IL: 708-677-7660

ET Valueline is the telemarketing and mail order department of ELEK-TEK, inc.

E.T. VALUELINE or/ ELEK-TEK never sells its customers' names. Prices subject to change; products subject to availability while quantities last. ELEK-TEK is not responsible for printing or typesetting errors.

RETURN POLICY-- All sales are final except defectives which will be replaced with identical merchandise only. Computers and large peripherals - 3 work days after delivery, most small items, 30 calender days, after which manufacturer's warranty applies. No returns will be accepted without an RMA number. Unauthorized returns and refused shipments subject to 15% restocking charge. ALL ELEK-TEK MERCHANDISE IS BRAND NEW, FIRST QUALITY AND COMPLETE.

In no event will ELEK-TEK be liable for any damages whether incidental, consequential or otherwise. Except as stated herein, no warranties (including fitness for a particular purpose or merchantability) shall apply. This does not reduce the benefit of any manufacturer's warranty. AL002

Circle 213 on Inquiry Card.

A legendary year in the history of naval conflict has returned.

Actual screens may vary.

The Pacific Solomons 1942. Setting for a series of naval confrontations that would change the course of World War II. And the setting for the first in a new series of spectacular Pacific War simulations from MicroProse.

Task Force 1942 is your chance to command a fleet of destroyers, cruisers, and battleships against aggressive enemy forces in the South Pacific.

No detail has been overlooked in this painstakingly researched simulation. Torpedo wakes. Thrilling night combat. Blinding explosions. Flares. Even harsh weather conditions. All presented in breathtaking realism.

Issue commands to ships and convoys. Fire torpedos into enemy backsides. Control crucial battle positions. Shell enemy targets. Confront enemy ships head-on. And, if you choose, lead the Japanese forces into battle.

Task Force 1942 from MicroProse. It's the *only* way to experience the thrills...and risks...of naval combat in World War II. To order, visit your nearest retailer or call **1-800-879-PLAY.** Call today.

TASK FORCE 1942

SURFACE NAVAL ACTION IN THE SOUTH PACIFIC™

MICROPROSE™

ENTERTAINMENT • SOFTWARE

180 Lakefront Drive, Hunt Valley, Maryland 21030-2245.

© 1992 MicroProse Software, Inc. ALL RIGHTS RESERVED.

For IBM-PC/Tandy/compatibles.

Circle 221 on Inquiry Card.

Say Good-bye To The Language Barrier.

Breakdown

A global computing event that unites, under one roof, today's connectivity experts for one targeted purpose — to pronounce that networking is the universal language of choice.

NetWorld 92
The United Nations Of Networking

NetWorld 92 is the talk of the connectivity industry. A cutting-edge exhibition of conferences and seminars where hardware and software developments are introduced, discussed and demonstrated. A conference that speaks the language of productivity and translates ideas into action.

Whether you communicate over LANs, WANs or wireless networks, or operate over diverse operating systems, NetWorld 92 is your primary venue for innovative products and services. Converse in many languages with industry-leading manufacturers and form a lasting connection that can translate into increased efficiency and sales.

Educational Seminars
A Universe Of Networking Possibilities

NetWorld 92 presents an encyclopedic display of intensive educational conferences and hands-on educational seminars on internetworking. Digest state-of-the-art technologies and processes that can propel your present networking plans forward, allowing you to expand software applications into new environments. And learn an unlimited vocabulary that will place you at the forefront of future strategies.

Improve Your Communication Skills

Don't isolate yourself and your company within the confines of yesterday's network architecture. NetWorld 92 lets you open your lines of network communication, resulting in bottom-line benefits to your company.

For additional show information, contact Jodi Levine, Show Manager, at 201-346-1400 or Fax 201-346-1602.

NETWORLD 92 Dallas
The Universal Language

October 13-15, 1992
Dallas Convention Center

Circle 387 on Inquiry Card.

U.S. Department of Commerce International Trade Administration
Foreign Buyer Program

Bruno Blenheim Inc. • Fort Lee Executive Park • One Executive Drive • Fort Lee, NJ 07024 • 201-346-1400 • 800-829-3976 • Fax: 201-346-1602

NetWorld Expositions in the U.S.A. and Europe are owned, produced and managed by Bruno Blenheim Inc. NetWorld is a servicemark of Novell, Inc. licensed exclusively in the U.S.A. and Europe to Bruno Blenheim Inc.

Rake In the Savings With Bulldog!

9 Years of Dedicated Service to PC Users!

1-800-438-6039

Network

3COM
- 3C503 Etherlink II/ 5-pack 189/799
- 3C503TP 10 Base T 229
- 3C505B Ethernet Plus 579
- 3C507 Etherlink 16 279
- 3C523 MCA Ethernet 269

ARTISOFT
- Starter Kit 2mbps/AE2 ..... 325/459
- Starter KitAE3 539
- Lan Cards 2mbps/AE2 ..... 129/199
- Lan Car/AE3 229
- Central Station 419

NOVELL
- Novell Lite 1.0/starter kit 69/399
- Netware 2.2 5/10 User 479/1099
- Netware V.2.2-50 user 1899
- Netware 3.11 20/100 User. 1899/3648
- Netware 3.11-10 User 1375
- NE1000/NE2000 ..... 129/155
- NE 3200 669
- Access Server 1595

SMC
- PC130/PC130E 75/99
- PC600WS/PC600FS 129/209
- HUB 8-Active/4-Passive 249/69
- Ethercard 8 bit/16 bit 149/169
- Token Card 8 bit/16 bit. 349/399
- 10 Base-T Card 8 bit/16 bit. .. 185/205
- 3608TP 10BT concentrator 409
- 3106 16 bit Ethernet 10BT coax .. 159
- 3512TP Ether.10BT conc.12 port 709

THOMAS CONRAD
- TC4045 16/4 Token Ring 499
- TC6151-11 16 port smart hub 679
- TC6242/TC6242-TP+ 69/99
- TC6245/TC6245-TP+ 199/219
- TC6045/TC6045-TP+ 199/219

Network Software

- Borland D Base IV LAN-1 user 249
- Borland Quatro Pro V.4.0 ntwkable ..319
- Close-Up Lan 2user/8 user 249/479
- Foxpro Lan 6 user 515
- Lotus 2.4 server/node 559/339
- Lotus 3.1 server/node 625/409
- Norton PC Anywhere V.4.5 119
- Norton P C Anywhere V.4.5 Lan 325
- Peachtree Network Accounting 469
- Procomon Plus Network 5 pack 325
- Untouchable Network 429
- Word Perfect Office- 5 user 289
- Wordstar 2000 LAN-3 pack 259
- X Tree Virus Safe Lan 379
- X Tree Net/ for Unix 319/189

Software

- Aldus Pagemaker 499
- Carbon Copy/Close Up 110/109
- Clarion ProDeveloper 449
- Clipper 5.0 429
- Corel Draw 365
- Dbase IV 1.5 489
- Desqview 386 129
- Foxbase/FoxPro 195/449
- Freelance Plus 309
- Harvard Graphics 359
- Lotus 2.4/3.1 Plus 345/379
- Lotus Symphony 469
- Lotus for Windows 415
- Smart Suite/Upgrade 449/339
- Microsoft Windows 3.1/Word 89/219
- Microsoft Word for Windows 319
- Microsoft Excel for Windows 299
- Norton Desktop for Windows 94
- Norton Utilities 6.0 115
- Norton AntiVirus 85
- Peachtree III Complete 139
- Paradox ..... call
- Q&A 4.0 219
- Quattro Pro 299
- Ventura Desktop Publishing 479
- Word Perfect 5.1 255
- Word Perfect for Windows 259
- Wordstar 7.0/2000+ 259/225

Chips

- **INTEL** 387-33 199
- 387-SX16/20 ..... 119/129
- **CYRIX** SX16/20/25 77
- SX33 95
- DX33/40 ..... 95/125

Notebooks

TEXAS INSTRUMENTS
- 3000-60/80/120 ..... 2025/2195/2589
- 3000 Win SX-60/80 ..... 1995/2339
- 3000 Win SX/120 2699
- *TM4000 Win+ 4MB*
- SX/16 w/80MB HD 2495
- SX/25 w/ 120MB HD 2999
- DX/25 w/ 120MB HD 3325

LIBREX
- SX/20 • 4 MB w/40HD 1250
- SX/20 • 4 MB w/60HD 1325
- SX/20 • 4 MB w/80HD 1450

AST *386SX-20*
- 43V • w/ 40MB •2MB 1995
- 63V • w/ 60MB • 2MB 2299

NEC
- Ultralite SX20 w/ 60 2539
- Ultralite SX20 w/ 80 2599
- Ultralite SX25 color w/80 4999

Monitors

NEC MULTISYNC
- 3FGX/4FG 689/769

PANASONIC
- 1381/1395 ..... 329/439
- 1991-20"1280x1024 1559

SAMSUNG
- Flat White ML4571 119
- CVB 4995 Syncmaster 2E 269
- CVM 4967 Syncmaster 3E 299

CTX
- 5468/5468NI 289/329
- 3436 Multiscan .28 399
- 1760 17" VGA.28 869
- 5439/5432 ..... 229/275

NANAO
- 907OU/9080i 869/1025
- 550i/560I 1149/1899

VIEW SONIC
- 7/6/6SF 1069/369/629

Video Cards

ATI
- VGA Integra 512K 89
- Graphics Vantage 1mb 349
- Graphics Ultra w/ 1MB 459
- 8514 Ultra Plus w/ 1MB 389
- VGA Wonder XL w/ 1mb 189

BOCA
- Basic VGA/Super VGA 63/129

CARDINAL
- VGA 700/732 w/1MB 119/139

ORCHID
- Prodesigner II w/ 1 mb 185
- Fahrenheit 1280 degreewith 1 MB...289

VIDEO SEVEN
- 1024i Plus w/ 512 95
- V RAM II 1 mb. 269
- Win. VGA w/ 1 mb 159

Modems & Fax

CARDINAL
- 2400 INT/EXT 62/84
- 2400 INT/EXT w/MNP 89/99
- 9600 INT/EXT 249/279
- 96/24 Fax modem INT 89

HAYES
- Ultra 1.44 V.32 679
- Ultra 9600 ext 599
- Optima 9600 V.32 349

HEWLET-PACKARD
- Plain Paper Fax 200/310 .... 999/1339

INTEL
- Satisfaction Modem 200/400. 309/409

PRACTICAL PERIPHERALS
- 9600 V.42 Int/Ext 269/279
- 1.44FX fax/modem Int/Ext 350/389

US ROBOTICS
- 16.8 HST ext. w/ ASL 569
- Dual 16.8 HST ext 749
- Shared Access Kit 649

ZOOM
- FC 9624 99

Printers

CANON
- LPB4+/LBP8+ 919/1499
- BJ20 399
- BJ 300/330 ..... 469/599

DICONIX
- 180si/701 ..... 299/439

EPSON
- LX810/AP 3250 ..... 155/219
- FX850/FX1050 ..... 289/379
- LQ570/LQ870 ..... 269/435
- LQ1070/LQ1170 ..... 375/579
- LQ2550 849
- EPL8000/7500 ..... 1295/1899
- DFX5000/8000 ..... 1269/2139

HEWLETT-PACKARD
- Laser Series III/IIID 1549/2599
- Laser IIP/IIIP 869/1069
- Desk Jet 500/500c 439/759

IBM Laser
- 6/6P 1479/1825
- 10/10P 1749/2899

NEC
- Silentwriter 95 1469

OKIDATA
- 184/380 ..... 229/219
- 320+/390+ 314/439
- 321+/391+ 435/595
- 393+/393C+ 919/999
- 400/800 LASER 599/925
- 810/820 LASER 1064/1249
- 830/840 LASER 1269/1589
- 3410 1299

PANASONIC
- 1123/1124i 199/275
- 1624/1654 ..... 339/539
- 2180/2123 ..... 175/255
- 1695/2624 ..... 369/379
- 4410/4450i 649/1079
- 4430/4455 ..... 909/1719

QMS
- PS 410/815 ..... 1529/2949
- Color Script 100 model 10p 4699

LASER ACCESSORIES
- Upgrade for HP III 1 mb 79
- Upgrade- HP III 2mb/4mb .. 109/179
- Pacific Data 25-N-1 249
- Pacific Page PE/PEXL 269/649
- Pacific Connect 256K 249
- Complete Font Library 249
- Font Bank Cartridge 1.5 Mb 269

Memory Boards

AST
- Six Pack+ w/384K XT. 129
- SixPack286w/0KAT 95
- Rampage PCw/1 mb 285

ORCHID
- Ramquest 16/32w0KPS/2 199
- Ramquest 8/16 w/0K XT/AT 129

ACCELERATOR BOARDS
- Orchid Tiny Turbo 286/Extra. 119/179
- Intel Inboard 386PCw/1 mb 499

Bulldog Systems

Bulldog's Standard Configuration

Dual Floppy Drives • Super VGA Card with 1 Mb RAM • 14" Color VGA Monitor (1024 x 768) • DOS 5.0 • Windows 3.1 • Mouse • 1 year warranty!

386-SX/25 w/ 2 MB w/80 MB HD .. 1249

386-33 (64K CACHE) 4MB , 130HD $1549

486-33 (256K CACHE)4MB, 213MB HD $2395

486-50 (256K CACHE)4MB, 213MB HD $2650

Call for other configurations

Drives

CONNER
- 120 IDE 3.5/200IDE 3.5 ..... 349/549

IOMEGA
- 90 MB Insider/Transportable 579/689
- Dual 90 ext 1495

MAGNAVOX
- 461RSEXTCDw/ software 369

MAXTOR
- 7120A 130 mg 369
- 213 A 210 meg 589

MICRO SOLUTIONS
- Backpack Ext. Floppy 1.2/1.44 .. 189

NEC
- CDR 84 Int/74 ext 509/549
- CDR 37 portable 389

QUANTUM PASSPORT XL removable
- 50MB/105MB 359/495
- 120MB/240MB 699/869

SEAGATE
- ST3096A 89 mb IDE 289
- ST 3144A 120 IDE 379

SYSGEN-Mobile Disk
- 40/80/120 ..... 399/569/649

FLOPPY DRIVES
- 360K/1.2MB/1.44MB. 59/59/59

Tape Drives

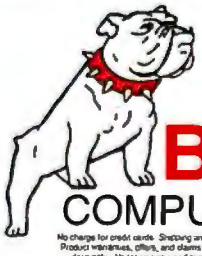
IRWIN
- Accutrak 120/250 ..... 189/239

COLORADO MEMORY SYSTEMS
- DJ10 120 Meg IntJumbo 199
- DJ20 250 Meg IntJumbo 259
- QFA 700 Meg Int 719

MICRO SOLUTIONS
- 40/120 Backpack 365
- 60/250 Backpack 429

Mice & Misc.

- Microsoft Mouse w/Windows 3.1 ... 149
- Microsoft Ball Point Mouse 118
- Logitech Fotoman. 519
- Logitech Trackman Serial/Bus 69/85
- Epson 300C w/ interface 1175
- Logitech Scan Man 256 269
- Sound Blaster Pro 189



610 Industrial Park Drive
Evans, Georgia 30809
PO Box 211043, Martinez, GA 30907
OPEN weekdays: 8:30 a.m. to 6:00 p.m.
(706) 860-7364 • FAX (706) 860-7358

BULLDOG
COMPUTER PRODUCTS

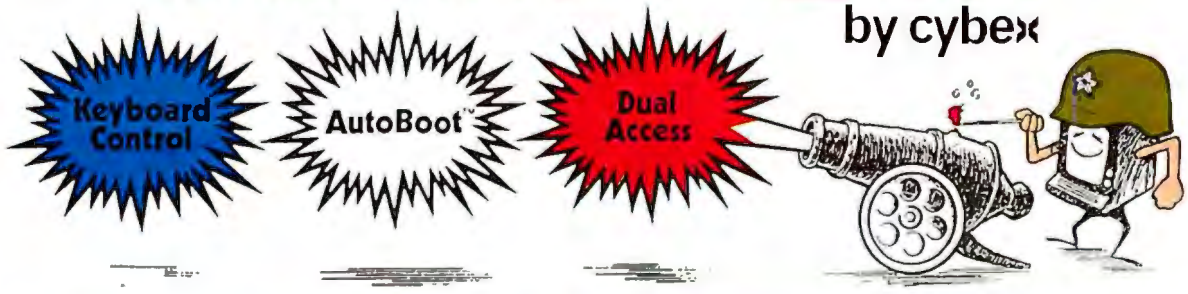
No charge for credit cards. Shipping and handling extra (minimum $6) APO & FPO addresses additional 5% (we rest pay the same) Product warrantees, offers, and claims are handled by the manufacturer DOA's agreed on replaced at our option during the first 30 days only No returns on used items All returns/shipments are subject to a 15% minimum restocking fee Defectives/returns replaced with same item only Call 404-860-7354 for a Return Authorization number prior to returning any product Shipping charges are non-refundable Bulldog cannot guarantee compatibility All prices are U.S. and are subject to change and availability Georgia residents add sales tax

Visa | Discover | American Express | Master Card

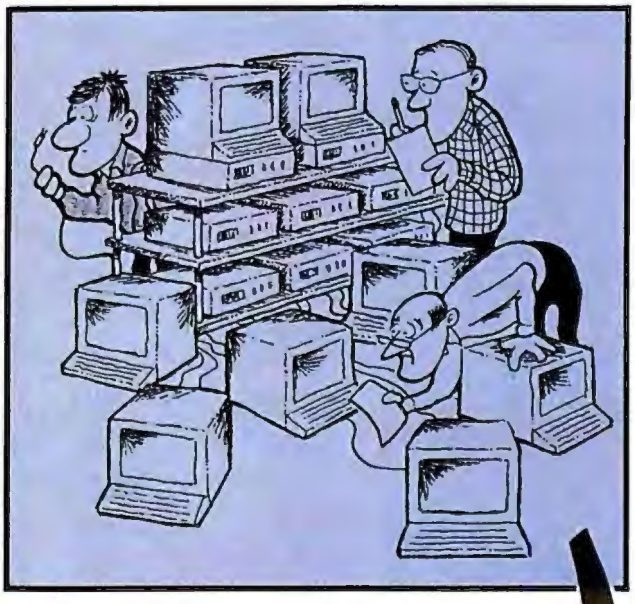
CONTROL UP TO 96 PC FILE SERVERS WITH 1 KEYBOARD AND MONITOR USING...

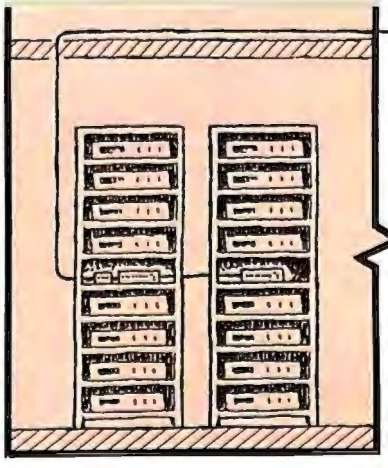
COMMANDER

by cybex

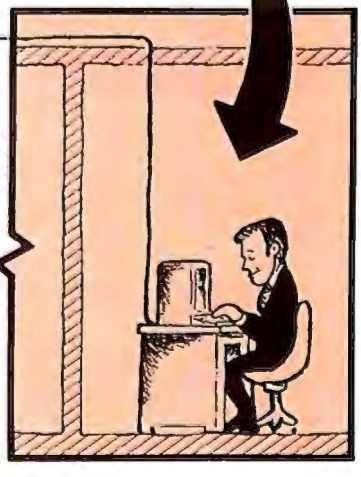


- Select via Keyboard
- Dual access up to 250 feet away (optional)
- No external power
- Mix PC, PC/XT, PC/AT and PS/2
- "AutoBoot™" Feature boots attached computers without operator intervention
- Shows PC power status





- PS/2 Mouse support available
- Each unit accommodates from 2 to 8 PCs
- Up to 12 units can be cascaded
- Mounting kit available for 19" and 24" rack installation



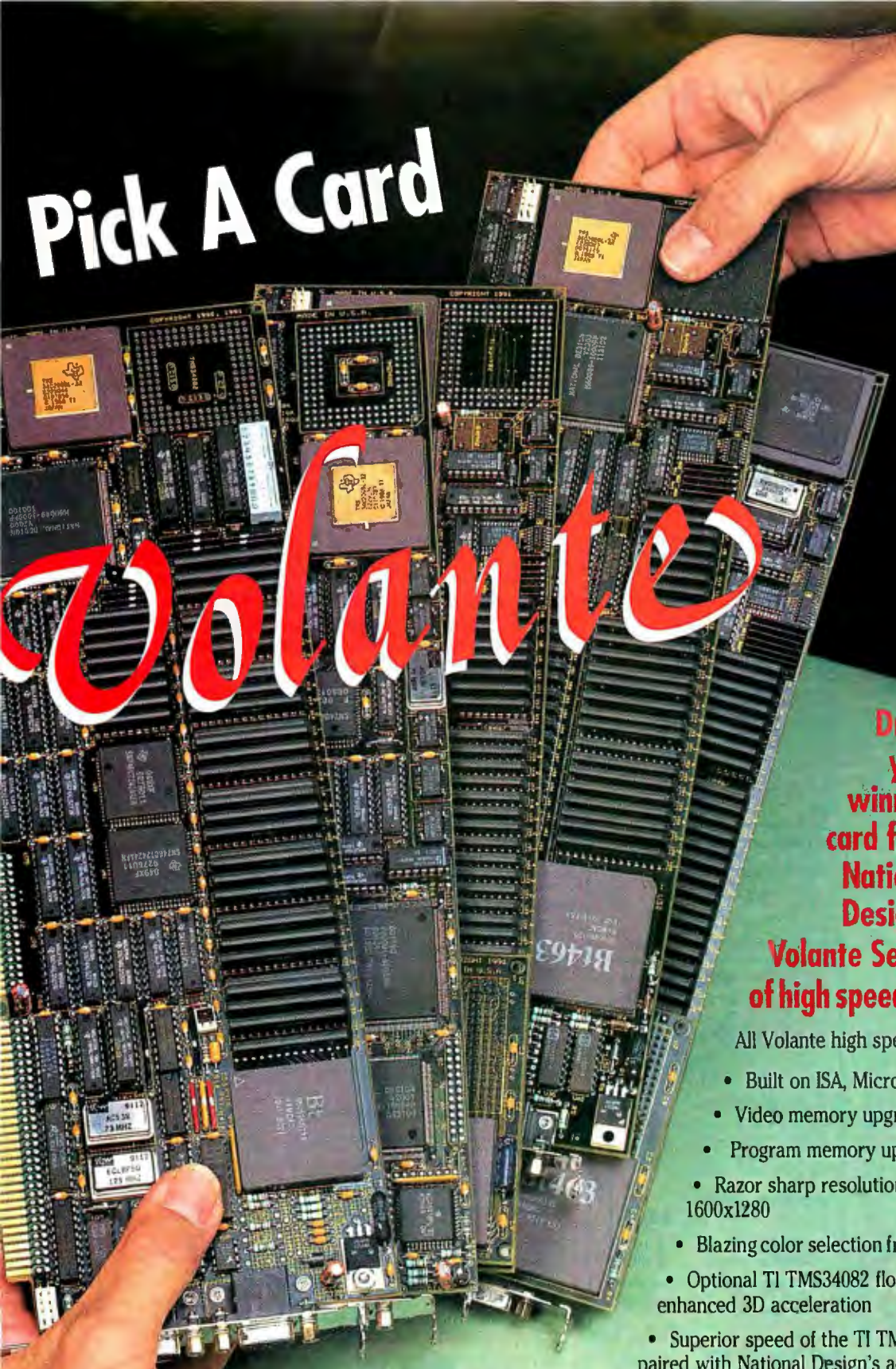
Dealer Program Available

Cybex Corporation
2800-H Bob Wallace Ave.
Huntsville, Alabama 35805
(205) 534-0011
Fax (205) 534-0010

PC, PC/XT, PC/AT and PS/2 are trademarks of International Business Machines Corp.

Circle 210 on Inquiry Card.

Pick A Card



Draw your winning card from National Design's Volante Series of high speed graphics boards.

PC MAGAZINE EDITORS' CHOICE
June 25, 1991
National Volante AT1000

All Volante high speed graphics boards offer:

- Built on ISA, MicroChannel or VME bus
- Video memory upgrades to 4 MB
- Program memory upgrades to 4 MB
- Razor sharp resolutions from 1024x768 up to 1600x1280
- Blazing color selection from 8-bit to 24-bit true color
- Optional TI TMS34082 floating point processor for enhanced 3D acceleration
- Superior speed of the TI TMS34020 graphics engine paired with National Design's advanced ASIC technology
- LIFETIME WARRANTY - no gamble here!

Whether your game is CAD, Microsoft Windows, graphic arts, multi-media or medical imaging, Volante has a card for you at a fraction of the cost charged by the competition.

Call 800-253-8831 now for information on the breathtaking Volante series.
Phone: 512-343-5055 Fax: 512-343-5053

NDI
NATIONAL DESIGN, INC.
9171 CAPITAL OF TEXAS HWY, H-230
AUSTIN, TEXAS, 78759

Circle 224 on Inquiry Card (RESELLERS: 225).

Get your copy of Computer Hotline!

ACP-The Superstore with Super Deals!

Hard Drives

Western Digital
High performance "Caviar" series with 1" height, Cache Flow™ and 32K buffer.

AC280	80Mb	1" 3.5"	14ms	IDE .... Call
AC2120	125Mb	1" 3.5"	14ms	IDE .... Call
AC2200	200Mb	1" 3.5"	14ms	IDE .... Call

Maxtor

7080A	80Mb	1" 3.5"	15ms	IDE .... Call
7120A	120Mb	1" 3.5"	15ms	IDE .... Call
LXT213A	213Mb	1" 3.5"	15ms	IDE .... Call
MX1240	1.2Gb	1" 3.5"	15ms	IDE .... Call

Panther 1.2Gb SCali Panther 1.7Gb Call

Conner Peripherals

30104	120Mb	3.5"	19ms	IDE .... Call
3204	200Mb	3.5"	16ms	IDE .... Call

Call for Quantum, Micropolis, Seagate. Also controllers from Ultrastor, Always, WD etc.

Hard Drive Cards

Plus Development

Hard Card IIXL	50Mb	16bit 9ms	298
Hard Card IIXL	105Mb	16bit 9ms	448

Backups

Colorado

DJ10	120Mb Tape Drive Internal ..	199
DJ20	250Mb Tape Drive Internal ..	268
QFA700	700Mb Tape Drive Internal ..	779

Syquest

44Mb	Removable 5.25" Drive Int. ..	308
88Mb	Removable 5.25" Drive Int. ..	469

Dual drive case with power supply ... 169

Syquest External

Syquest	44Mb external (8-bit)	549
Syquest	88Mb external (8-bit)	669

Floppy Disk Drives

Toshiba

ND04DG	360K	5.25" HH	PC/XT	59
ND08DEG	1.2Mb	5.25" HH	PC/AT	72
ND3561GR	1.44Mb	3.5" HH	w/AT Kit	72

ACP

360K	5.25"	HH	55
1.2Mb	5.25"	HH	66
720K	3.5"	HH	59
1.44Mb	3.5"	HH	67
2.88Mb	3.5"	HH	Call

Call for 5.25" Mtg. Kit

Pacific Rim

1.2Mb	External for any parallel port	235
1.44Mb	External for any parallel port	235

MultiMedia

Sony
7205 CD Laser Libra y w/six CD's 499

Creative Labs
Complete all-in-one MPC compatible upgrade kit includes: Panasonic CD Drive, Sound Blaster Pro, five CD's, Microsoft Multimedia Windows, Bookshelf, Hyperglide, Games, drivers, cables, connectors and more.

MultiMedia Kit (internal)	539
MultiMedia Kit (external)	599
Sound Blaster	109
Sound Blaster Pro	199

MediaVision

Subsystem CDPC (external)	1079
Pro 16 Multimedia Sys (internal)	1019
MultiMedia Upgrade Kit (internal)	799

Input Devices

ACP 3-button Mouse (limited supply) 14.95

CH Products Flightstick	49
Mouseman Combo/Cordless	75/88
Logitech Trackman serial/bus	69/72
Logitech Trackman Portable	104
Logitech Fotoman	599
Microspeed PC-Trac ser/bus	79/89

PC's BELOW COST!

286/12 $269

80286/12 CPU • 3.5" Floppy
1 Mb • 101 Keyboard
Monitor not included

CPI MODEM BUNDLE!

2400 Baud $45.95

with FREE Prodigy Software
Easy -to-use, Free software to help you get on-line fast and easy!

Chips and SIMM's

RAM Chips

41256-100	256K RAM	100ns	DIP	1.99
41256-80	256K RAM	80ns	DIP	2.19
414256-80	256Kx4 RAM	80ns	DIP	4.99
1Mb-100	1Mb RAM	100ns	DIP	4.75
1Mb-80	1Mb RAM	80ns	DIP	4.95

Call for VIDEO RAMS & CACHE RAMS
Over 20,000,000 IC's in-stock including We Specialize in 486DX/25 & 33 Upgrades

SIMM Modules *New Low Prices!*

421000A9B-10	1Mbx9	100ns	SIMM	32.95
421000A9B-80	1Mbx9	80ns	SIMM	37.95
421000A9B-70	1Mbx9	70ns	SIMM	39.95
424000A9B-80	4Mbx9	80ns	SIMM	119
424000A9B-70	4Mbx9	70ns	SIMM	125
41256A9B-80	256Kx9	80ns	SIMM	9.95
A21000A3B-80	1Mbx9 (3 CHIP)	80ns		34.95

Math Coprocessors

AMD 80C287...increase your 286 PC performance ..... $ 39.95

IBM 8087 Genuine w/manual .... $ 29.95

Intel-Call for "OverDrive"Rapid CAD

8087	5MHz	79	80387DXP	16/33	199
8087-2	8MHz	89	80387SX	16	128
8087-1	10MHz	89	80387SX	20	144
80287XL	all 286	89	80487SX	20	499

Cyrix

83D87-16	16MHz	89	83D87-40	40MHz	129
83D87-20	20MHz	99	83S87-SX16		79
83D87-25	25MHz	99	83S87-SX20		79
83D87-33	33MHz	99	83S87-SX25		79

IIT

2C87-8	8MHz	77	2C87-12	12MHz	85
2C87-10	10MHz	85	2C87-20	20MHz	99

Memory Upgrades

Laser Printer Upgrades

HP IIP/IIP+/III/IIID/IIIP	2Mb	124
Okidata OL400	2Mb	148
Okidata OL800/820	2Mb	148
Panasonic 4420/4450i	2Mb	148

Call for other models plus we stock most Laser memory upgrades with OK RAM

Laptop Upgrades

Apple PowerBook	2Mb	Call
AST Executive	1Mb	Call
Compaq LTE386s/20/Lite	1Mb	Call
Everex Tempo/LX/16	2Mb	Call
IBM L40SX	2Mb	Call
Toshiba T2200/4400SX	2Mb	Call
Toshiba T6400SX/DX	2Mb	Call
Toshiba T3300SL	2Mb	Call

Call for Zenith, Sharp, TI, and more

Palmtop Upgrades
HP 95LX 2Mb ... Call Poquet 1Mb .. Call

Computer Upgrades

AST Premium 386/25,33,SX16/20		Call
Compaq DP386/33,486/33,SysPro		Call
IBM 30-286	#30F5360 2Mb	Call
IBM 35,40,55sx,65,70	#6450604 2Mb	Call
IBM 90,95,P75	#6450902 2Mb	Call

Call for NEC, HP, Zenith, Leading Edge.

CO STAR

the AddressWriter™
The first printer specifically designed to print envelopes, postcards and labels. Great for the office. Time saver, plus it received the "Industrial Design Excellence Award".

AddressWriter™ for PC and MAC only **$449**

LabelWriter II PC	$ 189
LabelWriter II Plus	$ 299

ACP will Custom Configure...call!

Computer Motherboards

Micronix

486DX2/50MHz w/256K cache	999
486DX/33 w/256 cache	699
486DX/50 w/64K cache	1049
486DX/50 (EISA) w/256K cache	1699

ACP

286-12 half-size	89
386SX-20/25/33	169/175/179
386DX-40	279
486SX-25	299
486/DX2/50	999

Advanced Computers AMD Power

AMD CPU's Faster! High Performance!
• Enhanced 101 Keyboard • IDE Hard Drives
• 1 Year Warranty • Mouse • Free MS-DOS
Feature by feature! **Experience the AMD Advantage...**

Advanced Micro Devices

1r Warranty • FCC Class B/UL • Documentation †FREE! With each system....Coupon for Complete Accounting Software ($3500.00 Value!)

COMPUTER	386SX/33	386DX/40	486SX/25	486DX2/50
CPU	AMD	AMD	INTEL	INTEL
RAM	2 MB	2 MB	2 MB	4 MB
FLOPPY	5.25 or 3.5"	5.25 or 3.5"	5.25 or 3.5"	5.25 or 3.5"
BIOS/Chipset	AMI/CPTT	AMI/CPTT	AMI/ACC	AMI/ACC
CACHE	32 K	64 K	8 K (int.)	64 K
ACP Price	529.	699.	679.	1299.

Call for hard drive upgrade, monitor, VGA, cse options etc. Also available, Tower, Mini-Tower and other configurations.

Leading Edge 386SL-25MHz Notebook Computers
• Low Power Designs plus SCSI-2
• 2 Mb RAM expand up to 10 Mb
• VGA-64 shades • Mouse
60Mb $1999 w/32k Cache
New! Color 386SL Notebooks
60Mb...$2799 80Mb...$2999

SHARP
Killer Notebook!!!
6781-386SL/20
80 Mb • 3.5" Floppy
Built-In Trackball
$2175
Call for Color

386/SX20 Notebook
1 Mb RAM • 3.5" Floppy
30 or 60 Mb Hard Drive
5.8 lbs. • VGA LCD
$1099
with 30 Mb

Software Special Purchase...up to 90% Off!

35,000 Packages in stock! Volume discounts-Call

Entertainment • Learning

Product Title	Price
Electric Jigsaw Puzzl	9.95
Life and Death	9.95
Wunder Book	9.95
Desert Storm/	12.95
Dvorak on Typing	12.95
Canis	14.95
Complete Craps	14.95
Computer Comic	14.95
The Golf Doctor	14.95
Major Leag. Baseball	14.95
ProFootball Analyst	14.95
Puzzle Master	14.95
Young Math/ MemoryLane	14.95
Bible Trivia	19.95
Designasaurus II/ Coinbase 4.0	19.95
Super Spellicopter	19.95
Family Bettr Lrng Pac	19.95
Family Value Pack	19.95
Household Hits	19.95
I.Q. Smarts	19.95
Run Your Own Train	19.95
Scorekeeper	19.95
Stickybear Preschal	19.95
The Sky	19.95
Flowers	24.95
Quiz Control	24.95
Trees	24.95
Bugs	29.95
MindViewer	29.95
Jap. Lang. Explorer	39.95
Fren. Trnsprnt Lang.	39.95
Span. Trnsprnt Lang.	39.95

Utilities • Productivity

On-screen Help...

WardPerfect 5.0	5.95	Home Finance Pack	19.95
Lotus 2.01	5.95	HotLine	19.95
101 WordPrfct Macros	7.95	Outside In	19.95
Diskette Labeler	9.95	Personal Biz Base	19.95
The Computer Glass.	4.95	Post Card Writer	19.95
The Computer Gloss.	9.95	DOS Partner	19.95
Slice	19.95	Golden Retriever	19.95
Just The Fax	12.95	Quick Up	19.95
Disc Director	12.95	Correct Grammar	29.95
Back Loader	14.95	DataMrge Sources 3.1	29.95
Double DOS	14.95	hDC First Apps	29.95
Switch it	14.95	Job Sketch	29.95
Home Office Productivity Pac	19.95	Mail Master Eye Relief	29.95 99.95

Graphics • Desktop Publishing

My Paint	14.95		
Page Pak I	14.95	Christian Images PCX	19.95
Business Images PCX	19.95	Perspective Junior	19.95

PC6781 SHARP
386SL Notebook
• Only 4.9 LBS.!
• 386SL/20 w/2Mb
• 60Mb Hard Drive
• IC Card Slot
• Built-In Trackball
$2175

MINUTEMAN
Minuteman UPS
• 2 mms. Transfer, 600 VA
• LAN Comm Port
• 2 Year Warranty
Regular Retail $579.
ACP $379

Business and Home Office

Retail value to 74.95 **$9.95** Your Choice only
JK Lasser Taxes91 w/92 bk.
ResumeMate/5.25
ResumeMate/3.5

Retail value to 99.95 **$14.95** Your Choice only
Career Design/5.25
Career Design/3.5
Meet Easy (Alex. Sys)/Dual
Make a List

Retail value to 99.95 **$19.95** Your Choice only
CompareRite/Dual
Code Mate
Counterpoint
First Base (Excel Bus Res.)/D
Flex Forms (Corporate)/Di
Flex Forms (Personal)/Dual
Nvelope Plus
Personal Biz Base/3.5
ThoughtLine/Dual
Register Mate (Champ)/D
Up Your Cash Flow (Gran.)
Race
Register Mate (Champ)/D
Timeslips
Turbo Flow
Vehicle Record System

Retail value to 119.95 **$24.95** Your Choice only
Corporate Voice (Scand.)
Home Buyer (finTech)
Mail Master/5.25
Pal Friday (Pyramid)/5.25
Retirement Planner/Dual
Power Billing/Dual

Retail value to 149.95 **$29.95** Your Choice only
Design your own Home/D
30 minute Negociator
Anytime Automate/Dual
Business&Personal Power Pk
Design yr own Landscape
Easy Order

Retail value to 199.95 **$49.95** Your Choice only
TimeClock I (Fought Data)
Employee Handbook Bldr.
Merge Purge (ArcTangent)
Power Quote/Dual
Project Outlook

SPECIAL OFFER!!!
Pick any 6 Business / Home Office titles
$99.95
Must be a mix of 6 different titles from section above

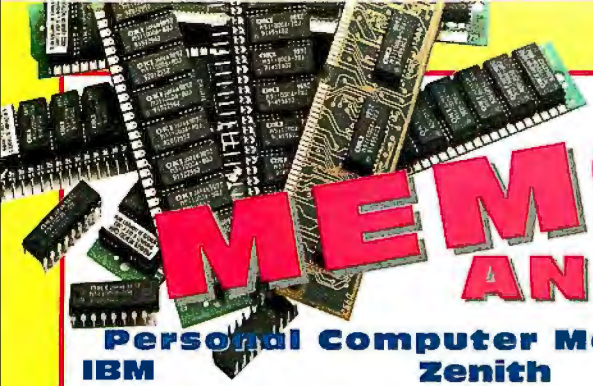
Advanced Computer Products, Inc.

1310 E. Edinger, Santa Ana, CA 92705 • FAX 714-558-8849 • Toll-Free 1-800-FONE ACP • Sales 714-558-8813

No surcharge on credit card. Credit cards not charged until we ship. 100% risk free return guarantee! If you are not 100% satisfied just return insured within 15 days complete with all materials in new resaleable condition with original invoice. ACP will immediately exchange product or issue ACP credit less shipping for future purchase. No Returns on software Special Purchase

Circle 202 on Inquiry Card (RESELLERS: 203).

CALL 1-714-558-8813 ORDER BY FONE OR FAX



MEMORY AND MORE...

We have memory for 386SL & 486 Notebooks!

COMPATIBILITY 100% GUARANTEED OR YOUR MONEY BACK!

Personal Computer Memory

IBM

PS/1 286, 386SX
2MB 92F9935 ..... $89
PS/230/286
512K 30F5348 ..... $35 2MB 30F5360 ..... $99
PS/2 355X; LS, 405X, S02, 555X; LS, 655X; LS, 70
1MB 6450603 ..... $51 2MB 6450604 ..... $89
PS/2 70-A21; A61; B21; B61
2MB 6450608 ..... $95
PS/2 355X; LS, 405X, 555X; LS, 655X; LS, 34F30XX
4MB 34F2933 ..... $169
PS/2355X;LS, 405X
8MB 6450129 ..... $349
PS/2 90,95 (Install in pairs)
4MB 6450128 ..... $169 8MB 6450130 ..... $349
Expansion boards for 50 and 60
2-8MB w/2MB 1497259 ..... $269
Expansion boards for all models 70 and 80
2-14MBw/2MB 34F3077 ..... $529

Compaq

DeskPro 386-20, 20Eand25
4MB Module 113132-001 ..... $179
4MB Board 113645-001 ..... $249
DeskPro 386S/16
4MB Module 112534-001 ..... $179
4MB Board 113634-001 ..... $259
DeskPro 286N, 386N, 386SX/20, 386/25M, 486/33M, 486s/25M, 486s/16M; SysPro LT, 486SX/25S; 386/25S; Port 486c
2MB 118689-001 ..... $99
4MB 118690-001 ..... $169
DeskPro 386M, 486M, SystemPro LT (32-Bit Exp. Board)
8 Socket Brd w/2MB 129160+118688-001 ..... $379
DeskPro 386/33L, 486/33L, SystemPro
6 Socket Brd w/2MB 116569+115144-001 ..... $389

Zenith

Zenith Z-386/20; 25; 33 and 33E
1MB ZA3800ME ..... $59 4MB ZA3800MK $179
Zenith z-386SX, 286PL+, Z-LS
2MB Kit Z-605-1 ..... $99
Zenith 486/33ET; 25E
4MB ZA4200M2 .... $209 16MB ZA4200MB $699

AST

Bravo 386-SX, WS/286, 386
2MB 500510-002 .... $89 4MB 500510-008 .. $179
Premium 386/25; 33, Premium II 386SX/16; 20
1MB w/WPB 500780-003 ..... $69
Premium II 386SX/20 and 386SX/16
4MB w/WPB 500780-004 ..... $169
All Premium and Bravo 486 Models
8MB w/WPB 500780-001 ..... $339

Hewlett-Packard

Vectra 05/16S; 20PC, RS/20PC; 25PC, 20C
4MB Kit 01542 or 1842A $179
Vecta 386/16N, 386/20N
2MB D2406A ..... $109 8MB D2604A $329
Vectra 486 PC (Install in pairs)
8MB D2152A ..... $359 4MB D2151A $479
Vectra 386/25, 486/25T, 33T (Install in Pairs)
2MB D2381A $99

NEC

Powermate 286/12; SX/16 and SX/20
2MB Kit OP-410-8103 ..... $99
Powermate 386/20; 25
2MB APC-H65S ..... $359 8MB APC-H65G $899
Powermate 386/33E and 486/25E
2MB OP-410-5101 ..... $219

Motherboards

UPGRADE YOUR SYSTEM TODAY!

• Intel or AMD CPU • Expand CACHE to 128Kb/256Kb •
• AMI BIOS • Expand to 32MB using SIMM's • Baby Footprint •

25MHz 386SX $299
33MHz 386 64Kb CACHE $589
40MHz 386 64Kb CACHE ..... HOT DEAL $689
33MHz 486 64Kb CACHE $989
20MHz 486SX 64Kb CACHE $549

Mass Storage

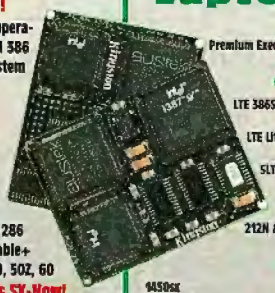
Data Master

IBM PS/2 Mod 50 & 50Z Internal IDE Drive w/controller
52MB ..... $369 105MB $539
IBM PS/2 Mod 60; 65; 80; 90 & 95 Internal SCSI w/controller
115MB ..... $849 159MB $949

Data Traveler

Add a hard drive to your desktop, laptop or notebook PC. Connects to parallel port on system running DOS 3.3 or better.
52MB ..... $499 105MB $669

TURN YOUR 286 INTO A 386 WITH THE SX/NOW!



True multitasking, background operation for Windows 3.0, OS/2, and 386 software. Sx/Now! improves system performance by up to 350%.

SX/Now! available for:

- ✔ HP ES286/12 & ES/8
- ✔ Epson Equity IIe & II+
- ✔ IBM Original AT & XT/286
- ✔ AGI 1800A,1800B & 1800C
- ✔ AST Premium 286; Bravo 286
- ✔ Compaq Portable III, DeskPro 286
- ✔ NEC PowerMate 286+ & Portable+
- ✔ IBM PS/2 25/286, 30/286, 50, 50Z, 60

Kingston Technology Corp.'s SX-Now! is the undisputed performance champ.
-PC Magazine Oct 29, 1991

20MHz SX/Now! $309
25MHz SX/Now! $359

Laptop & Notebook Memory

AST

Premium Exec Notebook
1MB $69
4MB $169

Compaq

LTE 386S/20
1MB $99
4MB $249
LTE Lite 20; 25
2MB $199
4MB $289
SLT 286; 386
1MB $89
4MB $249

Dell

212N & 320N
1MB $109
2MB $159

Grid

1450sx
2MB $189
1500 Series
4MB $259

IBM

N51 Notebook
2MB $179
4MB $249
L40SX and N33SX
4MB $159
L40SX
8MB $339

NEC

UltraLite 286F; II, SX/20 and SL/20
2MB $199
4MB $449
ProSpeed 286
2MB $199
4MB $339
ProSpeed 386
2MB $159

Toshiba

T1000SE;LE;XE, 2000SX;SXe,Z200SX
2MB $119
4MB $219
8MB $399
T1200XE, 1600 and 3100E
2MB $99
T3100SX, 3200SX and SXC
2MB $99
4MB $169
T3200
3MB $159
T3300SL
2MB $179
4MB $329
T4400SX and T6400 NEW
2MB $209
4MB $309
8MB $649
T5100
2MB $109
T5200; T5200C and T8500
2MB $109
8MB $339

Zenith

MastersPort 386SL and SLC
2MB $129
MastersPort 386SX
2MB $129
SupersPort SX;286e; SlimsPort
2MB $139
SupersPort 286; 286e
1MB Kit $109
SupersPort 286e; SlimsPort
4MB $299
TurbosPort 386; 386e
1MB $89

We also have memory for Zeos, Sanyo, Everex, Packard-Bell, TI, Apple, Sharp, AT&T, Panasonic, Tandon, Epson, and more!

Laser Printer Memory

Hewlett-Packard LaserJet IIP, III, IIIP, IIID
2MB 33475B ..... $115 4MB 33477B $179
Hewlett-Packard LaserJet II and IID
2MB 33444B ..... $115 4MB 33445B $179
Hewlett Packard LaserJet IISi
1MB C2065A ..... $59 4MB C2065A $159
IBM Laser 4029 All Models
2MB 1183334 ..... $129 4MB 1183335 ..... $189
Canon LBP-8
1MB S63-2230 ..... $169 2MB PN N/A $229
Canon LBP-8II, 8III and 8IIT
2MB S63-1880 ..... $129 4MB PN N/A $209
Canon LBP-III and 8III Plus
2MB S63-2350 ..... $249 5MB S63-2360 ..... $299
Brother HL-8, 8E, 8D, 8V
1MB MB-810 ..... $149 2MB MB-820 ..... $199
Panasonic 4450i and 4420
2MB KX-P451 ..... $129 4MB PN N/A $209
Toshiba Page Laser 6
2MB LS6-N80090 .. $125 4MB LS6-N80100 .. $199
OkiLaser 400
1MB 70014701 ..... $99 2MB OKI PN N/A ... $129
Texas Instruments MicroLaser and XL
1MB 2555739-0001 ..... $59
Epson EPL 6000
2MB IBS401 ..... $119 4MB PN N/A $189
Epson ActionLaser II, EPL-8000
2MB PN N/A ..... $169 4MB PN N/A $259

BOCA RESEARCH INC

Expansion Boards

BocaRam AT Plus 2-8MB memory board for 286 & 386 IBM compatibles machines running up to 33MHz. Provides conventional, expanded(LIM EMS 4.0) and/or extended memory. Also supports OS/2.
w/2MB ..... $189 w/6MB $299
w/4MB ..... $249 w/8MB $379
BocaRam AT I/O Plus 2-4MB memory board, same as AT Plus with 1 serial and 1 parallel port.
w/2MB ..... $199 w/4MB $279

Video Graphics

Boca Research
Basic VGA 640x480 16 color $69
Super VGA 512K 1024x768 16 color $119
Super X VGA 1MB 1024x768 256 color $159
Diamond Computer
Stealth V-RAM High-Color SVGA 1MB $285
SpeedSTAR 24 True Color Card $199

Megahertz Modems for Your Laptop or Notebook

Internal, External, Send/Receive FAX

For use in these models:
- Compaq SLT, LTE, LTE Lite and Port. 486c
- Toshiba T1000SX/XE/LE, T1200; XE, T1600, T2000SX; SXe, T3100; T3100e, T3100SX, T3200SX, T5100, T5200
- Zenith SupersPort, MastersPort, MinisPort,SlimsPort
- NEC ProSpeed
- Sharp 6220, 6641
- TI TravelMate 2000, 3000
- AST Premium Executive

All Megahertz Modems include:

- Easy installation with illustrated user's guide
- Full 5-year warranty and toll-free technical support
- Data communications software
- Hayes-compatible
- Auto-answer, auto-dialing
- Full or half duplex
- Auto adaptive equalization

2400bps Modem $149
V.42/V.42bis Modems $210
9600bps Send/Receive Fax Modems $319
Universal Pocket Modems for any RS232 9-pin serial port
2400bps w/MNP 5 ..... $229
9600bps FAX/2400bps Modem $279

CALL FIRST SOURCE FOR THE BEST PRICE, QUALITY, AND SUPPORT.

- Toll-free technical support
- Thousands of products in stock
- Same day shipping
- Overnight delivery available
- You are never charged a surcharge on any CREDIT CARD purchases.
- All products are user installable and include installation instructions.
- We accept APO, FPO, and international orders
- Purchase orders accepted from Government Agencies, Universities, and qualified firms.
- Special pricing on volume orders
- Manufacturer's warranties

DELIVERY GUARANTEED

You get fast, inexpensive, dependable delivery to anywhere in the world. FEDERAL EXPRESS

Call First Source today... We're the experts, so you don't have to be. OPEN SATURDAY

CALL TOLL FREE

from anywhere in the US or Canada
Monday thru Friday 8AM - 5PM,
Saturday 10AM - 3PM P.S.T.

800/535-5892

FAX ORDERS
714/588-9872
INTERNATIONAL ORDERS
714/588-9866

WE PROUDLY ACCEPT:

The Only Source For Computer Upgrades

First SOURCE International

Mail orders to: FIRST SOURCE
36 Argonaut, Suite 140
Aliso Viejo, CA 92656 USA

Terms/Conditions: Memory products are third party, manufacturers' part numbers are for your convenience. Freight charges are non-refundable. A 20% restocking fee will be charged on all non-defective returns, unopened, and refused or cancelled orders. Items must be returned within 15 days with original documentation and packaging. All returned Merchandise Authorization number is required. Prices and availability are subject to change without notice. Purchase prices at the time of order are final. First Source International cannot be responsible for errors in typography or photography. We will beat any advertised price valid only on identical brands, offer not good for SIMMs or DRAM. Trademarks and registered trademarks are of their respective companies.

START SAVING TIME AND MONEY NOW...CALL FIRST SOURCE TOLL FREE 1-800-535-5892

IBM

N45SL-120 meg, notebook 3125
N51SX-80 meg, notebook.....2795
PS/2 70-121 meg 3125
PS/2 40SX-40 meg 1655
PS/2 90 OK9, 160 meg 5575
*** Monitor Extra ***

COMPAQ

DESKPRO 386/25M 1895
DESKPRO 386/33M 2125
DESKPRO 486/25M 2125
DESKPRO 486/33M 2425
DESKPRO 486/50L .....CALL
Prolinea 3/25S, 86SX/25, 84 meg.....1295
Prolinea 3/25ZS, 386SX/25, 84 meg.....1195

Contura 386SL/20, 40 meg.....1595
Contura 386SL/25, 60 meg.....1945
*Call for other models – Monitor Extra *

NOVELL SPECIALS

Netware 386 V.3.11
Authorized Dealer

5 users.....695
10 users.....1395
20 users.....1895
100 users.....3795
250 users.....CALL

BRAND NAMES LOW PRICES

LEADER SINCE 1983

We export to Europe, Asia & the Far East

We Honor Manufacturer's Warranties

Call for details

NOTEBOOKS

TI TravelMate 4000, 386SX, 120 meg.....CALL
Compaq LTE Lite 386SL .....CALL
Toshiba 2200SX, 80 meg .....CALL
Toshiba 4400SXC, 120 meg.....CALL
Toshiba 6400SXC, 120 meg.....CALL
Toshiba 3300SL, 80 meg .....CALL

AST

Exec 386SX/25, 80 meg 2150
Exec 386SX/25, 120 meg .....CALL
Exec 386SX/25C, 80 meg 3195
Exec 386SX/25C, 120 meg.....CALL

Call for pricing on other brand name models

EVEREX

MEGACUBE EISA BUS
486-33 MHz System
8 meg, 128K Cache, ESDI.....3695

486/33 MHz System
4 meg, 256K Cache, 1.2 &
200 meg drives, SVGA Combo.....2995

Step 386-33 MHz System
2 meg, 64K Cache, 1.2 & 120 meg
drives, 1024x768 SVGA Combo.....2595

Tempo LX 386sx/16 MHz Notebook
3 meg, 60 meg hard drives, VGA.....1695

AST

Bravo 386SX/20 model 1.....1070
Bravo 386/25 model 1 2295
Premium 386SX/20 model 1.....1295
Premium 386/33 model 1 2225

CD ROM/Multi Media

NEC CD ROM 36M 385
NEC CD ROM 73M 580
Sound Blaster Pro 205

WE STOCK TOSHIBA

CITIZEN
OKIDATA
EPSON

HITACHI
TALLGRASS
ARCHIVE

NEC
ALR
WYSE

HOUSTON INSTRUMENTS
MICROSOFT
SUMMAGRAPHIC

INTEL
PC MOUSE
CALCOMP

ACS Computers

All systems include

Made in USA

- Intel CPU with 4 meg RAM
- Desktop or tower case
- 2 serial, 1 parallel, 1 game (joystick) ports
- 101 AT enhanced keyboard
- 1.2 (5.25") & 1.44 (3.5") TEAC floppy drives
- SVGA card w/1 meg & SVGA 0.28mm monitor
- MS DOS 5.0 (complete w/manuals)
- MS Windows 3.1 (complete w/manuals) & mouse

486/50 with 200 meg HD.....2395
486/33 with 120 meg HD.....1995
386/40 with 120 meg HD.....1490
386SX/25 with 40 meg HD.....1195

One year limited warranty

LAN BOARDS

8 bit Arcnet 75
16 bit Arcnet 160
Novell NE 1000 160
Novell NE 2000 175
8 port Active Hub 325
Token Ring Card 399
Tokenhub 4-port 355
Call for other
LAN Accessories

PRINTERS

Epson LQ 570 289
Epson LQ 1170 565
OKIDATA ML320.....315
OKIDATA ML390.....460
HP DeskJet 500 399
HP PaintJet 705
Citizen, Panasonic ..CALL

HARD DISKS

CONNOR
CP30104 120 meg....CALL
CP3204F 220 meg....CALL
QUANTUM
Pro Drive 120 meg ...CALL
Pro Drive 240 meg ...CALL
MAXTOR, SEAGATE
MICROPOLIS, MICRONET
CALL FOR ALL MODELS

SVGA Monitors

NEC 3FGX, 14" 665
NEC 4FG, 16".....825
NEC 4DS, 16" 875
Viewsonic 4E, 14".....365
Viewsonic 8, 17".....1785
Aamazing, 14" 335

LASER PRINTERS

HP Laser IIISI 3595
HP Laser IIID .....CALL
HP Laser III 1495
HP Laser IIIP .....CALL
HP IIP Plus .....CALL
OKI OL 400, 800 .....CALL
OKI OL 840 P.S. 1720
Panasonic 4450 1295
NEC Model 95.....1465

Corporate Accounts Welcome

Call for Discounts on Volume

And Consultant Orders

Exports Available

Computerlane inc.

Outside California: 1-800-526-3482

Inside California: 818-884-8644 • FAX: 818-884-8253

7500 Topanga Canyon Boulevard, Canoga Park, CA 91303

Hours: Monday - Friday 9 -6, Saturday 10-6

ALL QUOTED PRICES ARE CASH PRICES ONLY

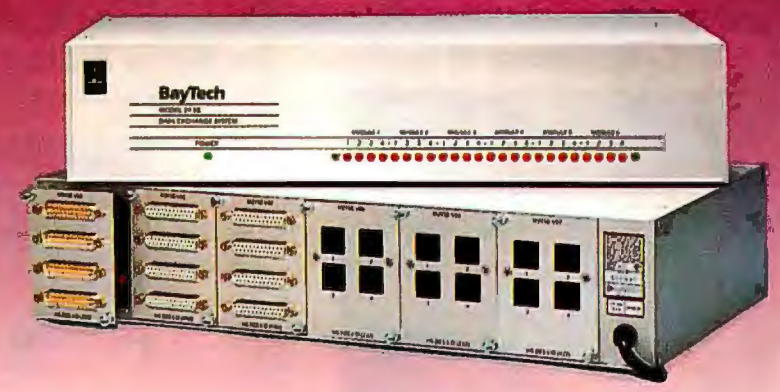
Visa, MasterCard and American Express are higher

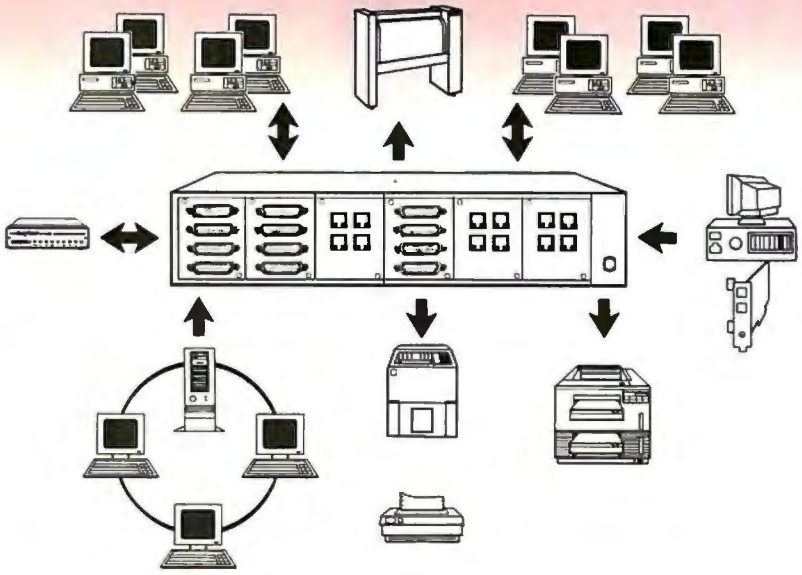
Prices subject to change without notice.
*Quantities are limited

Compaq is a Registered Trademark of Compaq. IBM is a Registrered Trademark of International Business Machines.

Circle 209 on Inquiry Card.

PRINTER SHARING THAT MAXIMIZES YOUR HIGH SPEED PCS AND PRINTERS





Outstanding Features:

- 5.5 M bps total throughput speeds
- Up to 60,000 character per second parallel communications
- 46,000 character per second serial communications (printer sharing)
- Use with BayTech Tran-x parallel extension products for data transmission to 46,000 characters per second over 1000+ feet
- Expandable up to 24 ports
- Up to 16MB dynamically allocated buffer
- Full duplex communication at 115.2k baud for high speed file transfer
- Device selection while in Windows® or graphics programs

The Model 24SII Data Exchange System (DES), with total throughput speed exceeding 5.5M bits per second, is the answer to your need for the fastest, cost effective peripheral sharing available.

These high speeds allow computers and file servers to off-load large text and graphic files to plotters, modems, printers, and other computers at extremely fast rates.

With more than 1.5 million connections, BayTech has been serving customers worldwide for over 16 years. For high speed data communications, contact a BayTech representative *today!*

Because Resources Should Be Shared

BayTech

Data Communications Products Division
200 N. Second Street, P.O. Box 387
Bay St. Louis, MS 39520
Fax: 601-467-4551 Phone 601-467-8231 or toll-free

800-523-2702

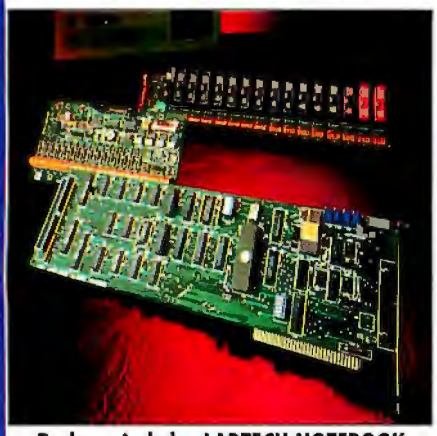
All products or company names are trademarks of their respective holders.

High Speed Printer Sharing • Parallel/Serial Converters • Statistical Multiplexers • Data Acquisition Controllers

Circle 206 on Inquiry Card (RESELLERS: 207).

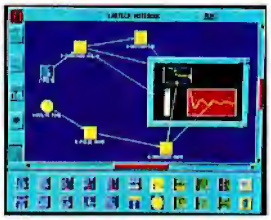
CyberResearch PC Products for Scientists & Engineers

CyberResearch System of the Month Features RTI® DAS from Analog Devices



Package includes LABTECH NOTEBOOK

The **RTI** series of data acquisition boards were designed by **Analog Devices** with industrial users in mind. With the lowest failure rate in the industry, these are the boards to choose when reliability is critical. Designed from the outset to be compatible with the full line of Analog Devices' signal conditioning modules, RTI boards can be used for the broadest possible range of data acquisition applications.



Labtech Notebook

CyberResearch has now made this top-of-the-line product affordable for everyone. By bundling an **RTI 815A** together with **LABTECH NOTEBOOK®** software at one low price, we've saved over $500 and made it possible for you to afford the very best.

Each combination package includes:

- **RTI 815A** data acquisition board configured for 32 Single-Ended or 16 Differential analog input channels with a 50KHz A/D conversion rate, 2 analog output (D/A) channels, 16 Digital I/O lines, and 3 Counter/Timer I/O channels.
- **LABTECH NOTEBOOK** menu-driven software with new IconView diagramming user interface and drivers for controlling the RTI 815A board.

Order **#RTI 815LN** RTI DAS Combination Package.**$1995**

Circle 395 on Inquiry Card.

Guarantee Valid Data with Signal Conditioning Modules

Signal conditioning modules serve several purposes: they protect your computer, isolate your signal of interest from noise, amplify low-level signals, and provide power and excitation to transducers.

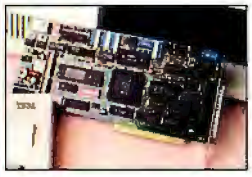
One name is virtually synonymous with signal conditioning: **Analog Devices**. And CyberResearch is your Analog Devices distributor carrying every signal conditioning line: the versatile **3B** series, the low-cost **5B** series, and the new, intelligent **6B** series with on-board A/D conversion.

Call **800-394-3300** to receive additional information.

Circle 395 on Inquiry Card.

Low-Cost 16-Bit A/D Board offers High Resolution

New from Keithley Metrabyte, the **ADC 16** is a low-cost, 16-bit data acquisition board, ideal for high-resolution applications and portable PC DAS systems. The Advanced Software Option provides File I/O drivers for all languages; call drivers for Pascal, C, & Turbo Pascal; and a Windows-compatible Dynamic Link Library with Visual BASIC example program. Perfect for temperature or flow measurement, the **ADC 16**'s features include:



- 8 Fully-Differential Analog Input Channels
- 16-Bit Resolution for Highest Accuracy
- On-board 1mA source for Sensor Excitation
- 16 Sample-per-second Data Acquisition
- Input Autozeroing helps eliminate offset errors
- QuickBASIC & QBASIC drivers included free
- ±5V & ±3.2767V Input Ranges
- Programmable Gains of 1, 10, or 100

#ADC 16 Low-Cost 16-Bit Data Acquisition Board **$550**
#ADC 16S Advanced Software Option w/Pascal, C, & Windows Drivers **$99**

Circle 397 on Inquiry Card.

FREE PC Systems Handbook for Scientists & Engineers

This Combination Tutorial/Catalog Includes Many Examples of PC-based Systems

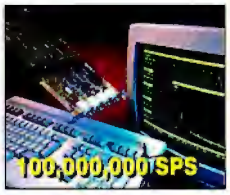
The CyberResearch *PC Systems Handbook for Scientists & Engineers* describes over 1400 unique and hard to find items for PC-based engineering. Packed with useful technical information and easy-to-read diagrams, this invaluable reference should be part of every engineer's library.

Fax, Call, or Write for a complimentary copy.

Circle 396 on Inquiry Card.

100MHz PC-Based Oscilloscope

CompuScope 250 from **Gage Applied Sciences** is a family of high quality 100 MegaSPS PC/XT– compatible Data Acquisition Cards with advanced oscilloscope software. Features include:



- 100MHz sampling on 1 channel (10ns/sample) or 50MHz simultaneous sampling on 2 chan.
- 8-bit resolution
- 50MHz bandwidth
- 32 or 128-KiloByte memory buffer
- Software programmable inputgains
- Store and load setups and signals
- Drivers available in C, Pascal and Basic.

#DSO 200 40MHz CompuScope Lite w/16K Buffer **$595**
#DSO 250L 100MHz CompuScope 250 Lite **$2750**
#DSO 250-32 100MHz Scope w/32K Buffer **$3495**
#DSO 250-128 100MHz Scope w/128K Buffer **$3895**

Circle 397 on Inquiry Card.

The CyberResearch Advantage:

- ☑ FREE Application Engineering
- ☑ Everyday Low Prices
- ☑ Broadest Product Selection
- ☑ 100% Satisfaction Guarantee

CyberResearch

Mailing Address:
P. O. Box 9565
New Haven, CT 06535

Worldwide
(203) 483-8815
Fax: (203) 483-9024

TOLL-FREE (800) 394-3300

MasterCard VISA American Express Card

New 19" Rack-Mount Computers & Peripherals

CyberResearch, Inc. offers a complete line of rack-mount computers and data acquisition hardware. Affordable EIA 19" rack-mount monitors, printers, surge protectors, keyboards, UPS's, and other PC peripherals can seem impossible to find, but here at CyberResearch, they've been a specialty of ours since 1984.

The rugged & reliable Elma keyboard shown here is made in the USA. It features extended 101-key layout, full-travel keys for touch-typing, and is only 1 rack-space (1.75") high. Call for additional information.

#DIX 3010 Low-cost, Drawer-Mounted Rack-Mount Keyboard (not shown) .. **$295**
#DIX 6010 Slide-out, Rack-Mount Keyboard w/locking drawer **$395**

Circle 397 on Inquiry Card.

Notice to International Customers

You can buy direct from CyberResearch and **save 50%** or more! A majority of the leading brands of PC-based engineering products are available for export from CyberResearch at the same low prices as those enjoyed by our customers in the United States.

Due to contractual restrictions, products from some manufacturers are not available for export to certain countries.

Please fax a request for quotation listing brand and/or performance requirements, and we'll fax back a prompt response.

Circle 396 on Inquiry Card.

"Eltech Systems have won three Best Buys since October... ... a testimonial to the company's reliability."

PC WORLD *June 1992*

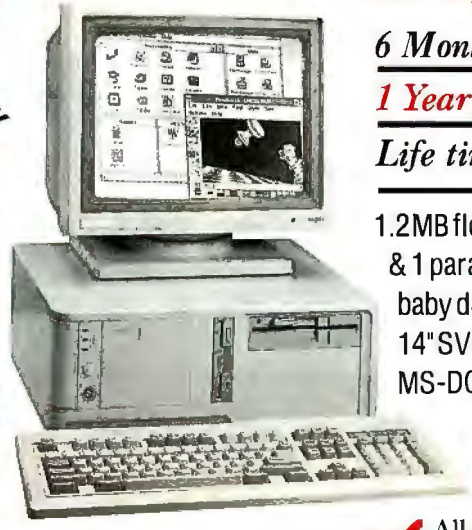
ELTECH

Novell Labs Tested & Approved

PC WORLD BEST BUY

YOUR BEST BUY!

Purchase Direct! No Middleman! No Markup!



All Systems Include:

6 Months ON-SITE Service

1 Year parts & labor warranty

Life time toll free technical support

intel inside

1.2MB floppy, high-speed HD, 2 serial & 1 parallel ports, SVGA card w/512K, baby desktop case, 101 keyboard, 14" SVGA monitor 1024 x 768 0.39mm. MS-DOS™ 5.0 & MS-Windows™ 3.1.

MICROSOFT® WINDOWS™ COMPATIBLE

CONVENIENT PHONE ORDERING!
No high-pressure sales people.

- ✔ 100% no risk, 30 day money back guarantee.
- ✔ 100% Q.C. & burn in. DOS 5.0 & Windows 3.1 installed.
- ✔ Gold authorized Novell Reseller, our Certified Engineers can help work out your network requirements.
- ✔ All Systems can be configured to your exact specifications and our trained specialists are available to discuss your applications and make system recommendations.
- ✔ Additional savings are available on upgrades to hard drives, monitors, and popular accessories.
- ✔ All systems MADE IN USA.

386DX-25	486SX-25	486DX-33	486DX2-50
Model 9870 386DX-25 2MB RAM 64K cache 105MB SVGA System **$1,199**	Model 4200 486SX-25 2MB RAM 8K cache 120MB SVGA System **$1,299**	Model 4330 486DX-33, 4MB Internal RAM, 64K cache, 120MB HD, SVGA System **$1,599**	Model 4500DX2 486DX2-50, 4MB Internal RAM, 64K cache, 120MB HD, SVGA System **$1,799**

Call and order yours today!

1-800-358-8330

Canadian Distr. 604-275-1119

Fax: 510-438-0663

Government Purchases Welcome

GSA Contract No.: GS00K91AGS5086-PS01

MasterCard VISA

ORDER NOW AND RECEIVE $599 VALUE FREE

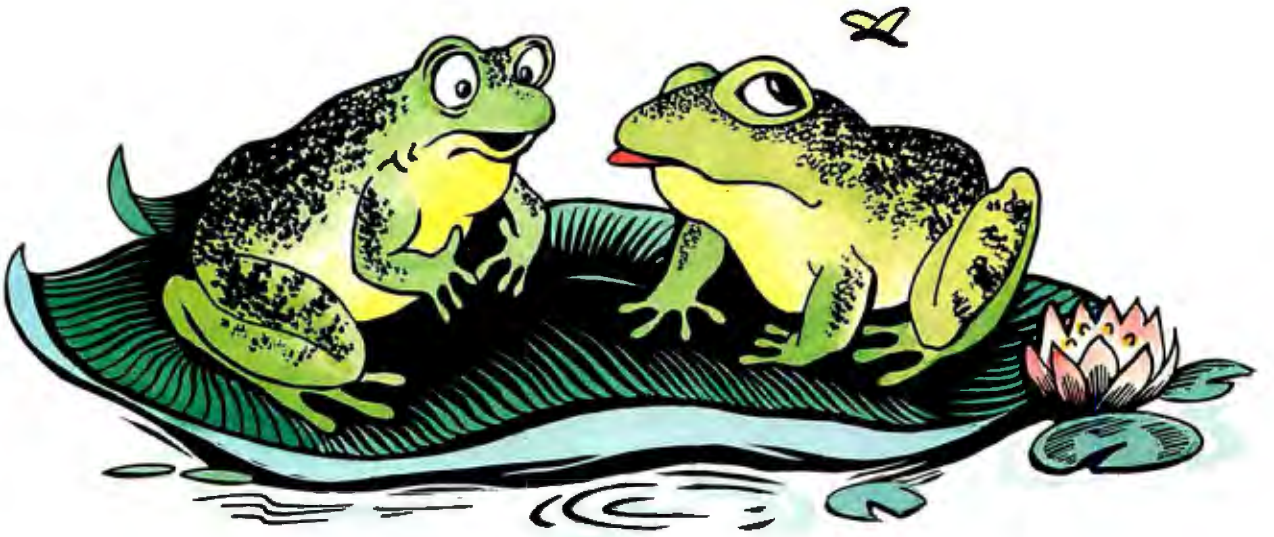
MS® DOS™ 5.0, Windows™ 3.1, Microsoft® Works™ for Windows™, Microsoft® Serial Mouse, Mouse Pad and Anti-Virus shareware by McAfee

ELTECH RESEARCH INC.

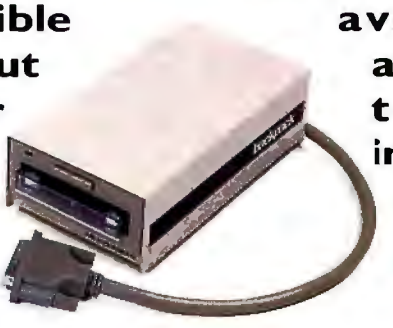
47266 Benicia St., Fremont, CA 94538

The Intel Inside Logo is a trademark of Intel Corporation.
All other trademarks are registered to the respective companies.
Sales tax, shipping & handling are extra. Eltech ad 7/92 V.1

TWO COMPUTERS CAN SHARE ONE BACKPACK.



With Backpack, several computers can share a single tape drive. Backpack connects quickly and easily to the parallel printer port of any PC compatible or portable – without interface cards or tools! The Backpack tape drive is also easy to transport, making it ideal for transferring data from one computer to another. QIC 40 (40/120MB) and QIC 80 (80/250) tape, diskette and hard drive models are available. So share and share alike! Call today for more information.



backpack

Computer Products

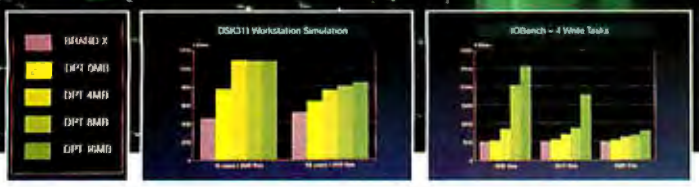
132 W. Lincoln Hwy., DeKalb, IL 60115 815-756-3411 Fax 815-756-2928

Circle 222 on Inquiry Card.

DPT

Break into Higher Performance!

SmartCache Plus is the SCSI controller that delivers higher performance without a higher price!



Windows, Netware, Unix and other high-end applications need a SCSI controller that delivers top disk I/O performance and a growth path. Only SmartCache Plus delivers both – and costs no more than less advanced controllers!

As the industry's fastest SCSI controller, SmartCache Plus is the easy choice. It's the smart choice, too – because if your system needs a performance boost, you can transform it from a non-caching host adapter into the world's fastest *caching* controller! Expandability is so simple: plug-on modules add caching, up to a total of 16MB of cache memory, and disk mirroring!

SmartCache Plus is supported by all major operating systems and applications, and provides connectivity to hundreds of SCSI devices. Reliable, scalable and simple to install, SmartCache Plus breaks your system's disk I/O bottleneck without breaking your budget!

Distributed Processing Technology
140 Candace Drive, Maitland, FL 32751

All trademarks are the property of their respective owners.

Circle 211 on Inquiry Card (RESELLERS: 212).

GET THE FACTS!

This free comprehensive Performance Report details the SmartCache Plus advantage over its leading competitor in nine different benchmarks for DOS 5.0, Netware 3.11 and Unix applications. For your copy, contact DPT Channel Marketing today...

TEL. 407-830-5522
FAX 407-260-5366

See us at Networld Booth #2370

The World's first TMS 34020 Graphics Board Manufacturer gives you . . .

THE BEST FOR LESS

High Resolution
CAD and Windows

Multimedia
Video for the PC

THE LOWEST PRICES ANYWHERE ON . . .

SEE US AT HAL-PC'S MONTHLY MEETING

High performance graphics for the PC. 1600 X 1280 resolution gives 6 times the visual information of standard VGA. Dedicated graphics processor handles graphics commands up to 100 times faster. All TEXANs are supplied with drivers for TIGA and MS-Windows, and a display list driver for AutoCAD® 386 rel. 10-12. X Window System for Interactive UNIX is optional. TI® TMS34020 processor, TMS34082 optional, VGA passthrough for single monitor operation, software selectable resolutions, 256 colors.

THE TEXAN 1600
1600 X 1280 display resolution, 256 colors, 60Hz noninterlaced, VGA passthrough and cables. **$1450.00**

THE TEXAN 1280
1280 X 1024 display resolution, 256 colors, 72Hz noninterlaced, VGA passthrough and cables. **$1250.00**

THE TEXAN 1024
1024 X 768 display resolution, 16 colors, 72Hz noninterlaced, VGA passthrough and cables. **$995.00**

NEW **M&M PRO** 24-bit true color NTSC/PAL/SECAM video window frame grabber. 12-bit digital stereo audio. Hardware compression. Outputs S-VGA and flicker-free NTSC/PAL S-Video/Composite. Single PC slot.
CALL OR FAX FOR INFO.

M&M Basic Frame Grabber puts live video in a window on existing VGA display. NTSC and PAL.
Composite Video only **$500.00**
S-Video and Composite **$600.00**

ViVA Video, VGA, and Audio mixer converts VGA to video, and outputs as an overlay on an input video signal.
NTSC Composite Video **$550.00**
PAL Composite Video **$630.00**

ViVA Basic VGA to Video Converter outputs VGA to composite and S-Video with flicker-free filters.
NTSC Composite Video **$300.00**

SWEET 16 Real-Time Frame Grabber displays 32K colors with full TARGA® 16 compatibility.
S-Video and Composite **$775.00**

Monitors . . .
IDEK 21" flat screen monitors multiscan 30-80 KHz
MF 5421A 1600x1280, .26 Dot Pitch **$2525.00**
MF 5221A 1280x1024, .31 Dot Pitch **$2125.00**
others available . . .

(PHONE 713) 464-2990
(FAX 713) 827-7540

WE ACCEPT VISA, MASTERCARD AND AMERICAN EXPRESS

Direct From Manufacturer
12-Month Warranty
F.O.B. Houston

Omnicomp™ Graphics Corporation

Omnicomp is a Houston based and owned manufacturer of high performance graphics hardware for popular computer platforms including PC/AT, VME, Micro Channel®, and others.

...The Texas Graphics Company
1734 W. Sam Houston Pkwy. N.
Houston, Texas 77043

Omnicomp, THE TEXAN, M&M PRO, M&M Basic, ViVA, ViVA Basic, and SWEET 16 are trademarks of Omnicomp Graphics Corporation. Windows and MS-Windows are trademarks of Microsoft Corporation. TI is a registered trademark and TMS34020, TMS34082, and TIGA are trademarks of Texas Instruments Incorporated. AutoCAD is a registered trademark of Autodesk, Inc. Interactive UNIX is a trademark of Interactive Systems Corporation. TARGA is a registered trademark of Truevision, Inc. Micro Channel is a registered trademark of International Business Machines Corporation. X Window System is a trademark of Massachusetts Institute of Technology.

Circle 226 on Inquiry Card (RESELLERS: 227).

The Ultimate Power Platforms.

For 486 Windows and CAD – Comtrade's EISA or Local Bus.

486 EISA Win-Station

- 64K Super Fast Write-Back Cache SRAM
- 4MB RAM & Built-in 487 Math Coprecessor
- 1.2MB 5.25" & 1.44MB 3.5" Floppy Drives

32-Bit EISA Hard Disk Controller (350% faster DTR)

- 130 MB 15ms IDE Drive with 64K Cache

Diamond Stealth S3 Graphics Accelerator w/ 1MB VRAM (Up to 25 times faster than standard super VGA)

- 14" Non-Interlaced .28mm SVGA Color Monitor
- 2 Serial, 1 Parallel, & 1 Game Ports
- Enhanced 101-Key Keyboard
- Hi-Resolution 400DPI Serial Mouse
- Microsoft DOS 5.0 & Windows 3.1

486/33 DX	$2245
486/50 DX2	$2425
486/50 DX	$2625
486/66 DX2	$2825

- 8MB RAM & 210MB Drive Upgrade Add $360
- 15" MAG Flat Screen 1280x1024 Monitor Add $290

Local Bus Win-Station

- 64K Super Fast Write-Back Cache SRAM
- 4MB RAM & Built-in 487 Math Coprocessor
- 1.2MB 5.25" & 1.44MB 3.5" Floppy Drives
- 130MB 15ms IDE Drive with 64K Cache
- 32-Bit Local Bus *Viper S3* Graphics Accelerator with 1MB VRAM (Up to 1280x1024 & up to 32K Colors) (Up to 50 times faster than standard super VGA)
- 14" Non-Interlaced .28mm SVGA Color Monitor (VESA Standard for 72Hz Flicker-Free Display)
- 2 Serial, 1 Parallel, & 1 Game Ports
- Enhanced 101-Key Keyboard
- Hi-Resolution 400DPI Serial Mouse
- Microsoft DOS 5.0 & Windows 3.1

486/33 DX	$1925
486/50 DX2	$2125

- 8MB RAM & 210MB Drive Add $360
- 32-Bit Local Bus Hard Disk Controller Add $90

Local Bus CAD-Station

- 64K Super Fast Write-Back Cache SRAM
- 8MB RAM & Built-in 487 Math Coprocessor
- 1.2MB 5.25" & 1.44MB 3.5" Floppy Drives
- 210MB 15ms IDE Drive with 64K Cache
- 32-Bit Local Bus *Viper S3* Graphics Accelerator with 1MB VRAM (Up to 1280x1024 & up to 32K Colors) (Up to 50 times faster than standard super VGA)
- AutoCAD Display List Driver
- 17" Flat Screen 1280x1024 SVGA Monitor
- 2 Serial, 1 Parallel, & 1 Game Ports
- Enhanced 101-Key Keyboard
- Hi-Resolution 400DPI Serial Mouse
- Microsoft DOS 5.0 & Windows 3.1

486/33 DX	$2875
486/50 DX2	$3075

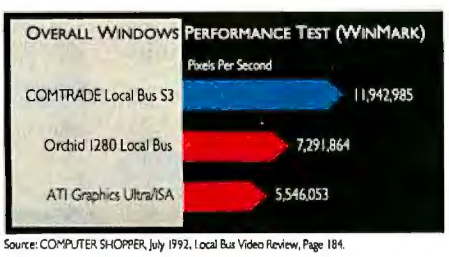
- Above System with 12"x12" Digitizer Add $330
- 32-Bit Local Bus Hard Disk Controller Add $90

WHEN IT COMES TO HIGH-SPEED EISA PERFORMANCE, COMTRADE IS FURIOUSLY BLOWING AWAY THE COMPETITION. "A VERY SWIFT GRAPHICS MACHINE," SAYS COMPUTER SHOPPER (MAY 1992). • AND THIS HURRICANE EISA POWER IS FINALLY AVAILABLE TO YOU AT A PRICE THAT WON'T BLOW YOU AWAY. • THESE EISA SYSTEMS FEATURE A POWERFUL 32-BIT EISA HARD DISK CONTROLLER THAT PROVIDES REAL 32-BIT ACCESS TO THE HARD DRIVE. THE RESULT IS A 350% FASTER DATA TRANSFER RATE (DTR) • COMTRADE 486 EISA SYSTEMS – THE ULTIMATE MACHINE THAT LETS YOU TAKE YOUR WORKLOAD BY STORM.

Comtrade Local Bus Wins Big!

In Comparison With Other Leading High Performance Super VGA.

INTRODUCING COMTRADE'S 32-BIT LOCAL BUS. • TRADITIONALLY, 486 ISA MACHINES COULD ONLY SUPPORT 16-BIT VIDEO CARDS AND RUN AT STANDARD 8MHZ BUS SPEED. • THAT WOULD RESULT IN A BOTTLENECK REGARDLESS OF HOW FAST THE CPU COULD RUN. • NOW YOU HAVE AN ALTERNATIVE. • COMTRADE'S LOCAL BUS SYSTEM USES A 32-BIT VIDEO CARD WHICH NOT ONLY PROVIDES DOUBLE THE DATA PATH, BUT ALSO THE VIDEO BUS RUNS AT TRUE CPU SPEED. • THE RESULT IS VIDEO SPEED UP TO 5X FASTER THAN REGULAR SVGA AND UP TO 50X FASTER WITH OUR LOCAL BUS S3 VRAM GRAPHICS ACCELERATOR.



Source: COMPUTER SHOPPER, July 1992, Local Bus Video Review, Page 184.

intel inside

Circle 230 on Inquiry Card (RESELLERS: 231).

30 Day Money Back Guarantee. Unconditional Two-year Parts Warranty.
One Year On-Site NationWide Service.

486 EISA Advantage

- 64K Super Fast Write-Back Cache SRAM
- 4MB RAM & Built-in 487 Math Coprocessor
- 1.2MB 5.25" & 1.44MB 3.5" Floppy Drives
- Optional 32-Bit EISA Hard Disk Controller $130
- 130 MB 15ms IDE Drive with 64K Cache
- 16-Bit 1024x768 SVGA Card with 1MB RAM
- 14" Non-Interlaced .28mm SVGA Color Monitor (VESA Standard for 72Hz Flicker-Free Display)
- 2 Serial, 1 Parallel, & 1 Game Ports
- Enhanced 101-Key Keyboard
- Hi-Resolution 400DPI Serial Mouse
- Microsoft DOS 5.0 & Windows 3.1

486/33 DX	$1945
486/50 DX2	$2125
486/50 DX	$2325
486/66 DX2	$2525

- 8MB RAM & 210MB Drive Upgrade Add $360
- 510MB Hard Drive & EISA Controller Add $960

Local Bus SVGA

- 64K Super Fast Write-Back Cache SRAM
- 4MB RAM & Built-in 487 Math Coprocessor
- 1.2MB 5.25" & 1.44MB 3.5" Floppy Drives
- 130MB 15ms IDE Drive with 64K Cache
- 32-Bit Local Bus *Turbo ET-4000* Card w/ 1MB RAM (Up to 1280x1024 & up to 32768 Colors) (5 times faster than standard super VGA)
- 14" Non-Interlaced .28mm SVGA Color Monitor (VESA Standard for 72Hz Flicker-Free Display)
- 2 Serial, 1 Parallel, & 1 Game Ports
- Enhanced 101-Key Keyboard
- Hi-Resolution 400DPI Serial Mouse
- Microsoft DOS 5.0 & Windows 3.1

486/33 DX	$1775
486/50 DX2	$1975

- 8MB RAM & 210MB Drive Add $360
- 32-Bit Local Bus Hard Disk Controller Add $90

1.800.969.2125

COMTRADE

"Where Quality is Everything"

International 818.961.6688
Japan 0473.34.3700
Fax 818.369.1479
Hours: 7:00-7:30 Pacific Mon-Fri
9:00-6:00 Pacific Sat

15314 East Valley Boulevard
City of Industry, California 91746

RIGHTON® COMPUTER SECURITY

AFFORDABLE • EFFECTIVE • MOBILE

SPOT® Anchor

SPOTLINK-5®

Righton® patented Spot® Anchors, with their special adhesive, are the best theft deterrents you can buy. Our versatile variety gives you options, easy access, and are easy to use. Spot-Link 5®, unlike competitors, is not dependent on the adhesive strength of a laminated top. Factory-direct prices from $8.20 to $32.50 save you money. Request our free brochure B with prices. Thank you.

© SecurTech Co. 1992

SECURTECH CO.

5755 SW WILLOW LANE, LAKE OSWEGO OR 97035-5340
(503) 636-6831 • FAX (503) 636-9642 Made in U.S.A.

Circle 235 on Inquiry Card.

AMT INTERNATIONAL
(COMPUTERS & PERIPHERALS)

3074 LANDESS AVENUE · SAN JOSE, CA 95132
TEL: (408) 942-9695 · FAX: (408) 942-5509

VISA
master charge

LOWEST PRICES
SAME DAY SHIPPING

COMPAQ MEMORY

DeskPro 286-E, 386-20/20E/25
1MB 113131-001 ..... $75.00
4MB 113132-001 ..... $169.00
DeskPro 286N, 386N and 386SX
2MB 118689-001 ..... $135.00
4MB 118690-001 ..... $230.00
DeskPro 386S
1MB 113646-001 ..... $99.00
4MB 112534-001 ..... $195.00
DeskPro 386-33, 486-33 & SystemPro
2MB 115144-001 ..... $185.00

AST MEMORY

Bravo-286, Workstation
512K Kit500510-010 ..... $59.00
2MB Kit500510-002 ..... $150.00
Premium 386-16/20C
1MB Kit 500510-003 ..... $75.00
4MB Kit 500510-004 ..... $185.00
Premium 386-20
1MB Kit 500510-003 ..... $75.00
4MB Kit 500510-004 ..... $185.00
Bravo-386SX
4MB Kit 500510-008 ..... $220.00
Premium 386-SX/25/33 & 486-25
1MB 500718-002 ..... $60.00
4MB 500-780 ..... $195.00

HEWLETT-PACKARD MEMORY

Vectra QS/16S
1MB $65.00
4MB $185.00
Vectra QS/20PC, RS/25PC and 20C
1MB D1640A $65.00
4MB D1642A $170.00
Vectra 486PC
1MB D2150A $75.00
4MB D2151A $165.00

IBM PS/2 MEMORY

Models 30-286, Exp. Board 1497259
512K Kit 30F5348 ..... $54.00
2MB Kit 30F5360 ..... $95.00
Models 70-E61/121, 55SX, 65SX
1MB 6450603 ..... $59.00
Models 70-E61/121, 50Z, 55SX, 65SX
2MB 6450604 ..... $99.00
Models 55SX, 65SX, 34F3077 & 34F3011
4MB34F2933 ..... $149.00
Models 70-A21
2MB6450608 ..... $99.00
Models 80-141
1MB 6450375 ..... $75.00
Models 80-111/311
2MB 6450379 ..... $99.00
All Models 70 and 80
2-14MB w/2M 34F3077 .. $290.00
4-16MB w/4M34F3011 .. $350.00
Models 50, 50Z, 55SX & 60
2-8MB 1497259 ..... $290.00

LASER PRINTER MEMORY

Hewlett-Packard Laser Jet IIP, III &IIID
1MB 33478 ..... $70.00
2MB 33475B $99.00
4MB 33477B $185.00
Hewlett-Packard Laser Jet IIP & IID
1MB 33443B $75.00
2MB 33444B $110.00
4MB 33445B $175.00
IBM Laser 4019 and 4019e
1MB 1039137 ..... $95.00
3.5MB 1038675 ..... $195.00
Canson LBP-811, 811R, 811T
2MB S63-1880 ..... $129.00

LAPTOP AND PORTABLE MEMORY

TOSHIBA MEMORY
1MB Model 1000SE/XE $110.00
2MB Model 1000SE/XE $99.00
2MB Model T1200XE $99.00
2MB Model T1600 ..... $99.00
2MB Model T3100E $99.00
2MB Model T3100SX $99.00
4MB Model T3100SX $195.00
2MB Model T3200SX $99.00
4MB Model T3200SX $195.00
2MB Model 5100 ..... $99.00
2MB Model T5200, T8500 .. $110.00
8MB Model T5200, T8500 .. $299.00

ZENITH MEMORY
1MB SuperSport 286 & 286ES$135.00
2MB SuperSport 286 & 286ES$140.00
2MB SuperSport SX/Alpha .. $140.00
2MB SuperSport SX/Beta .. $140.00
COMPAQ MEMORY
1MB Portable LTE 286 ..... $125.00
2MB Portable LTE 286 ..... $150.00
1MB SLT-286 ..... $140.00
4MB SLT-286 ..... $350.00
NEC MEMORY
1MB Prospeed 286 ..... $170.00
2MB Prospeed 386 ..... $240.00

ZENITH MEMORY

Zenith Z-386/20/25/33 & 33E
1MB ZA36/3800ME ... $90.00
2MB ZA3600MG $140.00
4MB ZA3800MK $205.00
Zenith Z-386 SX
2MB Z-605-1 ..... $125.00

MATH COPROCESSORS

INTEL
8087-5 MHz $70.00
8087-2 8MHz $70.00
8087-1 10MHz $135.00
80287-6 6MHz $79.00
80287-8 8MHz $79.00
80287XL 8/10MHz $89.00
80287XL & XLT $99.00
80287-10 10MHz $89.00
80C287-12 12MHz $89.00
80387SX-16 ..... $105.00
80387SX-20 ..... $125.00
80387DX-20 ..... $120.00
80387DX-25 ..... $155.00
80387DX-33 ..... $165.00
80487SX-20 ..... $435.00
WEITEK
3167-2020MHz $159.00
3167-25 25MHz $189.00
3167-33 33MHz $250.00
4167-25MHz $375.00
4167-33MHz $599.00
CYRIX
82S87XL $69.00
83D87-16 ..... $99.00
83D87-20 ..... $99.00
83D87-25 ..... $99.00
83D87-33 ..... $99.00
83D87-40 ..... $125.00
83S87-16 } SX $79.00
83S87-20 } SX $85.00
83S87-25 } SX $88.00
IIT
2C87-8 ..... $59.00
2C87-10 ..... $69.00
2C87-12 ..... $72.00
2C87-20 ..... $78.00
3C87-20 ..... $85.00
3C87-25 ..... $95.00
3C87-33 ..... $99.00
3C87-40 ..... $120.00
3S87-16 } SX $69.00
3S87-20 } SX $79.00
3S87-25 } SX $89.00
AMD
80C287-10 ..... $35.00
80C287-12 ..... $69.00

SIMM MODULES

IBM TYPE
ADD $2.00 FOR SIPPS
4Mx9-80 ..... $110.00
4Mx9-70 ..... $112.00
1Mx9-60 ..... $38.00
1Mx9-10 ..... $30.00
1Mx9-80 ..... $35.00
1Mx9-70 ..... $36.00
256x9-70 ..... $10.00
256x9-10 ..... $9.00
256x9-80 ..... $10.00
256x9-60 ..... $12.00
APPLE-MAC
1Mx8-70 ..... $33.00
1Mx8-10 ..... $29.00
1Mx8-80 ..... $33.00
4Mx8-80 ..... $108.00

DRAM

DRAM IMGX1
1 MGX1-120NS $3.00
1 MGX1-100NX $3.50
1 MGX1-80NX $3.60
1 MGXI-70NX $3.65
1 MGXI-60NX $3.75
DRAM 64X1
4164-150 ..... $0.85
4164-120 ..... $0.95
4164-100 ..... $1.50
4164-80 ..... $2.00
DRAM 64X4
4464-15 ..... $1.50
4464-12 ..... $1.99
4464-10 ..... $2.50
DRAM 256XI
256XI-150NS $0.85
256XI-120NS $0.89
256XI-100NS $0.99
256XI-80NS $1.10
256XI-70NS $1.20
S56XI-60NS $1.25
DRAM 256X4
256X4-100NS $4.00
256X4-80NS $4.25
256X4-70/60NS $4.50
256XI-STATIC COL
51258P-10 ..... $0.99
AAA 2800-08 ..... $1.29
AAA 2800-07 ..... $1.35
AAA 2800-60 ..... $1.55
1X4-80 ZIPP $14.00
1X4-80STT ZIPP $16.00
1X4-70STT ZIPP $17.00

SYSTEM

486-33 w/ 64k cache
• 4MB RAM • 1.2 & 1.44 • 130 HD
• VGA • SVGA 28 Monitor • 101 KB
• Mini-TowerCase • DOS 5.0
$1569.00

MONITORS

VGA 41 14" $225.00
SVGA 28 14" $280.00
SVGA 28 14" Non-Int $310.00
SVGA 25 14" Non-Int $510.00
SVGA 28 17" $850.00

MOTHER BOARDS OK

486-33 w/256k cache ... $595.00
486-33 w/ 64k cache $529.00
486SX-20/25 ..... $259/295.00
386-33 w/64k cache $219.00
386-25 Non-cache $220.00
386SX-16/25 ..... $120/145.00

MEMORY BOARDS OK

Boca AT+ $115.00
Boca XT or 30 ..... $115.00
Orchid 16/32 ..... $269.00
Orchid 8/16 ..... $159.00
Rampat $95.00
Simmply Ram $189.00
TI RamPS/2 ..... $199.00

1X4 4X1 STATIC

514402-80 (1x4) STT, ZIPP ..... CALL
514400-80 (1x4) ZIPP ..... CALL
514400-80 (1x4) DIPP ..... CALL
514400-80 (1x4) SOJ ..... CALL
514100-80 (4x1) SOJ ..... CALL

CASES

Mini-Tower $70.00
Mid-Tower $89.00
Full-Tower $119.00
Desktop $95.00

HARD DRIVES

44MB, 28ms, IDE $190.00
89MB, 14ms,IDE $270.00
130MB, 15ms, IDE $329.00
210MB, 15ms, IDE $539.00

FLOPPY DRIVES

1.2MB, 5.25" $58.00
1.44MB, 3.5" $58.00

MODEMS

2400bps Internal $45.00
9600bps Internal $299.00

FAX/MODEM

9600bps IntS/R Fax $79.00
2400bps Modem $99.00

Circle 205 on Inquiry Card.

LIFETIME* WARRANTY
100% GUARANTEED

MEMORY

WE WILL BEAT ANY ADVERTISED PRICE

80 NS 1 X 9 SIMMS $35.00

SIMM-SIPP MODULES

4MB X 9-80NS SIMM-PC	124.00	256K X 9-80NS SIMM-PC	11.00	1MB X 9-100NS SIPP-PC	35.00
4MB X 9-70NS SIMM-PC	124.00	256K X 9-70NS SIMM-PC	13.00	1MB X 9-80NS SIPP-PC	37.00
4MB X 9-60NS SIMM-PC	138.00	256K X 9-60NS SIMM-PC	13.65	1MB X 9-70NS SIPP-PC	37.00
1MB X 9-100NS SIMM-PC	34.00	1MB X 8-100NS SIMM-MAC	32.00	1MB X 9-60NS SIPP-PC	39.00
1MB X 9-80NS SIMM-PC	35.00	1MB X 8-80NS SIMM-MAC	33.00	256K X 9-100NS SIPP-PC	11.75
1MB X 9-70NS SIMM-PC	35.00	1MB X 8-70NS SIMM-MAC	34.00	256K X 9-80NS SIPP-PC	14.65
1MB X 9-60NS SIMM-PC	37.00	4MB X 8-80NS SIMM-MAC	120.00	256K X 9-70NS SIPP-PC	15.00
256K X 9-100NS SIMM-PC	9.00	4MB X 8-70NS SIMM-MAC	120.00	256K X 9-60NS SIPP-PC	16.00

DYNAMIC RAMS

1MB X 1-100NS	3.95	256K X 1-80NS	1.80	64K X 4-120NS	1.75
1MB X 1-80NS	4.20	256K X 1-70NS	1.90	64K X 4-100NS	2.10
1MB X 1-70NS	4.25	256K X 1-60 NS	2.20	64K X 4-80NS	2.25
1MB X 1-60NS	4.70	256K X 4-100NS	4.35	64K X 1-150NS	1.50
256K X 1-150NS	1.50	256K X 4-80NS	4.45	64K X 1-120NS	1.75
256K X 1-120NS	1.55	256K X 4-70NS	4.50	64K X 1-100NS	1.95
256K X 1-100NS	1.70	256K X 4-60NS	4.75	**256K X 1-STTATIC RAM**	
1 x 4-80NS	21.00	DIPP		AAA2800P-08 (256x1)	2.65
1 x 4-80NS	21.00	STATIC ZIPP		AAA2800P-07 (256x1)	2.85
1 x 4-80NS	21.00	ZIPP		AAA2800P-06 (256x1)	3.05

CACHE MEMORY

8 X 8-15	10.00
32 X 8-15	25.00
8 X 8-25	7.00
32 X 8-25	15.80
64 X 4-25	21.00
16 X 4-25	7.00
8 X 8-20	8.00
32 X 8-20	17.50
64 X 4-20	22.50
16 X 4-20	8.00

IBM MEMORY

LASER PRINTER	1MBBOARD	1039136 $ 83
MODEL 4019	2MBBOARD	1039137 140
4019E	35MBBOARD	1039675 225
LASER PRINTER	1MBBOARD	1H8333 115
MODEL 4029	2MBBOARD	1H8334 185
	4MBBOARD	1H8335 290
PS/1 & 386SX	512K MODULE	[illegible] 70
	2MB MODULE	[illegible] 170
	4MB MODULE	[illegible] 320
PS/2 25	512K KIT	2684853 70
PS/2 25-286	512K KIT	30F3346 45
30-286	2MB KIT	30F3362 115
ABOVE INSTALLED ON EXPANSION BOARD		
1497259 FOR 16, 32z & 80		
386SX LS, 4SX3	2MB SIMM	[illegible] 100
PS/2 50Z, 55SX, 65SX		[illegible]
56LS, 65LS		
386SX LS, 4SX3	4MB MODULE	34F7600z 195
56SX, 65SX		61H917
56LS, & 95LS ABOVE INSTALLED ON SYSTEM BOARD		
UPGRADES	1-1MB BOARD	6450885 150
W 6450883	2-1MB BOARD	6450889 290
6450840,34F7823	4-1MB BOARD	6450888 550
PS/2	1MB SIMM	6450801 80
70-B31,B61,121,T70	2MB SIMM	6450802 100
		6450804
PS/2 70-A21,A61	2MB SIMM	6450805 185
B21 & B61		
PS/2 90-XP	1MB MODULE	64500751 85
PS/2 80-111, 121	2MB MODULE	64500759 195
181, 311 & 331		
PS/2 90-A21,	4MB MODULE	64500760 350
A31, A61		
PS/2 90, 95 & P75	2MB SIMM	64500922 130
(INSTALL IN PAIRS)	4MB SIMM	64500728 220
PS/2 ALL 70s & 80s	2-8MB BOARD	6450805 330
(UPGRADES	4-8MB BOARD	34F3611 600
W/8TSD BANKS)	8MB BOARD	6450806 550
PS/2	2-14MB BOARD	34F3077 270
ALL P90 & 95s	4-16MB BOARD	34F3081 380
	8-16MB BOARD	620
	16MB BOARD	540
34F3077 IS INTERCHANGABLE WITH 16450605		
RISC 6000	16MB KIT	4010 1,100
(NO BOARD	32MB KIT	4033 2,400
INCLUDED)	64MB KIT	4036 4,800
L40SX & N33SX3	2MB SIMM	79F9599 165
LAPTOP	4MB SIMM	79F1000 340
	8MB SIMM	79F1001 500
*25SX, L40 & 40SX	2MB SIMM	64F3240 470
*20SX, 99 & 95	8MB SIMM	64F3230 490

COMPAQ MEMORY

DESKPRO 386	512K KIT	113012-001 $ 45
DESKPRO	1MB MODULE	113121-001 65
386E	4MB MODULE	113132-001 225
DESKPRO	EXPBOARD	118700-001 90
286/i, 386/i		
DESKPROP	1MB SIMM	113695-001 70
286/i,	2MB SIMM	113696-001 110
286SX/20, 386/25M,	4MB SIMM	118690-001 210
486/33M, 486S/25M,	8MB SIMM	126677-001 400
486S/16M	16MB BOARD	
SYSTEMPRO LT 486SX/25S, 386/25S, PORTABLE 486C		
NOTE: 8MB SIMM FORM, SYSTEMPRO & PORTABLE SERIES ONLY.		
DESKPRO	1MB BOARD	108263-001 210
386/16	2MB BOARD	108259-001 290
	1MB KIT	108701-001 70
	2MB KIT	108702-001 140
	8MB BOARD	108070 440
		W/72K/T
	4MB KIT	108072-001 315
DESKPRO	1MB BOARD	113533-001 145
386S	4MB BOARD	113534-001 275
	1MB MODULE	113645-001 75
	4MB MODULE	112734-021 230
DESKPRO	1MB BOARD	103644-001 145
386/20, 20E	4MB BOARD	113645-001 275
25 & 25E	1MB MODULE	113131-001 75
	4MB MODULE	113132-001 230
DESKPRO 386/33L	8SOCKET BD	119569-001 315
486/25, 33, 33L,	2MB MODULE	115184-001 130
SYSTEMPRO	8MB MODULE	115561-001 450
	32MB MODULE	116568-001 2,700
DESKPRO 486/33M,	8SOCKET BD	129160-001 299
486/25M, 16M,		
386/25M, SYSTEM PRO LT,		
486SX 25S, 386 25S		

TOSHIBA MEMORY

PORTABLE	1MB CARD	PC-PA8311U	$ 109
T1000SE & XE-LE	2MB CARD	PC-PA8312U	160
PORTABLE T2000SX	1MB CARD	PC16-PA8316U	109
& T2000	2MB CARD	PC16-PA8317U	160
PORTABLE T2000,	4MB CARD	PC1K-PA8314U	340
T2000SX & T 1000LE	5MB CARD	PC1K-PA8315U	740
*PORTABLE	2MB CARD	PC-PA2000U	185
T2000SX	4MB CARD	PC-PA2004U	295
& T3200SX	8MB CARD	PC-PA2008U	800
PORTABLE T1200XE	2MB MODULE	PC13-PA8306U	115
PORTABLE T1600	2MB MODULE	PC8-PA8302U	115
PORTABLE T3100E	512K KIT	PC5-PA8340U	99
	2MB SIM	PC5-PA8341U	115
PORTABLE T3100SX	2MB MODULE	PC15-PA8308U	115
	4MB MODULE	PC15-PA8310U	215
PORTABLE 3200	3MB MODULE	PC6-PA7137U	190
PORTABLE T3200SX	2MB KIT	PC12-PA8307U	115
	4MB KIT	PC12-PA8309U	215
PORTABLE T3200SXC	1MB KIT	PC19-PA8314U	125
	4MB KIT	PC19-PA8319U	225
T4400SX	2MB CARD	PC-PA2003U	220
	4MB CARD	PC-PA2004U	360
	8MB CARD	PC-PA2005U	695
PORTABLE T5100	2MB MODULE	PC-PA8301U	130
T5100C			
PORTABLE T5200C	2MB KIT	PCX-PA8304U	115
DESKTOP-T5500	8MB KIT	PCX-PA8313U	475

AST MEMORY

BRAVO 286	128K KIT	500510-011	$ 25
	512K KIT	500510-010	35
	2MB KIT	500516-002	105
	4MB KIT	500516-008	205
BRAVO 386SX-20	512K KIT	500510-012	42
	2MB KIT	500710-003	110
	8MB KIT	500604-001	395
BRAVO 386SX	2MB KIT	500508-002	110
	4MB KIT	500510-004	205
BRAVO 486/25	2MB KIT	500718-004	120
	8MB KIT	500780-001	465
PREMIUM 286	512K KIT	500510-001	40
FASTRAM			
ADV-FASTRAM	1MB KIT	500510-007	40
PREMIUM	512K KIT	[illegible]	35
WKST 286, 386SX	1MB KIT	[illegible]	60
	2MB KIT	[illegible]	105
	4MB KIT	[illegible]	205
FASTBOARD 286	1MB KIT	500510-007	60
PREMIUM 286 & 16	4MB KIT	500510-008	205
PREMIUM	512K KIT	500510-010	35
WKST 286	2MB KIT	500510-002	105
	4MB KIT	500510-008	205
PREMIUM	1MB KIT	500510-003	85
386	4MB KIT	500510-004	245
PREMIUM 386/20	1MB SIMM	580718-001	55
386-16SX	1MB SIMM	500716-002	60
CUPID 32	1MB SIMM	500705-003	55
PREMIUM SERIES	4MB SIMM	500705-004	205
386DESKTOP	8MB KIT	500780-001	390
16SX 26, 33	CUPID DB	500818-001	295
PREMIUM II DESKTOP 386SX/20			
486DESKTOP-25, 25E, 33 PREMIUM			
TOWER 386-33TE, 486-25TE, 486-33TE			
PROCESSOR CARD FOR 25 & 33			
PREMIUM EXEC	1MB SIMM	500814-001	79
386SX, 20MB	4MB SIMM	500814-002	185
NOTEBOOK 500814-001 FOR PREMIUM EXEC 286/12 ONLY			
386SX 25, 25C	1MB SIMM	N A	90
	4MB SIMM	500814-004	300

APPLE MEMORY

POWERBOOK 100	2MB MDL	M1002LL/A	$ 300
	4MB MDL	M1003LL/A	395
	6MB MDL	N A	550
POWERBOOK	2MB MDL	N A	300
140/170	4MB MDL	M1033LL/A	395
	6MB MDL	N A	550
QUADRA 700	4MB KIT	M0292LL/A	180
	16MB KIT	N A	640
	64MB KIT	N A	3,500
QUADRA 900	4MB KIT	M0293LL/A	180
	16MB KIT	N A	640
	64MB KIT	N A	3,000
IISI	2MB SIMM	M0314LL/A	95
	8MB KIT	M0163LL/A	350
MACLC	4MB KIT	N A	$195
	8MB KIT	N A	260
MACIICI, IISI	512K SIMM	M0301LL/A	109
	1MB KIT	M0291LL/A	55
	4MB KIT	M0292LL/A	170
	16MB KIT	N A	650
CLASSIC	1-3-4 BRD	M5361LL/A	75
	2MB KIT	M0298	90
MACPORTABLE	2MB BD	N A	550
	4MB BD	N A	750
MACIIX, IIX,	1MB KIT	M0219	60
IICX & IISE/30	2MB KIT	M0295	85
	4MB KIT	M0207	180
	16MB KIT	N A	700
MACIIFX	4MB KIT	M9378LL/A	165
	16MB KIT	N A	650
LASERWRITER	1MB KIT	M5005	75
IINTX,	4MB KIT	M5006	185
LF & F & G	16MB KIT	N A	650
MACIIVIDEO	KIT	M0213	90
MAXIMA	SOFTWARE	N A	75

ALR MEMORY

VENTURA	1MB MODULE	12407979	$225
NOTEBOOK 16 & 20	4MB MODULE	12407980	1,090
POWERFLEX	1MB KIT	12904080	79
& 20CSX	2MB KIT	12902080	155
	4MB KIT	12904080	310
	16MB KIT	N A	705
POWERPRO	4MB KIT	12904-XX	210
	16MB KIT	12904-XX	750
POWERCACHE	2MB KIT	12902000	110
486 & 466E	8MB KIT	12904-000	395
	32MB KIT	12916000	1,400
BUSINESS/	1MB KIT	12904080	79
POWERVEISA	4MB KIT	12904080	295
	16MB KIT	12916080	805
1-32MB EXPBO	12407480		
	4-32MB EXPBO	12447480	532
	8-32MB EXPBO	12457480	732
	16-32MB EXPBO	12497480	1,465

DELL MEMORY

450/SE OE,	2MB KIT	310-2405	$118
420 SE OE,	4MB KIT	310-2457	230
433TE, SE OE &	8MB KIT	310-2458	420
425TE, SE DE	16MB KIT	310-2459	730
	32MB KIT	N A	1,750
433E & 425E	2MB KIT	310-2389	110
	4MB KIT	310-2390	230
	8MB KIT	N A	470
320N & 212N	1MB SIMM	310-3203	155
	2MB SIMM	310-3204	295
320LT & 316LT	2MB KIT	310-2434	106
	4MB KIT	310-2434	210
	8MB KIT	310-2494	420
325P/D & 333P/D	1MB MODULE	310-3165	65
	4MB MODULE	310-3166	230
325,316,320LS,316	1MB KIT	310-2104	79
316SX & 210	4MB KIT	310-2373	220

EPSON MEMORY

NB3	1MB MODULE	A8026501	$130
	4MB MODULE	A8026511	395
EQUITY LT 286E	1MB MODULE	A8026151	115
EQUITY LT 386SX	2MB MODULE	A8026361	235
EQUITY 386	1MB KIT	A8026291	84
386/25,20	2MB KIT	A8026101	111
386SX,20,25 & 286	1MB KIT	A8026231	66
486SX/25-	2MB KIT	A8026101	116
386SX,20 -	1MB KIT	A8026531	500

EVEREX MEMORY

TEMPO LX	2MB MODULE	PCA-020053-00	$ 180
TEMPO LX 20	2MB MODULE	PCA-020054-00	200
TEMPO 286	512K KIT	N A	40
	2MB KIT	N A	125
TEMPO 386SX	1MB KIT	N A	60
	2MB KIT	N A	125
	4MB KIT	N A	225
CACHE KIT	8MB	N A	70
286STEP 12, 16	1MB KIT	N A	60
	2MB KIT	N A	100
	4MB KIT	N A	225
286 STEP 230	1MB KIT	N A	60
	2MB KIT	N A	100
	4MB KIT	N A	225
386 STEP	1MB KIT	N A	60
16, 20, 25	2MB KIT	N A	100
	4MB KIT	N A	225
STEP 386 20	4MB, IDL	N A	650
	64KI+IDI	PWA-005802-00	230

HP VECTRA MEMORY

486PC, 486/33T/25T	1MB SIMM	D2150A	$ 70
(INSTALL IN PAIRS)	2MB SIMM	D2301A	125
486S/20	4MB SIMM	D2302A	250
	8MB SIMM	D2125A	450
386/0 S 25	2MB SIMM	D2306A	125
	8MB SIMM	D2125A	450
QS/16 S & RS/20PC	1MB KIT	D1540A	65
QS/16S & ES 12PC	2MB KIT	D1534A	105
QS/16S & RS 20PC	4MB KIT	D1542A	215
QS 20PC & RS 25PC	1MB KIT	D1540A	65
	4MB KIT	D1542A	215
LS 13	16 MB MODULE	D1654A	150
9000 SERIES			
425E	4MB BDSET	A2200A	425
	8MB BDSET	A2201A	840
	16MB BDSET	A2202A	1,575
345, 375, 433S,	4MB BDSET	[illegible]	425
400S, 400T,	8MB BDSET	[illegible]	840
400D, 400T	16MB BDSET	[illegible]	1,575
	32MB BDSET	[illegible]	3,250

LAPTOP MEMORY

BONDWELL			
B210 SUPERSLIM	1MB MODULE	2305D-09100	$ 150
COMMODORE			
LAPTOP	2MB MODULE	390650-01	150
GOLDSTAR			
GSS30 386SX 16	1MB MODULE	N A	135
	4MB MODULE	N A	350
LEADING EDGE			
DLT 386SX	1MB MODULE	2305M900	100
PACKARD BELL, MAGNAVOX & MITSUBA			
PB286MB	1MB MODULE	N A	175
	4MB MODULE	N A	385
PB386MB2	1MB MODULE	N A	170
	2MB MODULE	N A	305
	4MB MODULE	N A	385
PANASONIC			
CF170/270/370	1MB MODULE	CF-BA166	121
(INSTALL IN PAIRS)			
SAMSUNG			
NOTEMASTER	2MB MODULE	SNM202	210
386S	4MB MODULE	SNM204	405
SANYO			
17 MB, 18 MB	2MB MODULE	MBC-NSMEM2	145
SHARP			
PC-6220	1-4MB MODULE	CE-6218	122
PC-6640	2MB KIT	N A	195
PC-4700/4Z-200	1MB MODULE	CE471	180
PC-6501 COLOR STAR	2MB MODULE	N A	280
TANDON			
RB386SX	1MB MODULE	N A	115
	4MB MODULE	N A	270
TI			
TRAVELMATE 2000	1MB MODULE	2568304-0001	110
TRAVELMATE 3000	2MB KIT	2566996-0001	145

NEC MEMORY

POWERMATE SX	1-4MB BD	APC-H536	$216
PLUS	1MB KIT	APC-H5516	80
	2MB BD	APC-H5517	160
	4-8MB BD	APC-H2532	615
	8MB BD	N A	772
POWERMATE	4-16MB BD	N A	765
386/16 & 20	8-16MB BD	N A	965
	16MB BD	N A	1,322
POWERMATE/			
BUSINESS	4-16MB BD	N A	527
386/25S	8-16MB BD	N A	777
	16MB BD	N A	1,250
POWERMATE/			
BUSINESS	2MB KIT	DP-410-5201	$150
386/25S	8MB KIT	DP-410-5202	422
POWERMATE SX/20	2MB MODULE	DP-410-8101	211
	2-8MB BD	DP-410-8102	240
	4-8MB BD	DP-410-8103	140
POWERMATE SX/16	2-8MB SO	DP-410-8201	240
	2MB KIT	DP-410-8103	140
POWERMATE SX	2-1MB BD	APC-H555	577
	4-8MB BD	APC-H553	744
	8MB BD	N A	1,222
POWERMATE	2MB MODULE	DP-411-5101	225
386 S 33E & 486 25E			
POWERMATE	2MB MODULE	APC-H751X	327
PORTABLE SX	8MB MODULE	APC-H753X + H754X	1,166
ULTRALITE 286F	1MB MODULE	PC-22-21	185
	4MB MODULE	PC-22-22	485
ULTRALITE SX 20	2MB MODULE	PC-44-21	275
	8MB MODULE	PC-44-22	705
PROSPEED	1MB MODULE	PC-21-21	145
286 & 386SX/16	4MB MODULE	PC-21-22	450
PROSPEED SX/20	1MB BD	PC-43-21	185
	4MB BD	PC-43-22	385
PROSPEED 386	2 MB	PC-31-21	200
	8MB	PC-31-22	875
POWERMATE	1-3-4 BD	APC-H750J	385
PORTABLE PLUS	2-3-4 BD	H750+751	595
	3-4-8 BD	750+751+751	995

NCR MEMORY

PC286_E, PC386SX	2MB KIT	3302-4102	$152
NCR EXPBD	2MB KIT	3275-KIT1	162
PC386SX-20	1MB KIT	3304-4101	102
	2MB KIT	3304-4102	152
	4MB KIT	3304-4103	530
PC386SX/16C20	2MB MODULE	3421-4202	160
	2-14MB EXPBD	N A	270
	4-14MB EXPBD	N A	360
PC486/16C20	2MB KIT	3314-4102	300
	8MB KIT	3314-4104	570
	2-14MB EXPBD	N A	298
	4-14MB EXPBD	N A	384

ZENITH MEMORY

Z-386/33ET	4MB MODULE	ZA-4720-M2	$ 235
	16MB KIT	ZA-4720-M8	899
Z-386/25 & 33E	1MB MODULE	ZA-3800ME	75
	2MB MODULE	ZA-3802ME	115
	4MB MODULE	ZA-3804ME	185
486/25E	1MB MODULE	ZA-3800ME	54
Z-386/25, 33	2MB MODULE	ZA-3802ME	115
	4MB MODULE	ZA-3804ME	310
Z-248, Z-286LP, Z-LS	1MB MODULE	Z-825-1	120
286SX			
TURBOSPORT	1MB MODULE	ZA-3234ME	170
386E	4MB MODULE	ZA-3236ME	495
SUPERSPORT	1MB MODULE	ZA-180-64	185
SX	2MB MODULE	ZA-180-86	185
	2MB MODULE	ZA-180-87	185
	1MB MODULE	ZA-180-56	185
SUPERSPORT	1MB MODULE	CE-6218	122
286, 286E	2MB KIT	N A	195
286E ONLY	1MB MODULE	CE471	180
286 ONLY	2MB KIT	N A	280
SLIMSPORT	1MB MODULE	ZA-180-95	185
	2MB MODULE	ZA-180-64	185
	4MB MODULE	ZA-180-67	185
MASTERSPORT	1MB MODULE	ZA-212-1	145
286			
MASTERSPORT			
SL, SLC	2MB MODULE	ZA-4-4	215
386SX	2MB MODULE	ZA-386-1	215

LASER PRINTER

SUPERSPORT	1MB MODULE	ZA-180-65	$ 120
286, 286E	2MB MODULE	ZA-180-64	185
286E ONLY	4MB MODULE	ZA-180-74	425
286 ONLY	4MB MODULE	ZA-180-67	CALL
SLIMSPORT	1MB MODULE	ZA-180-95	185
	2MB MODULE	ZA-180-64	185
	4MB MODULE	ZA-180-74	425
MASTERSPORT 286	1MB MODULE	ZA-212-1	145
MASTERSPORT			
SL-SLC	2MB MODULE	ZA-4-4	215
386SX	2MB MODULE	ZA-386-1	215
BROTHER HL-4	1-4MB MODULE	N A	$150
BROTHER HL-8	1-4MB MODULE	N A	150
CANON LBP	1MB MODULE	563-1301	120
811, 811R, 811T	2MB MODULE	563-1302	185
	4MB MODULE	N A	260
LBP 811 & 811 PLUS	1MB BD	563-2340	175
	2MB BD	563-2350	295
	3MB BD	563-2360	395
LBP-4 & 4 PLUS	1MB BD	563-2341	185
	2MB BD	N A	315
	1-4 MB MODULE	563-2230	185
EPSON			
EPL-6000	1MB MODULE	N A	160
	2MB MODULE	N A	180
	4MB MODULE	N A	295
COMPATIBLE WITH:			
TOSHIBA PAGELASER 6, MANNESMANN TALLY 906, PHILLIPS NMS 1490, EVEREX, ESSELTE T-6			
HARRIS 3M, C-ITOH C1-8, ATARI SLM-804 PCY			
DATSYL, NCR 4404, LANIER, FACIT P8000			
PACKARD BELL P8900			
EPL 7000	1MB MODULE	N A	110
	2MB MODULE	C8222-01	195
	3-4MB MODULE	N A	280
FUJITSU	1MB MODULE	N A	225
RX7100 6	2MB MODULE	N A	295
7200M			
HP DESKJET	256K MODULE	N A	114
PLUS 500			
HP LASERJET	1MB MODULE	C2063A	75
4 SI	4MB MODULE	C2063A	195
8 & 8D	2MB MODULE	33444D	140
	4MB MODULE	33445D	250
IIP, IID, IIP, III	1MB SIMM	33471A	85
P7500	2MB MODULE	33475A	140
	4MB MODULE	N A	250
KOMICA	1-3MB MODULE	3MB	150
NEC SILENTWRITER	2MB MODULE	4852	175
MOD. 90, 290			
OLIVETTI PG-108	1-4MB	N A	115
& PG-208			
KYOCERA	1, 2, 4MB	N A	140
F800 & AT			
F1200S/F2300 A	1-4MB	N A	195
F810, F-1800 &	1MB SIMM	N A	139
F-5000			
OKIDATA			
LASER 400	1-4 MB MODULE	70014701	119
LASER 800	1MB MODULE	N A	135
	2MB MODULE	N A	185
	4MB MODULE	N A	290
PANASONIC			
KX-P4420-4450	1MB MODULE	KXP-443-286209	135
	2MB MODULE	KXP-441/2/5/6210	180
	3MB MODULE	N A	225
	4MB MODULE	N A	495
4450	1MB MODULE	N A	189
4455	1-2MB MODULE	N A	130
QMS-PS 410	1-4MB MODULE	N A	150
SHARP JX-9500 PS	1MB MODULE	N A	95
STARLASER 4	1, 2, 4MB MODULE	N A	120
STARLASER 8	1, 2, 4MB MODULE	N A	CALL
TI			
MICROLASER	1MB MODULE	N A	115
	2MB KIT	N A	170
	3MB KIT	N A	270
	4MB KIT	N A	360
TEC LB1321C	1MB SIMM	N A	120
C-ITOH 4			
MANNESMANN TALLY 9304			

If you find a better price, call us before you buy!

MOTHER BOARDS

MOTHER BOARDS PRICES ARE NEGOTIABLE WHEN PURCHASED WITH CPU & MEMORY

ONE BOARD SOLUTION

PA486 SMT-20-25-33-DX2 & PA386-SMT-25-33
486DX-486SX-386DX 64KB-256KB CACHE

- Same board for 486DX-25-33-DX2, 486SX-20/25 and 386DX-25-33 Microprocessor
- Employ most advanced Surface Mount Technology (SMT)
- Support 1MB 2MB 4MB 8MB 16MB 20MB 32MB memory on board
- Support 64KB 256KB cache
- Parity Check enabled/disabled by Hardware Jumper
- Support Shadow RAM, Extended Memory (Legal AMI BIOS
- Seven 16 bit AT slots and one 8 bit slot
- High Quality 4 layer PCB for noise reduction
- OS/2 ipc-mation Good Sys 13 C L a & 6 D

386 486-64K Cache no CPU DK	$200.
386 486-256K no CPU DK	$250.
486DX 50MHz	$CALL

CPU CHIPS

80386DX-20 INTEL	$ CALL
80386DX-25 INTEL	72.00
80386DX-33 INTEL	81.00
80486DX-33 INTEL	349.00
80486DX-50 INTEL	625.00
80486SX-25 INTEL	120.00
80486SX-20 INTEL	98.00
80386DX-25 AMD	64.00
80386DX-33 AMD	70.00
80386DX-40 AMD	85.00
80286-16	40.00
80286-20	46.00

EXPANSION BOARDS

SIMMply-RAM™ for the PS/2 16 - Up to 16 MB of memory for PS/2-16 Models 50 & 60 - Full 16-bit Micro Channel interface - Uses standard IBM or IBM compatible SIMMS **$195.**

SIMMply-RA™ for the PS/2-32 - Up to 32 MB of memory for PS/2-32 Models 70 & 80 - Full 32-bit Micro Channel Interface - Uses standard IBM or IBM compatible SIMMS **$195.**

RA pAT!™ - Uses up to 16 MB of memory - 16-bit ISA (PCAT) bus compatible - Self-installing - no switches or software setup required - Supports extended or LIM 4.0 expanded memory modes **$98.**

RAMpAT!-Plus™ - Up to 16 MB of memory - Half-card plugs into 8-bit or 16-bit ISA expansion slots - Hard are support for LIM 4.0 expan ed memory - Self installing soft are **$145.**

AST Rampage Plus $140. BOCA BRAT 90 W/2MB $169.

MATH CO-PROCESSORS

INTEL		CYRIX		IIT	
8087 5MHZ INTEL	72.00	83D87DX-16 16MHZ CYRIX	89.00	2C87-8 8MHZ IIT	59.00
8087-2 8MHZ INTEL	135.00	83D87DX-20 20MHZ CYRIX	89.00	2C87-10 10MHZ IIT	59.00
8087-1 10MHZ INTEL	165.00	83D87DX-25 25MHZ CYRIX	89.00	2C87-12 12MHZ IIT	65.00
80287-6 6MHZ INTEL	70.00	3D87DX-33 33MHZ CYRIX	89.00	2C87-20 20MHZ IIT	89.00
80287-8 8MHZ INTEL	80.00	83D87DX-40 40MHZ CYRIX	119.00	2C87-16 16MHZ IIT	89.00
80287-10 10MHZ INTEL	85.00	83S87SX16 16MHZ CYRIX	79.00	3C87-20 20MHZ IIT	89.00
80287-12 12 MHZ INTEL	95.00	83S87SX20 20MHZ CYRIX	79.00	3C87-25 25MHZ IIT	89.00
80287XL 10MHZ INTEL	75.00	83S87SX25 25MHZ CYRIX	79.00	3C87-33 33MHZ IIT	89.00
80287XLT 12MHZ INTEL	75.00	82S87XL CYRIX	79.00	3C87-40 40MHZ IIT	119.00
80387SX-16 16MHZ INTEL	85.00			3S87SX-16 16MHZ IIT	75.00
80387SX-20 20 HZ INTEL	89.00	**WEITEK**		3S87SX-20 20MHZ IIT	75.00
80387DX-16 16MHZ INTEL	89.00	3167-20M

Make it better in ABC

If you think your notebook computer is portable, think again.

BICOM B260i

When we travel with our computers, we want to be able to take with us all the data and information we need for the trip without adding too much weight to our already overloaded baggage. The BICOM B260i weighs only 2.2 lbs. with a size just half that of a notebook and operates on "AA" size batteries; it is the ideal computer for business travellers. BICOM B260i is compact yet powerful. It comes with a 60MB Hard Disk Drive, IC Card interface with which you can use credit-card-size memory cards to store your important information or modems to send your urgent messages home. Transferring programs between BICOM and your Desktop is easy with the serial cable and file transfer software provided or through the optional external floppy drive. BICOM B260i is an enhanced 286-based computer with 386SX class performance that you can really carry around.

- Weight 2.2 lbs. (BICOM and Battery)
- Dimension 8.78" x 6.36" x 1.22"
- 16 MHz AMD 80286LX Processor, 386SX Class Performance.
- 5 "AA" size NiMH Batteries, 4-hour operation*
- 60 MB Hard Disk Drive
- 2MB RAM
- PCMCIA 2.0/JEIDA standard port for memory card and I/O card
- Double-scan CGA Screen 640 x 400 resolution
- 64-key Keyboard
- 1 parallel (bi-directional)/ 1 serial
- External FDD port for optional Floppy Drive
- DR-DOS 6.0, File Transfer Software & Serial Download Cable
- Built-in Personal Data Manager software
- Built-in Programmable Power Management Software
- Universal AC/DC adaptor

$1250

Options: External Floppy Drive, SRAM Memory Cards, 2400bps IC Card Modem, extra batteries

*Battery life is measured with power management enabled. All brand names are registered trademarks of their respective owners.

See Us At COMDEX/Fall '92

ABC COMPUTERS®

ABC Computer (USA) Corp. 1-800-336-2280
2531 237th Street, Suite 122, Torrance CA 90505
310-325-4005 Fax 310-325-6369

MICRO-L®

ISA 486DX-50	$2095
ISA 486DX2-50	$1995
ISA 486DX-33 Upgrades to 50MHz	$1865

- Intel 486-DX Processor
- AMI BIOS, Symphony™ Chipset, Dallas DS1287 real-time clock (w/10-year warranty) • 256k Cache SRAM exp. to 1MB
- 4MB RAM 60ns exp. to 32MB onboard (Upgrade per 1MB - $40)
- 1.2MB & 1.44MB Floppy Disk Drives (TEAC)
- 130MB, 15ms, 64k Cache IDE HDD (Maxtor)
- 14" Super Multiscan, 1024x768, non-int., 0.28dp, (Relisys-1422)
- Diamond SpeedStar 24/1MB, SVGA card , 16.7 Million colors
- 2 Serial , 1 Parallel , 1 Game Port
- Keytronics 101 Keyboard (USA)
- Mid Tower case (Heavy duty) 230W UL P/S & digital display
- MS-DOS 5.0 • MS-Windows 3.1 and MS compatible mouse

OPTIONS: (Add to System Price)

- Nanao 9080i/F550i/T560i monitors .....$735/$835/$1575
- NEC 3FGX/4G/5G monitors .....$345/$475/$1065
- IDEK 5217 /5221 monitors .....$650/$2065
- Sony CPD 1304S/1604S monitor .....$275/$695
- Maxtor 213MB/340MB IDE HDD.....$170/$485
- ATI Graphic Ultra, 1MB w / mouse.....$295
- DiamondStealth 1280 Card, 1MB VRAM, HiColor $95
- Full Tower - 10-bays, 275W Power supply w/ 2 Fans.....$75

MICRO-L®

386-33 CACHE (Symphony)	$1395

- Intel 80386-33MHz CPU - Upgrades to 40MHz: Socket for removable crystal allows for CPU changes
- AMI BIOS, Symphony™ Chipset, Dallas DS1287 real-time clock (w/10 year warranty) • 64k Cache SRAM exp. to 1MB onboard (Option: 256k Cache - add $45)
- 4MB RAM 70ns exp. to 32MB onboard (Upgrade per 1MB - $40)
- 1.2 and 1.44MB floppy disk drives(TEAC)
- 2 Serial, 1 Parallel, Game port
- 130MB 15ms 64K cache IDE HDD (Maxtor)
- 14" Super Multi-scan, 1024 x 768NI, 0.28dp (Relisys RE-1422)
- 16-bit SVGA Card with 1MB onboard
- Deluxe Baby Case with 200W UL power supply ,6-bays
- Keytronics 101 Keybd (USA) • MS-DOS 5.0
- MS-Windows 3.1 and MS compatible HiRes Serial mouse

intel inside™

* The Intel Inside Logo is a Trademark of Intel Corporation.

These Companies Trust Us.....Shouldn't You?

Intel Corporation	AT & T Coca Cola	U.S. Naval Dept.	U.S. Veteran's Hospital
U.C. Berkeley	N.A.S.A. Xerox	S.W. Bell U.S. Army	Admin. Ctr.
M.I.T. PG & E	Eastman Kodak	U.S. Marine Corps	Lawrence Livermore Lab
Procter & Gamble	Lockheed Missile/	DuPont Exxon	...and the list goes on and on...
Digital Equipment Corp.	Space Engineering	Washington Post	

- Visa and MasterCard add 3%
- Shipping extra
- 5 Year Labor and One Year Parts

Hours: Mon thru Fri - 8:30am to 6:00pm (PST)

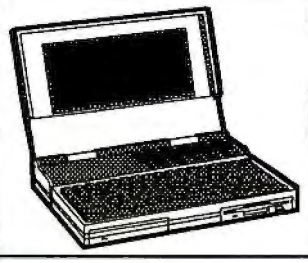
MICROLANE COMPUTERS INCORPORATED

46757 Fremont Blvd., Fremont, CA 94538

(510)770-1900

Fax:(510)770-1912

MICROLANE Computers Taiwan - Fax: 011-886-7-0060



The difference between their prices and ours is simply too great to ignore. No wonder we've been around

SINCE 1984

(AND WHAT AUDACITY THE COMPETITION HAS TO CLAIM THAT THEY WON'T BE UNDERSOLD)

"experts in portable intelligence"

PRICES COULD BE LESS BY THE TIME YOU READ THIS AD, SO PLEASE CALL FOR OUR MOST CURRENT PRICES

TOSHIBA MEMORY

T2200SX, T2000SXE,
T2000SX, T2000,
T1000XE, T1000LE, T1000SE

2MB..$ 77
4MB..$156
8MB..$334

*ALL CARDS ARE FAST 70ns

UPGRADED NOTEBOOKS

AST COLOR EXEC 386SX/25C 120MB W/ 8MB RAM	$3704
AST PREMIUM EXEC 386SX/25 120MB W/ 8MB RAM	$2725
EVEREX TEMPO/LX 120MB W/ 5MB RAM	$2037
SHARP PC-6340/40MB W/ 2MB RAM	$1198
SHARP PC-6881/80MB COLOR W/ 8MB RAM	$4271
SHARP PC-6881/120MB COLOR W/ 8MB RAM	$4741
TEXAS INSTRUMENTS TM3000/120MB WinSX w/6MB RAM	$2666
TOSHIBA T2200SX/80MB W/ 10MB RAM	$2527
TOSHIBA T3300SL/120MB W/ 8MB RAM	$3011
TOSHIBA T4400SX/120MB LCD W/ 10MB RAM	$3526
TOSHIBA T4400DX/120MB LCD W/ 10MB RAM	$3845
TOSHIBA T4400SX/120MB PLASMA W/ 10MB RAM	$3788
TOSHIBA T4400DX/120MB PLASMA W/ 10MB RAM	$4107
TOSHIBA T4400SXC/120MB COLOR W/ 12MB RAM	$5359
TOSHIBA T4400DXC/120MB COLOR W/ 12MB RAM	$5678
TOSHIBA T6400SX/120MB W/ 20MB RAM	$4830
TOSHIBA T6400SX/120MB COLOR W/ 20MB RAM	$7272
TOSHIBA T6400DX/200MB W/ 20MB RAM	$5833
TOSHIBA T6400DX/200MB COLOR W/ 20MB RAM	$8275
TOSHIBA T4400SX/T6400SX DX UPGRADE KIT	$498
ZENITH MASTERSPORT 386SLE/25 120MB W/ 8MB RAM	$3328

LAPTOP/NOTEBOOK MEMORY

AST PREMIUM EXEC 4MB (70ns LP)	$120	*WOW!*
COMMODORE CLT286/386 2MB (70ns LP)	$88	
COMPAQ CONTURA PC 2MB/4MB/8MB	$117/$229/$432	
COMPAQ LTE/386s, LITE/20, LITE/25 1MB/4MB	$88/$198	*WOW!*
COMPAQ LITE/20 & LITE/25 8MB	$336	*NEW!*
COMPAQ SLT/286 4MB	$328	
COMPAQ SLT/386S 4MB	$218	
COMPUADD COMPANION/SX 2MB (70ns)	$58	
EVEREX TEMPO/LX 2MB/4MB (70ns LP)	$88	
GRID 1720/1750 2MB	$88	
IBM N33SX 2MB/4MB (70ns LP)	$98/$158	
IBM CL57SX 4MB/8MB (70ns LP)	$288/$540	*NEW!*
IBM N51SX/N51SLC 2MB/4MB/8MB	$CALL	*NEW!*
NEC ULTRALITE 286F 4MB	$208	
PANASONIC CF170/270/370 1MB/2MB	$58/$88	
SANYO MBC -17NB/18NB 2MB (70ns LP)	$88	
SHARP PC-6600/6641/6681 2MB (70ns)	$58	
SHARP PC-6700/6781/6800/6881 2/4MB (60ns LP)	$CALL	*NEW!*
SHARP PC-8501 COLORSTAR 2MB	$119	
TANDY 1500HD/2810HD/3810HD 1MB/2MB	$58/$88	
TI TRAVELMATE TM3000 2MB (70ns).	$58	
TOSHIBA T1600/3100E /T5100 2MB UPGRADE	$88	
TOSHIBA T3100SX/T3200SX 2MB/4MB	$78/$148	*WOW!*
TOSHIBA T3300SL 2MB/4MB/6MB	$126/$175/$340	
TOSHIBA T4400/T6400 2MB/4MB/8MB	$148/$216/$398	
ZEOS 2s6/386SX NOTEBOOK 2MB (70ns)	$88	
ZENITH MASTERSPORT SX/SL/SLE/SLC 2MB (70ns)	$88	*WOW!*

NOTE: WE ALSO OFFER MEMORY UPGRADES FOR MOST BRANDS OF DESKTOP COMPUTERS. PLEASE CALL OR FAX FOR OUR ROCK-BOTTOM PRICES.

PALMTOP/SRAM MEMORY

DEC PALMTOP, DELL 320SLi SUB-NOTEBOOK, GRID GRIDPAD, HP 95LX, IBM PC RADIO, MOMENTA PENTOP, NCR 3125 NOTEPAD POQET, SHARP PC3000/3100, SHARP PC-6700/6741/6781/6785, SHARP PC-6800/6841/6881, TOSHIBA T3300SL, AND MORE

512K $128 1MB $174 2MB $376

PALMTOP FLASH MEMORY

256K $78 512K $98 1MB $138
2MB $238 4MB $288
10MB $588 20MB $998

LASER PRINTER MEMORY

APPLE LASERWRITER II/INT/INTX 4MB	$143	
AT&T 593 LASER 2MB/4MB	$128/$208	
BROTHER HL-4/4V/4VPS 2MB/3MB/4MB	$138/$178/$208	
BROTHER HL-8E/8D/8V 2MB UPGRADE	$138	
CANON LBP 8II/8IIR/8IIT 2MB/4MB	$118/$198	
C. ITOH-8 2MB/4MB UPGRADE	$128/$208	
EPSON ACTION LASER PLUS 2MB/4MB	$128/$208	
EPSON ACTION LASER II 2MB/3MB/5MB	$118/$168/$258	
EPSON EPL-4100/8000 2MB/3MB/5MB	$118/$168/$258	
EPSON EPL-6000 2MB/4MB UPGRADE	$128/$208	
EPSON EPL-7000 2MB/3MB UPGRADE	$128/$168	
FACIT P8060 2MB/4MB UPGRADE	$128/$208	
HP LASERJET II/IID 2MB/4MB UPGRADE	$118/$198	
HP LASERJET IIP/IIP+/III/IIID/IIIP 2/3/4MB	$108/$148/$188	
HP LASERJET FAX 1MB	$78/$118/$158/$188	
HP LASERJET IIISi 1MB/4MB UPGRADE	$68/$138	
HP DESIGN JET PLOTTER 1MB/4MB UPGRADE	$68/$138	
HP DESKJET+/500/500C 256K UPGRADE	$58	
IBM/LEXMARK 4019/E 2MB/3.5MB	$118/$178	
IBM LEXMARK 4029 (ALL MODELS) 2MB/4MB	$108/$158	
KYOCERA F800/800A/800T 2MB/4MB	$138/$218	
KYOCERA F1200S 2MB/3MB/4MB	$158/$198/$238	
KYOCERA F3300/3300A 2MB/3MB/4MB	$158/$198/$238	
MANNESMANN TALLY 905 2MB/4MB	$128/$208	
NEC SILENTWRITER 2 MODEL 90/290/S60/S60P 2MB	$138	
NEC SILENTWRITER 2 MODEL 95 2MB	$118	*NEW!*
NEC SILENTWRITER 2 MODEL S62P 2MB	$118	*NEW!*
OKIDATA OKILASER/400 2MB UPGRADE	$118	
OKIDATA OKILASER 800/820 2MB/3MB/4MB	$138/$178/$208	
OKIDATA OKILASER 830/840 2MB UPGRADE	$158	
OLIVETTI PG-108/208 2MB/4MB UPGRADE	$118/$198	
PACKARD BELL PB-9600 2MB/4MB UPGRADE	$128/$208	
PANASONIC KX-P4410/4430 2MB/3MB/4MB	$148/$188/$228	
PANASONIC KX-P4420/4450i 2MB/3MB/4MB	$118/$158/$198	
PANASONIC KX-P4450 1MB UPGRADE	$118	*NEW!*
PANASONIC KX-P4451 2MB/3MB/4MB	$118/$158/$198	
PANASONIC KX-P4455 2MB UPGRADE	$138	
QMS PS410 2MB/3MB/4MB UPGRADE	$138/$178/$208	
QMS PS815/825 2MB/4MB/6MB UPGRADE	$158/$238/$318	
QMS PS1700 1MB/4MB UPGRADE	$68/$178	
SHARP JX-9500/9700 1MB/2.5MB/4MB	$108/$208/$338	
SHARP JX-9500PS POSTSCRIPT 1MB UPGRADE	$58	
STAR LASER PRINTER 8 2MB/4MB UPGRADE	$148/$188	
STAR/STARCRIPT 4/4II 2MB/4MB UPGRADE	$148/$238	
TEC 1305B 2MB/4MB UPGRADE	$128/$208	
TI MICROLASER/PLUS/17/TURBO/XL 1MB	$58	
TOSHIBA PAGELASER6 2MB/4MB UPGRADE	$128/$208	
UNISYS AP9210 2MB UPGRADE	$118	

NOTE: IN THE VERY SLIM CHANCE THAT YOU DO FIND A BETTER PRICE ON ANY MEMORY UPGRADE, PLEASE LET US KNOW.

SHARP PC-6220
80286 4 LB. NOTEBOOK
20MB HD W/3MB $ 650
40MB HD W/3MB $ 800
60MB HD W/3MB $ 850
80MB HD W/3MB $ 990
120MB HD W/ 3MB $1,120

SHARP PC-6781
80MB HDD W/ 8MB $2082
120MB HDD W/8MB $2552

WE ARE LISTED IN THE TOSHIBA TECHNICAL INFORMATION GUIDE AS "THE LEAST EXPENSIVE MEMORY MANUFACTURER APPROVED FOR TOSHIBA LAPTOPS AND NOTEBOOKS"!!!

TOSHIBA T5200/T8500
2MB/8MB $88/$298

TOSHIBA T1200XE/T3100SX
2MB RAM UPGRADE $78

$78
1MB RAM UPGRADE
SHARP PC-6220
TI TRAVELMATE TM2000
COMPUADD COMPANION

HDD UPGRADES
40MB/60MB/80MB/120MB
$255/$309/$510/$698

EVERYONE ELSE CLAIMS THEY WILL BEAT ANY PRICE. WE DON'T EVEN CLAIM IT. INSTEAD, WE JUST DO IT. YOU BE THE JUDGE!

TOSHIBA T5200
200MB HDD UPGRADE
$798

IBM L40SX RAM UPGRADES
2MB/4MB/8MB
$98/$134/$267

ALL MEMORY UPGRADES COME WITH A LIFETIME WARRANY & A 48 HOUR EXCHANGE GUARANTEE!

APPLE POWERBOOK
2MB.....$103
4MB.....$180
6MB.....$246
*4MB & 6MB FOR MODEL 100 SLIGHTLY HIGHER

SE HABLA ESPANOL
pregunte por Hector

tote-a-lap

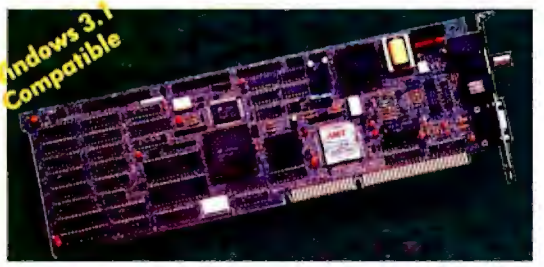
550 Pilgrim Drive, Ste.F, Foster City, CA 94404
PHONE: (415)578-1901 FAX: (415)578-1914
ORDERS ONLY: 1-800-9-LAPTOP
(PRIOR APPOINTMENTS ARE NEEDED FOR WILL-CALLS, PLEASE)

TERMS AND CONDITIONS: All sales final. We charge a 25% re-stocking fee on all refused shipments and pre-approved returns. Prices are subject to change w/out notice, and reflect all cash discounts. Warranty on all merchandise, except memory upgrades, is thru the original manufacturer only, unless previously agreed upon and stated on our invoice. All software, plus all merchandise that include a rom bios, are not returnable for credit, and are subject to an even exchange only. We accept purchase orders from credit-worthy institutions, although prices may be slightly higher on some items. We will not ship to any account with an overdue balance. Purchase prices at the time of sale are final.

Add-In Boards

New Generation Board Integrates Six in One

SIGMA SIX™



Six-in-One I/O Board

- √ 10 Mbps NE 2000 Ethernet LAN
- √ 9600/2400 fax modem
- √ Super VGA non-interlaced (70 Hz)
- √ Flash Disk (DOS in ROM)
- √ 2 Serial, 1 Parallel port
- √ Dual IDE FD/HD Controller
- √ Software Configurable Interrupt Lines (IRQ)
- √ Windows Accelerator

AMT Advanced Micro Technology, Inc.
123 University Pkwy., Pomona, Ca. 91768
Tel: (714) 598-6120 • Fax: (714) 598-7716

Circle 303 on Inquiry Card.

Add-In Boards

Industrial PCs and Data Acquisition

- Industrial Workstation and Monitor
- Industrial Computer Chassis
- All-in-one Plug-in CPU Card
- RAM/ROM Disk Card
- Data Acquisition & Control Series
- Industrial I/O Series
- IEEE-488 Interface Card
- 8/16 Port RS232 Interface Card
- Application Software Package

"Free 114 Pages Master Catalog for Your Inquiry"

AXIOM® MEASUREMENT & CONTROL

AXIOM TECHNOLOGY, INC.
13925 Magnolia Avenue Chino, CA 91710, U.S.A.
TEL: 714-464-1881 • FAX: 714-464-1882

Circle 294 (RESELLERS: 295) on Inquiry Card.

2.88MB Solutions for DOSs and OS/2

FEATURES :

1. Support 2.88M / 1.44M / 720K / 1.2M / 360K floppy disk drives.
2. Compatible to DOS 3.x/4.x/5.0 ,OS/2 2.0 DR.DOS 6.0 .
3. Formatting operation with DOS command.
4. Can diskcopy 5 1/4" diskettes to 3 1/2" diskettes.
5. Can boot from any floppy drives.
6. Non DOS trapped switch for UNIX and CP/M OS.
7. Can exist with any other FDC and HDC.
8. Support 4Mb drives as TOSHIBA ,TEAC old & new and PS/2 spec.

OEM and Distributor Welcome

TEKLINK

CHIA SHIN TECHNOLOGY CORP
1F NO.24, ALLEY 2, LANE 76, SEC. 6, SHIN YI RD. TAIPEI, R.O.C
FAX : 886-2-7270804
TEL : 886-2-7263859 · 7271861

Circle 314 (RESELLERS: 315) on Inquiry Card.

HOT PRICES!

80486 MOTHERBOARDS

486DX-50MHz w/256K Cache	$1050
486DX2-50MHz w/256K Cache	LOW
486DX-33MHz w/256K Cache	LOW

LOCAL BUS MOTHERBOARDS

486DX-50MHz w/256K	$850
486DX2-50MHz w/256K	LOW
486DX-33MHz w/64K	LOW

Local Bus Video Cards

32-bit S-3 Window Accelerator 1MB	$225
32-bit ET-4000 w/1MB	$129
32-bit ET-4000 w/True-Color (16.7 milliancolors) w/1MB	$159

MOTHERBOARDS

486DX-33MHz w/64K Cache	$499
486SX-25MHz	$249
386DX-40MHz w/64K Cache	$199

SIMMs

1MB x 9 -70/60/50ns	Lowest
4MB x 9 -70/60/50ns	Lowest

ALSO AVAILABLE

Floppy Drives, Tape Drives, Ethernet Adapters, Keyboards, Monitors, Hard Disks, Video Adapters, EISA controllers, etc.

LAPTOP & NOTEBOOK MEMORY

Toshiba 1000,2000,2200,3300,4400,6400 Series
Toshiba 1200,1600,3100,3200,5200,8500 Series
1MB/2MB/3MB/4MB/8MB/16MB FROM $95
COMPAQ LTE, LTE/LITE, SLT
APPLE POWERBOOK, AST, AT&T BONDWELL, EPSON, EVEREX, GOLDSTAR, HP PALMTOP, IBM, LIBREX, LEADING EDGE, MAGNOVOX, NEC, PACKARD BELL, POQET, SAMSUNG, SONY, SHARP, TI, ZENITH

LASER PRINTER MEMORY

HP LASERJET II, IID, IIP, IIP+, III, IIIP, IIISI
1MB/2MB/3MB/4MB FROM $69
Panasonic, Oki, Epson, Toshiba, Brother, C-Itoh, NEC, Sharp, QMS, Star, TI, etc.

FAX/MODEMS

9600/2400bpsw/V.42bis INT./EXT. $69/$119
9600/9600bpsw/V.42bis INT./EXT. $295/$345
14,000/14,000bpsw/.42bisINT./EXT. $345/$395

ATLAS INDUSTRIES, INC.
1-800-ATLAS-11 (285-2711)
(310)478-6920 FAX (310)479-2334
11601 Wilshire Blvd., Suite 1820, L.A., CA 90025

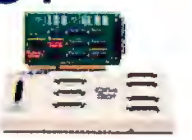
509

All products new with a 1 to 5 year warranty. VISA, M/C, Discover, COD. Prices subject to change. Usually lower when you call!

Circle 309 on Inquiry Card.

Announcing...

THE One Slot™



COMBINATION MULTIPORT BOARD
with Single Slot Expansion: 3 parallel & 4 Serial Ports

Ideal for people who love their PCs but don't like running out of slots. Simple to install and use. Save slots & money. Perhaps the last I/O board you'll ever need.

Features

• Supports Windows, Multimedia, OS/2, Novell, DOS and SCO Unix • ISA, EISA compatibility • Ports easily configured • Easy connect remote panel • Diagnostics software available. ***Call 1-800-782-7428.***

STAR GATE™
People and products you can depend on.

Star Gate Technologies, Inc. • 29300 Aurora Road • Solon, OH • 44139
216-349-1860 • FAX: 216-349-2056 •
BBS: 216-349-2904 • INTERNET: custsvc@sgtech.com

Circle 299 (RESELLERS: 300) on Inquiry Card.

Portable Bar Code Readers

TimeWand I DuraWand TimeWand II

Data collection is fast, easy, and extremely accurate when using Videx portable bar code readers. Cordless operation, compact size and light weight allow you to take the Wands wherever the work needs to be done. **Call Videx today for your free information kit, 503-758-0521.** Prices starting at:

Videx®

TimeWand I $248
DuraWand $495
TimeWand II $698

1105 NE Circle Blvd., Corvallis, OR 97330-4285
503-758-0521 • FAX 503-752-5285

TimeWand and Videx are registered trademarks of Videx, Inc.
DuraWand is a trademark of Videx, Inc.

Circle 281 on Inquiry Card.

Intelligent PrintShare

SPECIAL OFFER - STARTER KIT

Everything you need to share your printer with two computers is included. (1) printer transmitter, (2) computer receivers, (2) 25 ft interconnect cables and a manual. Allows expansion up to 40 computers. Employs collision avoidance technology, intelligence detection, auto switching, no software required. Any topology wiring, uses popular 4 wire modular cables. PrintShare Kit as described $248.00 + $4.50 S&H. Additional computer adaptors with 25 ft. cable $89.50, PP. Toll free ordering: 800-343-1455.

Call or fax for further information on this and also multi printer PrintShare network systems.

Call for FREE catalog! Specify - BYTE

AGENTS WANTED

L-com Inc. TEL: 508-682-6936 FAX: 508-685-6467
1755 Osgood Street, North Andover, MA 01845

Circle 293 on Inquiry Card.

LET YOUR COMPUTER DO THE TALKING!

Integrated Voice/Fax Mail

integrates major voice/fax applications plus program control into one full-featured high performance software. PC-AT/386/486 based. Menu driven. Easy to use. Full support for Rhetorex, New Voice, Dialogic, TTI and Intel voice and fax hardware. Supports up to 24 voice lines and up to 8 fax lines.

Hardware + Software
4 voice lines package starts at **$950**

Tel: (818) 368-6132 Fax: (818) 368-7859

SigmaTech Software

24 hours demo lines: 818-368-1566 or 818-368-8848
10801 Bismarck Ave., Northridge, CA 91326 USA
(Resellers Dealers/OEMs/Private labels are welcome)

- Auto-Attendant
- Unlimited Audiotex
- Voice Mail
- Call Processing
- Telemarketing
- Fax Mail
- Fax-on-Demand
- Fax Broadcasting
- Party/Chat lines
- Talking Yellow pages

Circle 310 on Inquiry Card.

PC/AT Four Port Com. Coprocessor

GMM Sync4/CCP™

- High Performance 16 MHZ 16 bit CPU.
- 80X86 code compatible.
- 4 Sync/Async Ports (2 Serial Ports with Full Duplex DMA).
- Uses Zilog 85C30, 85230 SCC chip.
- 512K Dual Ported Ram (STD) (1, 2, or 4 MEG Dual Port Ram - optional).
- 8k, 16k, 32k, 64k Window Size (Programmable).
- 8 Software Selectable and Shareable Interrupts.
- RS232/RS422/RS485
- Source Code Debugger Kit Available.

GMM Products Are All Made in USA.

PC/AT Dual Port Com. CoProcessor also available
GMM Sync2/CCP™

Other PC/AT & PS/2 8530 based products available. Extremely competitive pricing.

GMM Research Corporation
(714)752-9447 Fax (714)752-7335
18092 Sky Park South - Unit E, Irvine CA 92714

Circle 256 on Inquiry Card.

Circle 275 on Inquiry Card.

NEW! SUPER FAST SPEED!

Order Toll-Free 1-800-282-4835

PCSS-8F INTELLIGENT SERIAL COPROCESSOR

- The **PCSS-8F** is GTEK's newest, *fastest* serial coprocessor. With a real-time status port and a 24MHz processor, it boasts **two times** the data throughput of GTEK's popular PCSS-8I.
- Up to 128K bytes of *Dynamemory* for on the fly allocation and reallocation of buffer memory. Does not use any computer memory.
- Eight RS-232 channels per card. (RS-485 or RS-422 optional)

OEM & Dealer Inquiries Welcomed!

GTEK INC.

DEVELOPMENT HARDWARE & SOFTWARE
P.O. Box 2310 • Bay St. Louis, MS 39521-2310 U.S.A.
Order Toll-Free 1-800-282-4835 • Fax: 601-467-0935
Mississippi & Technical Support 601-467-8048

Circle 259 on Inquiry Card.

Single Board Computer

SC486DX-33C

All include:
2 serial ports & 1 parallel port
Floppy controller
IDE hard disk interface
Watch Dog Timer
UNIX and DOS verified

SC286-16MHz 1/2 size SBC
SC386SX-25MHz 1/2 size SBC
SC386DX-33MHz 64KB Cache SBC
SC486DX-33MHz 64KB Cache SBC

Also Available:
Industrial Rack-Mount PC Chassis
Backplane: 4, 6, 8, 12, 14, 18, 20-slot

ACI 1-800-886-ACI-3

U.S.A.
TEL: 617-938-8020
Fax: 617-938-8037

International
Tel: 886-2-7582571 (Taiwan)
Fax: 886-2-7589615

Circle 301 (RESELLERS: 302) on Inquiry Card.

Computer Systems

AT Systems in ROM

- Single Board Computers
- Run DOS code from ROM
- PC Code compatible
- Large Memory space
- Backplane systems

- Develop code on a PC. Run on our CPU cards with DOS and code in ROM. Use off-the-shelf expansion cards.
- KS6: NEC V53 CPU (286eq), 5 serial, 2 Par, Clock, AT bus, Max 4M Ram, 2M Rom, 512K NV Sram, $349 (q1-oem ver).
- KS3: V40 CPU, 3 Serial, 2 Par, Clock, Flop, Kbd. $249 (q1).

303-444-7737 *Fax 303-786-9983*
655 Hawthorn Ave., Boulder CO 80304 U.S.A.
KILA

Circle 263 on Inquiry Card.

Rackmount Solutions

RACKMOUNT COMPONENTS – QTY 25 PRICING

Rackmount Chassis 19"x7"x17"	$183
Rackmount VGA Monitors	$531
Rackmount Monitor Shelf	$113
Rackmount Keyboard Shelf	$88

RACKMOUNT PLATFORMS – Qty 1 Pricing

RMS286-12	$549	RMS386-33	$1095
RMS386SX-16	$795	RMS486-33	$1695

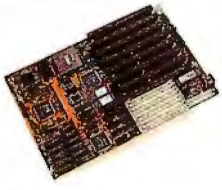
System Platforms include 7" Rackmount Chassis, 200W Power Supply, Motherboard, 1.0MB Memory, IDE, FDC, 2-Ser, Par, 1.2MB or 1.44MB Floppy Disk Drive, 1 Year Warranty

RACKMOUNT CHASSIS – 15 Models up to 20 Board Slots
SLOT CPU BOARDS – 486, 386, 386SX, 286
RACKMOUNT MONITORS – Super VGA and Monochrome
RACKMOUNT CABINET – Modular from 21" to 96" high

VALLEY TECHNOLOGY INC.
2468 Armstrong Street
Livermore CA 94550
(510) 447-2030 FAX: (510) 447-4559

Circle 287 on Inquiry Card.

50 MHZ 80486 ISA/EISA 23 MIPS
Faster than Compaq & Dell



EISA/ISA
BABY SIZE
MADE IN USA

ISA SYSTEM BOARD

MODEL	CACHE	MIPS	OK Board	Base System
486DX/50	64K	23.0	1150	1350
486DX2/50	64K	23.0	945	1145
486DX/33	64K	15.0	745	945
486SX/20	64K	9.0	480	680
386DX/40	64K	10.8	340	540
386DX/33	64K	8.3	330	530

EISA UPGRADABLE BOARD

MODEL	CACHE	MIPS	OK Board	Base System
486DX/50	256K	23.0	1599	1799
486DX2/50	256K	23.0	1399	1599
486DX/33	256K	15.0	1199	1399

All bare systems include a baby desktop, IDE 2s/1p, 101-keyboard, 200 Watt power supply. Tower system with 250 Watt power supply add $150. FCC Class B, UL, TUV are available.

FEATURES
- 64/256K Write Back Cache
- Burst Mode Design
- Shadow RAM on Video & BIOS
- 64MB 32 Bit Memory Expansion
- Baby-size with Eight Expansion Slots
- 100% UNIX, OS/2 & Novell Compatible
- One Year Full Warranty
- Made in USA

FEATURES
- 256K Write Back Cache
- Burst Mode Design
- Upgradable Architecture (66 Mhz)
- 64MB 32-bit Memory Expansion
- Proprietary Local for Video
- 100% EISA/ISA Compatible
- One Year Full Warranty
- Made in USA

386SX with IDE/2s/1p

MODEL	BOARD	Base System
386SX/33	210	410
386SX/25	199	399
386SX/20	185	385

TECHNOLOGY POWER ENT., INC.
47273 Fremont Blvd., Fremont, CA 94538
Tel: 510-623-3818 FAX: 510-623-3840

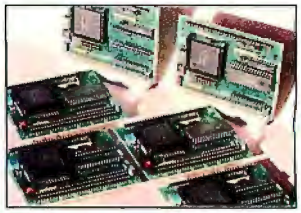
All names mentioned above are trademarks of their respective companies. Prices are subject to change without notice.

Circle 276 on Inquiry Card.

Computer Systems • Data Acquisition • Disk & Optical Drives

EMBEDDED COMPUTERS

If you would like to....
- Use powerful 3-MIPS 16-bit processing
- Drive graphics LCDs and keyboard
- Collect 10-bit analog data from 8 channels
- Store information on PCMCIA Cards
- Interface with a PC or modem
- Perform multitask operations
- Buy at competitive prices

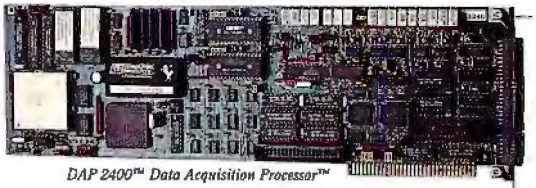


...then the TDS2020 Series is for you

For more information contact:
The Saelig Company Tel (716) 425-3753 Fax (716) 425-3835
Outside USA & Canada: **Triangle Digital Services Limited**
223 Lea Bridge Road, London Tel 081-539 0285 Fax 081-558 8110

Circle 278 on Inquiry Card.

The Intelligent Solution For Data Acquisition



DAP 2400™ Data Acquisition Processor™

ANALOG I/O
DIGITAL I/O
- Inputs to 235K samples per second
- Outputs to 250K samples per second

FFT and FIR-filtering
Digital Signal Processing at 10 MIPS
16 MHz CPU with DRAM to 512K

20 MHz DSP with SRAM to 96K
DAPL™ Operating System
- 100+ standard commands
- Custom commands in C

Send for FREE catalog.
Or call us at (206) 453-2345

MICROSTAR LABORATORIES™
2265 116th Avenue NE
Bellevue, WA 98004
FAX (206) 453-3199

Circle 268 on Inquiry Card.

Let your "true colors shine through" when you advertise your computer products in BYTE's

HARDWARE/SOFTWARE SHOWCASE

our newest, affordable, 4-color advertising section!

Call for more details:
(603) 924-2695 or **(603) 924-2598**

SHARE A SIGEN 250MB PORTABLE TAPE BACKUP & REDUCE COST/USER

THE PC/COMPUTING 200 BEST PC PRODUCTS

No controller card required. Connects to parallel port. Installs in less than 3 minutes. Great for Laptops. 9.5 MB/min transfer rate.

Capacity
60/100 MB 1/4" cartridge
250/500 MB 1/4" cartridge
1200/2000 MB 4mm DAT

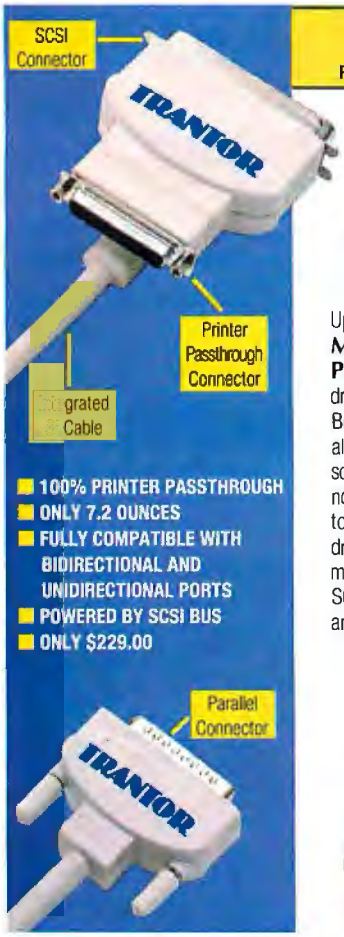
Supports
DOS, OS/2
Novell 286, 386
Unix, Xenix

Industry standard SYTOS Plus software and for file server based NLM and VAP Tapeware.

SIGEN
Phone (408) 737-3904 • Fax (408) 737-3910

Circle 277 on Inquiry Card.

Disk & Optical Drives • Diskettes/Duplicators



MiniSCSI*Plus*
PARALLEL-TO-SCSI ADAPTER

- 100% PRINTER PASSTHROUGH
- ONLY 7.2 OUNCES
- FULLY COMPATIBLE WITH BIDIRECTIONAL AND UNIDIRECTIONAL PORTS
- POWERED BY SCSI BUS
- ONLY $229.00

WANT BETTER CONNECTIONS?

CONNECT UP TO 7 SCSI DEVICES AND A PRINTER TO YOUR PARALLEL PORT!

Up to twice as fast as our original **MiniSCSI**, the **MiniSCSI Plus** lets you run a CD-ROM, tape drive, SCSI hard disk, SyQuest, Bernoulli or other SCSI device from almost any parallel port (tape software optional). For most notebook users, it's the only way to use SCSI CD-ROMs and tape drives. Plus, its integrated cable makes it a snap to move and share SCSI devices between desktops and notebooks.

Call For Details!
(510) 770-1400

TRANTOR

Trantor Systems, Ltd.
5415 Randall Place
Fremont, CA 94538-3151
FAX: (510) 770-9910

© 1992 Trantor Systems Ltd. MiniSCSI and MiniSCSI Plus are trademarks of Trantor Systems Ltd. All other product names are trademarks of their respective companies

Circle 286 on Inquiry Card.

STAND ALONE DISKETTE DUPLICATOR

OVER 300 DISKS PER HOUR

5.25" and 3.50" Models

SIMPLE AND FAST FROM **$1699**

TEL: (416) 503-3335
FAX: (416) 252-4084

AXIOMATIC

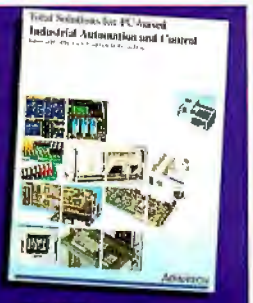
Circle 251 (RESELLERS: 252) on Inquiry Card.

Mail Order • Memory/Chips/Upgrades

Industrial PC Solutions

RELIABLE, AFFORDABLE, FLEXIBLE

- Industrial PCs
- 286/386/486 CPU Cards
- RAM/ROM Disks
- Industrial I/O Cards
- PC-Bus Card Cages
- Rack Mount Keyboards



1-800-800-6889
(In California 408-293-6786)

Industrial & Lab Automation with PCs
ADVANTECH

1310 Tully Road, #115, San Jose, CA
FAX: 408-293-4697

FREE! New 140-page PC-based industrial automation reference guide for your system and OEM needs.

Circle 250 on Inquiry Card.

Specialist in Industrial PC Modules for OEMs

- **Industrial Single Board PCs:** 286, 386SX, 386DX and 486DX CPU Cards, 6 layers, low power consumption, 60°C operating temperature, watchdog timer, 2S/1P ports, HDD/FDD interface and piggyback connector for RAM/ROM Disk Module.
- **RAM/ROM Disk Card/Module:** 1.44MB x 2, SRAM or EPROM
- **PC Bus Passive Backplanes:** 6, 8 and 12 slots.

Fax us to order our FREE CATALOG and obtain OEM pricing info.

AAEON

AAEON TECHNOLOGY INC.
FL2, NO. 41, Jin-Wen Street,
Jin-Mei District, Taipei, Taiwan, R.O.C.
Tel: 886-2-218-1568 Fax: 886-2-218-2463

Circle 248 (RESELLERS: 249) on Inquiry Card.

AmRam

408-559-0603
FAX 408-559-0301

1MB SIMM 80ns $29 **4MB SIMM 80ns $119**

TYPE	PKG.	80ns	60ns
256K x 1	DIP	$0.85	$1.12
256K x 4	DIP	$4.39	$4.76
1M x 1	DIP	$3.82	$4.17
256K x 9	SIMM	$10.05	$11.47
1M x 9	SIMM	$29.00	$32.94
4M x 9	SIMM	$119.00	$130.00

—MATH CO-PROCESSORS—

80287-XL	$82.35	8C87SX-20	$67.06
80287-XLT	$82.35	3C87SX-25	$69.41
80387-SX25	$76.47	3C87DX-25	$85.88
80387-DXP	$82.35	3C87DX-33	$88.24
80487-SX	$475.00	3C87DX-40	$114.12

LOW WAREHOUSE PRICES!

2059 Camden Avenue, #330 San Jose, CA 95124

All Merchandise 100% guaranteed. We accept VISA, MC, Discover and company PO's with prior approval. Price, delivery & manufacturer subject to change. Minimum order $100. Returns require RMA; non-defective returns subject to a 15% restocking fee.

Circle 304 on Inquiry Card.

ROM BIOS UPGRADES

AMI ✦ AWARD ✦ PHOENIX ✦ MR BIOS

With our six years experience in the Rom Bios Business, you can be sure we will direct you to the **CORRECT SOLUTION** for **ALL YOUR ROM BIOS UPGRADE NEEDS.** We are a **FULL STOCKING BIOS DISTRIBUTOR,** and we have **THOUSANDS OF ROM BIOS UPGRADES.** We have the Bios Upgrade for you, whether you have an Original IBM Computer or one of the many Compatibles on the market.

FEATURES OF A NEW BIOS

- ✦ SUPPORT FOR 360K, 720K, 1.2 MB, 1.44 MB AND 2.88 MB FLOPPY DRIVES
- ✦ COMPLETE SETUP IN ROM
- ✦ VGA AND SVGA SUPPORT
- ✦ NOVELL AND NETWORK SUPPORT
- ✦ FASTER I/O SPEED
- ✦ DOS 5.0 SUPPORT
- ✦ SUPPORT FOR 46 DIFFERENT HARD DRIVES, PLUS TWO USER DEFINED
- ✦ IDE DRIVE SUPPORT
- ✦ FULL OS/2 SUPPORT
- ✦ PASSWORD PROTECTION
- ✦ FULL WINDOWS 3.1 SUPPORT
- ✦ LATEST VERSIONS, *AND MORE....*

SMART MICRO TECHNOLOGIES, Inc.
"YOUR ROM BIOS UPGRADE SOLUTION"

C.O.D.

143 Triunfo Canyon Road • Westlake Village • CA 91361
Fax (805) 371-0012 ORDER (800) 266-1576 Local (805) 371-0055
• FREE catalog • Corp. & Univ. PO's are welcome • Dealers welcome • Volume discounts

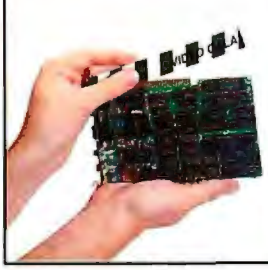
Circle 297 on Inquiry Card.

Multimedia

VIDEO FRAME GRABBERS

RECORD TO VCR AND TV MONITORS. PC/XT/AT, PAL/NTSC

VGA VIDEO GALA .....$695.00 Three boards in one: 1) It's a Super VGA card which replaces your existing card. 2) It has recordable output to VCRs & TVs. 3) Live TV/VCR video on your VGA monitor and frame grabbing in 24-bit color.



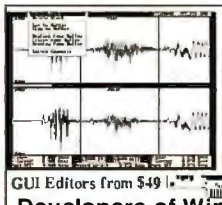
HRT 512-8.....$995.00 Real time, grey scale frame grabber. This is a multifeatured high performance industrial model. (LUT, overlay, external trigger, EX./IN. pixel clock, genlockable, optional square pixels, video output...) Applications include machine vision, medical imaging, robotics, microscopy etc. Resolution is 512 X 512 with 256 levels of grey (optional 2nd buffer or 640 X 512 res). Rock-solid capture even from a VCR. Library of Image processing routines included free. 100+ functions such as histograms, convolutions, edge detection, point and area operations, arithmetic and logical operations between frames, board control, IO, etc.

HIGH RES TECHNOLOGIES INC.

P.O. Box 76, Lewiston, New York 14092 U.S.A.
Tel: 416-497-6493 Ext. 102 Fax: 416-497-1636 Dept. 102

Circle 260 on Inquiry Card.

SuperSound™



Best Value!
Easy To Use Too!
Digital Audio Authoring Workstations $239 - $640

GUI Editors from $49

Having Problems With BigName Productsor Their Tech Support - Try Us And Be Pleased.

Developers of Windows 3,Toolbook, Visual Basic use our DLLs, Create SuperSound, SoundBlaster, Covox, Disney Sounds; Import sound files from Mac, Amiga

IBM-PC DOS DIGITAL AUDIO from $20 (User's Player D/A Module (Plugs Into Printer Port))

USA Made High Quality,30 Day Money-Back Guarantee

- LIKE HAVING A CASSETTE TAPE RECORDER IN A PC.
- Fastest, easiest Editors with the most features for the price.
- Simple hardware / software installation- NO DMA jumpers.
- No Extra Charge for Technical Support on our products.
- DOS Extender Version - Up To 16 MB Working Space.
- Programmer's Libraries for Popular Languages.

Products by Silicon Shack, 4760 Castlewood Drive, San Jose, CA 95129
Ph:408 - 446 - 4521 FAX: 408 - 446 - 5196

Tech. Info./Orders: 800 - 969-4411 Ask for FREE PRODUCT CATALOG.

In Far East : Bayware Japan, Inc. Tel:(03)972-5391 FAX: (03)959-1214 ™ SuperSound, SoundBlaster and Sound Blaster are trademarks of Silicon Shack Ltd

Circle 274 on Inquiry Card.

Make Your Image Fly !

Capturing, Compression and Printing.

Video Blaster, Full Motion, True Color, Windowing Video Capture & Sound Controller

- *3 Switchable NTSC/PAL Video Inputs
- *720x512 Digitized Video Resolution
- *D/A Sound Mixer & Volume Control
- *Mixed Amplified Stereo Output of 0.5W
- *Versatile Utility for Captured Video Image Manipulation, Editing, Storage, Retrieval

- *Windowing controlled by Independent X-Y coordinates & by Color Keying
- *Independent X-Y Scaling
- *Lots of Bundled Software!
- *MS-Dos & Windows 3.X Dynamic Link Library Available

Picture Packer, 30:1 Image Compression Software for Windows 3.0

- *Dramatically Saves Precious Hard Disk Space by 30:1 with Minimum Image Quality Loss and 5:1 with NO Image Quality Loss
- *Supports Full Color or Gray-Scale Image Files
- *Supports Windows 3.0 and MS-DOS 5.0
- *Adheres to JPEG Standards
- *Compatible with All Major Graphic File Format: TIFF, TARGA, PCX, GIF

- *Memory-Resident Program Operates Transparently within Popular Applications such as:
  - -Aldus Pagemaker
  - -PhotoStyler
  - -Picture Publisher

  to automatically Access and Decompress Picture Files
- *Affordable Price of $99.00 with $99.00 Coupon Toward Purchase of Packer Card

WinPrinter, Cost Effective 800 DPI Laser Printing

- *Host-Based Processing. The More Powerful Your Computer, The Faster the Printing Speed.
- *Made-for Windows Printing
- *Printing Versatility - 3 Ways with Windows Direct Driver, PostScript Emulator, PCL-4
- *800 DPI Laser Printing -4 Page-Per Minute
- *Upgrade Kit for your HP LaserJet Series Printers Available

For Order, Catalog and Price Quotes Call:

1-800-446-1967

Mon - Sat,
9am - 6pm

VISA MasterCard

Empire Computech

9668 Hermosa Ave.
Rancho Cucamonga, CA 91730
Tel:714-466-1400 Fax:714-466-1400

All trademarkes are trademarks of their respective owners

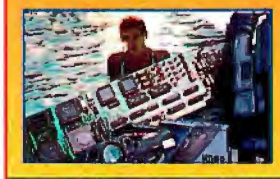
Circle 307 on Inquiry Card.

Programmable Hardware

VIDEO CAPTURE

IMAGER 2000

- Real time true color **768 x 576 x 24** for PC AT !!! **$1495**
- **Multistandard** all 60-50 Hz NTSC, PAL, SECAM, VHS ...
- Complete with **Windows 3** software, cables, ...
- Motion **video preview** in a window,
- External triggering, 3 video inputs, BMP, TIF, PCX...



EXPANSION OPTIONS

- **24 bits RGBS** output with **GENLOCK** **$ 395**
- **S-VHS, HI-8,** (Y/C input) **$ 195**
- **JPEG S/W** : image compression/decompression **$ 249**
- **JPEG H/W** : capture up to **30 frames per second** !!! **$1795**

VITEC

US & Canada TOLL FREE : 800 982 46 24
EEC PH : 33 1 46 29 03 00 - FAX : 33 1 46 29 03 04

Circle 298 on Inquiry Card.

µPLC

"High speed scan rate at a fraction of the cost"

HARDWARE: • 8 optically isolated digital inputs at 12 or 24 VDC • 8 isolated relay outputs rated at up to 3A continuous at 120 VAC with a 10 A surge • SIZE: (9" L x 3.5" W x 1.5" D) • 108 internal bits • 8 K of EPROM • up to 1ms per K of boolean logic • serial communications optional

100 GENERAL PURPOSE REGISTERS: used for • timers • counters • pulsars • data storage • sequencers

SOFTWARE: • programmable with IBM XT/AT/386/486 compatible and EPROM programmer • ladder logic • text annotation • easy to use editor with menus and function keys

hardware $139.00 software $99.00 both for $188.00

1-800-668-2707 tel: (519) 681-2818 fax: (519) 681-9822

DAVISON • WORTH
CORPORATION

Circle 312 (RESELLERS: 313) on Inquiry Card.

For Your Development Needs!

MODEL 9000 EPROM PROGRAMMER

- QuickPulse and intelligent algorithms.
- Programs Eproms (up to 4Mb), EEproms & MPU's.
- Up to 57K baud.
- *Ultra Fast!*

ORDER TOLL-FREE
800-282-4835

OEM & Dealer Inquiries Welcomed!

GTEK INC.

DEVELOPMENT HARDWARE & SOFTWARE
P.O. Box 2310 • Bay St. Louis, MS 39521-2310 U.S.A.
Fax: 601-467-0935
Mississippi & Technical Support 601-467-8048

Circle 258 on Inquiry Card.

STOP *NEW!* STOP

Virus Protection Power

The card that provides a comprehensive and continuous protection automatically!

Why choose the AVP card and not the leading anti-virus software?
Because unlike anti-virus software:

- **AVP** does not occupy RAM memory...
- **AVP** does not waste time scanning your drives...
- **AVP** is not vulnerable to viral infection...
- **AVP** provides an optional password to prevent the unauthorized use of your computer...
- **AVP** does not require software and therefore you will not need constant updates, nor can it be inadvertantly deleted...
- **AVP** is *easy* to install, *easy* to use and *easy* to pay for!

The Card...don't leave your computer without it!

Order NOW for only: **$59.95** plus tax if applicable plus $5 & H

VISA, MasterCard accepted.
Dealers Welcome

GRANICOR
Call 24 hours a day **(415) 244-9999**
or fax your order to **(415) 244-9279**

Circle 305 on Inquiry Card.

IEEE 488.2

Hardware for IBM PC/AT, Micro Channel, Sun, Macintosh, DEC, and NeXT.

Software for DOS, Windows, UNIX, VMS, menu- and icon-driven environments.

IEEE 488 extenders, analyzers, converters, analog I/O, and digital I/O.

Call for your free IEEE catalog

IOtech

IOtech, Inc. • 216.439.4091 • Fax 216.439.4093

Circle 262 on Inquiry Card.

UNIVERSAL PROGRAMMER, EMULATOR, & TESTER

TUP-400 $745.00 *NEW*
TUP-300 $575.00

- New improved hardware and software.
- The most complete PC-based Universal Programmer. Programs PLD (PAL, GAL, FPL, EPLD, PEEL, MAX, MACH...), E(E)PROM, (up to 16Mbit), Flash EPROM, BPROM, Special PROM, MPU (87XX, 68XX, Z8, PSD301, PIC16XX, TMS320EXX, UPD75PXXX, HD637XXX...).
- Covers DIP, PLCC, QFP, SOP, and PGA with 8 to 84 pins. Gang Progamming adapters available also.
- EPROM EMULATION capability.
- Tests digital ICs and DRAMs (SIMM/SIP adapter available).
- Freesoftware updates and new device added upon request.
- IC Manufacturers' approval.
- 1-year warranty, 30-day money-back guarantee.

CALL TODAY FOR MORE INFORMATION.
Distributors are welcome!

- We accept Trade-ins for ANY programmer.
- Call about our Rent-a-programmer/emulator plan.

Tribal Microsystems Inc.
44388 S. GRIMMER BLVD., FREMONT, CA 94538
Tel (510) 623-8859
FAX (510) 623-9925

Circle 279 on Inquiry Card (RESELLERS: 280).

DOS IN ROM!

Always waiting for a prompt? Speed up with MVS ROM Drive!

- Boot 0.1 sec
- 1/2 size card
- Any programs, DOS
- LANs, Control

64K.....$75
360K.....$150
1.44M.....$195

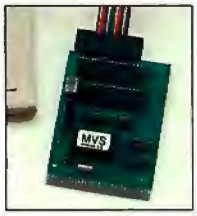
8088 SINGLE BOARD COMPUTER

1. Debug on PC
2. Test SBC RAM
3. Burn EPROM

- Battery, solar
- 5-yr warranty
- 62 pin PC Bus
- 2PAR, 3SER, RTC
- LCD/KBD ports

MVSBC1.....$95
MVSBC1.....$27/1K
MVBIOS.....$60
PC CABLE.....$50
PC CARD.....$85

PC on a card!



MVS
(508) 792-9507

Circle 267 on Inquiry Card.

SUPERPRO®

now $599 (US only)

Over 2,000 devices, desktop programmer for your IBM PC with high speed & reliability

- Easy to use menu driven Software.
- Universal programming for E(E)PROM, Flash E(E)PROM, Bipolar PROM, PAL, FPL, PEEL, GAL, E(E)PLD, & Microcontroller, etc.
- Test TTL/CMOS logic ICs, & memory (DRAM/SRAM).
- Life time free Software updates on BBS & technical support.
- 1 year Hardware warranty & 30 day money back guarantee.
- Developed & made in U.S.A.
- Call for demo disk.

Distributors are welcome!!

E(E)PROM programmer to 4-Mbit
- ROM MASTER: $149

E(E)PROM programmer 4 gang version
- ROM MASTER/4: $239

757 N. Pastoria Avenue, Sunnyvale, CA 94086
(408) 524-1929
FAX (408) 245-7084 BBS (408) 245-7082

XELTEK

Circle 284 on Inquiry Card.

POWERFUL • AFFORDABLE INSTRUMENTS

200 MHz Logic Analyzer

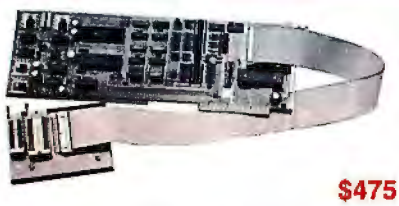
- 400 MHz max sampling rate
- up to 128 channels
- 16K samples/channel
- 16 level triggering
- Variable threshold voltage
- Sophisticated triggering
- FREE software updates

$799 - LA12100 (100 MHz)
$1299 - LA32200 (200 MHz-32-ch.)
$1899 - LA32400 (400 MHz-32-ch.)

Price is complete. Pods and software included.

Universal Programmer

PAL
GAL
EPROM
FLASH
EEPROM
PROM
87xxx...



$475

- 16V8, 20V8, 22V10, GALs
- 26V12, 20RA10, 18V10 GALs
- 2716-27040 EPROMs
- 87xxx MICROs
- EEPROMs (incl. 8 pin serial)
- 16 bit EPROMs
- Byte Split/Merge (16 & 32 bit)
- JEDEC, INTEL HEX, Motorola 'S' files
- Dallas NVS RAM programming
- FREE software updates on BBS

Call - (201) 808-8990
Link Computer Graphics, Inc.
369 Passaic Ave., Suite 100, Fairfield, NJ 07004 FAX: 808-8786

Circle 266 on Inquiry Card.

MICROCONTROLLERS

- C Programmable
- Data Acquisition
- Control / Test
- Excellent Support
- From $159 Qty 1
- *New* Keyboard Display Modules

Use our **Little Giant**™ and **Tiny Giant**™ miniature controllers to computerize your product, plant or test department. Features built-in power supply, digital I/O to 48+ lines, serial I/O (RS232 / RS485), A/D converters to 20 bits, solenoid drivers, time of day clock, battery backed memory, watchdog, field wiring connectors, up to 8 X 40 LCD with graphics, and more! Our $195 interactive **Dynamic C**™ makes serious software development easy. You're only *one* phone call away from a total solution.

Z-World Engineering
1724 Picasso Ave., Davis, CA 95616 **(916) 757-3737** Fax: (916) 753-5141
Automatic Fax: (916) 753-0618 (Call from **your fax**, request catalog #18)

Circle 285 on Inquiry Card.

9 Track/3480 Tape Subsystems
1/4" DAT 8mm Optical

- **Best Quality**
- **Lowest Prices**

800/1600/3200/6250 BPI

CALL 1-800-859-8856

Laguna Data Systems
23151 Alcalde Drive, Suite B-3, Laguna Hills, CA 92653
Tel: 714-586-3010, Fax: 714-586-5538

Circle 265 on Inquiry Card.

Tape Drives • Books/Publications

FOR ALL YOUR TAPE NEEDS

3480 ■ 9-Track ■ 1/4" ■ 4mm ■ 8mm

Tape to Tape Copy
Tape Backup/Restore
Conversion
Data Interchange

NovaStor Corp.
30961 Agoura Rd., Suite 109
Westlake Village, CA 91361

Phone (602) 396-3616
or 818-707-9900 • Fax: 818-707-9902

Circle 292 on Inquiry Card.

THE BEST IN 9-TRACK? WELL, WE HATE TO BOAST.

3480 Too!

But, if you insist...
800-729-8725
OVERLAND DATA®
TEL: 619-571-5555 • FAX: 619-571-0982 • EUROPE: TEL: 49-6172-35027 • FAX: 49-6172-35028

Circle 270 on Inquiry Card.

Desktop 9-Track Tape Subsystem
#1-selling 9-track system on desktop.

Qualstar's low cost 1/2-inch 9-track Streaming tape systems bring full ANSI data interchange to IBM AT, PS/2 or Macintosh, giving your micro the freedom to exchange data files with nearly any mainframe or minicomputer in the world.

Systems include DOS or Xenix compatible software, coupler card and cables. High reliability 1600 or 6250 BPI capability may be used for disk backup as well as data interchange.

QUALSTAR®

Call us today! **For details and to order: Fax (818) 882-4081**
Phone (818) 882-5822

9621 Irondale Ave., Chatsworth CA 91311

©1989 Qualstar Corp.
All product and company names and trademarks are the exclusive property of their respective owners.

Circle 272 on Inquiry Card.

LOST FOR THE WRITE WORD?
Get it *right* with **COLLINS ON-LINE**

French, German, Italian & Spanish bilingual dictionaries for your PC.
40,000 references, 70,000 translations

FEATURES INCLUDE:

- ☐ **TSR** - memory resident so it can be used with most word processors for MS-DOS.
- ☐ **Look-up** –enables you to find words in the dictionary, choose the appropriate translations and paste them into your document quickly and easily.
- ☐ **Screen-read** –reads words in your document automatically for quick and accurate translation.
- ☐ **Annotate** –allows you to create your own specialized glossaries for use with Collins' world renowned bilingual dictionaries.

PRICE £49 (Additional dictionaries £29)

HarperCollins*Publishers*
14 Steep Lane, Findon, Worthing, West Sussex BN14 OUF England
Tel +44 (0)903 873 555 • Fax +44 (0)903 873 633

Circle 316 on Inquiry Card (RESELLERS: 317).

Miscellaneous Hardware • CAD/CAM • Communications/Networking

TVR

Silencer for Personal Computers

Let us help you remove the noise from your PC.
Everybody is aware of the constant noise from a PC. It causes you headache and gives you stress.

This noise comes from the fan. Our TVR-Silencer is mounted between the PSU and the fan. It reduces the noise level from approximately 45dB to 35dB. That's almost 50% less noise.

1. Regulation of the temperature is monitored by a thermostat, which ensures that internal operating temperature of the PC is kept within that specified by the manufacturer (approximately 35° C); as operating temperature increases through heavy use or ambient temperature, the unit will increase the speed of the fan to maintain safe operating temperature.
2. A primary backup circuit ensures that the voltage to the fan never falls below 6.2 volts to maintain rotation and therefore supply the sensor with airflow.
3. A secondary circuit ensures that in the event of failure, the fan will return to full operating speed.

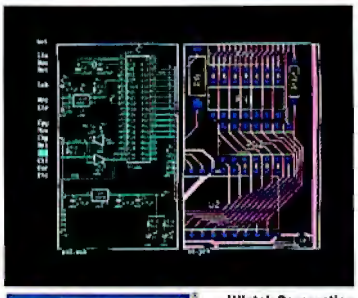
The TVR-Silencer suits almost every PC-model. No service after installing. A liability insurance exists for this product.

This product has been approved by DEMKO in Denmark and by the German TUV. It has been distributed successfully for about 2 years. We are looking for importers and distributors all over the world.

Please do not hesitate to contact us by phone or fax for further details. The TVR-Silencer - Made in Denmark, is probably the most reliable Silencer in the world.

IBC Data
P.O. Box 106, Svendborgvej 102, DK-5260 Odense S
Phone: **65 91 97 00** • Fax: **65 91 51 57**

Circle 288 on Inquiry Card.



HiWIRE® II Schematic and PCB Software

With support for expanded and extended memory, HiWIRE II can handle your most demanding schematic and PCB designs. The unique HiWIRE II editor allows you to display and edit schematics and PCBs simultaneously, using the same commands for each. HiWIRE II is $995, and is guaranteed.

Call (800) 742-6809
or (317) 448-1903

WINTEK®
Wintek Corporation
1801 South Street
Lafayette, IN 47904
(800) 742-6809

Circle 283 on Inquiry Card.

EM320
W I N D O W S

DEC VT320 Emulation for Microsoft Windows 3.X

- *132 column display*
- *Cut and paste*
- *Kermit file transfer*
- *Windows style help*
- *Local or ANSI color*
- *Multiple instances*
- *Automatic window sizing*
- *Double high/wide characters*
- *LAT, INT 14 or TCP/IP support*
- *Modem dialer/Phone book*
- *Command language*
- *International character sets*

Diversified Computer Systems, Inc. *(303) 447-9251*
FAX (303) 447-1406 Other products: EM320 DOS, Tektronix 4105 DOS

Circle 254 on Inquiry Card.

Acquisition

Free Data Acquisition Software Tool

DAQ Designer is a free software tool that helps determine which hardware and software combinations are best for your PC-based data acquisition system. DAQ Designer will (1) ask questions about your application, (2) analyze your answers to determine your system needs, and (3) describe what hardware and software you need to develop your data acquisition system.

National Instruments
6504 Bridge Point Parkway
Austin, TX 78730
(512) 794-0100 • (800) 433-3488

Circle 269 on Inquiry Card.

Education • Engineering/Scientific • Mathematical/Statistical

EARN YOUR COLLEGE DEGREE AT HOME

B.S. & M.S. In Computer Science

Get the opportunity and earning power a college degree confers—without leaving home and without spending thousands of dollars.

- Approved for tuition reimbursement by leading corporations
- ALL COURSES BY CORRESPONDENCE
- Most courses interactive
- Approved Ada course available
- Qualified instructors available on telephone help lines

AMERICAN INSTITUTE for COMPUTER SCIENCES
The learning edge of learning

Phone: 1-205-323-6191 • FAX: 1-205-328-2229
2101 BYX Magnolia Ave. • Suite 200 • B'ham, AL 35205

Affordable Statistic with Microstat-II

Don't let the low price fool you. Microstat-II is a full-featured statistics package and includes descriptive statistics, ANOVAS, Stepwise multiple regression, nonparametrics, hypothesis tests, canonical correlation, principal components analysis plus many other procedures. Find out why Microstat-II is one of the fastest, easiest-to-use statistical packages on the market. 30 day money back guarantee. Call or write:

Ecosoft Inc.
8295 Indy Court
Indianapolis, IN 46214

Orders: 1-800-952-0472
Info: 1-317-271-5551
FAX: 1-317-271-5561

~~$395~~

$99.95

Circle 255 on Inquiry Card.

dBASE Data Entry

The TransTerm 5 is a work station data entry/display terminal for on-line shop floor data collection into PC/AT/PS-2 systems. The unit is one of a family of such terminals which feature LC displays for operator prompting and data entry via sealed touch keys or an optional barcode scanner or badge reader (Code39,UPC+). A multi-terminal network controller (up to 250 stations) and a dBASE IV compatible software package are also available. System costs start below $300 per station. Options include display backlighting, barcode scanning, counter inputs, control output.

COMPUTERWISE.®
302 N. Winchester • Olathe, KS 66062
913-829-0600 • 800-255-3739 • FAX 913-829-0810

Circle 253 on Inquiry Card.

FINALLY, SERIOUS PC HARDWARE DIAGNOSTICS!

New for '92 V-ATE PLUS — Now Supports XT, AT & EISA

STOP SCRAPPING FAULTY MOTHERBOARDS

If you've been disappointed with traditional diagnostics and "Passive Post Cards," or are looking for an alternative to high cost ATE Systems - Put V-ATE plus to the test! We're certain you'll find V-ATE the best investment you've made in years.

- Find Failures in 100% DEAD Systems
- Find Intermittent Faults
- Test for PC Compatibility and reject Sub-standard or Faulty hardware
- Tests 88/286/386/486 PCs
- Complete Test Systems From $995

VISTA MICROSYSTEMS, Inc.
6 Whipple St., No. Attleboro, MA 02760
Tel. 508-695-8459 • FAX 508-695-8688

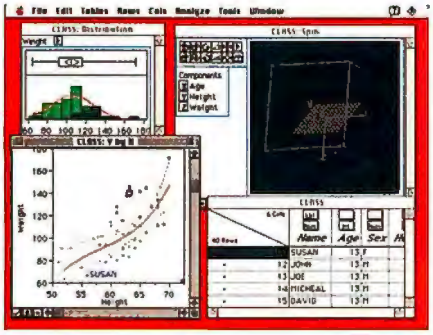
Circle 282 on Inquiry Card.

Mathematical/Statistical •

Make this your "leap" year with

JMP® Statistical Discovery Software

"JMP, from the SAS Institute, is the most surprising Mac product in years...with the most helpful Mac interface of all the statistics programs and one of the best interfaces ever produced for scientific software. It's nothing less than dazzling."



MACWORLD

Call today for a free demo disk and Points of Interest from the leading name in data analysis software...SAS Institute Inc. 919-677-8000. Fax 919-677-8166.

WINNER MacWEEK 1991

JMP is a registered trademark of SAS Institute Inc.
Copyright © 1992

Circle 273 on Inqt

Programming Languages/Tools

APL

Complete APL system $60. PC, 386, WINDOWS.

J

Ken's new APL for teaching and research. Uses ASCII. Shareware and documentation $24. Source $90.

Iverson Software Inc.
33 Major St., Toronto, Ontario, Canada M5S 2K9
Phone (416) 925-6096 Fax (416) 488-7559

Circle 306 on Inquiry Card.

HYPERCROSS – asm*

Multi-target Macro Cross Assembler

FEATURES:

Fast One Pass Execution – up to 6000 LOC/Second
Flexible "Library Driven" Architecture
Full-Featured PC-asm Style Directives/Expressions
Popular Vendor Style Instruction Syntax Rules
Six Run Code Formats & Program/X Ref List Options
Host: IBM PC or Compatible (PC-DOS/MS-DOS)

STANDARD SYSTEM: $249.00 US
Macro Cross Assembler – Supports 32 Processors
BASE SYSTEM: $129.00 US
Cross Assembler – Supports 23 Processors
Call for Site Licenses, Custom Systems & Libraries
*Trademark/Product of Hypersys Corporation

PROCESSORS:

8048	6801	Z8
8051	6805	Z80
8085	6809	Z180
8086	6811	Z280
8096	68000	SUPER8
8019		664180
1802	7800	320C1X
6502	70XXX	320C2X
65816	TMP4300	TMS370
COP400	TCP4600	TMS7000
COP800	TMP4700	TMS9900

Hypersys Sales Agent: K & M Associates
P.O. Box 670054, Marietta, GA 30066 Phone (404) 971-2649

Circle 264 on Inquiry Card.

RS-232++ NEW!

Greenleaf Comm++™ Asynchronous Comm Class Library

- C++ class library for DOS, Windows 3.x and OS/2.
- Device independence through inheritance.
- Supports Zortech, Microsoft 7.0, JPI and Borland C++.
- IBM PC, XT, AT, PS/2 and compatibles.
- COM1..COM8, and DigiBoard.
- Baud rates to 115,200.
- XON/XOFF, RTS/CTS flow controls.
- XMODEM, Kermit file transfer protocols.
- VT52, VT100 subset, ANSI & TTY terminal emulation
- Hayes modem control classes.
- Line and link level controls & status.
- Extensive examples help you get started with OOP applications using communications.

- **FREE Source Code**
- **FREE Unlimited Support**
- **No Royalties**
- **Money-Back Guarantee**
- **Top Rated Documentation**

Greenleaf Software

CALL (800)523-9830 NOW!
Fax (214) 248-7830

Circle 257 on Inquiry Card.

CODE RUNNER®

"Makes your C TSRs smaller than you could imagine."
Mark Davidson, Computer Language

CodeRunneR **The #1 TSR Library for C and ASM**

- 300+ functions in highly optimized assembler
- Auto-Disposal of initialization code and data
- Hotkeys, schedulers, fast background COMs
- Safe DOS use from TSRs, Network Friendly
- Online hypertext help, Quick start templates
- Swap apps or graphics to EMS/XMS, spawn ...

Pick of the Professionals

"cream of the crop" Tom Swan, PC World

"highly useful" R. Bradley Andrews, DDJ

"not only solves problems, it inspires new possibilities. It is destined for the programmer's Hall of Fame" Joe Campbell, Author C Programmer's Guide to Serial Communications

"the size of any program you create with CodeRunneR will astound you" Mark Davidson, Computer Language

"excells in its TSR capabilities, coexistence with other DOS applications and support" Victor R. Volkman, The C Users Journal

"professional development tool that'll let you create compact, fast TSRs" Gary Entsminger, Micro Cornucopia

Omega Point Omega Point,Inc.

Omega Point, Inc.
25 Birch Rd., Framingham, MA 01701
508 877-1819 FAX: 508 877-0915

Circle 308 on Inquiry Card.

Cross Assemblers, Simulators, Disassemblers

Processor Families:

8051	8096	8048
Z80	64180	6301
6805	6800	1802
6811	6502	68k
8085	6801	Z8

Join Thousands of Satisfied Customers Worldwide.

Call:

PseudoCorp

716 Thimble Shoals Blvd., Newport News, VA 23606
Tel: (804) 873-1947 • Fax: (804) 873-2154

Circle 271 on Inquiry Card.

Dive Deeper Into Your Hard Drive than ever before

No more DEBUG - Finds & executes controller's on-board firmware.

No more FDISK - Full featured partition table creator and editor.

No more SETUP - View and edit BIOS drive type table, set CMOS.

No more FORMAT - DOS format with operating system transfer.

No more BIOS DRIVE TABLE LIMITATIONS Custom drive types for **any** bios.

For Complete Information: **1-800-926-8299**

Limited Time Offer
$99.95

DrivePro™
Professional Hard Drive Setup
FAX 303-443-3323
BBS 303-443-9957

MICRO HOUSE

Circle 296 on Inquiry Card.

Setting The Standard in Graphical Menuing Systems!

QuikMenu™ III

Demo Disk Available
OEM & Dealer Inquiries Welcome
References Available

Features: Free Form Screen Layout, Choice of Fonts & Colors, Automatic Installation, File Manager, Icon Editor, Calculator, Calendar, Phone Dialer, Usage Tracking, Password Protection, User Prompting, NOT Memory Resident, PCX Background (req. EMS), Network Compatible, Supports CGA/EGA/VGA/Hercules, Does NOT Require Windows™

$89.95*
30 day money back guarantee!
1-800-545-1392
*Please add $5.00 shipping & handling

PC JOURNAL BEST DOS GRAPHIC MENU SYSTEM

OSCS Software Development Inc.

354 NE GREENWOOD AVENUE, SUITE 108 ▲ BEND, OREGON 97701
VOICE: (503) 389-5489 ▲ FAX: (503) 388-8221 ▲ BBS: (503) 383-7195

Circle 291 on Inquiry Card.

ILLUSTRATION BY JOANNE COUGHLIN

ColorFax®

ColorFax for Windows - only for those who view the world in color.

Black Ice Software, Inc.
Amherst Station, Route 122,
Amherst New Hampshire 03031
Tel: (603) 673-1019 Fax (603) 672-4112
M/C / Visa / C.O.D. / Check

Circle 289 on Inquiry Card (RESELLERS: 290).

JOIST

DOS like operation!

Copy, delete, move and more! You can operate files just like MS-DOS commands.
Req. Windows Environment
3.5 & 5 (2DD) disk include
until end of Sept., $49.50-
VISA/MC/AMEX

tectamm, Inc
401, Avalon Drive
South San Francisco, CA 94080
tel: (415) 873-5188

Circle 311 on Inquiry Card.

BYTE

Breaks the 4-Color Price Barrier with the **Hardware/Software Showcase**

See how affordable it is to advertise to BYTE's 500,000 computer professionals in this section!

■

Call for more advertising information:
(603) 924-2695 or (603) 924-2598

THE BUYERS MART

A DIRECTORY OF PRODUCTS AND SERVICES

THE BUYER'S MART is a monthly advertising section which enables readers to locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes a reader Inquiry number to assist interested readers in requesting information from participating advertisers.

Effective January 1, 1992.

RATES: 3 issues–$625 6 issues–$600 12 issues–$525 13 issues–$500
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 Margot Gnade at 603-924-2656. FAX: 603-924-2683.

ACADEMIC COMPUTING

LEARN PARALLEL PROCESSING
Transputer Education Kit
$396
Kit includes ready-to-use PC add-in board with T400 transputer, 1MB of RAM, and PC interface. Complete with Occam2 and C compilers, assembler, source-level debuggers, example programs, and 1500 pages of documentation (incl. schematics). Expandable!
Computer System Architects
100 Library Plaza, 15 North 100 East, Provo UT 84606-3100
(800) 753-4CSA (801) 374-2300 FAX (801) 374-2306

Inquiry 701.

ACCESSORIES

RADIOACTIVE?
Plot it on your PC with The RM-60 RADIATION MONITOR Serial or printer port. Detects: ALPHA • BETA • GAMMA • X-RAY. MicroR, 1000 times the resolution of standard geiger counters. Excellent for tracking RADON GAS. Find sources. New: Version 2.8 + WINDOWS, Plot: • Background • Cosmic Rays • Clouds • Foods Call/Write for PC MAGAZINE review. • TSR • GM Tube VISA/MC/EURO Phone orders. Not satisfied? Full refund.
800-729-5397 or Tel/Fax: (302) 655-3800
Aware Electronics Corp.
P.O.Box 4299, Wilmington, DE 19807 **$149.50**

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 **In IA: 319-987-2976**

Inquiry 702.

KEYBOARD, VIDEO, MOUSE, AUDIO
Extend signals from PC with **EXTENDER**
Split signals with **COMPANION/PC EXPANDER**
Switch signals among PCs with **COMMANDER**
Boosts signals up to 600 feet. Control up to 96 PCs with one keyboard, monitor and mouse.
CYBEX CORPORATION
2800H Bob Wallace Ave., Huntsville, AL 35805
Phone: 205-534-0011 **Fax: 205-534-0010**

Inquiry 703.

HEWLETT PACKARD
Buy – Sell – Trade
LaserJet
DeskJet
RuggedWriter
ColorPro
DraftPro
DraftMaster
Electrostatic Plotters
• Monochrome and Color
HP 9000 Workstations and Vectras also available.
T. E. Dasher & Associates
4117 Second Ave., S. Birmingham, AL 35222
Phone: (205) 591-4747 Fax: (205) 591-1108
(800) 638-4833

Inquiry 704.

ARTIFICIAL INTELLIGENCE

FUZZY LOGIC AND NEURAL NETWORK TRAINING AND DEVELOPMENT SYSTEMS
PC-based add-in cards with menu-driven software and instruction manual. Allows user to learn Fuzzy Logic and Neural Networks in addition to developing actual applications. Pricing from $395.00
AMERICAN NEURALOGIX, INC.
411 Central Park Drive, Sanford, FL 32771
Phone: 407-322-5608 Fax: 407-322-5609

Inquiry 705.

ASSEMBLER PRE-PROCESSOR

LISTEN up you ASSEMBLER nuts!
S-ASM Structured Assembler Preprocessor
* Adds high level verbs to 286 Assembly code
* Generates the most efficient code ever
* No registers are used in verb generation
* Can preprocess any size source program
* Increase your productivity by 400% or more

$49 Limited Time Special Offer so ORDER TODAY!!
Software Tools, Inc.
825 East Roosevelt Road Suite 182
Lombard, IL 60148 Call (708) 776-7061 for Info.

Inquiry 706.

BAR CODE

LABELING SOFTWARE
On EPSON, IBM, OKI dot matrix or LaserJet. Flexible design on one easy screen. Any format/size. Up to 120 fields/label. 18 text sizes to 3"-readable at 100'. 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
(408) 458-9938 **(800) 345-4220**

BAR CODE READERS
For PC, XT, AT, & PS/2, Macintosh, and any RS-232 terminal. Acts like 2nd keyboard, bar codes read as keyed data. With steel wand–$399. Top rated 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
(408) 458-9938 **(800) 345-4220**

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 through 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
(408) 458-9938 **(800) 345-4220**

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
(408) 458-9938 **(800) 345-4220**

BAR CODE READERS
Keyboard emulation for PC/XT/AT & PS/2's, all clones and any RS-232 Terminal. Transparent to your operating system. Available with Steel wands, Lasers, Slot & Magstripe Readers. Same day shipping. 30-day money-back guarantee. One-year warranty. Reseller discounts available.
AMERICAN MICROSYSTEMS
2190 A Regal Parkway, Euless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

BAR CODE PRINTING SOFTWARE
- MS/PC DOS SYSTEMS
- 9 & 24 PIN DOT MATRIX
- H-P LASER JET/PLUS/SERIES II
- MENU-DRIVEN or MEMORY RESIDENT
- CODE 39, I2/5, UPC A/E, EAN 8/13
- BIG TEXT & BAR CODE SOFTFONTS

AMERICAN MICROSYSTEMS
2190 A Regal Parkway, Euless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

PORTABLE BAR CODE READER
Battery operated, handheld reader with 64K RAM, 54 key keyboard, real-time clock, 2X16 LCD display, and built-in calculator. Supports WAND, CCD, and LASER. Built-in program generator supports multiple programs and data files. Interfaces to PC & PS/2 keyboards. RS-232 terminals, and HAYES compatible modems. 30-DAY MONEY-BACK GUARANTEE.
AMERICAN MICROSYSTEMS
2190 A Regal Parkway, Euless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

BAR CODE READERS
Complete line of bar code reading hardware and software for PC/XT/AT/PS/2 & terminals. Reads all major symbologies (39, I2/5, UPC/EAN). Laser scanners, badge slot & mag stripe readers. We can assist in any stationary or portable application. 30-day $$ back. 1 year warranty. Reseller discount. We speak Spanish!
BARCODE INTERNATIONAL SYSTEMS
9190 Palm Canyon Dr., Corona, CA 91719
(714) 277-1917 **FAX: (714) 277-1005**

Inquiry 707.

BAR CODE

PRINT & READ BAR CODES!
The Standard Edition of KNOW-WEDGE for CODE 39
Complete with Stainless Steel Wand.
Includes FREE bar code printing software!
ONLY $159.00.
For alternative hardware or software solutions
CALL
COMPUTER RESOURCES GROUP
629 Silverdale Drive, Claremont, CA 91711
VOICE: (714) 624-8734 BBS: (714) 626-1054

Inquiry 708.

LAPTOP WAND & SOFTWARE: $199
PC WAND & WEDGE: $188
Both complete with STAINLESS STEEL WANDS. AUTOSELECT ALL POPULAR CODES and SOFTWARE-TRANSPARENT. LASERS from $375. CCD scanners from $245. PORTABLE & RF DATA COLLECTORS 8 line x 24 display. OPTICAL MARK (test form) readers. MAG STRIPE readers/writers. Slot (badge) readers. Bar code PRINTING SOFTWARE. Reseller discounts. 30-day money back.
DATA HUNTER
6181 Medford, Huntington Beach, CA 92647
(714) 892-5461 Fax 714-892-9768

Inquiry 709.

I. T. S. Bar Code Solutions
Bar codes are easy using our FULL line of readers & printers. They plug and play with your existing CPU/printer/terminals/ software systems in your office, store, truck, factory or warehouse. ITS' bar code DOS programs print on matrix or laser printers. 30 day refund. 1 year warranty. OEM/VAR/ Dealer discounts.
International Technologies & Systems Corp.
655-K North Berry St., Brea, CA 92621 - Western USA
13 Welwyn Court, Richmond, VA 23229 - Eastern USA
(800) 228-9487 (714) 990-1880 (804) 741-6725 (FAX) 990-2583

Inquiry 710.

PC BAR CODE SPECIALISTS
Bar code readers designed for fast, reliable, cost-effective data entry. They emulate your keyboard, so data looks just like it was typed in! Choose from stainless steel wand, laser gun, card slot or magnetic stripe scanners. Also, powerful label printing software. Great warranty. Generous reseller discounts. 30-DAY MONEY-BACK GUARANTEE.
Seagull Scientific Systems
15127 N.E. 24th, Suite 333, Redmond, WA 98052
1-800-758-2001 206-451-8966

Inquiry 711.

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
1-800-526-5920 FAX: 415-856-3843

Inquiry 712.

BAR CODE

LABEL SOFTWARE...$299.95
WYSIWYG for HP, Epson and popular THERMAL/TTR. Print from ASCII, Screen, Command Line or Database.
PORTABLE SOFTWARE $199.95
RS422/RF MGT SFT $999.95
DOS/NOVELL/UNIX - Easy to use - Most Popular HWD Also Inventory - Tool - Warranty - Asset $999.95 ea.
WINTERCAMP TECHNOLOGIES
PO BOX 1875, Ramona CA 92065
(619) 788-9660 FAX (619) 788-9690

Inquiry 713.

BASIC LANGUAGE TOOLS

BASIC TOOLBOX - $99
Advanced BASIC library for the serious MS BASIC PDS 7 & 7.1 and QuickBasic 4.5 programmer. Complete library comprised of nearly 350 routines including the following: file manipulation, string handling, mathematical, input fields, bit arrays, mouse, array management, memory manipulation, dos routines, list boxes, 2-D file scrolling/windowing, more.
CALL (409) 832-6510
AMERICAN DIGITAL TECHNOLOGY GROUP
PO Box 1375, Beaumont, TX 77704

Inquiry 714.

BASIC Pop-Ups
Want to add text-based mouse integration, pull-down menus, pop-up windows, scroll bars and much much more to your Quick-Basic Programs? Then order the IB Library NOW. Only US$40. Includes library, demo program with source and documentation. Easy and quick to use. Dual Media.
UHLIK Software
GPO Box 1842, Hobart Tas 7001, Australia

Inquiry 715.

CAD

NEW! Power Tools for AutoCAD®
GT Express Professional™ 3.0
The Leading Display List Software. Includes:
- Up to 1280 x 1024 resolution and 256 colors
- TIGA, VGA, SuperVGA, 8514/A, SPARC
- Flexicon™ - User Definable Menus
- Powerful Utilities
- AutoCLIC™ - Productivity Breakthrough

ARTIST SOFTWARE
Free Demo Disk
1-800-999-9678 Fax # 612-631-7802

Inquiry 716.

PCB & SCHEMATIC CAD–$195
"EASY-PC" for single-sided and multilayer boards to 17"x17" with up to 1500 ICs including surface mount. Phenomenally fast and easy to use. Over 11,000 copies sold. Needs PC/XT/286/386 HERC/CGA/ EGA/VGA. Output to laserjet/inkjet/dot matrix printer, pen-plotter, photo-plotter and NC Drill. Not copy protected. VISA/MC/AMEX welcome. For full info circle inquiry # or contact us directly.
NUMBER ONE SYSTEMS LTD.
Harding Way, St. Ives, Huntingdon, Cambs, England, PE17 4WR
Tel: 011-44-480-61778 Fax: 011-44-480-494042

Inquiry 717.

Sirlin's CAD ++ ENGINE
- Read and Write AutoCAD DWG and DXF files.
- Object oriented, modular, database-like access to CAD data.
- View, Print (rasterize), Plot (vectorize), and Pick (interact) modules.
- Available for C/C++ for DOS, Extended DOS, Windows, Sun and other Unix systems.

Sirlin Computer Corporation
25 Orchard View Dr., Ste 14, Londonderry, NH 03053
Phone: (603) 437-0727 • Fax: (603) 437-0737

Inquiry 718.

CAD

AUTOCAD USERS
Increase your productivity with AutoMate/PRO™
graphical display list software for Release 10(386) 11 & 12.
• user definable icon menus • movable, resizable bird's eye view • real-time anti-aliasing • magnifying glass • real-time pan & zoom • Quick Menu • True Clean feature • enhanced shading support • supports VGA & TIGA at any resolution
Only $295. Money-back guarantee.
Call Vermont Microsystems
1-800-354-0055 1-802-655-2860

Inquiry 719.

CAD/CAM

CONTOURING MOTION CONTROL
FROM A PRINTER PORT!
IndexerLPT™ software
NEW **VERSION 3** $249 VISA/MC
- Controls up to six step motors simultaneously.
- Linear and Circular Interpolation.
- New features to accommodate machine control.
- Easy-to-use DOS device driver. Super Manual.
- CAD-CAM interface available.

Ability Systems Corporation, 1422 Arnold Ave. Roslyn, PA 19001 (215) 657-4338 FAX: (215) 657-7815

Inquiry 720.

Desktop Prototyping
Printed Circuit Boards
Now, with our kit and a desktop plotter, you can make single and double sided printed circuit boards IN MINUTES. Fine pitch lines with throughpad routing plotted directly on rigid board! Our product includes a complete tutorial package with demonstration CAD files on disk. For more information on kit, plotters, and/or accessories write:
Tri State Technical
P.O. Box 350, Westbrookville, NY 12785
Fax: 914-888-0531

Inquiry 721.

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 **Margot Gnade** for more information
603-924-2656
or
Fax: 603-924-2656

CD-ROM

CD-ROM DRIVE & 10 FREE DISCS
High Performance CD-ROM drive:
DOS/MPC: Encyclopedia, Atlas, Mammals, Shareware, Danger Hot Stuff, Games II, Wild Places, World View, Crossword Cracker, Demonstration Disc. $499.00 (Plus Freight)
Free Catalog (Overseas send $5.00)
Hundreds of discs and optical products.
CD ROM, Inc.
1667 Cole Blvd., #400, Golden, CO 80401
Orders: 800-821-5245
Questions: 303-231-9373 Fax: 303-231-9581

Inquiry 722.

* Simtel MSDOS CD-ROM: Find what you need, when you need it. 550+ meg in 8300 files have the best utilities, applications, editors, programming tools, source code, etc. Thoroughly indexed, BBS ready. Produced June 92. $24.95
* Unix/MSDOS Source CD-ROM: Stop reinventing the wheel. 600+ meg of source code, internet comp. sources.*, Simtel Unix-C, lots of MSDOS source. Thousands of complete working programs in C, Asm, Pascal, etc. March 1992. $39.95
*ISO9660, fully guaranteed. Visa/MC/COD S&H $5, $10 air overseas.
WALNUT CREEK CDROM
1547 Palos Verdes Suite 260 Walnut Creek CA 94596
1 800 786 9907 +1 500 9475996 +1 500 947 1644 (fax)

Inquiry 723.

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

46560 Fremont Blvd., Suite 206/Fremont, CA 94538/(510) 440-2870
800-666-4BAR FAX: (415) 623-1372

THE BUYER'S MART

COMMUNICATION/VOICE MAIL

VOICE/FAX MAIL HEADQUARTERS
Affordable; Full Featured; Menu Driven Voicemail
- Bigmouth $195 • Faxmouth $99 • Telemarket $79
- Tavis Talk 4 Liner (Hardware/Software) $1495
- Tavis Voice/Fax Mail (Hardware/Software) $1995
- Custom Software Application Specialist

(KCI) K.I.S.S. Communications, Int'l
34 Robbie Ave., North York, Ontario M3H 1Y4
Voice (416) 633-0351 Fax (416) 638-8512

Inquiry 724.

COMMUNICATIONS

SDLC, HDLC AND X.25 SUPPORT
Use Sangoma hardware and software to provide cost effective, robust and easy-to-use SDLC, HDLC and X.25 links from MS-DOS, UNIX, PC-MOS, etc.
All real time communication functions performed by intelligent co-processor card.
Full function SNA emulation packages also available.
Sangoma Technologies Inc.
(416) 474-1990 1-800-388-2475

Inquiry 725.

COMPILERS

FS: PASCAL
Compile your Pascal Program for 32-bit 80386 protected mode. Forget about memory limitations. Gain speed. Fully compatible with TP 6.0.
Royalty-free Dos extender. Over 250 new functions. Starting with $150. 30-day money-back guarantee.
To order call: 1-800-934-FSDC
1-718-520-4197
Fax: 1-718-575-8038
Frontier Software Development Corp.
68-30 Harrow St., Forest Hills, New York 11375

Inquiry 726.

COMPUTER INSURANCE

INSURES YOUR COMPUTER
SAFEWARE Computerowners coverage provides replacement of hardware, media and purchased software. As little as $49 a year covers accidents, theft, power surges and more. One call does it all.
TOLL FREE 1-800-848-3469
SAFEWARE, The Insurance Agency Inc.
PO Box 02211, 2929 N. High St., Columbus, OH 43202

Inquiry 727.

COMPUTER SYSTEMS

MULTIPROCESSOR BASED SYSTEMS
OS $50 up; Lan/Wan Batch job Qing & Scheduling $99, Remote Control $50 up. Multi-PC's: e.g. 486-33=$999, 33=$699, 286-20=$365; (case + 1Meg + 1.44FD/IDE + IO). Components; Multiprocessor, Transputer & accelerator cards, Svga, Hd. Ram, MultiPc housing, switches & cables, etc. Apps: Neural Nets, Distributed Apps., AI. Your single source for Lan/Wan/Pc multiprocessing.
MB Scientific
7432 Lake Willis Drive, Orlando, FL 32821
PH: (407) 238-1451 FAX: (407) 238-0324

Inquiry 728.

LOW-LOW-LOW
Computer Systems/Notebooks/Network Solutions
IBM-Apple-Compaq-AST-ALR-Everex-&others
SURAH 386/486 ISA/EISA–AMI/Mylex Motherboards • CD ROMS • Tape Backup • Pocket FAX Modem LAN Cards • Hard Drives/Floppy Drives • Memory/upgrades • DRAMS, SIMM Modules • Laser Printers/Scanners • Plotters & Digitizers • Software
SURAH inc. 44912 Osgood Road, Fremont CA 94539 USA
Phone: (510) 651-5101 Fax: (510) 651-5241
1-800-543-1001 Nationwide Orders

Inquiry 729.

COPROCESSORS

MATH ACCELERATOR - $25
Near-coprocessor performance from software!
• Up to 6X faster spreadsheets, graphics, CAD, fonts generation, etc. • DOS, Windows, EMM, & DOS Extenders compatible. • Uses NO DOS memory! • For 386SX and higher processors. • Full coprocessor emulation, application transparent.
Get Q387 Ver. 3.0 from CompuServe (IBM hardware forum), America OnLine, Genie, Delphi, etc., or call:
QuickWare
(512) 280-1452

Inquiry 730.

CROSS ASSEMBLERS

CROSS ASSEMBLERS
Fast, reliable with unlimited length of source code. Conditional assembly, complete set of arithmetic and logical operators. Optional listing with sorted Cross-reference Table. Price $100.00 each.
SIMULATOR-DEBUGGERS/DISASSEMBLERS
We offer excellent full-function simulators with built-in disassemblers for the 8048/49, 8051/52, 8080/85, and Z80 controllers, and now for the 8096 and 80C196, with their unique features fully supported. Prices from $200 to $300 each, with $50.00 discounts for XASM + SIM packages.
Lear Com Company
2440 Kipling St., Ste. 206, Lakewood CO 80215
(303) 232-2226 FAX (303) 232-8721

Inquiry 731.

CROSS DISASSEMBLERS

PROFESSIONAL DEVELOPMENT SOFTWARE
ASSEMBLERS/DISASSEMBLERS
8051, 8048, 8096, 8080/85, Z80/180
Z8000, SPARC, 6800, 6809, 68HC11, 680X0, 6502/C02, 6301, 9900
COMPLETE, OPTIMIZED DEVELOPMENT TOOL SETS FOR THE ENGINEERING PROFESSIONAL
CALL (408) 773-8465
LOGISOFT PO BOX 61929, SUNNYVALE CA 94086
FAX: (408) 773-8466

Inquiry 732.

DATA RECOVERY

Now we're ONTRACK in London Too.
ONTRACK DATA RECOVERY EUROPE, LTD.
Surrey House, 34 Eden St., Kingston upon Thames, Surrey KT1 1ER U.K.
0800-24-39-96 • 44-81-549-3444

Inquiry 733.

Lst yr dta?
We can find it.
• Unsurpassed success rate • Fast turn around • Priority service available • Clean room
• Expertise in DOS, OS/2, Novell, Macintosh, Unix, Xenix, Sun, DEC, Wa g, Banyan Vines and more
ONTRACK DATA RECOVERY, INC.
6321 Bury Drive, Eden Prairie, MN 55346
MN: 1-800-872-2599 • CA: 1-800-752-7557

Inquiry 734.

DATA/DISK CONVERSION

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
Graphics Unlimited Inc.
3000 Second St. North, Minneapolis, MN 55411
(612) 588-7571 FAX: (612) 588-8783
1-800-745-7571

Inquiry 735.

DATA/DISK CONVERSION

IBM PC ⟵ TO ⟶ HP FILE COPY
FASTER EASIER TO USE
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
Box 310 708/554-3567
Oswego, IL 60543 FAX 708/554-3573

Inquiry 736.

CONVERSION SERVICES

Convert any 9-track magnetic tape to or from over 3000 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) Convert

Inquiry 737.

DATABASE

Application Development for dBASE III Plus
dBREADY™ Limited time offer only $79
NO PROGRAMMING REQUIRED.
Complicated dBASE III Plus/Clipper applications developments which take weeks/months are completed within hours including multiple databases/relations, unlimited queries and fixed/custom reports, user friendly screens and menu-driven steps. Modifications/additions made easily. Actual price $379. SATISFACTION GUARANTEED.
Absolute Computer Services, Inc.
5033 Lincoln Oaks Dr. S., Ste. 1203, Fort Worth, TX 76132
(817) 370-8385

Inquiry 738.

DIAGNOSTIC

"..PINPOINT ANY PC FAILURE."
John C. Dvorak, PC Magazine 7/30/92
Top-rated PocketPOST Power On Self-Test card with diagnostic software for ISA/EISA/Micro-Channel. 180-page book. Hones your trouble shooting skills. CALL NOW.
DATA DEPOT, Inc.
1710 Drew Street #5, Clearwater, FL 34615
1-800-275-1913
813-446-3402 FAX 813-443-4377

Inquiry 739.

EDUCATION

B.S. & 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. B.S. subjects covered are: MS/DOS, BASIC, PASCAL, C, Data File Processing, Data Structures & Operating systems. M.S. program includes subjects in Software Engineering and Artificial Intelligence.
AMERICAN INST. for COMPUTER SCIENCES
2101-BY Magnolia Ave. South, Ste. 200, Birmingham, AL 35205
800-767-2427 205-323-6191

Inquiry 740.

ENTERTAINMENT

Vegetable Garden Design
SPROUT!
Planting tool produces a graphic vegetable garden plan with correct plant and row spacing. Contains database for 7 climate regions. Prints out garden layouts, calendars, shopping lists, and reports.
IBM ... $59.95 Macintosh ... $79.95
Abracadata, Ltd.
PO Box 2440, Eugene, OR 97402
To order or request free catalog Call (800) 451-4871
FAX (503) 683-1925

Inquiry 741.

ENTERTAINMENT

FREE GAMES!

53 Games on 15/5.25" or 8/3.5" disks. It's FREE! You pay only $5.00 shipping and handling per collection. Credit cards only. Foreign add $5.00 per package.

Call Today!

SMC SOFTWARE PUBLISHERS
(619) 931-8111 ext. 511

Inquiry 742.

Go, NEMESIS, Go

Go - a Zen game. So appealing, it has endured 4,000 years. So useful governments study it.

NEMESIS Go Junior entices novices of any age.
NEMESIS Go Master Deluxe satiates the addicted.
Windows, Macintosh and DOS versions available.

Chaos Manor User's Choice Award (BYTE/1990)

Toyogo, Inc. (800) 869-6469
PO Box 25460-Y, Honolulu, HI 96825-0460
(808) 396-5526 fax: (808) 396-4126

Inquiry 743.

FILE MANAGEMENT

Disk Cataloging System

wkDIR puts your disk file system data into a spreadsheet for analysis. For disk management, PC auditing, backup, security. Compatible with all spreadsheets. Handles deleted and hidden files. Saves time and disk space. $69 + $6 S&H. 30 day money-back guarantee.

E Soft
1840 Oak Avenue 800-835-2246 ext. 23
Evanston, Illinois 60201 708-467-2203

Inquiry 744.

FINANCIAL SOFTWARE

BrainMaker:

"The most fascinating computer software I've ever seen...learn about this stuff." *John Dvorak, PC Mag.* Predicts stocks, bonds, sales, inventories. Comprehensive manual. Menus. 12,000 sold. PC or Mac.

Still only $195!

Free Flyer: 800/284-8112, 916/477-7481
California Scientific Software

Inquiry 745.

FLOW CHARTS

New! - ADS Diagrammer 2.0

Why buy just a flow charter when you can have the power of a Windows™ technical illustration tool?

Call for your free trial disk today!

800-745-6095

$199 - Atlantic Design Systems
77 Sprucewood Dr., Gilford, NH 03246
Phone: (603) 524-2943 Fax: (603) 524-3657

Inquiry 746.

FLOW CHARTING 3

FRIENDLY
FAST
FLEXIBLE

- High resolution print outs... dot matrix or laser
- Multi-page charts... portrait or landscape
- Import/export capabilities
- 35 shapes, 10 fonts, 4 line styles

ONLY $250

Call for free demo disk:

PATTON & PATTON 800-525-0082 ext. 1317
Software Corporation 485 Cochrane Cr., Morgan Hill, CA 95037
See our ad on page 120

Inquiry 747.

FLOW CHARTS

WINDOWS FLOWCHARTER $129

RFFlow 2.0 is a professional drawing tool for flowcharts & org. charts. Requires Microsoft Windows. 100 shapes auto adjust in size. Diagonal lines and curves. Auto line routing and re-routing. Click on a shape to bring up a sub-chart. Move charts to other apps. via the Clipboard. Call for free trial disk.

RFF ELECTRONICS
1053 Banyan Court, Loveland, CO 80538
Phone: (303) 663-5767 FAX: (303) 669-4889

HARD DRIVE REPAIR

Pre-Owned Electronics, Inc™

THE Independent Provider, serving the Dealer, Professional, Corporate, Government, and Educational Buyer since 1985

APPLE II® & MACINTOSH®
SYSTEMS • PARTS • EXCHANGE REPAIRS

Call for a Catalog... **800-274-5343**
INT'L: 617-275-4600 • FAX: 617-275-4848
205 BURLINGTON ROAD • BEDFORD, MA 01730

Inquiry 748.

HARDWARE

ASCI BUYERS CLUB™

You've seen our ad, ***now take a look at our prices !!!***

1 Meg x 9 SIMM 70ns	$34.50
INFINITI 2400 Baud Modem W/Software	$37.95
Mini-Tower W/200 Watt P/S	$71.00
TRIDENT SVGA Card (8900 Chip Set) 1 Meg	$73.60
386DX-33 Motherboard W/64K Cache & CPU	$225.00

All Items Factory New With One Year Warranty
FREE MEMBERSHIP WITH FIRST ORDER OVER $25.00, CALL OR WRITE

ALCO Sec./Com., Inc.
P.O. Box 7049, Hicksville, NY 11802 800-238-ASCI
Tel: 516-935-1602 Dealer Inquiries Welcome FAX: 516-935-5231

Inquiry 749.

HARDWARE/COMPUTERS

SC/FOX™ EMBEDDED COMPUTERS

PC Parallel Coprocessor Plug-in Boards: 15 MIPS avg 50 MIPS burst, using the SC32 32-bit CPU or the 16-bit Harris RTX 2000™.

VME Master/Slave System Controller SBC: 18 MIPS avg 70 MIPS burst, uses RTX 2000 cpu, SCSI, 2 ser, 1 ptr ports, to 640K bytes.

Stand-Alone Single Board Computers: 18 MIPS avg 60 MIPS burst, 3U or 100x100mm Eurocard-size using either SC32 or RTX 2000.

Ideal for embedded real-time control, data acquisition, robotics, and signal processing. OEM software development system included.

SILICON COMPOSERS INC (415) 322-8763
208 California Avenue, Palo Alto, CA 94306

Inquiry 750.

EVB - II

68030 and 68EC030

32 bit Microprocessor Trainer and Development System with 32 Bit User Bus, Upload, Download, Assembler and Disassembler Onboard. The EVB - II uses the Serial Port of a Terminal or PC and is similar to 8 and 16 bit units featured in many popular books. Other 8, 16 and 32 bit systems are available.

Phone URDA, Inc.
1-800-338-0517 or 412-683-8732

Inquiry 751.

INDUSTRIAL SOFTWARE

RUN A PLC, CNC, DATA LOGGER ON YOUR PC using our PCLog environment

PCLog is entirely written in C. It easily transforms your PC into a system that runs industrial applications.

DON'T WAIT! Download your free DEMO now at (142)453165

ELSIST
Electronic Systems
Via Brodolini, 15, 15033 Casale MTO, Italy
PH. 142/451987, FAX. 142/451988, BBS. 142/453165

Inquiry 752.

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 Orders 800-628-7992

Inquiry 753.

LAPTOP COMPUTERS

IBM CONVERTIBLE

HARD TO FIND ACCESSORIES

- **MEMORY**–128K $79 256K $225
- **MODEMS**–Standard $75 Enhanced $175
- **CRT ADAPTER**–for monitors $99
- **SERIAL/PARALLEL ADAPTER**–$120
- **MONITORS**–Monochrome $59 Color $109
- **CARRYING CASES**–Standard $69 Compact $39
- **ENHANCED LCD**–$79 **BATTERY**–$89
- **HARD DRIVES**–40 Meg $495

COMPUTER RESET
P.O. Box 461782, Garland, TX 75046
Phone (214) 276-8072 BBS & FAX (214) 272-7920

Inquiry 754.

NEURAL NETWORKS

NEURAL NETWORKS

We needed a good development system, were dissatisfied with the available ones, so wrote our own: N-TRAIN™, an industrial strength neural network training tool designed for power, speed, accuracy and reliability. Runs *much faster* than several popular systems. Trains on difficult fact sets. No limit on number of interconnections, layers or facts. Many highly desirable features. For 386/486 or i860. Also available: pretrained neural network systems for financial forecasting.

SCIENTIFIC CONSULTANT SERVICES, INC.
20 Stagecoach Road, Selden, NY 11784; 516-696-3333

Inquiry 755.

NOTEBOOKS

SAVE! **PALMTOPS • NOTEBOOKS** ***SAVE!***

TOSHIBA • EVEREX • ZENITH • AT & T • TANDON
AST • SHARP • BONDWELL • ALR • LIBREX
PANASONIC • ALTIMA • LEADING EDGE
PACKARD BELL • SAMSUNG • NEC • TI • COMPAQ
• We *ALSO* carry accessories and software •

Computer Options Unlimited
12 Maiden Lane, Bound Brook, NJ 08805
Advice?: 908-469-7959
For Notebooks: 1-800-424-Port For Sub-notebooks: 1-800-Palmtop
6 days Worldwide Sales

Inquiry 756.

PROGRAMMERS TOOLS

C and C++ DOCUMENTATION TOOLS

- **C-CALL ($69)** Graphic-bee of caller/called hierarchy.
- **C-CMT ($69)** Generate, insert, update comment-blocks.
- **C-METRIC ($59)** Path complexity, lines/stmts/comments.
- **C-LIST ($69)** List, action-diagram, reformat programs.
- **C-REF ($59)** Local/global/parameter cross-reference.
- **C-DOC ($199)** All 5 as 1 DOS program, <=15,000 lines.
- **Professional ($299)** <=150,000 lines, DOS, OS/2, Windows.

SOFTWARE BLACKSMITHS INC.
6064 St. Ives Way, Mississauga, ONT, Canada L5N-4M1
Voice/Fax: (416) 858-4466 Demos/BBS: (416) 858-1916

Inquiry 757.

DON'T DEVELOP NETWORK APPLICATIONS

without NPPC, a powerful library sub-routine package that handles all the details of NetBIOS or IPX programming! **NPPC** supports high-level program communications at the message level for all server/ client and peer-to-peer models. If you are using C or Assembler, **NPPC** allows you to write a single application that runs on BOTH IPX AND NetBIOS without any modifications. **NPPC** is compatible with any true NetBIOS emulator, therefore applications written with **NPPC** will work with most LANs in the marketplace. We offer a 30 day money back guarantee.

NPPC for IPX or NetBIOS: $195.00, with source: $395.00

SOFTWAREHOUSE CORPORATION
326 State Street, Los Altos, CA 94022
(415) 949-0203 FAX: (415) 949-0208

Inquiry 758.

THE BUYER'S MART

PROGRAMMERS TOOLS

Boost Your BASIC with ProBas!
- Adds 938 new commands to QB and PDS
- Written in assembly for speed
- Gives your programs a professional look
- Easy to use, money back guarantee
- Other add-ons for BASIC, C & Visual Basic avail.

FREE DEMO Disk AND BOOKLET

TeraTech (800) 447-9120 x142

Dept 128, Suite 360, 3 Choke Cherry Rd., Rockville, MD 20850

Int'l (301) 330-6764 Fax (301) 963-0436 BBS (301) 963-7478

Inquiry 759.

PUBLIC DOMAIN

FREE SOFTWARE for IBM®

TRY US! GET 15/5.25" or 8/3.5" disks full of our best selling software–FREE! Games, Windows™, utilities, business, educational, religion, home/health. Pay $5.00 shipping/handling per collection. Credit cards only. Foreign add $5.00 per pkg. Call today!

SMC SOFTWARE PUBLISHERS
(619) 931-8111 ext. 511

Inquiry 760.

SECURITY

FIGHT PIRACY!
★ EVERLOCK 3.0 ★
SOFTWARE COPY PROTECTION
New Option Board Safe-New Remote Registration
New CPU LOCK-CD ROM LOCK and more
★ EVERKEY HARDWARE LOCKS ★

Az-Tech Software, Inc.

Call for a FREE Demo (800) 227-0644

201 East Franklin, Richmond, MO 64085
(816) 776-2700
FAX (816) 776-8398

Inquiry 761.

THE ULTIMATE COPY PROTECTION
- Completely menu driven
- Defeats all Hardware/Software Copiers
- No Source Code Changes
- Multiple Layering
- No Damaged Media
- Full Hard Disk & LAN Support
- Unlimited Metering, FREE Demo Disk

Quite Simply The Best Ways To Protect Your Valuable Software Investment

STOPVIEW™ STOPCOPY PLUS™ (800) 879-2224

BBI COMPUTER SYSTEMS, INC. (301) 871-1094
14105 Heritage Lane, Silver Spring, MD 20906
FAX: (301) 460-7545

Inquiry 762.

Cop's CopyLock II

The professional software protection with TRUE Machine Install. Option Board safe. Supports **OS/2, Windows** and **Trace.**

LINK Computer

Int'l: + 45 31232350 Fax: + 45 31238448
US/CAN: 800-344-2545 FAX: 408-923-7061

BIT-LOCK® SECURITY

Piracy SURVIVAL 10 YEARS proves effectiveness of powerful multilayered security. Rapid decryption algorithms. PARALLEL or SERIAL port-transparent security device. Complemented by economical KEY-LOK™ and multifeatured COMPU-LOCK™ including countdown, timeout, data encryption, and multiproduct protection. (Dos/Unix/Mac). Also, access control.

MICROCOMPUTER APPLICATIONS
3167 E. Otero Circle, Littleton, CO 80122
(303) 770-1917

Inquiry 763.

SHAREWARE

THE AMISH OUTLAW
SHAREWARE COMPANY
★★★★★★★★★ FREE ★★★★★★★★★
WITH EVERY ORDER YOU WILL RECEIVE A GREAT NEW GAME
NOT LISTED IN OUR CATALOG ABSOLUTELY FREE
ALL DISKS HAVE EASY-TO-USE MENUS
SIMPLY TYPE "GO" TO ACCESS PROGRAMS
$3.00 PER DISK 1-9 – $2.50 PER DISK 10-UP
3.5" AND 5.25" DISKS SAME PRICE
(IBM PUBLIC DOMAIN AND SHAREWARE ONLY)
3705 RICHMOND AVE., STATEN ISLAND, NY 10312
1-(800) 947-4346 or (718) 317-0198 FAX 1-(718) 966-4766

Inquiry 764.

SOFTWARE/ACCOUNTING

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/$198 ea. + S&H

dATAMAR SYSTEMS Cred. Card-Check-COD
8586 Miramar Place, San Diego, CA 92121
(619) 452-0044 (800) 223-9963

Inquiry 765.

SOFTWARE/BUSINESS

DATA ENTRY SOFTWARE

Full featured, heads-down data entry with two-pass verification, edit language, operator stats, much more! Designed for the PS/2®, PC, XT, AT or compatibles.

PCs from $395 LAN version available

FREE 30 day trial

Computer Keyes
21929 Makah Rd.,
Woodway, WA 98020

Tel: 206/776/6443
Fax: 206/776-7210
USA: 800/356-0203

SOFTWARE/DATA COMPRESSION

Double your hard disk ZIPIT™

Continuous floppy archive of huge files.
Automatic creation of self-extract file.
One-step imploding of directory trees.
Transfer huge files between PCs.
Send $49. Visa/Ms/Check/MO.

DIRTRAN SYSTEMS INC.
PO BOX 1207, ROSLYN PA 19001
Phone (800) 995-2501 Fax: (215) 659-2029

Inquiry 766.

SOFTWARE/DOCUMENTATION

Automated User Manuals
Faster! Easier! Better!
- Interactive Structured System Cuts Documentation Time 50% to 80%
- Graphics, Fonts, Extensive Printing Options
- Manuals Include Table of Contents, Full Index, Getting Started, Reference, Tutorials and More!
- Just $199.95! Call 1-800-221-8275 for Special Offer!

Doc Maker Automated Documentation System

Task Software Co.
2856 Falling Tree Circle
Orlando, FL 32837
407-826-0348

SOFTWARE/ENGINEERING

Analog & Digital
Circuit Design & Simulation
for Windows™ & the MacIntosh™
B² Spice® $130/ea. B² Logic®

MOSFET BJT JFET & others. Transient, Ac, DC analyses. Graphs & tabulates results.

Over 100 components. Interactive and batch simulations. View results in timing diagrams.

Graphical Schematic Entry
• Now in use at over 20 major universities •

Beige Bag Software Ph: (313) 663-4309
715 Barclay, Ann Arbor, MI 48105 Fax: (313) 663-0725

Inquiry 768.

SOFTWARE/ENGINEERING

Analog Circuit Simulation
- PC and Macintosh CAE
- Schematic Entry
- SPICE Simulator
- Monte Carlo Analysis
- Parameter Sweeping
- Filter Design
- Extensive Model Libraries
- Waveform Analysis
- Report-Quality Plotting
- Full SPICE programs starting at $95. Complete systems from $990

Call for your Free Demo and information kit.
P.O. Box 710, San Pedro, CA 90733-0710
310-833-0710, FAX: 310-833-9658 **intusoft**

Inquiry 769.

GEOMETRY/TRIGONOMETRY CALCULATOR

Apollonius – Sketch-based geometry/ trigonometry solver. State-of-the-art variational geometry system lets you sketch your geometry or trig problem and automatically solves for distances, angles and areas. Integrated equation calculator, graphs and tables plus DDE and clipboard support. Ideal for surveyors, engineers, machine shops, students, architects, or anyone who uses trig. Runs under MS Windows 3.0 $98

Saltire Software 1-800-659-1874

Inquiry 770.

CAE SOFTWARE

■ ECA-2: Analog Circuit Simulator • AC, DC, Transient Analysis • MonteCarlo, WCA • Interactive/full nonlinear
■ SAUNA: 3-D Thermal Analysis • PC Bds, heat sinks, & enclosures • All HT modes • Thermal parameters library
■ ACTIVE: Switched Cap & Active Filters • Order 1-50 of 5 cascaded filters • (45) topologies • (8) Types

For FREE demo call:

Tatum Labs Inc.
1287 North Silo Ridge Drive, Ann Arbor MI 48108
(313) 663-8810

Inquiry 771.

SOFTWARE/GRAPHICS

TIFF, PCX, TARGA, GIF, DIB, BMP, WMF, WPG
AccuSoft Image Format Library

Import, export, convert, display and print images. DOS & Windows versions included in one low-priced, royalty-free package. Sample applications with complete source code. Compatible with all major C, C++ compilers and all Windows languages. Supports all flavors of each format up to 24 bits/pixel. 30 day satisfaction guarantee. $295

AccuSoft Corporation
160 E. Main St., Westboro, MA 01581
(800) 525-3577 (508) 898-2770 FAX (508) 898-9662

Inquiry 772.

SCIENTIFIC VISUALIZATION

Graphics library for VGA and ET4000 Super VGA boards. Over 75 routines callable from MS FORTRAN. Up to 1024x768 in 256 colors. 2-D & 3-D w/perspective. Gouraud shaded polygons. Hidden surface removal. Animation. Mouse & joystick support. Scale and rotate text. Store/retrieve in PCX format. $100 postpaid. No royalties. Call for free demo disk.

AEROSOFT CORPORATION
5562 Bells Ferry Rd., Suite 233, Acworth, GA 30102
Tel/FAX: (404) 917-1309

Inquiry 773.

Develop CAD/CAM, GIS, A/E/C Products ON TIME and UNDER BUDGET with the "CAD/CAM Developer's Kit" Series

The CCDKs are libraries of C functions which support routines for DXF input/output, graphical display, line/arc/ellipse/NURB spline construction/ed ding, and much more than can be described here.

Building Block Software, Inc.
371 Moody Street, Waltham, MA 02154
Voice (617) 899-4350 Fax (617) 899-4399

Inquiry 774.

SOFTWARE/GRAPHICS

"The Ultimate CAD/CAM/CAE Programming Engine"

Stash development time with TG-Professional v.4.0, the most complete C/C++ toolbox of 2D & 3D geometric routines available today! Over 800 routines including NURBS, DXF, Graphics, Surfacing, Hidden Line, Transforms, Perspectives, Polygon (Int/Union/Diff), Clipping, Tangents, Graphics routines for drawing using BGI or MSC Graphics and more. Full source, 30 day guarantee. USA $500.00, Foreign $565.00US. Use MSC, Borland C/C++, WATCOM C/386 or Metaware High C/C++. Call 1-800-635-7760 or Fax/Phone 214-423-7288 for free technical information.

Disk Software Inc.
2116 E. Arapaho Rd., Suite 487, Richardson, TX USA 75081

Inquiry 775.

RAINDROP™

FAST, compact PrtScrn Utility for end users AND developers. Hardcopy as fast as 10 secs. Average binary size - 6 kbyte. 14 video graphic standards. Scale, rotate, colorize and more. 'CALL' from user-written programs. Complete 9- & 24-pin dot-matrix, inkjet, and laserjet library $44.95 + $3 s/h.

ECLECTIC SYSTEMS
8106 St. David Ct., Springfield, VA 22153
(703) 440-0064 Fax (703) 455-8965

Inquiry 776.

FORTRAN GRAPHICS

GRAFMATIC - FORTRAN callable graphics Library for creating 2-D and 3-D graphics, contour plots and solid models. PRINTMATIC and PLOTMATIC provide high resolution FORTRAN callable printer and plotter drivers for your graphics. NO ROYALTIES. $249.95 ea.

Supports Microsoft/Lahey/RM FORTRAN compilers

Jewell Technologies, Inc.
130 Nickerson St., Suite 105, Seattle, WA 98109
1 (800) 284-2574 (206) 285-6860

Inquiry 777.

SOFTWARE/MATHEMATICS

OPERATIONS RESEARCH @ $149 for your IBM or Compatible

LP88–Linear Programs up to 3000 by 15000.
BLP88–Linear Programs with Bounded Variables.
MILP88–Mixed-Integer Linear Programs.
MXLP88–Large Model Mixed-Integer LP.
TSA88–Transportation/Transshipment Problems.
NLP88–Nonlinear Objective Programs.
Student/Demo–Reduced capacity versions for students.
Turbo Pascal Units–Object modules for developers

Eastern Software Products, Inc.
P.O. Box 15328, Alexandria, VA 22309
(703) 360-7600, Fax (703) 360-7654

Inquiry 778.

SOFTWARE/PACKAGING

FREE SOFTWARE PACKAGING CATALOG

Everything you will need to Package, Distribute, and Ship Your Software!! From manuals and binders to mailers and shippers

LABELS • LABELS • LABELS
For your diskettes, plain or custom printed dot matrix or laser printer... free samples
•••FREE CATALOG•••
Hice & Associates
8586 Monticello Dr., West Chester, OH 45069
Phone/Fax: 513-777-8586

Inquiry 779.

SOFTWARE/SCIENTIFIC

Weather Monitor & Weatherlink!

The ultimate in weather monitoring systems! A state-of-the-art weather station and a PC link allow you to view, record, summarize, and graph weather information. The perfect marriage of computer and weather technology.

DAVIS INSTRUMENTS
3465 Diablo Avenue, Hayward, CA 94545
1-800-678-3669 FAX 1-510-670-0589 8Y2I

Inquiry 780.

SOFTWARE/SCIENTIFIC

VTEX Scientific Desktop Publishing

• Equations • Tables • Graphics • Scalable Fonts • Supports most printers • WYSIWYG previewer • Foreign Languages • Special Symbols • Font Effects • Indices • Only $299

"TEX of Tomorrow"–Notices of AMS, March 1991.

MicroPress, Inc.
68-30 Harrow Street, Forest Hills, NY
Tel (609) 497-0008 Fax (609) 497-0917

Inquiry 781.

FREE CATALOG

A great selection of scientific software products for plotting, non-linear curve fitting, chemical equilibrium, simulation, statistics, symbolic algebra, and more. Prices from $150. Call:

1-801-943-0290

MicroMath, Salt Lake City, UT 84121-0550

Inquiry 782.

OVER 300 PROGRAMS AVAILABLE!
FREE CATALOG!

- COGO Routines
- Surface Modeling
- Gridding & Contouring
- Groundwater Modeling
- Molecular Modeling
- Astronomy
- Geophysics
- Base Mapping
- Log Plotting & Analysis
- Petroleum Databases
- Oil & Gas Economics
- USGS Digital Elevation Quads
- Data Conversion
- Statistical Analysis & Plotting
- Geo & Hydro Chemical Analysis
- Hydrodynamic Modeling

RockWare 4251 Kipling St., Ste. 585 Wheat Ridge, CO 80033
(303) 423-5645 • Fax (303) 423-6171 • RockFAX* (303) 423-7112
*24-hr. fax on-demand product information service

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 783.

SOFTWARE/VOICE/FAX

MULTI-VOICE® TOOLS

Multi-Voice Tools is a complete development Toolkit for Pascal or "C" to access a ll the features for most speech processing boards available today. It helps you write MULTI-LINE VOICE APPLICATION systems in minutes. A number of programming examples are provided. All programs and libraries are delivered with source code.

Dialogic, Rhetorex, Pika, VBX: $599, Watson (Single Line): $99. ALSO AVAILABLE: Fax Programmer's Toolkit ($199). Based on CAS specifications. Visa/MC accepted.

ITI Logiciel
4263 Cristophe-Colomb, Montreal, Quebec, Can. H2J 3G2
TEL (514) 597-1692 FAX (514) 526-2362

STATISTICS

VISUALIZE YOUR DATA

MCA+ transforms most marketing and social science data to easily understood perceptual maps. Communicate complex relations with ease using presentation quality charts. Most printers supported. Demos available.

Bretton-Clark
89 Headquarters Plaza, Morristown, NJ 07960
(201) 993-3135 FAX: (201) 993-1757

Inquiry 784.

STATISTICS

NCSS 5.x Series – $125

Easy-to-use menus & spread sheet. Multiple regression. T-tests. ANOVA (up to 10 factors, rep. measures, covariance). Forecasting. Factor, cluster, & discriminant analysis. Nonparametrics. Cross Tabulation. Graphics: histograms, box, scatter, etc. Reads ASCII/Lotus. Many new add-on modules.

NCSS
329 North 1000 East, Kaysville, UT 84037
Phone: 801-546-0445 Fax: 801-546-3907

Inquiry 785.

TRANSLATION

SOFTWARE LOCALIZATION

Since 1980, IDOC has translated hundreds of packages for the world's most prominent computer firms: Ashton-Tate, Borland, HP, Sun Microsystems, Novell and many more. We offer FULL SOFTWARE ADAPTATION WITH IN-HOUSE ENGINEERING, TRANSLATION INTO ALL MAJOR LANGUAGES WITH IN-HOUSE LINGUISTS, DTP SPECIALISTS, AND EDITORS. With production and sales offices in Los Angeles, Dublin, Milan, Buenos Aires, and Tokyo (Fall 92). IDOC is the leader in worldwide translation services.

IDOC, an International Documentation Company
1-800-336-9898 (U.S.) 353-1-284-4223 (Europe)
10474 Santa Monica Blvd, Suite 404, Los Angeles, CA 90025

Inquiry 786.

UTILITIES

PEN PLOTTER EMULATOR

FPLOT turns your printer into an HP pen plotter. Fast hi-res, no jagged lines. Vary line width, color. Screen preview – zoom, pan. Works with most CAD programs. Supports most printers. Requires DOS 2.1 or higher. $119+$3 S&H. VISA/MC/Chk/MO.

FPLOT Corporation
24-16 Steinway St., Suite 605, Astoria, NY 11103
718-545-3505

Inquiry 787.

The Absolute *BEST* in Virus Protection

Compare anti-virus software and the *ViruStop PC Immunizer Card*

	ViruStop	Leading Software
Needs constant updates	NO	YES
Vulnerable to virus infection	NO	YES
Takes time to scan drives	NO	YES
Password Function	YES	NO
Network Compatibility	YES	Requires Special Version
Cost (S&H extra)	$59	$80 and up, plus the upgrade costs

As seen in Computer Shopper 7/92, ISP News 5/92, PC Magazine 5/26/92

MULTIX, INC. 4203 Bellway Dr., Suite 7, Dallas TX 75244
Tel: (214) 239-4989 Fax: (214) 239-6826 We accept MasterCard and VISA

Inquiry 788.

Why You Want BATCOM!

BATCOM is a batch file compiler that transforms your .bat files to .exe files to make them faster. BATCOM extends DOS with many new commands so you can read keyboard input, use subroutines, and much more. In addition, BATCOM protects your source code. No royalties! Only $59.95. Order today!

Wenham Software Company
5 Burley St., Wenham, MA 01984
(508) 774-7036

Inquiry 789.

WINDOWS

A Hyperimage/document management system under MS-Windows™ 3.x

Displays multiple windows of images and documents in true color or with color matching. Associates text info, images or symbols to any pixel inside an image. Easily switches from image to image through successive levels of detail. Finds a point inside an image by entering its name e.g. address. Organize images and files in a network/relational database. Users can design their own information templates and search with multiple keys. Include a powerful editor. File security & Treesearch. Link to clipboard. Pan and zoom within images. Work with PCX, BMP, TIF, GIF, Postscript file Formats. Network Ves. Avail. *Introductory offer– $185.*

Friendly Information Systems, Inc.
34 Bow Avenue, Oedham, MA 02026
(508) 486-0003 or (617) 329-1620

Inquiry 790.

YOUR DIRECT LINK

ADVERTISER CONTACT INFORMATION

To order products or request FREE information, call advertisers directly or send in the Direct Link Card by mail or fax! ***Let them know you saw it in BYTE!***

Inquiry No.		Page No.	Phone No.
	A		
248-249	AAEON	357	
71-72	ABACUS SOFTWARE	191	800-451-4319
391-392	ABC COMP (USA) CORP	352	310-325-4005
301-302	ACI/ACQUIRE	355	886-2-758-9615
202-203	ADVANCED COMP PROD	340	714-558-8813
73-74	ADVANCED LOGIC RESEARCH	254,255	714-581-6770
77	ADVANCED MICRO DEVICES	10,11	800-222-9323
303	ADVANCED MICRO TECH	354	714-598-6120
76	AITECH	66	
75	ALADDIN KNOWLEDGE SYS	65	800-223-4277
328	ALADDIN KNOWLEDGE SYS	284IS-3	800-223-4277
557	ALADDIN KNOWLEDGE SYS	332NE-4	800-223-4277
558	ALADDIN KNOWLEDGE SYS	332NE-5	800-223-4277
204	ALTEX ELECTRONICS	330,331	800-531-5369
*	AME INSTIT FOR COMP SCI	361	205-323-6191
201	AMERICA ONLINE INC (N.A.)	146A–B	800-827-6364
250	AMERICAN ADVANTECH	357	800-800-6899
78-79	AMERICAN MEGATRENDS	117	800-828-9264
80	AMER SMALL BUSI COMP	145	918-825-4844
304	AMRAM	357	408-559-0603
205	AMT INT'L	350	408-942-9695
*	APPLE COMPUTER INC	21,23,25	
*	APPLE COMPUTER INC	149	
*	APPLE COMPUTER INC	151	
*	APPLE COMPUTER INC	170A–D	
560	APPRO INT'L INC	332NE-6	408-732-6091
573	APPRO INT'L INC	332MW-4	408-732-6091
*	APS TECHNOLOGIES	325	800-235-3707
374	ARABIC PUBLISHER	268IS-2	357-2-448326**
329	ASP COMP PROD (INT'L)	221	800-952-6277
61-62	AST RESEARCH INC	214	800-876-4AST
242	ATLAS INDUSTRIES INC	320	800-ATLAS-11
309	ATLAS INDUSTRIES INC	354	800-ATLAS-11
82	AUTODESK INC	94,97	800-964-6432
*	AUTODESK INC	95,96	800-964-6432
108-109	AUTODESK RETAIL PROD	128	800-228-3601
294-295	AXIOM	354	886-2-917-3200
251-252	AXIOMATIC	357	416-503-3335
	B		
206-207	BAY TECHNICAL ASSOC	343	800-523-2702
450	BIX	295	
289-290	BLACK ICE S/W, INC.	363	603-673-1019
371	BLACKWELL S/W	268IS-3	44-0865-721205
393	BLINK INC	259	804-355-4444
330-331	BORLAND INT'L (INT'L)	CIV	800-331-0877
83-84	BORLAND INT'L	17	800-331-0877
85-86	BORLAND INT'L	18,19	800-331-0877
388	BOSTON UNIV ED CTR	306	508-649-4200
322	BRENT COMMNCTNS	178UK-4	44-0423-501-44
399	BUFFALO PRODUCTS	35	800-345-2356
208	BULLDOG COMP PROD	337	800-438-6039
*	BUYER'S MART	112IS-7,8	603-924-2656
*	BYTE EURODECK	187	
87	BYTE PUBLICATION	375	
*	BYTE REPRINTS	178	
*	BYTE SUB MESSAGE	284	
	C		
*	C USERS JOURNAL	112IS-5,6	913-841-1631
*	C++ REPORT	112IS-7,8	212-274-0640
88	CAPITAL EQUIPMENT CO	184	800-234-4232
89	CAPITAL EQUIPMENT CO	185	800-234-4232
314-315	CHAI SHIN	354	886-2-9619586**
234	CITITRONICS	332	818-855-5688
333-334	CLARION SOFTWARE	146IS-3	305-785-4555
90	COMMODORE	31	
575	COMPAQ COMP CORP	166,167	800-345-1518
335-336	COMPEX (INT'L)	210IS-1	714-630-7302
91	COMPUCLASSIC	244	800-827-1994
384	COMPUDYNE	236,237	800-932-COMP
337	COMPUSAVE INT'L	210IS-4	602-437-8208
92	COMPUTER ASSOCIATES	39	
93	COMPUTER ASSOCIATES	73	
94	COMPUTER ASSOCIATES	111	
*	COMPUTER BOOK CLUB ,THE (N.A.)	162A–B	
*	COMPUTER BOOK CLUB ,THE (N.A.)	163	
95	COMPUTER FRIENDS	276	800-547-3303
338	COMPUTER QUICK (INT'L)	163	415-861-8330
209	COMPUTERLANE UNLTD	342	800-526-3482
253	COMPUTERWISE	361	800-255-3739
230-231	COMTRADE	349	800-689-2123
*	COPIA INT'L	146	708-682-8898
339-340	CORE INT'L	162IS-1	407-997-6044
96	COREL SOFTWARE	40	800-836-SCSI
327	CORPORATE ITEC SERVICES	178UK-4	44-0793-611-43
195	CREATIVE LABS INC	271	800-998-LABS
97	CURTIS INC	284	612-631-9512
395-397	CYBER RESEARCH	344	800-394-3300
210	CYBEXCORP	338	205-534-0010**
223	CYBEX CORP (INT'L)	CIII	205-534-0010**
385-386	CYRIX	140	800-FAS-MATH
	D		
318	DANTECH PLC	178UK-1	44-81-902-3300
382-383	DATA PROD &SERV	375	800-669-8194
98-99	DATALUX CORP	138	800-DATALUX
312-313	DAVISON-WORTH CORP	358	800-668-2707
87	DECISIONS	375	
100	DELL COMP CORP (N.A.)	CIII	800-626-8260
101	DELL COMP CORP (N.A.)	CIV	800-626-8260
102	DELL COMP CORP (N.A.)	36,37	800-626-8260
63	DELL COMPUTER CORP (N.A.)	218,219,221	800-626-8260
103	DIGITAL VISION	276	800-346-0900
254	DIVERSIFIED COMPUTER	360	303-447-9251
104	DOLCH COMP SYS	91	
211-212	DPT	347	407-830-5522
341	DR HUGGLE & PARTNER GMBH	268IS-2	49-0241-403118
236	DYNAMICSCAN	322,323	314-423-0044
	E		
213	E T VALUELINE/ELEK-TEK	334	800-395-1000
375	ECG (INT'L)	219	31-4937-96808
255	ECOSOFT INC	361	317-271-5551
*	ELONEX (INT'L)	177	44-81-452-6422
214	ELTECH RESEARCH	345	800-358-8330
307	EMPIRE COMPUTECH	358	800-446-1967
342	EUTRON	284IS-1	39-35-692-229**
	F		
343	FAST ELECTRONIC GMBH	162IS-3	49-089-533-401
215-216	FIRST SOURCE INT'L	341	714-588-9866
*	FRAME TECHNOLOGY	129,130	800-U4FRAME
105	FRAME TECHNOLOGY	131	800-U4FRAME
106-107	FTP SOFTWARE (N.A.)	84	617-246-0900
	G		
*	GATEWAY 2000	CII,1	800-523-2000
*	GATEWAY 2000	49–52	800-523-2000
344	GFK HAMBURG	146IS-4	49-040-231-789
110-111	GLENCO ENGINEERING	205	800-562-2543
256	GMM RESEARCH CORP	355	714-752-9447
305	GRANICOR	358	415-244-9999
257	GREENLEAF SOFTWARE	362	800-523-9830
345	GREY MATTER LTD	146IS-2	44-0364-53071**
332	GROUPE BLENHEIM SW DEV EXHIBIT	377	33-14-789-9984
258	GTEK INC	358	800-282-4835
259	GTEK INC	355	800-282-4835
	H		
198	HANDTOP COMP LTD	258	33-106177077**
346	HANTAREX SPA	209	39-55-49-73364
*	HARD DRIVES INT'L	329	800-998-8013
316-317	HARPER COLLINS	360	44-0903-873633
112	HAUPPAUGE COMP WKS	86,87	
260	HIGH-RES TECHNOLOGIES	358	416-497-6493
113-114	HONEYWELL KEYBOARD DIV (N.A.)	175,177	800-445-6939
116	HOUSTON INSTRUMENTS	299	
	I		
288	IBC DATA	360	45-6591-51-57**
117	IBM OS/2	28,29	
118	IBM PS/2	14,15	800-PS2-2227
325	ICONOGRAPHIC SYS	178UK-4	44-0280-823-31
119	IIYAMA ELECTRIC CO	101	
120	INTEGRAND RESEARCH	114	209-651-1203
64-65	INTEGRATED INFO TECH	223	800-832-0770
*	INTEL CORP	81	800-538-3373
121	INTEL CORP	99	800-538-3373
66	INTEL CORP	230,231	800-538-3373
122	INTEL CORP	246,247	800-536-3373
262	IO TECH	359	216-439-4091
378	ITALIAN S/W AGENCY	284IS-2	39-323-925208**
306	IVERSON SOFTWARE, INC	362	416-925-6096
	J		
67	JAMECO ELECTRONICS	224,225	800-831-4242
*	JDR MICRODEVICES	321	800-538-5000
372	JEN ELECTRONICA	162IS-2	39-73-3224035**
	K		
264	K & M ASSOCIATES	362	
123	KEA SYSTEMS LTD	116	800-663-8702
263	KILA	356	
554-555	KINGLI TECH, INC	332MW-6	800-788-0622
562-563	KINGLI TECH, INC	332NE-4	800-788-0622
347-348	KUO FENG CORP	284IS-4	886-2-754-8498
376-377	KYE SYSTEMS CORP (INT'L)	218	886-2-9956649**
	L		
293	L-COM, INC	355	508-682-6936
265	LAGUNA DATA SYSTEMS	359	800-859-8856
124	LAHEY COMPUTER SYS	122	800-548-4778
169-170	LANDMARK RESEARCH INT'L CORP	153	800-683-6696
237-238	LAPINE	326,327	800-927-3772
191-192	LIANT S/W CORP (N.A.)	298	800-662-9866
193-194	LIANT S/W CORP (INT'L)	298	
266	LINK COMP GRAPHICS	359	201-808-8990
232	LODESTAR COMP	314,315	800-875-7568
349	LOGIC PROGRAMMING ASSOC	284IS-1	44-81-874-0449
350-351	LONGSHINE ELECTRONIC CORP	162IS-4	886-2-362-6810
	M		
352	MAGIC/MSE (INT'L)	146IS-1	972-3-751-1901
*	MANCHESTER EQUIPMENT CO	332NE-A–B	516-435-1199
559	MANCHESTER EQUIPMENT CO	332NE-1	516-435-1199
167	MANUGISTICS, INC	245	
*	MARK WILLIAMS CO	127	800-627-5967
126	MATHSOFT INC	303	800-628-4223
*	MCGRAW HILL NRI (N.A.)	284A–B	
354-355	MEGADATA	284IS-1	516-589-6858**
296	MICRO HOUSE	363	800-926-8299
222	MICRO SOLUTIONS COMPUTER PROD	346	815-756-3411
127	MICROGRAFX	141	800-733-3729
402	MICROLANE COMPUTER	352	800-777-2219
220	MICROPROSE SOFTWARE	333	800-879-PLAY
221	MICROPROSE SOFTWARE	335	800-879-PLAY
*	MICROSOFT CORP	32A–B	
*	MICROSOFT CORP	32,33	
268	MICROSTAR LAB	356	206-453-2345
129	MICROWAY	272	
574	MINNESOTA COMP EXCHANGE	332MW-2	612-894-9811
356	MINOLTA GMBH (INT'L)	112IS-1	49-0511-779089
140	MINUTEMAN	121	214-446-7363
130	MIX SOFTWARE	311	800-333-0330
357	MORTICE KERN (MKS)	112IS-4	
267	MVS	359	508-792-9507
	N		
131-132	NANAO USA CORP	154,155	310-325-5202
224-225	NATIONAL DESIGN	339	800-253-8831
*	NAT'L INSTRUMENTS	112IS-7,8	512-794-5462
133	NAT'L INSTRUMENTS	9	800-433-3488
269	NAT'L INSTRUMENTS	361	800-433-3488
134	NEC	78,79	800-366-0476
387	NETWORLD DALLAS	336	800-829-3976
219	NEVADA COMPUTER	328	800-654-7762
135	NEW MEDIA GRAPHICS CORP	211	800-288-2207
326	NORMAN LASER OPTICAL LTD	178UK-2	
*	NORTHGATE COMP SYS	108,109	800-345-8709
*	NORTHGATE COMP SYS	157	800-345-8709
*	NORTHGATE COMP SYS	235	800-345-8709
*	NORTHGATE COMP SYS	243	800-345-8709
292	NOVASTOR CORP	360	
	O		
308	OMEGA POINT, INC	362	508-877-1819
226-227	OMNICOMP GRAPHICS CORP	348	713-464-2990
200	OMRON OFFICE AUTOMATION PROD	83	800-362-4411
373	ON TIME MKT/KARSTEN PETERSEN (INT'L)	163	49-040-435-196
136-137	OPTIQUEST	75	310-944-1185
291	OSCS	363	503-389-5489
138	OUTPUT TECHNOLOGY CO	45	800-468-8788
270	OVERLAND DATA INC	360	800-729-8725
	P		
*	PACIFIC DATA PRODUCTS	165	619-597-4631
139	PANASONIC	102,103	800-742-8086

YOUR DIRECT LINK

ADVERTISER CONTACT INFORMATION

Inquiry No.		Page No.	Phone No.
199	PARALLEL PERIPHERALS	257	714-394-7244
141	PATTON & PATTON	120	800-525-0082
142-143	PC POWER & COOLING	115	800-722-6555
68-69	PERISCOPE CO, THE	222	800-722-7006
144	PERSOFT INC	266	800-368-5283
145	PERSONAL TEX	164	
146	PHAR LAP SOFTWARE INC	77	617-661-1510
358	PHILIPS MONITORS	36,37	31-40-73-39-83
147	PIONEER COMMNCTNS	143	800-LASER-ON
148	PKWARE INC	48	414-354-8677
553	PLUSTEK USA, INC	332MW-5	408-980-1234
551	PROFESSIONAL COMP	332MW-1	408-263-0222
125	PROGRAMMER'S PARADISE	67–69	800-445-7899
*	PROGRAMMER'S SHOP	288–290	
149-150	PROGRESS SOFTWARE	188	800-4PROGRESS
70	PROMISE TECHNOLOGY	233	800-888-0245
271	PSEUDOCORP	363	804-873-1947
	Q		
153	QUA TECH INC	312	800-553-1170
272	QUALSTAR CORP	360	818-882-5822
151	QUANTUM SOFTWARE	213	800-363-9001
152	QUARTERDECK OFFICE SYSTEMS	132,133	310-392-9851
	R		
154	RAIMA CORP	105	800-327-2462
155-156	RAINBOW TECHNOLOGIES	123	800-852-8569
400-401	RAINBOW TECHNOLOGIES	220	800-852-8569
*	RALIN WHOLESALERS	317	800-752-9512
240-241	RALIN WHOLESALERS	318,319	800-752-9512
*	REASONABLE SOLU	112IS-5,6	503-776-5777
157	ROSE ELECTRONICS	124	800-333-9343
	S		
161	S'NW ELECTRONICS	122	
561	SAI SYSTEMS	332NE-3	203-929-0790
273	SAS INSTITUTE INC	362	919-677-8000
158-159	SECURE IT INC	146	800-451-7592
235	SECURTECH CO	350	503-636-6831
360	SEKISUI CHEMICAL CO LTD	284IS-4	81-06-365-4375
160	SEQUITER SOFTWARE INC	275	403 437-2410
277	SIGEN	356	408-737-3904
310	SIGMA TECH SOFTWARE	355	818-368-6132
274	SILICON SHACK	358	800-969-4411
297	SMARTMICRO TECH	357	800-266-1576
*	SOFTLINE CORP	112IS-3	
361	SOFTWARE SECURITY INC	268IS-4	44-784-430060
162	SONYCPPC	178A–H	800-352-7669
163	SPECTRUM S/W (N.A.)	209	408-738-4387
164	SPSS INC	181	800-543-2185
299-300	STARGATE TECH	354	800-782-7428
165-166	STATSOFT	85	918-583-4149
168	SUMMAGRAPHICS CORP	265	
552	SUMMIT MICRO DESIGN	332MW-3	408-739-6348
572	SUMMIT MICRO DESIGN	332NE-2	408-739-6348
197	SUNSOFT	2,3	800-227-9227 1
196	SUPRA CORP	125	800-727-8647
171-172	SYSTAT INC	107	708-864-5670
320	SYSTEMSTAR	194UK-1	44-0992-554-26
359	SZKI RECOGNITA CORP	84	361-201-7607**
	T		
275	TALKING TECH INC	355	800-685-4884
362-363	TATUNG CO	376	886-2-598-4509
276	TECHNOLOGY POWER ENTERPRISE	356	510-623-3818
364-365	TECHPOWER CO LTD	284IS-3	886-2-753-1940
311	TECTAMM	363	81-3-5374-7890
173	TEKTRONIX	118,119	800-835-6100
174	TEXAS INSTRUMENTS	71	800-527-3500
381	TOPTEK	210IS-3	886-2-961-9586
175	TOSHIBA AMERICA INC	6,7	800-457-7777
228	TOTE-A-LAP	353	800-9-LAPTOP
245	TRANSCEND INFO INC	324	714-598-5500
286	TRANTOR SYSTEMS LTD	357	510-770-1400
287	TRI VALLEY TECH INC	356	510 447-2030
278	TRIANGLE DIGITAL SERV	356	44-81-558-8110
279-280	TRIBAL MICROSYSTEMS	359	510-623-8859
366	TRITON TECH	112IS-2	908-855-9440
229	TRUE DATA PRODUCTS	316	800-635-0300
176-177	TRUEVISION INC	139	800-344-8783
367	TULIN TECHNOLOGY	268IS-2	
	U		
*	ULTIMATE TECH	112IS-5,6	
368-369	UNIAIR	210IS-2	886-2-2993210**
*	UNIXWORLD	251–253	
	V		
178-179	VENTURA SOFTWARE INC	201	800-822-8221
180	VERBATIM CORP	173	
324	VERIDATA	194UK-3	44-041-248-111
*	VERMONT CREATIVE S/W	13	800-848-1248
281	VIDEX, INC	355	503-758-0521
181-182	VIEWSONIC	93	310-944-3041
183-184	VISIONETICS INT'L	64	886-35-772170**
282	VISTA MICROSYSTEMS	361	508-695-8459
298	VITEC S.A.	358	33-146-29-03-0
	W		
370	WALKER, RICHER & QUINN	268IS-1	206-324-0407
186	WATCOM PRODUCTS INC	27	800-265-4555
185	WATCOM PRODUCTS INC	277	800-265-4555
319	WESTPOINT CREATIVE	178UK-3	44-0743-248-19
283	WINTEK CORP	360	800-742-6809
187-189	WOLFRAM RESEARCH	203	800-441-6284
233	WORLDWIDE TECH	351	800-457-6937
	X		
284	XELTEK	359	408-745-7974
	Z		
285	Z-WORLD ENGINEERING	359	916-757-3737
379-380	ZECKS (INT'L)	163	886-2-299-2027
*	ZENITH DATA SYSTEMS	42,43	800-523-9393
190	ZEOS INT'L	260,261	800-423-5891
389-390	ZYXEL USA	248	714-693-0333

** Correspond directly with company.*

BYTE ADVERTISING SALES STAFF

Jennifer L. Bartel, National Sales Manager, 14850 Quorum Drive, Suite 380, Dallas, TX 75240, Tel. (214) 701-8496
Liz Coyman, Inside Advertising Sales Director, One Phoenix Mill Lane, Peterborough, NH 03458, Tel. (603) 924-2518

NEW ENGLAND
ME, NH, VT, MA, RI, CT, ONTARIO CANADA & EASTERN CANADA
Michael Lamattina (617) 860-6344
Patricia Payne (603) 924-2654
McGraw-Hill Publications
24 Hartwell Avenue
Lexington, MA 02173
FAX: (617) 860-6899

EAST COAST
NY, NYC, NJ, DC, DE, MD, VA, WV, PA
Kim Norris (212) 512-2645
Ariane Casey (212) 512-2368
Barry Echavarria (603) 924-2574
McGraw-Hill Publications
1221 Avenue of Americas—
28th Floor
New York, NY 10020
FAX: (212) 512-2075

SOUTHEAST
NC, SC, GA, FL, AL, TN, MS, AR, LA, KY
MaryAnn Goulding (404) 843-4782
Patricia Payne (603) 924-2654
McGraw-Hill Publications
4170 Ashford-Dunwoody Rd., Suite 520
Atlanta, GA 30319
FAX: (404) 252-4056

MIDWEST
IL, MO, KS, IA, ND, SD, MN, WI, NE, IN, MI, OH
Kurt Kelley (312) 616-3328
Ed Ware (603) 924-2664
McGraw-Hill Publications
Two Prudential Plaza
180 North Stetson Ave.
Chicago, IL 60601
FAX: (312) 616-3370

SOUTHWEST, ROCKY MOUNTAIN
CO, OK, TX
JenniferWalker (214) 701-8496
Barry Echavarria (603) 924-2574
McGraw-Hill Publications
14850 Quorum Dr., Suite 380
Dallas, TX 75240
FAX: (214) 991-6208

NORTH PACIFIC: San Francisco, CA
NORTHERN CA, OR, ID, MT, WY, NORTHERN NV, UT
Roy J. Kops (415) 954-9728
Joseph Mabe (603) 924-2662
McGraw-Hill Publications
425 Battery Street
San Francisco, CA 94111
FAX: (415) 954-9786

NORTH PACIFIC: Campbell, CA
SILICON VALLEY, HI, WA, AK, W. CANADA
Bill McAfee (408) 879-0381
Jonathan Sawyer (603) 924-2665
McGraw-Hill Publications
1999 South Bascom Ave., Suite 210
Campbell, CA 95008
FAX: (408)879-9067

SOUTH PACIFIC: Los Angeles, CA
LOS ANGELES COUNTY, AZ, NM, SOUTHERN NEVADA
Alan El Faye (213) 480-5243
Jonathan Sawyer (603) 924-2665
McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010
FAX: (213) 480-5249

SOUTH PACIFIC: Costa Mesa, CA
ORANGE COUTY
SAN DIEGO COUNTY
Beth Dudas (714) 753-8140
Joseph Mabe (603) 924-2662
McGraw-Hill Publications
15535 Alton Pkwy., Suite 290
Irvine, CA 92718
FAX: (714) 753-8147

Regional Advertising
Brian Higgins (603) 924-2651
Larry Levine (603) 924-2537
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Peterborough, NH Office: Inside Sales FAX: 603-924-2683 Advertising FAX: 603-924-7507

Hardware/Software Showcase
Mark Stone (603) 924-2695
Ellen Perham (603) 924-2598
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

The Buyer's Mart (1x2)
Margot Gnade (603) 924-2656
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE Deck
Brad Dixon (603) 924-2596
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

EURO-DECK
James Ball (603) 924-2533
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE International Direct Response Postcards
Ellen Perham (603) 924-2598
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

INTERNATIONAL ADVERTISING SALES STAFF

Ron Cordek, Managing Director, European Operations
McGraw-Hill Publishing Co., Wimbledon Bridge House, One Hartfield Road, Wimbledon, London SW19 3RU, England, Tel: 44 81 545 6278, Fax: 44 81 545 6294

GERMANY, SWITZERLAND, AUSTRIA
Christina Barion
McGraw-Hill Publishing Co.
Wimbledon Bridge House
One Hartfield Road
Wimbledon, London SW19 3RU
England
Tel: 44 81 545 6270
FAX: 44 81 545 6294
TELEX: 892191

BENELUX
Ellen Pardede
Betenburg 105
3437 AB Nieuwegein
The Netherlands
Tel: 31 34 02 49496
FAX: 31 34 02 37944

UNITED KINGDOM
Michele Harris (44 81 545 6269)
Christina Barion (44 81 545 6270)
McGraw-Hill Publishing Co.
Wimbledon Bridge House
One Hartfield Road
Wimbledon, London SW19 3RU
England
FAX: 44 81 545 6294
TELEX: 892191

FRANCE, ITALY
Zena Coupé
A-Z International Sales Ltd.
70 Chalk Farm Road
London NW1 8AN
England
Tel: 44 71 284 3171
FAX: 44 71 284 3174

SCANDINAVIAN COUNTRIES
Zena Coupé
A-Z International Sales Ltd.
70 Chalk Farm Road
London NW1 8AN
England
Tel: 44 71 284 3171
FAX: 44 71 284 3174

ISRAEL
Dan Ehrlich
Ehrlich Communication Int'l.
P.O. Box 11297
Tel Aviv 61112, Israel
Tel: 972-52-586 245
Tel: 972-52-586 246
FAX: 972-52-585 685

AUSTRALIA
Rod Tremain
Rod Tremain Media
45 Pymble Ave.
Pymble 2073, Sydney
Australia
Tel: 2-988-3339
FAX: 2-988-3424

JAPAN
Masaki Mori
McGraw-Hill Publishing Co.
Overseas Corp.
Room 1528
Kasumigaseki Bldg.
3-2-5 Kasumigaseki,
Chiyoda-Ku
Tokyo 100, Japan
Tel: 81 33 581 9811
FAX: 81 33 581 4018

KOREA
Young-Seoh Chinn
JES MEDIA INT'L.
5th Floor, Banpo Bldg.
40-7, Chamwon-Dong, Seocho-Gu
Seoul 137-030, Korea
Tel: (82)2 545-8001/2
FAX: (82)2 549-8861

SINGAPORE
Stephen Tay
Acer TWP Corp.
1123 Serangoon Road., #03-01
Singapore 1232
Tel: 011-65-296-6166
FAX: 011-65-298-7551

MALAYSIA
Servex (Malaysia) Sdn. Bhd.
H.K. Lin
5th Floor, Bena Tower
160, Jalan Ampang
50450 Kuala Lumpur, Malaysia
Tel: (03) 262-4592
FAX: (03) 262-4591

THAILAND
Jack Hu
28/1 Prapawit Bldg., Surasak Rd.
Silom, Bangkok 10500
Thailand
Tel: 662-236-0295
FAX: 662-236-3960

HONG KONG
Candice Lo
AcerTWP Corp.
Unit2, 6F Hing Wah Center
82-84 To Kwa Wan Road
Kowloon, Hong Kong
Tel: 011-852-764-3830
FAX: 011-852-764-3857

INDIA, INDONESIA, PAKISTAN, PHILIPPINES, TAIWAN, OTHER ASIAN AND PACIFIC COUNTRIES
Liwen Lee
AcerTWP Corp.
19-2, Lane 231,
Fu Hsing North Road
Taipei 10445, Taiwan
R.O.C.
Tel: (886) 2 713 6959
FAX: (886) 2 715 1950

YOUR DIRECT LINK

PRODUCT CATEGORY INDEX

For FREE product information from individual advertisers, circle the corresponding inquiry numbers on Your Direct Link Card!

To receive information for an entire product category, circle the category number on Your Direct Link Card!

Category No. / Inquiry No. — Page No.

HARDWARE

1 ACCESSORIES/SUPPLIES

158-159 SECURE IT INC 146
235 SECURTECH COMPANY 350
379-380 ZECKS (INT'L) 163

2 ADD-IN BOARDS

303 ADVANCED MICRO TECHNOLOGY 354
78-79 AMERICAN MEGATRENDS 117
309 ATLAS INDUSTRIES INC 354
294-295 AXIOM 354
314-315 CHAI SHIN 354
335-336 COMPEX (INT'L) 210IS-1
195 CREATIVE LABS INC 271
211-212 DPT 347
344 GFK HAMBURG 146IS-4
260 HIGH-RES TECHNOLOGIES 358
67 JAMECO ELECTRONICS 224,225
372 JEN ELECTRONICA 162IS-2
129 MICROWAY 272
224-225 NATIONAL DESIGN 339
226-227 OMNICOMP GRAPHICS CORP 348
68-69 PERISCOPE COMPANY, THE 222
70 PROMISE TECHNOLOGY 233
153 QUATECH INC 312
* RALIN WHOLESALERS 317
240-241 RALIN WHOLESALERS 318,319
299-300 STARGATE TECHNOLOGIES 354
381 TOPTEK 210IS-3
176-177 TRUEVISION INC 139
367 TULIN TECHNOLOGY 268IS-2
319 WESTPOINT CREATIVE 178UK-3

3 BAR CODING

281 VIDEX, INC 355

4 COMMUNICATIONS/NETWORKING

339-340 CORE INTERNATIONAL 162IS-1
97 CURTIS INC 284
382-383 DATA PRODUCTS AND SERVICES 375
256 GMM RESEARCH CORP 355
269 GTEK INC 355
376-377 KYE SYSTEMS CORP (INT'L) 218
293 L-COM, INC. 355
350-351 LONGSHINE ELECTRONIC CORP 162IS-4
199 PARALLEL PERIPHERALS 267
157 ROSE ELECTRONICS 124
310 SIGMA TECH SOFTWARE 355
299-300 STARGATE TECHNOLOGIES 354
275 TALKING TECHNOLOGY INC 355
362-383 TATUNG CO 376

5 COMPUTER SYSTEMS

301-302 ACI/ACQUIRE 355
560 APPRO INTERNATIONAL INC 332NE-6
573 APPRO INTERNATIONAL INC 332MW-4
61-62 AST RESEARCH INC 214
242 ATLAS INDUSTRIES INC 320
234 CITITRONICS 332
90 COMMODORE 31
575 COMPAQ COMPUTER CORP 166,167
384 COMPUDYNE 236,237
230-231 COMTRADE 349
318 DAN TECHNOLOGY PLC 178UK-1
382-383 DATA PRODUCTS AND SERVICES 375
98-99 DATALUX CORP 138
100 DELL COMPUTER CORP (N.A.) CIII
101 DELL COMPUTER CORP (N.A.) CIV
102 DELL COMPUTER CORP (N.A.) 36,37
63 DELL COMPUTER CORP (N.A.) 218,219,221
236 DYNAMICSCAN 322,323
213 E T VALUELINE/ELEK-TEK 334
375 ECG (INT'L) 219
* ELONEX (INT'L) 177
* ELTECH RESEARCH 345
* GATEWAY 2000 CII,1
* GATEWAY 2000 49-62
198 HANDTOP COMPUTERS LTD 258
118 IBM PS/2 14,15
263 KILA 356
554-555 KINGLI TECHNOLOGY, INC 332MW-6
562-563 KINGLI TECHNOLOGY, INC 332NE-4
237-238 LAPINE 326,327
350-351 LONGSHINE ELECTRONIC CORP 162IS-4
* MANCHESTER EQUIPMENT CO 332NE-A-B
559 MANCHESTER EQUIPMENT CO 332NE-1
354-355 MEGADATA 284IS-1
402 MICROLANE COMPUTERS 352
574 MINNESOTA COMPUTER EXCHANGE 332MW-2
* NORTHGATE COMPUTER SYSTEM 108,109
* NORTHGATE COMPUTER SYSTEM 157
* NORTHGATE COMPUTER SYSTEM 235
* NORTHGATE COMPUTER SYSTEM 243
142-143 PC POWER & COOLING 115
551 PROFESSIONAL COMPUTER 332MW-1
561 SAI SYSTEMS 332NE-3
552 SUMMIT MICRO DESIGN 332MW-3
572 SUMMIT MICRO DESIGN 332NE-2
362-383 TATUNG CO 376
276 TECHNOLOGY POWER ENTERPRISE 356
364-365 TECHPOWER COMPANY LTD 284IS-3
287 TRI VALLEY TECHNOLOGY INC 356
278 TRIANGLE DIGITAL SERVICES 356
229 TRUE DATA PRODUCTS 316
368-369 UNIAIR 210IS-2
* ZENITH DATA SYSTEMS 42,43
190 ZEOS INTERNATIONAL 260,261

6 DATA ACQUISITION

268 MICROSTAR LABORATORIES 356
* NATIONAL INSTRUMENTS 112IS-7,8

7 DISK & OPTICAL DRIVES

78-79 AMERICAN MEGATRENDS 117
* APS TECHNOLOGIES 325
339-340 CORE INTERNATIONAL 162IS-1
97 CURTIS INC 284
* HARD DRIVES INTERNATIONAL 329
222 MICRO SOLUTIONS COMP PROD 346
326 NORMAN LASER OPTICAL LTD 178UK-2
147 PIONEER COMMUNICATIONS 143
277 SIGEN 356
162 SONY CPPC 178A-H
286 TRANTOR SYSTEMS LTD 357

8 DISKETTES/DUPLICATORS

251-252 AXIOMATIC 357
180 VERBATIM CORP 173

9 FAX BOARDS/MACHINES

554-555 KINGLI TECHNOLOGY, INC 332MW-6
562-563 KINGLI TECHNOLOGY, INC 332NE-4
389-390 ZYXEL USA 248

10 GRAPHICS TABLETS/MICE/PEN INPUT

103 DIGITAL VISION 276
113-114 HONEYWELL KEYBOARD DIV (N.A.) 175,177
376-377 KYE SYSTEMS CORP (INT'L) 218
158 SUMMAGRAPHICS CORP 265

11 KEYBOARDS

* NORTHGATE COMPUTER SYSTEM 108,109
* NORTHGATE COMPUTER SYSTEM 157
* NORTHGATE COMPUTER SYSTEM 235
* NORTHGATE COMPUTER SYSTEM 243

12 LAN HARDWARE

206-207 BAY TECHNICAL ASSOC 343
97 CURTIS INC 284
210 CYBEX CORPORATION 338
223 CYBEX CORPORATION (INT'L) CIII
119 IIYAMA ELECTRIC CO 101
142-143 PC POWER & COOLING 115

13 LAPTOPS & NOTEBOOKS

391-392 ABC COMPUTER (USA) CORP 352
73-74 ADVANCED LOGIC RESEARCH 254,255
* APPLE COMPUTER INC 170A-D
104 DOLCH COMPUTER SYSTEMS 91
236 DYNAMICSCAN 322,323
* NORTHGATE COMPUTER SYSTEM 108,109
* NORTHGATE COMPUTER SYSTEM 157
* NORTHGATE COMPUTER SYSTEM 235
* NORTHGATE COMPUTER SYSTEM 243
174 TEXAS INSTRUMENTS 71
175 TOSHIBA AMERICA INC 6-7
228 TOTE-A-LAP 353
324 VERIDATA 194UK-3
190 ZEOS INTERNATIONAL 260,261

14 MAIL ORDER

248-249 AAEON 357
202-203 ADVANCED COMPUTER PRODUCTS 340
204 ALTEX ELECTRONICS 330,331
250 AMERICAN ADVANTECH 357
205 AMT INTERNATIONAL 350
208 BULLDOG COMPUTER PRODUCTS 337
* BUYER'S MART SECTION 112IS-7,8
234 CITITRONICS 332
209 COMPUTERLANE UNLIMITED 342
395-397 CYBER RESEARCH 344
87 DECISIONS 375
67 JAMECO ELECTRONICS 224,225
* JDR MICRODEVICES 321
293 L-COM, INC 355
232 LODE STAR COMPUTER 314,315
219 NEVADA COMPUTER 328

15 MEMORY/CHIPS/UPGRADES

77 ADVANCED MICRO DEVICES 10,11
304 AMRAM 357
88 CAPITAL EQUIPMENT CO 184
89 CAPITAL EQUIPMENT CO 185
385-386 CYRIX 140
215-216 FIRST SOURCE INT'L 341
112 HAUPPAUGE COMP WORKS 86,87
64-65 INTEGRATED INFO TECH 223
* INTEL CORP 81
66 INTEL CORP 230,231
122 INTEL CORP 246,247
67 JAMECO ELECTRONICS 224,225
297 SMARTMICRO TECHNOLOGIES 357
245 TRANSCEND INFORMATION INC 324
233 WORLDWIDE TECHNOLOGIES 351

16 MISCELLANEOUS HARDWARE

195 CREATIVE LABS INC 271
382-383 DATA PRODUCTS AND SERVICES 375
120 INTEGRAND RESEARCH 114
326 NORMAN LASER OPTICAL LTD 178UK-2
155-156 RAINBOW TECHNOLOGIES 123
400-401 RAINBOW TECHNOLOGIES 220
235 SECURTECH COMPANY 350
360 SEKISUI CHEMICAL CO LTD 284IS-4
162 SONY CPPC 178A-H

17 MODEMS/MULTIPLEXORS

95 COMPUTER FRIENDS 276
121 INTEL CORP 99
200 OMRON OFFICE AUTOMATION PROD 83
* RALIN WHOLESALERS 317
240-241 RALIN WHOLESALERS 318,319
196 SUPRA CORP 125
389-390 ZYXEL USA 248

18 MONITORS & TERMINALS

346 HANTAREX SPA 209
347-348 KUO FENG CORP 284IS-4
131-132 NANAO USA CORP 154,155
136-137 OPTIQUEST 75
358 PHILIPS MONITORS 36,37
162 SONY CPPC 178A-H
362-383 TATUNG CO 376
181-182 VIEWSONIC 93

19 MULTIMEDIA

195 CREATIVE LABS INC 271
307 EMPIRE COMPUTECH 358
260 HIGH-RES TECHNOLOGIES 358
135 NEW MEDIA GRAPHICS CORP 211
326 NORMAN LASER OPTICAL LTD 178UK-2
553 PLUSTEK USA, INC. 332MW-5
* RALIN WHOLESALERS 317
240-241 RALIN WHOLESALERS 318,319
274 SILICON SHACK 358
173 TEKTRONIX 118,119
183-184 VISIONETICS INTERNATIONAL 64
298 VITEC S.A. 358
319 WESTPOINT CREATIVE 178UK-3

20 PRINTERS/PLOTTERS

329 ASP COMPUTER PRODUCTS (INT'L) 221
206-207 BAY TECHNICAL ASSOC 343
399 BUFFALO PRODUCTS 35
116 HOUSTON INSTRUMENTS 299
356 MINOLTA GMBH (INT'L) 112IS-1
134 NEC 78,79
138 OUTPUT TECHNOLOGY CO 45
* PACIFIC DATA PRODUCTS 165
89 PANASONIC 102,103
* RALIN WHOLESALERS 317
240-241 RALIN WHOLESALERS 318,319
173 TEKTRONIX 118,119

continued on page 373

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

BYTE

Yes, I want FREE products!

Fill out this coupon carefully. ***Please Print.***

Company

Address

City State Zip

Phone Fax

A. What is your primary job function/principal area of responsibility? (Check one)

1 ❑ MIS/DP
2 ❑ Programmer/Systems Analyst
3 ❑ Adminstration/Management
4 ❑ Sales/Marketing
5 ❑ Engineer/Scientist
6 ❑ Other

B. What is your level of management responsibility?

7 ❑ Senior-level 9 ❑ Professional
8 ❑ Middle-level

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ❑ Yes 11 ❑ No

D. What operating systems are you currently using? (Check all that apply)

12 ❑ PC/MS-DOS 15 ❑ Unix
13 ❑ DOS + Windows 16 ❑ MacOS
14 ❑ OS/2 17 ❑ VAX/VMS

E. For how many people do you influence the purchase of hardware or software?

18 ❑ 1-25 20 ❑ 51-99
19 ❑ 26-50 21 ❑ 100 or more

❑ **Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.**

September 1992 89

Product Category Information

Circle the numbers below for information on the entire category of products you're interested in.

Hardware

Accessories/Supplies 1
Add-in Boards 2
Bar Coding 3
Communications/Networking 4
Computer Systems 5
Data Acquisition 6
Disks & Optical Drives 7
Diskettes/Duplicators 8
Fax Boards/Machines 9
Graphics Tablets/Mice/Pen Input 10
Keyboards 11
LAN Hardware 12
Laptops & Notebooks 13
Mail Order 14
Memory/Chips/Upgrades 15
Miscellaneous Hardware 16
Modems/Multiplexors 17
Monitors & Terminals 18
Multimedia 19
Printers/Plotters 20
Programmable Hardware 21
Scanners/OCR/Digitizers 22
Tape Drives 23
UPS 24

Software

Business 25
CAD/CAM 26
Communications/Networking 27
Data Acquisition 28
Database 29
Educational 30
Engineering/Scientific 31
Entertainment 32
Graphics 33
Macintosh 34
Mail Order 35
Mathematical/Statistical 36
Miscellaneous Software 37
On-Line Services 38
Operating Systems 39
Programming Languages/Tools 40
Security 41
Shareware 42
Software Duplication 43
Spreadsheets 44
Unix 45
Utilities 46
Windows 47
Word Processing 48

General

Books/Publications 49
Recruitment 50
Miscellaneous 51

52	78	104	130	156	182	208
53	79	105	131	157	183	209
54	80	106	132	158	184	210
55	81	107	133	159	185	211
56	82	108	134	160	186	212
57	83	109	135	161	187	213
58	84	110	136	162	188	214
59	85	111	137	163	189	215
60	86	112	138	164	190	216
61	87	113	139	165	191	217
62	88	114	140	166	192	218
63	89	115	141	167	193	219
64	90	116	142	168	194	220
65	91	117	143	169	195	221
66	92	118	144	170	196	222
67	93	119	145	171	197	223
68	94	120	146	172	198	224
69	95	121	147	173	199	225
70	96	122	148	174	200	226
71	97	123	149	175	201	227
72	98	124	150	176	202	228
73	99	125	151	177	203	229
74	100	126	152	178	204	230
75	101	127	153	179	205	231
76	102	128	154	180	206	232
77	103	129	155	181	207	233

409	435	461	487	513	539	565
410	436	462	488	514	540	566
411	437	463	489	515	541	567
412	438	464	490	516	542	568
413	439	465	491	517	543	569
414	440	466	492	518	544	570
415	441	467	493	519	545	571
416	442	468	494	520	546	572
417	443	469	495	521	547	573
418	444	470	496	522	548	574
419	445	471	497	523	549	575
420	446	472	498	524	550	576
421	447	473	499	525	551	577
422	448	474	500	526	552	578
423	449	475	501	527	553	579
424	450	476	502	528	554	580
425	451	477	503	529	555	581
426	452	478	504	530	556	582
427	453	479	505	531	557	583
428	454	480	506	532	558	584
429	455	481	507	533	559	585
430	456	482	508	534	560	586
431	457	483	509	535	561	587
432	458	484	510	536	562	588
433	459	485	511	537	563	589
434	460	486	512	538	564	590

766	792	818	844	870	896	922
767	793	819	845	871	897	923
768	794	820	846	872	898	924
769	795	821	847	873	899	925
770	796	822	848	874	900	926
771	797	823	849	875	901	927
772	798	824	850	876	902	928
773	799	825	851	877	903	929
774	800	826	852	878	904	930
775	801	827	853	879	905	931
776	802	828	854	880	906	932
777	803	829	855	881	907	933
778	804	830	856	882	908	934
779	805	831	857	883	909	935
780	806	832	858	884	910	936
781	807	833	859	885	911	937
782	808	834	860	886	912	938
783	809	835	861	887	913	939
784	810	836	862	888	914	940
785	811	837	863	889	915	941
786	812	838	864	890	916	942
787	813	839	865	891	917	943
788	814	840	866	892	918	944
789	815	841	867	893	919	945
790	816	842	868	894	920	946
791	817	843	869	895	921	947

1123	1149	1175	1201	1227	1253	1279
1124	1150	1176	1202	1228	1254	1280
1125	1151	1177	1203	1229	1255	1281
1126	1152	1178	1204	1230	1256	1282
1127	1153	1179	1205	1231	1257	1283
1128	1154	1180	1206	1232	1258	1284
1129	1155	1181	1207	1233	1259	1285
1130	1156	1182	1208	1234	1260	1286
1131	1157	1183	1209	1235	1261	1287
1132	1158	1184	1210	1236	1262	1288
1133	1159	1185	1211	1237	1263	1289
1134	1160	1186	1212	1238	1264	1290
1135	1161	1187	1213	1239	1265	1291
1136	1162	1188	1214	1240	1266	1292
1137	1163	1189	1215	1241	1267	1293
1138	1164	1190	1216	1242	1268	1294
1139	1165	1191	1217	1243	1269	1295
1140	1166	1192	1218	1244	1270	1296
1141	1167	1193	1219	1245	1271	1297
1142	1168	1194	1220	1246	1272	1298
1143	1169	1195	1221	1247	1273	1299
1144	1170	1196	1222	1248	1274	1300
1145	1171	1197	1223	1249	1275	1301
1146	1172	1198	1224	1250	1276	1302
1147	1173	1199	1225	1251	1277	1303
1148	1174	1200	1226	1252	1278	1304

234	259	284	309	334	359	384
235	260	285	310	335	360	385
236	261	286	311	336	361	386
237	262	287	312	337	362	387
238	263	288	313	338	363	388
239	264	289	314	339	364	389
240	265	290	315	340	365	390
241	266	291	316	341	366	391
242	267	292	317	342	367	392
243	268	293	318	343	368	393
244	269	294	319	344	369	394
245	270	295	320	345	370	395
246	271	296	321	346	371	396
247	272	297	322	347	372	397
248	273	298	323	348	373	398
249	274	299	324	349	374	399
250	275	300	325	350	375	400
251	276	301	326	351	376	401
252	277	302	327	352	377	402
253	278	303	328	353	378	403
254	279	304	329	354	379	404
255	280	305	330	355	380	405
256	281	306	331	356	381	406
257	282	307	332	357	382	407
258	283	308	333	358	383	408

591	616	641	666	691	716	741
592	617	642	667	692	717	742
593	618	643	668	693	718	743
594	619	644	669	694	719	744
595	620	645	670	695	720	745
596	621	646	671	696	721	746
597	622	647	672	697	722	747
598	623	648	673	698	723	748
599	624	649	674	699	724	749
600	625	650	675	700	725	750
601	626	651	676	701	726	751
602	627	652	677	702	727	752
603	628	653	678	703	728	753
604	629	654	679	704	729	754
605	630	655	680	705	730	755
606	631	656	681	706	731	756
607	632	657	682	707	732	757
608	633	658	683	708	733	758
609	634	659	684	709	734	759
610	635	660	685	710	735	760
611	636	661	686	711	736	761
612	637	662	687	712	737	762
613	638	663	688	713	738	763
614	639	664	689	714	739	764
615	640	665	690	715	740	765

948	973	998	1023	1048	1073	1098
949	974	999	1024	1049	1074	1099
950	975	1000	1025	1050	1075	1100
951	976	1001	1026	1051	1076	1101
952	977	1002	1027	1052	1077	1102
953	978	1003	1028	1053	1078	1103
954	979	1004	1029	1054	1079	1104
955	980	1005	1030	1055	1080	1105
956	981	1006	1031	1056	1081	1106
957	982	1007	1032	1057	1082	1107
958	983	1008	1033	1058	1083	1108
959	984	1009	1034	1059	1084	1109
960	985	1010	1035	1060	1085	1110
961	986	1011	1036	1061	1086	1111
962	987	1012	1037	1062	1087	1112
963	988	1013	1038	1063	1088	1113
964	989	1014	1039	1064	1089	1114
965	990	1015	1040	1065	1090	1115
966	991	1016	1041	1066	1091	1116
967	992	1017	1042	1067	1092	1117
968	993	1018	1043	1068	1093	1118
969	994	1019	1044	1069	1094	1119
970	995	1020	1045	1070	1095	1120
971	996	1021	1046	1071	1096	1121
972	997	1022	1047	1072	1097	1122

1305	1330	1355	1380	1405	1430	1455
1306	1331	1356	1381	1406	1431	1456
1307	1332	1357	1382	1407	1432	1457
1308	1333	1358	1383	1408	1433	1458
1309	1334	1359	1384	1409	1434	1459
1310	1335	1360	1385	1410	1435	1460
1311	1336	1361	1386	1411	1436	1461
1312	1337	1362	1387	1412	1437	1462
1313	1338	1363	1388	1413	1438	1463
1314	1339	1364	1389	1414	1439	1464
1315	1340	1365	1390	1415	1440	1465
1316	1341	1366	1391	1416	1441	1466
1317	1342	1367	1392	1417	1442	1467
1318	1343	1368	1393	1418	1443	1468
1319	1344	1369	1394	1419	1444	1469
1320	1345	1370	1395	1420	1445	1470
1321	1346	1371	1396	1421	1446	1471
1322	1347	1372	1397	1422	1447	1472
1323	1348	1373	1398	1423	1448	1473
1324	1349	1374	1399	1424	1449	1474
1325	1350	1375	1400	1425	1450	1475
1326	1351	1376	1401	1426	1451	1476
1327	1352	1377	1402	1427	1452	1477
1328	1353	1378	1403	1428	1453	1478
1329	1354	1379	1404	1429	1454	1479

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

See reverse side for card.

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

BYTE

BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 176 PITTSFIELD, MA
POSTAGE WILL BE PAID BY ADDRESSEE

BYTE
READER SERVICE
P.O. BOX 5110
Pittsfield, MA 01203-9926
USA

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

Yes, I want FREE information on the following products!

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

Fill out this coupon carefully. ***Please Print.***

Name

Title

Company

Address

City State Zip

Phone Fax

A. What is your primary job function/principal area of responsibility? (Check one)

1 ❑ MIS/DP
2 ❑ Programmer/Systems Analyst
3 ❑ Administration/Management
4 ❑ Sales/Marketing
5 ❑ Engineer/Scientist
6 ❑ Other

B. What is your level of management responsibility?

7 ❑ Senior-level 9 ❑ Professional
8 ❑ Middle-level

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ❑ Yes 11 ❑ No

D. What operating systems are you currently using? (Check all that apply)

12 ❑ PC/MS-DOS 15 ❑ Unix
13 ❑ DOS + Windows 16 ❑ MacOS
14 ❑ OS/2 17 ❑ VAX/VMS

E. For how many people do you influence the purchase of hardware or software?

18 ❑ 1-25 20 ❑ 51-99
19 ❑ 26-50 21 ❑ 100 or more

❑ **Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.**

September 1992 89 96 99

Product Category Information

Circle the numbers below for information on the entire category of products you're interested in.

Hardware

Accessories/Supplies	1
Add-in Boards	2
Bar Coding	3
Communications/Networking	4
Computer Systems	5
Data Acquisition	6
Disks & Optical Drives	7
Diskettes/Duplicators	8
Fax Boards/Machines	9
Graphics Tablets/Mice/Pen Input	10
Keyboards	11
LAN Hardware	12
Laptops & Notebooks	13
Mail Order	14
Memory/Chips/Upgrades	15
Miscellaneous Hardware	16
Modems/Multiplexors	17
Monitors & Terminals	18
Multimedia	19
Printers/Plotters	20
Programmable Hardware	21
Scanners/OCR/Digitizers	22
Tape Drives	23
UPS	24

Software

Business	25
CAD/CAM	26
Communications/Networking	27
Data Acquisition	28
Database	29
Educational	30
Engineering/Scientific	31
Entertainment	32
Graphics	33
Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Miscellaneous Software	37
On-Line Services	38
Operating Systems	39
Programming Languages/Tools	40
Security	41
Shareware	42
Software Duplication	43
Spreadsheets	44
Unix	45
Utilities	46
Windows	47
Word Processing	48

General

Books/Publications	49
Recruitment	50
Miscellaneous	51

52	78	104	130	156	182	208
53	79	105	131	157	183	209
54	80	106	132	158	184	210
55	81	107	133	159	185	211
56	82	108	134	160	186	212
57	83	109	135	161	187	213
58	84	110	136	162	188	214
59	85	111	137	163	189	215
60	86	112	138	164	190	216
61	87	113	139	165	191	217
62	88	114	140	166	192	218
63	89	115	141	167	193	219
64	90	116	142	168	194	220
65	91	117	143	169	195	221
66	92	118	144	170	196	222
67	93	119	145	171	197	223
68	94	120	146	172	198	224
69	95	121	147	173	199	225
70	96	122	148	174	200	226
71	97	123	149	175	201	227
72	98	124	150	176	202	228
73	99	125	151	177	203	229
74	100	126	152	178	204	230
75	101	127	153	179	205	231
76	102	128	154	180	206	232
77	103	129	155	181	207	233

409	435	461	487	513	539	565
410	436	462	488	514	540	566
411	437	463	489	515	541	567
412	438	464	490	516	542	568
413	439	465	491	517	543	569
414	440	466	492	518	544	570
415	441	467	493	519	545	571
416	442	468	494	520	546	572
417	443	469	495	521	547	573
418	444	470	496	522	548	574
419	445	471	497	523	549	575
420	446	472	498	524	550	576
421	447	473	499	525	551	577
422	448	474	500	526	552	578
423	449	475	501	527	553	579
424	450	476	502	528	554	580
425	451	477	503	529	555	581
426	452	478	504	530	556	582
427	453	479	505	531	557	583
428	454	480	506	532	558	584
429	455	481	507	533	559	585
430	456	482	508	534	560	586
431	457	483	509	535	561	587
432	458	484	510	536	562	588
433	459	485	511	537	563	589
434	460	486	512	538	564	590

766	792	818	844	870	896	922
767	793	819	845	871	897	923
768	794	820	846	872	898	924
769	795	821	847	873	899	925
770	796	822	848	874	900	926
771	797	823	849	875	901	927
772	798	824	850	876	902	928
773	799	825	851	877	903	929
774	800	826	852	878	904	930
775	801	827	853	879	905	931
776	802	828	854	880	906	932
777	803	829	855	881	907	933
778	804	830	856	882	908	934
779	805	831	857	883	909	935
780	806	832	858	884	910	936
781	807	833	859	885	911	937
782	808	834	860	886	912	938
783	809	835	861	887	913	939
784	810	836	862	888	914	940
785	811	837	863	889	915	941
786	812	838	864	890	916	942
787	813	839	865	891	917	943
788	814	840	866	892	918	944
789	815	841	867	893	919	945
790	816	842	868	894	920	946
791	817	843	869	895	921	947

1123	1149	1175	1201	1227	1253	1279
1124	1150	1176	1202	1228	1254	1280
1125	1151	1177	1203	1229	1255	1281
1126	1152	1178	1204	1230	1256	1282
1127	1153	1179	1205	1231	1257	1283
1128	1154	1180	1206	1232	1258	1284
1129	1155	1181	1207	1233	1259	1285
1130	1156	1182	1208	1234	1260	1286
1131	1157	1183	1209	1235	1261	1287
1132	1158	1184	1210	1236	1262	1288
1133	1159	1185	1211	1237	1263	1289
1134	1160	1186	1212	1238	1264	1290
1135	1161	1187	1213	1239	1265	1291
1138	1162	1188	1214	1240	1266	1292
1137	1183	1189	1215	1241	1267	1293
1138	1164	1190	1216	1242	1268	1294
1139	1165	1191	1217	1243	1269	1295
1140	1166	1192	1218	1244	1270	1296
1141	1167	1193	1219	1245	1271	1297
1142	1168	1194	1220	1246	1272	1298
1143	1169	1195	1221	1247	1273	1299
1144	1170	1196	1222	1248	1274	1300
1145	1171	1197	1223	1249	1275	1301
1146	1172	1198	1224	1250	1276	1302
1147	1173	1199	1225	1251	1277	1303
1148	1174	1200	1226	1252	1278	1304

234	259	284	309	334	359	384
235	260	285	310	335	360	385
236	261	286	311	336	361	386
237	262	287	312	337	362	387
238	263	288	313	338	363	388
239	264	289	314	339	364	389
240	265	290	315	340	365	390
241	266	291	316	341	366	391
242	267	292	317	342	367	392
243	268	293	318	343	368	393
244	269	294	319	344	369	394
245	270	295	320	345	370	395
246	271	296	321	346	371	396
247	272	297	322	347	372	397
248	273	298	323	348	373	398
249	274	299	324	349	374	399
250	275	300	325	350	375	400
251	276	301	326	351	376	401
252	277	302	327	352	377	402
253	278	303	328	353	378	403
254	279	304	329	354	379	404
255	280	305	330	355	380	405
256	281	306	331	356	381	406
257	282	307	332	357	382	407
258	283	308	333	358	383	408

591	616	641	666	691	716	741
592	617	642	667	692	717	742
593	618	643	668	693	718	743
594	619	644	669	694	719	744
595	620	645	670	695	720	745
596	621	646	671	696	721	746
597	622	647	672	697	722	747
598	623	648	673	698	723	748
599	624	649	674	699	724	749
600	625	650	675	700	725	750
601	626	651	676	701	726	751
602	627	652	677	702	727	752
603	628	653	678	703	728	753
604	629	654	679	704	729	754
605	630	655	680	705	730	755
806	631	656	681	706	731	756
607	632	657	682	707	732	757
608	633	658	683	708	733	758
609	634	659	684	709	734	759
610	635	660	685	710	735	760
611	636	661	686	711	736	761
612	637	662	687	712	737	762
613	638	663	688	713	738	763
614	639	664	689	714	739	764
615	640	665	690	715	740	765

948	973	998	1023	1048	1073	1098
949	974	999	1024	1049	1074	1099
950	975	1000	1025	1050	1075	1100
951	976	1001	1026	1051	1076	1101
952	977	1002	1027	1052	1077	1102
953	978	1003	1028	1053	1078	1103
954	979	1004	1029	1054	1079	1104
955	980	1005	1030	1055	1080	1105
956	981	1006	1031	1056	1081	1106
957	982	1007	1032	1057	1082	1107
958	983	1008	1033	1058	1083	1108
959	984	1009	1034	1059	1084	1109
980	985	1010	1035	1060	1085	1110
961	986	1011	1036	1061	1086	1111
962	987	1012	1037	1062	1087	1112
963	988	1013	1038	1063	1088	1113
964	989	1014	1039	1064	1089	1114
965	990	1015	1040	1065	1090	1115
966	991	1016	1041	1066	1091	1116
967	992	1017	1042	1067	1092	1117
968	993	1018	1043	1068	1093	1118
969	994	1019	1044	1069	1094	1119
970	995	1020	1045	1070	1095	1120
971	996	1021	1046	1071	1096	1121
972	997	1022	1047	1072	1097	1122

1305	1330	1355	1380	1405	1430	1455
1306	1331	1356	1381	1406	1431	1456
1307	1332	1357	1382	1407	1432	1457
1308	1333	1358	1383	1408	1433	1458
1309	1334	1359	1384	1409	1434	1459
1310	1335	1360	1385	1410	1435	1460
1311	1336	1361	1386	1411	1436	1461
1312	1337	1362	1387	1412	1437	1462
1313	1338	1363	1388	1413	1438	1463
1314	1339	1364	1389	1414	1439	1464
1315	1340	1365	1390	1415	1440	1465
1316	1341	1366	1391	1416	1441	1466
1317	1342	1367	1392	1417	1442	1467
1318	1343	1368	1393	1418	1443	1468
1319	1344	1369	1394	1419	1444	1469
1320	1345	1370	1395	1420	1445	1470
1321	1346	1371	1396	1421	1446	1471
1322	1347	1372	1397	1422	1447	1472
1323	1348	1373	1398	1423	1448	1473
1324	1349	1374	1399	1424	1449	1474
1325	1350	1375	1400	1425	1450	1475
1326	1351	1376	1401	1426	1451	1476
1327	1352	1377	1402	1427	1452	1477
1328	1353	1378	1403	1428	1453	1478
1329	1354	1379	1404	1429	1454	1479

BYTE

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

See reverse side for card.

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

BYTE

BUS NESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 176 PITTSFIELD, MA

POSTAGE WIL BE PAID BY ADDRESSEE

BYTE

READER SERVICE
P.O. BOX 5110
Pittsfield, MA 01203-9926
USA

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

YOUR DIRECT LINK

PRODUCT CATEGORY INDEX

For FREE product information from individual advertisers, circle the corresponding inquiry numbers on your Direct Link Card!

To receive information for an entire product category, circle the category number on your Direct Link Card!

Category No. / Inquiry No.		Page No.
21	**PROGRAMMABLE HARDWARE**	
312-313	DAVISON-WORTH CORP	358
305	GRANICOR	358
258	GTEK INC	358
262	IOTECH	359
266	LINK COMPUTER GRAPHICS	359
267	MVS	359
279-280	TRIBAL MICROSYSTEMS	359
284	XELTEK	359
285	Z-WORLD ENGINEERING	359
22	**SCANNERS/OCR/DIGITIZERS**	
376-377	KYE SYSTEMS CORP (INT'L)	218
23	**TAPE DRIVES**	
78-79	AMERICAN MEGATRENDS	117
339-340	CORE INTERNATIONAL	162IS-1
265	LAGUNA DATA SYSTEMS	359
292	NOVASTOR CORP	360
270	OVERLAND DATA INC	360
199	PARALLEL PERIPHERALS	257
272	QUALSTAR CORP	360
24	**UPS**	
206-207	BAY TECHNICAL ASSOC	343
140	MINUTEMAN	121
142-143	PC POWER & COOLING	115

SOFTWARE

25	**BUSINESS**	
371	BLACKWELL SOFTWARE	268IS-3
393	BLINK INC	259
378	ITALIAN SOFTWARE AGENCY	284IS-2
387	NETWORLD DALLAS	336
141	PATTON & PATTON	120
145	PERSONAL TEX	164
359	SZKI RECOGNITA CORP	84
26	**CAD/CAM**	
80	AMERICAN SMALL BUSINESS COMP	145
82	AUTODESK INC	94,97
*	AUTODESK INC	95,96
108-109	AUTODESK RETAIL PRODUCTS	128
283	WINTEK CORP	360
27	**COMMUNICATIONS/NETWORKING**	
254	DIVERSIFIED COMPUTER	360
291	OSCS	363
144	PERSOFT INC	266
366	TRITON TECHNOLOGIES	112IS-2
*	ULTIMATE TECHNOLOGY	112IS-5,6
370	WALKER, RICHER & QUINN	268IS-1
28	**DATA ACQUISITION**	
133	NATIONAL INSTRUMENTS	9
269	NATIONAL INSTRUMENTS	361
*	NATIONAL INSTRUMENTS	112IS-7,8
29	**DATABASE**	
371	BLACKWELL SOFTWARE	268IS-3
85-86	BORLAND INTERNATIONAL	18-19
94	COMPUTER ASSOCIATES	111
253	COMPUTERWISE	361
*	COPIA INTERNATIONAL	146
378	ITALIAN SOFTWARE AGENCY	284IS-2
352	MAGIC/MSE (INT'L)	146IS-1
*	MICROSOFT CORP	32A-B
*	MICROSOFT CORP	32,33
154	RAIMA CORP	105
160	SEQUITER SOFTWARE INC	275
30	**EDUCATIONAL**	
71-72	ABACUS SOFTWARE	191
*	AME INSTIT FOR COMP SCIENCES	361
332	GROUPE BLENHEIM SW DEV EXHIBIT	377
*	MCGRAW HILL NRI (N.A.)	284A-B

Category No. / Inquiry No.		Page No
31	**ENGINEERING/SCIENTIFIC**	
341	DR HUGGLE & PARTNER GMBH	268IS-2
169-170	LANDMARK RESEARCH INT'L CORP	153
126	MATHSOFT INC	303
373	ON TIME MKT/KARSTEN PETERSEN (INT'L)	163
163	SPECTRUM SOFTWARE (N.A.)	209
164	SPSS INC	181
171-172	SYSTAT INC	107
282	VISTA MICROSYSTEMS	361
187-189	WOLFRAM RESEARCH	203
32	**ENTERTAINMENT**	
327	CORPORATE ITEC SERVICES	178UK-4
220	MICROPROSE SOFTWARE	333
221	MICROPROSE SOFTWARE	335
*	REASONABLE SOLUTIONS	112IS-5,6
33	**GRAPHICS**	
374	ARABIC PUBLISHER	268IS-2
96	COREL SOFTWARE	40
*	FRAME TECHNOLOGY	129,130
105	FRAME TECHNOLOGY	131
127	MICROGRAFX	141
291	OSCS	363
*	PACIFIC DATA PRODUCTS	165
173	TEKTRONIX	118,119
34	**MACINTOSH**	
*	APPLE COMPUTER INC	21,23,25
*	APPLE COMPUTER INC	149
*	APPLE COMPUTER INC	151
*	APPLE COMPUTER INC	170A-D
371	BLACKWELL SOFTWARE	268IS-3
554-555	KINGLI TECHNOLOGY, INC	332MW-E
562-563	KINGLI TECHNOLOGY, INC	332NE-4
171-172	SYSTAT INC	107
35	**MAIL ORDER**	
208	BULLDOG COMPUTER PRODUCTS	337
91	COMPUCLASSICS	244
337	COMPUSAVE INTERNATIONAL	210IS-4
338	COMPUTER QUICK (INT'L)	163
345	GREY MATTER LTD	146IS-2
125	PROGRAMMER'S PARADISE	67-68
*	PROGRAMMER'S SHOP	288-290
161	S'NW ELECTRONICS	122
*	SOFTLINE CORP	112IS-3
36	**MATHEMATICAL/STATISTICAL**	
255	ECOSOFT INC	361
273	SAS INSTITUTE INC	362
165-166	STATSOFT	85
187-189	WOLFRAM RESEARCH	203
37	**MISCELLANEOUS SOFTWARE**	
373	ON TIME MKT/KARSTEN PETERSEN (INT'L)	163
38	**ON-LINE SERVICES**	
201	AMERICA ONLINE INC (N.A.)	146A-B
450	BIX	295
39	**OPERATING SYSTEMS**	
117	IBM OS/2	28,29
*	MARK WILLIAMS CO	127
152	QUARTERDECK OFFICE SYSTEMS	132,133
40	**PROGRAMMING LANGUAGES/TOOLS**	
322	BRENT COMMUNICATIONS	178UK-4
*	COPIA INTERNATIONAL	146
327	CORPORATE ITEC SERVICES	178UK-4
106-107	FTP SOFTWARE (N.A.)	84
257	GREENLEAF SOFTWARE	362
345	GREY MATTER LTD	146IS-2
306	IVERSON SOFTWARE, INC	362
264	K & M ASSOCIATES	362
124	LAHEY COMPUTER SYSTEMS	122
191-192	LIANT SOFTWARE CORP (N.A.)	298
193-194	LIANT SOFTWARE CORP (INT'L)	298
349	LOGIC PROGRAMMING ASSOCIATES	284IS-1
352	MAGIC/MSE (INT'L)	146IS-1
167	MANUGISTICS, INC	245
130	MIX SOFTWARE	311
308	OMEGA POINT, INC	362
373	ON TIME MKT/KARSTEN PETERSEN (INT'L)	163
146	PHAR LAP SOFTWARE INC	77

Category No. / Inquiry No.		Page No.
*	PROGRAMMER'S SHOP	288-290
149-150	PROGRESS SOFTWARE	188
271	PSEUDOCORP	363
155-156	RAINBOW TECHNOLOGIES	123
400-401	RAINBOW TECHNOLOGIES	220
186	WATCOM PRODUCTS INC	27
185	WATCOM PRODUCTS INC	277
41	**SECURITY**	
75	ALADDIN KNOWLEDGE SYSTEMS	65
328	ALADDIN KNOWLEDGE SYSTEMS	284IS-3
557	ALADDIN KNOWLEDGE SYSTEMS	332NE-4
558	ALADDIN KNOWLEDGE SYSTEMS	332NE-5
342	EUTRON	284IS-1
343	FAST ELECTRONIC GMBH	162IS-3
110-111	GLENCO ENGINEERING	205
155-156	RAINBOW TECHNOLOGIES	123
361	SOFTWARE SECURITY INC	268IS-4
42	**SHAREWARE**	
*	REASONABLE SOLUTIONS	112IS-5,6
43	**SOFTWARE DUPLICATIONS**	
251-252	AXIOMATIC	357
44	**SPREADSHEETS**	
330-331	BORLAND INTERNATIONAL (INT'L)	CIV
83-84	BORLAND INTERNATIONAL	17
92	COMPUTER ASSOCIATES	39
93	COMPUTER ASSOCIATES	73
45	**UNIX**	
77	CORPORATE ITEC SERVICES	178UK-4
*	MARK WILLIAMS CO	127
307	MORTICE KERN (MKS)	112IS-4
151	QUANTUM SOFTWARE	213
400-401	RAINBOW TECHNOLOGIES	220
197	SUNSOFT	2,3
187-189	WOLFRAM RESEARCH	203
46	**UTILITIES**	
333-334	CLARION SOFTWARE	146IS-3
169-170	LANDMARK RESEARCH INT'L CORP	153
296	MICRO HOUSE	363
291	OSCS	363
149	PKWARE INC	48
*	VERMONT CREATIVE SOFTWARE	13
47	**WINDOWS**	
289-290	BLACK ICE SOFTWARE, INC	363
*	COPIA INTERNATIONAL	146
325	ICONOGRAPHIC SYSTEMS	178UK-4
123	KEA SYSTEMS LTD	116
131-132	NANAO USA CORP	154,155
144	PERSOFT INC	266
*	REASONABLE SOLUTIONS	112IS-5,6
320	SYSTEMSTAR	194UK-1
311	TECTAMM	363
178-179	VENTURA SOFTWARE INC	201
298	VITECS.A.	358
48	**WORD PROCESSING/DTP**	
322	BRENT COMMUNICATIONS	178UK-4
*	PACIFIC DATA PRODUCTS	165

GENERAL

49	**BOOKS/PUBLICATIONS**	
78	AITECH	66
*	C USERS JOURNAL	112IS-5,6
*	C++ REPORT	112IS-7,8
*	COMPUTER BOOK CLUB ,THE (N.A.)	162A-B
*	COMPUTER BOOK CLUB ,THE (N.A.)	163
315-317	HARPER COLLINS	360
8	IBC DATA	360
*	UNIXWORLD	251-253
51	**MISCELLANEOUS**	
388	BOSTON UNIV EDUCATION CENTER	306
*	BYTE EURODECK	187
*	BYTE REPRINTS	178
*	BYTE SUB MESSAGE	284
332	GROUPE BLENHEIM SW DEV EXHIBIT	377

EDITORIAL INDEX

For more information on any of the companies covered in articles, columns or news stories in this issue, circle the appropriate inquiry number on Your Direct Link Card. Each page number refers to the first pages of the article or section in which the company name appears.

Inquiry No.		Page No.
	A	
1149	Aapex Software	113
	Aberdeen Group	24
1105	Acer America	24, 44, 215
1106	Acma Computers	215
1199	Acorn Computers	70
1107	Addtech Research	215
1222	Adobe Systems	24, 263, 309
1191	Advanced Digital Holographics & Holographic Dimensions	195
1192	Advanced Holographics	195
1303	AIQ Systems	106
988	Alacrity Systems	198
	Aladdin Enterprises	20
	Aldus	24, 309
1108	AMAX Engineering	215
1276	Ambitron	89
1193	American Bank Note Holographics	195
	Apollo Computer	134
	Apple Computer	24, 63, 70, 159, 283, 291
	Applied Optics	134
	Apricot	24
1109	Ariel Design	215
1148	ASDG	113
1196	AST Research	46
1075	AT&T	24, 134, 159, 169, 183, 273, 279, 283, 286
	Atari	390
	Athena Design	24
1305	The Athena Group	110
1271	Austin Computer	88
1195	Autodesk	46
1302	Avantos Performance Systems	106
	B	
	Bell Atlantic	24
	Bellcore	183
989	Benson Computer Research	198
	Berkeley Software Design	309
1304	Bimillennium	110
981	BIX	147
1158	Blue Sky Software	113
	Borland International	41, 249, 273, 305, 309
990	BRS Software Products	198
	BT Laboratories	169
	C	
	Caere	24, 309
1110	Cardinal Technologies	215
	Carnegie Institution	286
	Carnegie Mellon	134
1298	Caseworks	104
	Casio Computer	159
	Chips & Technologies	159
1111	Club American Computers	215
1147	Commodore Business Machines	113
	Communication Intelligence	159
	Compaq Computer	24, 46, 238
986	The Complete Portable	147
1112	CompuAdd Computer	24, 215
1234	Compudyne Direct	249
	Conductus	169
1165	Corel Systems	195, 263
1155	Creative Labs	113
	D	
1274	Data General	88
	Dataquest	134
	DEC	24, 63, 74, 134, 198
	Defence Research Agency	169
1113, 1224	Dell Computer	24, 215, 238
	Destiny Technology	24
	Detroit Edison	159
1166	Digital Interfaces	195
	DMR Group	134
1190	Drexler Technology	195
1114	Duracom Computer Systems	215
	E	
	Eastman Kodak	24, 309
982	EcoNet	147
1203	Electronic Publishing, Oxford University Press	70
1225	Epson America	238
1154, 1235	Ergo Computing	113, 249
	Everex Systems	24
1309	ExperVision	112
	F	
1306	FEA Limited	110
	Frame Technology	24
	Fujitsu Personal Systems	159
	G	
1204	GammaLink	70
1115, 1156, 1236	Gateway 2000	113, 215, 249
1318	General Software	98
	Georgia Institute of Technology	169
	GeoWorks	159
1288	Global Village Communication	98
	Go	159
	Grid Systems	159
	H	
	Hercules Computer Technology	20
	Heriot-Watt University	169
1167	Hewlett-Packard	24, 134, 159, 169, 195, 305, 307, 317
	Hiroshima University	169
1168	Hitachi America	24, 195
	Honeywell	169
	Howtek	309
	I	
	IBM	20, 24, 63, 134, 169, 183, 249, 269, 307, 309
992	Imara Research	198
993	Information Dimensions	198
1295	Infralink	100
1226	Insight Computers	238
	Intel	24, 44, 46, 134, 159, 169
	Interleaf	24
1317	Intermatic	92
976	International Cartridge Recycling Association	147
	International Data	44
994	Interpreter	198
1169	Introl	195
	J	
1116	JCC Systems	215
	Jet Propulsion Laboratory	134
	Jostens Learning	24
	K	
	Kaleida	24
1287	Kansai Electric	92
1314	KDI	89
995	Keyfile	198
	KnowledgePoint	24
996	Kolax Image Products	198
983	Kyocera Electronics	147
	L	
1308	Labtech	110
1273	Lanco	88
1170	Laser Magnetic Storage	195
1152	LaserMaster	113
1194	The Lasersmith	195
1162	Litton Data Systems	134, 195
	Logitech	249, 309
1200	Lotus Development	41, 70, 249
	M	
1202	MacVonk USA	70
	Mainstream Data	309
1301	Management Information Software	106
1300	MapInfo	106
	Marger, Johnson, McCollom & Stolowitz	134
1171, 1278	Mass Microsystems	89, 195
1172	Mass Optical Storage Technologies	195
	Matsushita	24
1289	Micom Communications	98
1173	Micro Design International	195
997	Micro Dynamics	198
1174	MicroNet Technology	195
1297	MicroQuill	104
1153, 1232	Microsoft	70, 113, 134, 159, 249, 267, 273, 305, 307
	MIT	134, 286
	Mitac	44
	Mitsubishi	24
	Motorola	159
1175	Mountain Network Solutions	195
	Multiscope	24
	N	
1197	National Instruments	63
977	National Office Paper Recycling Project	147
984	National Research Council of Canada	147
998, 1227	NCR	24, 198, 238
1117, 1176, 1228	NEC Technologies	195, 215, 238
	Nestor	159
1315	Neural Computer Sciences	90
1157	New Horizons Software	113
	Next	134
	Nippon Telephone & Telegraph	183
	Northgate Computer	24
1272	Notebook Computer	88
	Novell	24, 134
1280	Number Nine Computer	90
	O	
1163	OCA Applied Optics	195
1198	Olivetti Advanced Tech	24, 70
1177	Online Computer Systems	195
	Open Software Foundation	24
	Open Systems Advisors	134
	Optical Corp. of America	134
999	Optika Imaging	198
1307	Oxford Molecular	110
	P	
	Palm Computing	24
	Palm Systems	159
1178	Panasonic Communications & Systems	195, 279
	Paragraph International	159
978	Partnership for Plastic Progress	147
1292	Patton Electronics	100
1118	PC Brand	215
1131	PC DOCS	198
1285	PCubid Computer Technology	92
	Pencom	134
1179	Peripheral Land	195
	Personal Library Software	285
	Phar Lap Software	279
1180	Philips Key Modules	195
1181	Pinnacle Micro	195
1150	Pioneer Communications of America	113
	Pixar	46
1182	Plasmon Data Systems	195
1119	PolyWell Computers	215
	Poqet Computer	159
1282	Positive	90
	Primax	44
1183	Procom Technology	195
	ProLytix	24
1277	Proxima	89
	Q	
	QMS	20
	Quarterdeck Office Systems	70
	R	
1279	Radius	90
1184	Ricoh	195
1275	Ricoh File Products	89
	S	
1293	Samsung Software America	100
	The Santa Cruz Operation	134
1284	Science Accessories	92
	Scriptel	159
	Seiko	20
985	Sequence Electronics	147
1229	Sharp Electronics	238
979	Silicon Valley Toxics Coalition/ Campaign for Responsible Technology	147
	Sitka	159
	Slate	159
1151	Softac	113
1312	SoftLogic Solutions	112
1132	SoftSolutions Technology	198
	Software Architects	309
1291	Software Marketing Group	98
980	Solid Waste Information Clearinghouse Hotline	147
1185	Sony	24, 195
	Stanford Resources	159
	Starlight Networks	24
1186, 1201	Storage Dimensions	70, 195
	SunDisk	159
	Sun Joy	44
	Sun Microsystems	24, 46, 134, 283
	SunSoft	134
1160	Supra	113
	Symantec	24, 273, 285
	SynthaVoice Computers	24
1231	Systems Compatibility	281
	T	
1120	Tandy/Radio Shack	159, 215
1121	Tangent Computer	215
1187	Tecmar	195
1164	Teledyne Brown Engineering	134, 195
1188	Ten X Technology	195
1296	TeraTech	104
	Texas Instruments	24, 249
	Thinking Machines	169
	3M	169
	Time Warner	24
1189	Toshiba America Information Systems	24, 70, 195, 249
	Touchstone Delta	169
1283	Trantor Systems	92
1286	Trend Micro Devices	92
1319	TrippLite	100
	TRW	169
	U	
1316	UDP Data Products	92
	Univel	134
	Unix Software Laboratories	24, 134
	USL	134
	V	
	VeriFone	24
987	Video Display	147
1281	Video Dynamics	90
	Visionetics International	44
	W	
	Watcom	305
1146	Waterloo Maple Software	113
1294	Webcorp	100
1133	Westbrook Technologies	198
	Western Digital	46
1290	Western Telematic	98
	The Whitewater Group	24
1161	Windowcraft	113
	WordPerfect	24
1122	Wyse Technology	215
	X	
1311	XTree	112
	Z	
1159, 1230	Zenith Data Systems	24, 113, 238
1299	Zinc Software	104
1310	ZyLab	112

Decisions, decisions, decisions.

Decider, decider, decider.

There are more computer products, more emerging standards, more technical issues to consider than ever before. So how do corporations make buying decisions?

According to IntelliQuest, they turn to the only person qualified to decide. An individual with over 10 years of technical experience. Who spends 24 hours a month learning about products and technologies.

They turn to the BYTE reader. A full 94% of whom are directly involved when products are bought. Each of whom influences 107 others.

If you want to reach people who make buying decisions, decide to advertise in BYTE.

BYTE reader Davis M. DeBard, Financial Systems Analyst, The Boston Company, a subsidiary of Shearson Lehman Brothers, an American Express Company.

Circle 87 on Inquiry Card.

It doesn't get bought without

© 1992 BYTE, a McGraw-Hill publication. Phone (603) 924-9281. Source: IntelliQuest, March 1992.

HOW DO YOU GET A JOB WITHOUT EXPERIENCE? AND HOW DO YOU GET EXPERIENCE WITHOUT A JOB?

Most young people have one answer to this problem. They avoid it until they're out of college. But they could be getting solid work experience while they're still in college. With your company's help. And ours.

We're Co-op Education. A nationwide program that helps college students get real jobs for real pay, while they're getting an education.

But we can't do it without you. Those real jobs have to come from real companies. Like yours.

For more information on how you can participate in this valuable program, write Co-op Education, Box 775E, Boston, MA 02115.

Not only will you be giving students a chance to earn money and pick up the most valuable kind of knowledge, you'll be giving yourselves a chance to pick up the most valuable kind of employee.

Co-op Education.

You earn a future when you earn a degree.

Ad Council A Public Service of This Publication ©1987 National Commission for Cooperative Education

COPY SOFTWARE ILLEGALLY AND YOU COULD GET THIS HARDWARE ABSOLUTELY FREE.

Software piracy isn't just a crime. It's a shame. Because most people who do it aren't even aware that it's illegal. If you copy software that's protected by copyright, you could lose your job, face a civil suit, pay a $100,000 fine and possibly be imprisoned. So get the facts now. To request more information, contact the Software Publishers Association at 1-800-388-7478. Because in a court of law, ignorance is one thing you won't be able to plead.

Please send me more information on the legal use of software.

Name _____

Organization _____

Title _____

Address _____

City _____ State _____ Zip _____

Please check software format you prefer if you would like to receive SPAudit, a software inventory management tool:

___ DOS 3.5" ___ DOS 5.25" ___ Macintosh®

Mail to: Piracy Update, 1730 M Street, N.W., Suite 700, Washington, D.C. 20036-4510

H-1

SPA Don't Copy That Floppy

Macintosh is a registered trademark of Apple Computer, Inc.

STOP BIT

NOLAN BUSHNELL

THE ARTICHOKE THEORY

In the beginning, we were the gigafreaks, nerds, and dweebs. We thought Pascal was a romance language, and we all had girlfriends named Ada. We read BYTE and loved those intricate line drawings, which we discussed at Homebrew and the Boston Computer Society. We spawned the PC revolution, and we began it by meeting and selling products to each other. But we didn't get rich until we figured out how to sell the stuff to the "others."

Why not tailor the user interface to each user's ability level? I call this the artichoke approach.

The others were not computer champs. They were people who wore white socks only with running shoes. They were people with "real" jobs who used PCs not for the sheer joy of it, but for solving problems at work. They hated user's manuals thicker than unabridged dictionaries. They found the dot prompt user-hostile. Nevertheless, they were willing to climb that steep learning curve for the productivity benefits offered by products like dBase and VisiCalc. Times have changed.

Twenty years ago, I created a computer interface that was so easy to use that people understood how to operate my program within 15 seconds. The interface was so compelling that people were willing to pay 25 cents every few minutes for the excitement of using it. It was called Pong, and it started Atari.

My contribution to the PC revolution was in trying to make computers easy to use and compel millions of people to play. To some degree, that has happened. But it has not gone nearly as far as I had hoped.

The PC cannot be mastered in 15 seconds. It still isn't as easy to use as a toaster or TV. And when I think of all the aspects of new technology—networking, voice-mail, E-mail, fax, and video—I fear that things may be getting more difficult.

Go to Comdex and walk the floor. Everyone is jabbering about tying together all aspects of automation. To use the stuff, all one needs is an E.E. degree from MIT. To install it, one needs about five consultants. And to afford it, one needs to float junk bonds on the house, business, wife, and kids. Then, the E-mail, LAN, PCs, telephone, video, fax, peripherals, and so on probably won't be compatible. And even if they are, it's going to take a few hundred years to actually get them to work together and to learn how to use them. No wonder the industry hit a slump.

The problem goes beyond simply providing an easy-to-use product. Different people—from the receptionist to the MIS manager to the CEO—have different needs to know the many aspects of integrated or unified systems. And they each have different desires to understand it. Yet we force them all to use the same interface.

Why can't we technologists assemble a multidimensional interface system? Why not let those who have the greatest fear and the least time to learn deal with just the outer level of a complex system? Let the technologists in an organization have access to the depth and complexity. I call this configuration the artichoke approach.

The complexity of the technology may be a joy to the gigafreak, but it is an intimidating nightmare to the others. We need to make all of it run so easily that even a CEO can comprehend how to use the system productively. I am only partly joking. CEOs are the busiest people in an organization, and they have less time to learn new things than anyone else. If a CEO is not part of a unified automation system, then that automation system will not truly be the spine of the organization.

How do we take this incredible complexity and present it so that everyone is empowered to use it? With games, we tell the machine our level of expertise. Why not with networked office systems?

The interface can best be described as a great electronic artichoke. At its heart is a complex mass of technology in which the systems integrator can feast. At the outer leaf is a system so easy to use that even a CEO will partake.

The CEO can learn the outer leaf of this electronic artichoke in 30 seconds. Once the user learns and digests the first leaf, the next leaf can be taken, digested and understood, and so on, until he or she readily understands all the capabilities at its heart.

The key to true ease of use is to make the front end enjoyable, easy, nonintimidating, and intuitive. The value of the system should be apparent. Everyone should want to take the next bite. ■

Nolan Bushnell is the founder of Atari and inventor of Pong, the world's first video game. He is currently chairman of OCTuS, a communications server vendor in San Diego. You can reach him on BIX c/o "editors."

Stop Bit is a forum for informed opinion on personal computing topics. The opinions expressed are those of the author and not necessarily those of BYTE. Your contributions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

ILLUSTRATION: CHRIS SPOLLEN © 1992

LAW.

MURPHY'S LAW #43

AN AFFORDABLE NOTEBOOK IS A BLACK AND WHITE NOTEBOOK.

OUTLAW.

It's things like this that put us on everyone's most wanted list.

A 7.1 pound, 25 MHz i386™SL notebook for only $2,899. That's a color notebook, mind you. The Dell 325NC.

Considering that's a better price than other leading black and white notebooks, you must be thinking we're skimping somewhere, right?

Wrong.

You not only get 4 MB RAM and an 80 MB hard drive, you also get Dell's unmatched guarantees.

Namely, guaranteed next-business-day lapside service: in your office, home or hotel.

Guaranteed response within five minutes to support phone calls. And a guarantee to help you solve any compatibility issues you might have.

DELL 325NC i386SL
25 MHz COLOR NOTEBOOK

LEASE: $107/MO. • 4 MB RAM • 80 MB HARD DRIVE • VGA COLOR LCD (9", 640 X 480) • 3-HOUR BATTERY LIFE • MS-DOS 5.0

So call us. And Murphy, take a hike. Because now there's a new law in these parts.

DELL™

800-232-5620

WHEN CALLING, PLEASE REFERENCE #11E75.
HOURS: 7AM-9PM CT MON-FRI,
8AM-4PM CT SAT, 10AM-3PM CT SUN.
IN CANADA, CALL 800-668-3021. IN MEXICO CITY, 250-7111.

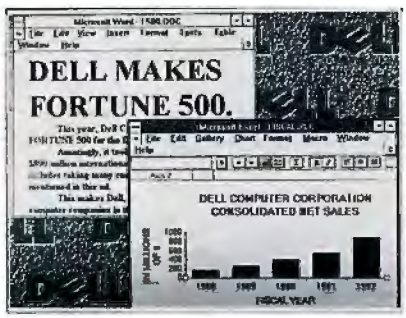
THE BEST COMPUTER IN AMERICA,

We call it a notebook, but it's actually smaller. Just 7¼" x 11" and only 1¼" thick. So you might be able to fit some briefs in your briefcase. Maybe even a sandwich or two.

$2,149

LEASE◊: $80/MONTH

This small number gets you all these big numbers: 20MHz i386SL processor, 2 MB of RAM, 60 MB hard drive, (80 or 120 MB hard drive optional), VGA Reflective (9.5", 640 x 480) LCD, external 3.5" floppy drive, and up to 4 hours of work from the NiMH battery.



Comes standard with everything you need to run even the most hardcore software: MS-DOS 5.0, Microsoft® Windows™ 3.1 and a keyboard mouse. We'll even throw in the new Lotus® Organizer so you can throw out that outdated datebook.

intel inside

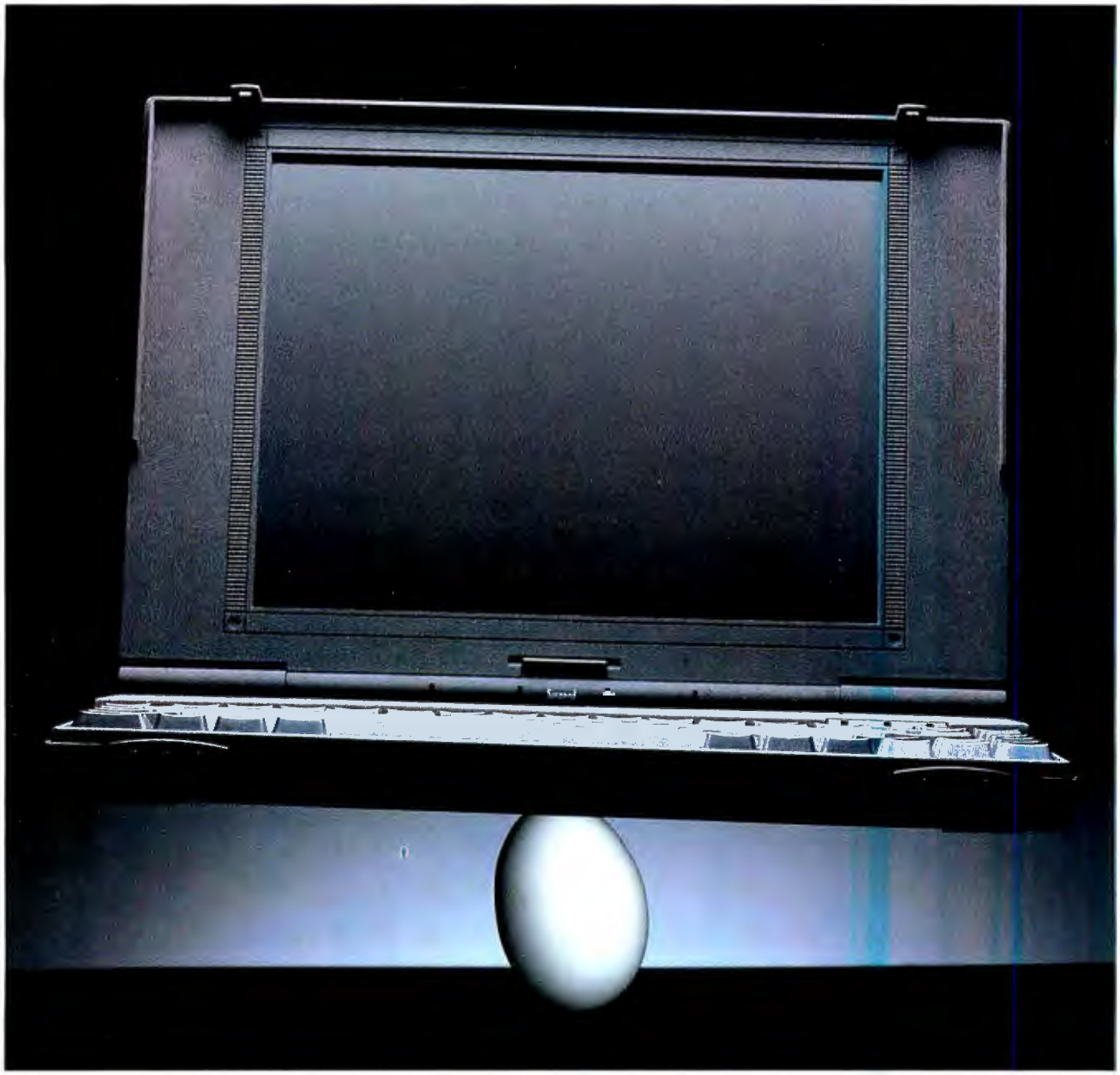
That's not all you'll find in here. There's room for a 120 MB hard drive, math coprocessor, and 10 MB of RAM. There's even an industry-standard PCMCIA slot for a modem or other expansion.

Dell's toll-free support lines are now open 6 AM to midnight every day. And the 320SLi's field serviceable components and next-day, lapside service let you keep your data and your composure in the event of an emergency.

Your hands don't get smaller just because your computer does. So Dell gave the 320SLi a full 85-key keyboard, including special screen navigation keys in the familiar inverted-T layout.

Guarantees available in USA only. For a copy please write Dell USA L.P., 9505 Arboretum Blvd., Austin, TX 78759-7299, Attention Guarantees or call our Tech Fax line at 1-800-950-1329. △Service provided by BancTec Service Corporation. On-site service may not be available in certain remote locations. ◊ Leasing arranged by Leasing Group, Inc. i386, i486 and the Intel Inside Logo are trademarks of Intel Corporation. Microsoft and MS-DOS are registered trademarks and Windows is a trademark of Microsoft Corporation. Lotus is a registered trademark of Lotus Development Corp. FORTUNE 500 is a registered trademark of The Time Inc. Magazine Company. Dell disclaims proprietary interest in the marks and names of others. ●1992 Dell Computer Corporation. All rights reserved.

POUND FOR POUND FOR POUND AND A HALF.



At just over 3.5 lbs, the Dell 320SLi offers features and functions usually reserved for systems twice its weight. So call and order one today. At this price, it shouldn't be a heavy decision.

DELL™

800-545-3604

WHEN CALLING, PLEASE REFERENCE **#11E77**.
HOURS: 7AM-9PM CT MON-FRI, 8AM-4PM CT SAT, 10AM-3PM CT SUN.
IN CANADA, CALL 800-668-3021. IN MEXICO CITY, 250-7111.

Circle 100 on Inquiry Card.

MURPHY'S LAW #17

NEW TECHNOLOGY IS ALWAYS PRICED JUST BEYOND YOUR BUDGET.

IF THAT'S THE LAW THEN THIS IS A CRIME.

We didn't get to be a FORTUNE 500® company by playing by the rules. Why start now?

Take our new Dell® i486™ 66 MHz systems, for example. They're all based on Intel's incredibly fast 66 MHz i486DX2 chip. They're available in four platforms, and in hundreds of configurations. And you can get a complete system for just $2,499. (Sorry, Murphy.)

Likewise, you can't find guarantees like ours with any other make of computer. That is, guaranteed response within five minutes to support phone calls. Guaranteed next-business-day service.Δ And a guarantee to help you solve any compatibility issues.*

So, fact is, we broke quite a few of Murphy's laws.

To us, it's the perfect crime.

DELL 486P/66 i486DX2 66 MHz SYSTEM

LEASE◊: $92/MO. • 4 MB RAM • 120 MB HARD DRIVE (17MS) IDE HARD DRIVE • SUPER ACCELERATED VIDEO CONTROLLER • SUPER VGA 1024i MONITOR (14", 1024 X 786, .28mm) • ONE FLOPPY DRIVE (3.5" OR 5.25") • MS-DOS® 5.0

DELL™

800-553-6046

WHEN CALLING, PLEASE REFERENCE #11EJ2.
HOURS: 7AM-9PM CT MON-FRI,
8AM-4PM CT SAT, 10AM-3PM CT SUN.
IN CANADA, CALL 800-668-3021. IN MEXICO CITY, 250-7111.

intel inside

Circle 101 on Inquiry Card.