

# BYTE

NOVEMBER 1990

A MCGRAW-HILL PUBLICATION

## Compaq's DAZZLING New Laptop



*Everything a Deskpro 386/20 offers—in a 7½-pound package*



**State-of-the-Art Mass Storage:**  
Magnetic, Optical,  
Holographic, and more

**The New Quattro Pro**  
AI.R's Modular Micro  
Channel MPS

**FPU Face-Off**  
Intel vs. Four Challengers

**Life in Storage**  
Capacity  
Drives

**Power for Windows**  
Laptop Glass vs. X.desktop  
Canon's New Bubble-Jet Printer  
ProFound vs. Imara  
AST, Club American,  
Everex 486/33s  
SmartConnex  
Poqet Portable



\$3.50 U.S. & CANADA  
£1.95 U.K.



**THE NEW DELL SYSTEM 433TE**  
33 MHz EISA i486™

- Intel 80486 microprocessor running at 33 MHz with 128 KB external cache.

**\*\*Commercial Lease Plan. Lease for as low as \$377/month.**

330 MB Super VGA Color System (800 x 600) \$10,499

Price listed includes 4 MB of RAM.\* 80, 100, 190, 330 and 650 MB hard drive configurations available.



**THE NEW DELL SYSTEM 425TE**  
25 MHz EISA i486.

- Intel 80486 microprocessor running at 25 MHz.

**Commercial Lease Plan. Lease for as low as \$278/month.**

190 MB Super VGA Color System (800 x 600) \$7,499

Price listed includes 4 MB of RAM.\* 80, 100, 190, 330 and 650 MB hard drive configurations available.



**THE DELL SYSTEM 433E**  
33 MHz EISA i486.

- i486 microprocessor running at 33 MHz.

**Commercial Lease Plan. Lease for as low as \$307/month.**

100 MB Super VGA Color System (800 x 600) \$8,499

Price listed includes 4 MB of RAM.\* 80, 100, 190, 330 and 650 MB hard drive configurations available.



**THE DELL SYSTEM 425E™**  
25 MHz EISA i486.

- i486 microprocessor running at 25 MHz.

**Commercial Lease Plan. Lease for as low as \$235/month.**

100 MB Super VGA Color System (800 x 600) \$6,499

Price listed includes 4 MB of RAM.\* 80, 100, 190, 330 and 650 MB hard drive configurations available.



**THE NEW DELL SYSTEM 325D**  
25 MHz 386™

- Intel 80386 microprocessor running at 25 MHz with 32 KB external cache.

**Commercial Lease Plan. Lease for as low as \$112/month.**

40 MB VGA Color Plus System \$2,999

Price listed includes 1 MB of RAM.\* 40, 80, 100, 190, 330 and 650 MB hard drive configurations available.



**THE DELL SYSTEM 316SX**  
16 MHz 386SX.

- Intel 80386SX microprocessor running at 16 MHz.

**Commercial Lease Plan. Lease for as low as \$79/month.**

40 MB VGA Color Plus System \$2,099

Price listed includes 1 MB of RAM.\* 20, 40, 80, 100 and 190 MB hard drive configurations available.



**THE DELL SYSTEM 320LX**  
20 MHz 386SX.

- Intel 80386SX microprocessor running at 20 MHz.

**Commercial Lease Plan. Lease for as low as \$104/month.**

40 MB VGA Color Plus System \$2,799

Price listed includes 1 MB of RAM.\* 40, 80, 100, 190, 330 and 650 MB hard drive configurations available.



**THE NEW DELL SYSTEM 320LT**  
20 MHz 386SX.

- Intel 80386 microprocessor running at 20 MHz.

**Commercial Lease Plan. Lease for as low as \$141/month.**

40 MB, 2 MB RAM \$3,899

20 MB hard drive configurations also available.



**THE DELL SYSTEM 210**  
12.5 MHz 286.

- Intel® 80286 microprocessor running at 12.5 MHz.

**Commercial Lease Plan. Lease for as low as \$59/month.**

20 MB VGA Monochrome System \$1,549

Price listed includes 1 MB of RAM.\* 20, 40, 80 and 100 MB hard drive configurations available.



**THE DELL SYSTEM 316LT**  
16 MHz 386SX.

- Intel 80386SX microprocessor running at 16 MHz.

**Commercial Lease Plan. Lease for as low as \$112/month.**

20 MB, 1 MB RAM \$2,999

40 MB hard drive configurations also available.

The Dell System 433TE and 425TE are class A devices sold for use in commercial environments only. Performance Enhancements. Within the first megabyte of memory, 128 KB (316SX, 320LX and 210), 96 KB (333D and 325D) or 384 KB (320LX, 425E, 433E, 425TE and 433TE) of memory is reserved for use by the system to enhance performance. Can be optionally disabled on 333D, 325D, 316SX and 210. All systems are photographed with optional extras. Dell cannot be responsible for errors in typography or photography. \*Payment based on 36-month, open-end lease. Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices may vary. DELL SYSTEM is a registered trademark, Dell 425E and SmartWare trademarks of Dell Computer Corporation. Intel is a registered trademark and 386, 486 and 486 are trademarks of Intel Corporation. Other trademarks and trade names are used to identify the entities claiming the marks and names or their products. Dell Computer Corporation disclaims any proprietary interest in trademarks and trade names other than its own. On-site service may not be available in certain remote locations. Shipping, handling and applicable sales tax not included in the price. For information on and a copy of Dell's 30-Day Total Satisfaction Guarantee, limited warranty, and Xerox's Service Contract, please write to Dell Computer Corporation, 9505 Arboretum Boulevard, Austin, Texas 78759 7299, ATTN: Warranty ©1990 Dell Computer Corporation. All rights reserved.

If all you're looking for is a cheap 386™ system, you won't be disappointed. You'll get a cheap 386 system. Probably with marginal service. From a company that was born yesterday.

On the other hand, if you want a 386 system from a worldwide company that provides instantaneous service, and has won eight PC Week Corporate Satisfaction Polls for PCs, call Dell.

The clincher is, you'll spend roughly the same for a great Dell™ 386 PC as a cheapo 386 PC.

# GREAT COMPUTERS, GREAT SERVICE, GREAT REPUTATION, GREAT PRICES.



**Our new 386 systems even pull a fast one on pricier computers.** Both the 25 MHz Dell System® 325D and 33 MHz Dell System 333D are

faster and more expandable than most higher priced systems.

Each holds up to 16 MB

of RAM on the system board. Which keeps all six slots free for expansion cards—enough for even the most peripheral-happy people.

The new Dell 325D is a fast, reliable machine with a 32 KB cache, LIM 4.0 hardware support, an integrated 16-bit VGA controller that supports

up to 1024 x 768 resolution, password protection, a software controlled reset switch, and a PS/2 compatible mouse port as standard equipment. All of which is designed into a compact footprint.

The Dell 333D is as good as a 386 PC can get.

TO ORDER, CALL  
**800-365-1480**  
HOURS: 6 AM-9 PM CT M-F 8 AM-4 PM CT SAT.

In Canada 800-387-5752. In the U.K. 0800 414535. In France (1) 30.60.68.00. In Germany 06109701-0. In Sweden 0760-713 50.

## THE NEW DELL SYSTEM 333D 33 MHz 386 AND THE NEW DELL SYSTEM 325D 25 MHz 386.

### STANDARD FEATURES:

- Intel® 80386 microprocessor running at 33 MHz (333D) or 25 MHz (325D).
- Page mode interleaved memory architecture.
- Standard 1 MB of RAM, optional 2 MB or 4 MB of RAM\* expandable to 16 MB on system board.
- Integrated VGA controller with 1024 x 768 support.
- 64 KB (333D) or 32 KB (325D) high-speed SRAM.
- Socket for Intel 80387 or WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- 6 industry standard expansion slots.

- High-performance IDE (40 MB, 80 MB, 100 MB, 190 MB) and ESDI (330 MB, 650 MB) hard disk drives.
- 1 parallel, 2 serial, PS/2 compatible mouse port, all integrated.
- SmartVc—advanced systems diagnostic display.
- 12-month On-Site Service Contract provided by Xerox.

	333D	325D
40 MB VGA Color Plus System:	\$3,599	\$2,999

Prices include 1 MB of RAM.

AD CODE 11E10

# HERE'S OUR NEW STORE, SO YOU'LL NEVER HAVE TO GO TO THEIR STORE AGAIN.

When you buy from a traditional computer store, here's what you get:

A beefy retail mark-up.

Pressure to buy something you don't want.

That crummy feeling of not knowing what you're getting, because the salesman isn't sure what he's selling.

And, when there's a problem, some guy with a screwdriver taking your computer apart.

When you call Dell, on the other hand, here's what you get:

A frank talk with experts about what you need, and a recommendation about



the best  
overall package  
for you.

Custom

## THE NEW DELL SYSTEM® 3333D 33 MHz 386. STANDARD FEATURES:

- Intel® 80386 microprocessor running at 33 MHz.
- Page mode interleaved memory architecture.
- Standard 1 MB of RAM, optional 2 MB or 4 MB of RAM\* expandable to 16 MB on system board.
- Integrated VGA controller with 1024 x 768 support.
- 64 KB high-speed SRAM.
- Socket for Intel 80387 or WEITEK 3167 math coprocessors.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- 6 industry standard expansion slots (five 16-bit, one 8-bit).
- High-performance IDE (40 MB, 80 MB, 100 MB, 190 MB) and ESDI (330 MB, 650 MB) hard disk drives.
- 1 parallel port, 2 serial ports, PS-2 compatible mouse port, all integrated.
- SmartVu™ Advanced System Diagnostic Display.
- 12-month On-Site Service Contract provided by Xerox.
- 40 MB VGA Color Plus System \$3,599

Price listed includes 1 MB of RAM, 40, 80, 100, 190, 330, and 650 hard drive configurations available.

AD CODE 11E10

TO ORDER, CALL  
**800-365-1480**  
HOURS: 6 AM-9 PM CT M-F 8 AM-4 PM CT SAT.

In Canada 800-387-5752. In the U.K. 0800 414535. In France (1) 30.60.68.00. In Germany 06103701-0. In Sweden 0760-713 50

configuration, with options including monitors, memory sizes, software, accessories and peripherals.

Service — often voted the best in the industry — by computer experts who know our computers inside and out.

A variety of financing and leasing<sup>o</sup> options.

A firm promise to build your computers, a

configured systems test, and shipment by two-day air standard.

A 30-day, no questions asked, money back guarantee.

A one-year limited warranty.

And a great price, with no retail mark-up.

Call us now. Why waste a trip when everything you need is right in front of you?

**UH,  
UH,  
UH,  
GREAT PRICES.**



Not only is it 33% faster than the Dell 325D, it also has a 64 KB RAM cache for an extra kick in performance.

**We design every machine to our specs, then build it to yours.** When you call us, we take you through all the choices you have in memory sizes, monitors, storage devices, high performance controllers and accessories. We'll help you decide exactly what you need, then custom build your computer and do a fully configured system test before we send it out.

Then you get 30 days to use it. If you aren't completely satisfied, send it back. We'll return

your money, no questions asked.

**Even if something goes wrong, it won't wreck your day.** Both the Dell 325D and 333D come with the built-in SmartVu™ diagnostic

display, an ingenious device that identifies problems even if the monitor goes down.

If you need help, the Dell toll-free technical hotline solves 90% of all problems over the phone, often within 4 or 5 minutes.

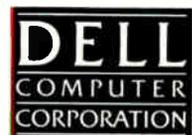
If we can't solve it over the phone, a trained

technician from Xerox will be sent to your desk the next business day with the solution in hand.

**For sale, for lease, for less.** Call us. Talk to a computer expert whose only job is to give you exactly what you want in computers, service, software, printers and financing. You'll get solid information that could save you time and money.

Call us now. You'll get a great computer.

With no "uhs" about it.



**Rip Your Competition  
to Shreds...**



photo: Ron Taylor/ Tom Stack & Assoc

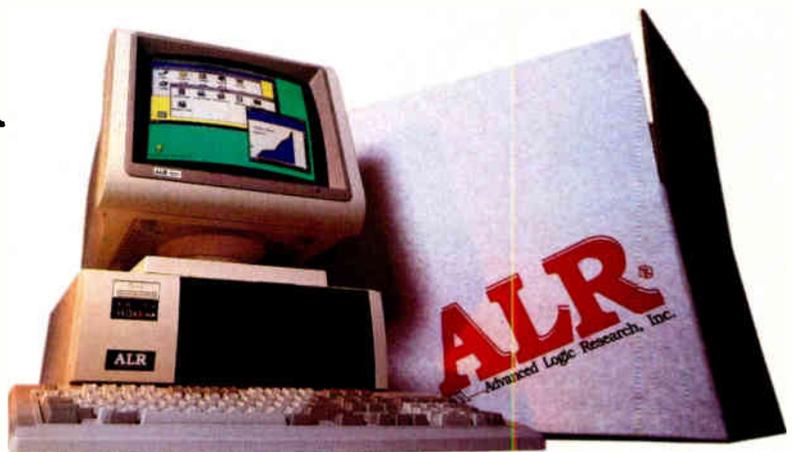
# 33-MHz 386DX™, EISA...\$1995

INTRODUCTORY  
SPECIAL!  
Rebates of up to  
**\$650**  
on great  
BusinessVEISA  
Peripherals till  
December 31, 1990.  
Contact ALR for details!

## The ALR BusinessVEISA

See us at  
**COMDEX/Fall '90**  
Booth # 1886, Main Hall

**It's What You Need  
to Thrive in Today's  
Hostile Business World**



It's a sink or swim world out there, and if you don't take advantage of the latest in today's technology, *your competition will*. To survive in a sea of reduced budgets and accelerated time schedules, you need a computer that's both inexpensive and fast. You need a system that will exploit the best of today's and tomorrow's technology without exploiting your budget. You need the ALR BusinessVEISA.

One of the easiest ways for your company to remain competitive is to reduce its spending; that's why we've priced the BusinessVEISA Model 101 at just \$1995. With its 33-MHz 386-processor and its advanced 32-bit EISA bus, the BusinessVEISA gives you all the power you'll need to devour today's most advanced business applications.

Designed to survive the changing tides of your business environment, the BusinessVEISA can take advantage of both standard 8- and 16-bit add-on boards and advanced 32-bit EISA enhancement products. This powerful system can feast on the latest in today's and tomorrow's high-speed I/O and multimastering technology.

As you conquer new territories, your BusinessVEISA can expand its jaws to accommodate i486 power. *Just Upgrade the CPU!*™ Simply plug in an ALR VEISA 25 or 33-MHz i486 CPU module to boost your performance up to 270%. Then watch your competition scatter.

Don't ignore your killer instinct. Call ALR today.

**1-800-444-4ALR**

Hunt for the Real 32-bit System		
	ALR BusinessVEISA	AST Premium™
Architecture	386/33-101 VEISA	386SX/16-5V CUPID-32?
CPU Speed	33-MHz ✓	16-MHz
CPU	386DX ✓	386SX
Data Path	32-Bit ✓	16-Bit
Memory	1-MB	1-MB
Bus	32-Bit EISA ✓	16-Bit ISA
List Price	\$1995	\$2495
Price of 25-MHz i486 Upgrade	\$1995	\$4895

### Just Upgrade the CPU!™

ALR VEISA 25-MHz i486 CPU Module  
ALR VEISA 33-MHz 386 CPU Module      33-MHz i486 CPU Module



**ALR** 9401 Jeronimo, Irvine, CA 92718  
(714) 581-6770 FAX: (714) 581-9240

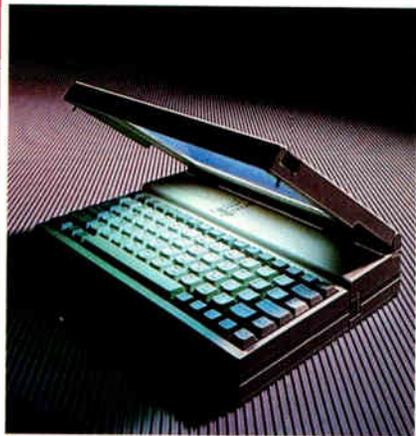
Available at these selected resellers:

Connecting Point® **ENTRE** **TCBC**  
COMPUTER CENTERS

Prices and configurations subject to change without notice. Prices based on U.S. dollars. System shown with optional monitor/graphics adapter and 3.5" floppy. VEISA, BusinessVEISA, and Just Upgrade the CPU! are trademarks and ALR is a registered trademark of Advanced Logic Research, Inc. All other brand and product names are trademarks or registered trademarks of their respective owners. Shark photo: Ron Taylor/ Tom Stack & Assoc. ©1990 by Advanced Logic Research. AST, we saw your mailer. Would you like some of our product literature so you can get your information right next time?

# CONTENTS

November 1990  
Volume 15, Number 12



## COVER STORY

FIRST IMPRESSIONS

### Compaq Notebook Ups the Ante

PAGE 140

The LTE 386s/20  
is the high-performance  
notebook PC to beat.

- 221 **Windows Takes On WingZ**  
Informix's graphical spreadsheet puts Windows 3.0 through its paces.
- 227 **Mac-ish Interfaces for Unix**  
Looking Glass and X.desktop provide point-and-click ease of use to Unix.
- 235 **New Bubble-Jet Outpaces Portable Printers**  
Canon's new portable printer bubbles over with sharp resolution and flexibility.
- 239 **A Poqet Full of Power**  
It's small. It's innovative. But is it practical? Wayne Rash Jr. takes the Poqet PC on the road.
- 245 **One-Size-Fits-All Code with Lattice C**  
A royalty-free DOS extender is standard with Lattice's new C compiler.
- 251 **Document Management on Networked PCs**  
Imara and ProFound offer two approaches to keeping track of documents.
- 258 **Small, Low-Cost UPSes**  
Small and inexpensive backup power systems make reliable power an individual choice.
- 262 **TravelMate 2000 Lives Up to Its Name**  
Texas Instruments puts AT-class power in a 4-pound package.
- 266 **Pricy Hard Disk Drive Portability**  
The Disctec 20 provides floppy disk convenience with hard disk storage in a very small package.
- 268 **Reviewer's Notebook**  
A new ALR PowerFlex model, and hard disk confusion at Micro Express.
- STATE OF THE ART**
- 272 **MAGNETIC VS. OPTICAL Introduction**
- 275 **State of the Media**  
A look at the conflict between traditional magnetic mass storage devices and optical technologies.
- 283 **Crystal Clear Storage**  
The holostore, a new mass storage device with supercomputer performance, could eliminate the I/O bottleneck.

## NEWS

- 19 **MICROBYTES**  
"MISC," a new minimalist microprocessor architecture, promises faster systems that can emulate other processor architectures.
- 46 **WHAT'S NEW**  
This month's product selections include GRiD's Isopoint laptop, entry-level multimedia software from MacroMind, a Mac scanner from HSD, and more.

## FIRST IMPRESSIONS

- 132 **Ventura Publisher, Macintosh Edition 1.0, for a mixed-machine environment**
- ScanMau 256, Logitech's scanner for Windows 3.0**
- NewWave 3.0, an updated version from Hewlett-Packard**
- WinSleuth, Dariana's new diagnostics package**
- WordPerfect Rhymer, for the student of the sound of language**

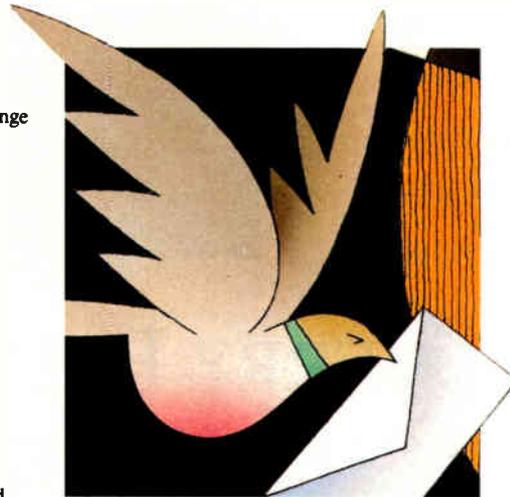
- 146 **The New Macs on the Block**  
At last, lower prices—and a new design.
- 156 **A New Status Quo for Quattro**  
Borland adds 3-D graphics to its spreadsheet.
- 162 **The ALR MPS: Modular Micro Channel**  
ALR gambles that it can take a bite out of the True Blue market.
- 165 **Fast New Systems from NeXT**  
Faster machines with lower prices and the long-sought floppy disk drive have arrived.

## REVIEWS

- 172 **PRODUCT FOCUS: Massive Storage for Multiple Platforms**  
The BYTE Lab puts 15 high-capacity hard disk drives to the test across four operating systems: DOS, Unix, NetWare 386, and the Mac OS.
- 190 **High-Performance 486 ATs**  
The great performance of three 33-MHz 486s shows there's still life in the old AT bus.
- 194 **FPU Face-Off**  
Not all FPUs are created equal. The BYTE Lab shows performance differences among FPUs from AMD, Cyrix, IIT, Intel, and Weitek.
- 205 **New Controller Makes SCSI Palatable to PCs**  
Distributed Processing Technology's SmartConnex/ISA hides SCSI's incompatibility from PCs.

BYTE (ISSN 0360-5280/90) is published monthly with an additional issue in October by McGraw-Hill, Inc. U.S. subscriber rate \$29.95 per year. In Canada and Mexico, \$34.95 per year. 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. Printed in the United States of America. Postmaster: Send address changes, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520.

- 289 **Entering a New Phase**  
Optical and magnetic are at opposite ends of the spectrum. Can phase-change technology bridge the gap?
- 301 **The Once and Future King**  
Hard disk technology will be your primary computer storage medium for years to come.
- 304 **Side by Side**  
You can store more data on a floppy disk if you can get the bits to stand up straight.
- 311 **Store Data in a Flash**  
The flash-memory disk offers a fast and rugged replacement for both hard and floppy disk drives.



Magnetic vs. Optical/272

- 323 **DAT's a Solution**  
Digital-audiotape technology comes of age.
- 331 **Getting Your Byte's Worth**  
Hardware-based data compression gives you more bang for your QIC, DAT, and hard disk buck.
- 338 **Masses of Storage**  
A guide to companies that provide mass storage solutions.

## FEATURES

- 342 **Chips for the Nineties and Beyond**  
New chips may make for higher-performance and unconventional ways of computing.
- 353 **Modem Business**  
Confused by modem standards like 212A, V.22, and V.32bis? Here's help.
- 364 **A Knowledge Engineering Toolkit, Part 2**  
The discussion continues, with a look at backward and forward chaining.
- 373 **Hot Links to Go**  
A look at Windows' and OS/2's Dynamic Data Exchange facility.
- 381 **Alternative Operating Systems, Part 4: Pick: OS or DBMS?**  
What do you get when you build an operating system around a database?
- 385 **Modula-3**  
An introduction to the OOP language that grew from Pascal and Modula-2.

## HANDS ON

- 395 **UNDER THE HOOD**  
**The Mouse that Roared**  
The history, anatomy, and physiology of the desktop mouse.
- 403 **SOME ASSEMBLY REQUIRED**  
**Talking Tasks, Part 2**  
Introducing the most common methods of interprocess communications for Unix and OS/2.

## DEPARTMENTS

- 6 **Spotlight**  
Jerry Pournelle: 10 years with BYTE and counting
- 10 **Editorial: Laptop Troubles and Triumphs**
- 33 **Letters, Ask BYTE, and Fixes**  
Readers find self-realization.

## PERSPECTIVES

- 465 **CHAOS MANOR MAIL**
- 466 **PRINT QUEUE**  
**Stomping the Nasties**  
Professor Kenner examines a new volume by computer virus hunter John McAfee.
- 468 **STOP BIT**  
**Promises, Promises**  
A lawyer looks at the warranties—real and implied—that come with computer equipment.

## EXPERT ADVICE

73  
**COMPUTING**  
**AT CHAOS MANOR**  
**Multimedia Video**  
by Jerry Pournelle  
Jerry locks at multimedia video boards, a new Modula-2, and assorted gadgets.

89  
**DOWN TO BUSINESS**  
**The Growth of Groupware**  
by Wayne Rash Jr.  
Wayne addresses groupware and how to determine what capabilities your company needs.

97  
**NETWORKS**  
**Hard Choices for Network Managers**  
by Mark L. Van Name and Bill Catchings  
You can't always wait for the perfect network management solution.

107  
**MACINATIONS**  
**Working with Windows 3.0 and a Mac**  
by Don Crabb  
Don presents the Mac/Windows 3.0 user's interoperability survival guide.

119  
**THE UNIX /bin**  
**Not Quite Unix**  
by David Fiedler  
The tribulations and treats of using a \$100 Unix clone.

127  
**BEYOND DOS:**  
**WINDOWS AND OS/2**  
**Tales from the Trenches**  
by Steve Mastrianni  
An OS/2 device-driver specialist talks shop.

### READER SERVICE

- 454 Editorial Index by Company  
456 Alphabetical Index to Advertisers  
458 Index to Advertisers by Product Category  
Inquiry Reply Cards: after 460

### PROGRAM LISTINGS

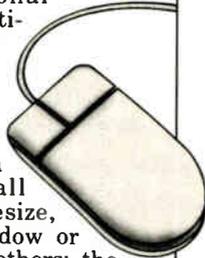
From BYTEnet: Call (617) 861-9764

## 6.0 AND COUNTING!

Integrate sophisticated features into your Microsoft C and QuickC applications with

### C TOOLS PLUS/6.0™

C TOOLS PLUS version 6.0 is filled with many advanced routines for developing high-powered C applications, including: virtual, stackable menus and windows with full mouse support and optional "drop shadows"; multiple virtual pop-up help screens; a miniature multi-line editor for gathering user responses in a robust fashion; a single function call which can move, resize, and promote a window or menu on top of all others; the ability to update covered windows automatically when they are written to; support for EGA, VGA, and MCGA text modes including 30-, 43-, and 50-line modes; support for the enhanced (101/102 key) keyboard.



**All this and more for only \$149!**

C TOOLS PLUS/6.0 also contains functions for writing interrupt service routines; creating pop-up memory resident applications; general memory "peeks" and "pokes"; access to the DOS PRINT utility; as well as many other general utility functions and macros.

#### COMPLETE PROFESSIONAL PACKAGE.

Blaise Computing's function libraries offer easy to use solutions to your programming needs. You get source code, complete sample programs, and a comprehensive reference manual with extensive examples. Supports QuickC and Microsoft C 5.0 and later.

#### 30 DAY GUARANTEE.

If during the first 30 days you are not completely satisfied, we'll refund your money.

#### Other powerful products from Blaise Computing

C ASYNCH MANAGER™	\$189
ASYNCH PLUS™	\$189
VIEW232™	\$189
POWER SCREEN™	\$149
Turbo C TOOLS™	\$149
POWER TOOLS PLUS™	\$149

Call today for more information

**(800) 333-8087**

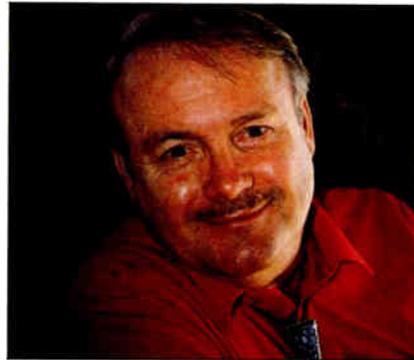
#### BLAISE COMPUTING INC.

2560 Ninth Street, Suite 316  
Berkeley, CA 94710  
(415) 540-5441

FAX (415) 540-1938

Trademarks are property of their respective holders.

S P O T L I G H T



## JERRY POURNELLE: 10 YEARS AND COUNTING

*There's a lot more to  
BYTE's senior contributing  
editor than just his column*

**H**e's been called "the world's most popular computer columnist," and with justification. Jerry Pournelle's columns appear in dozens of countries, both in English and in a variety of other languages. He has fans from Michigan to Moscow, from Kokomo to Kyoto.

As a BYTE reader, you probably already know why: For the last 10 years, Jerry's blend of hands-on, first-person experience with every conceivable kind of hardware and software has provided some of the most entertaining and informative pages in BYTE each month.

But there's a lot more to Jerry than his column. You've probably either read or heard of a number of Jerry's best-selling books (written alone or in collaboration with Larry Niven and others), including *The Legacy of Heorot*, *Footfall*, *Oath of Fealty*, *Lucifer's Hammer*, *The Mote in God's Eye*, and many others. Jerry's list of published works would more than fill the space we have here; over 20 books are still in print.

A native of Shreveport, Louisiana, Jerry earned a B.S. in psychology and

mathematics, an M.S. in experimental statistics and systems engineering, and two Ph.D.s: one in psychology, the other in political science.

With that broad a background, it's easier to understand how Jerry has ended up employed by agencies as varied as the City of Los Angeles, Pepperdine University, the U.S. Air Force, North American Rockwell Corp., and Boeing Aerospace Corp. What's harder to understand is how he did it while still developing a world-class writing career.

But wait, there's more: Jerry's also made time to chair the Citizen's Advisory Council on National Space Policy, and to be a consultant to the trustees of the California State Universities; a member of the Board of Visitors, Department of Mathematics, University of Texas; and a member of the advisory board, Lowell Observatory, Flagstaff, Arizona.

Jerry was one of the first authors to use a computer for writing both fiction and nonfiction (see "Writing with a Microcomputer," *onComputing*, Summer 1979). His work began appearing in BYTE just one year later.

We're pleased to be able to bring you a writer of Jerry's caliber each month. If you're already a fan, watch for some interesting, positive changes in the column over the next few months, as we usher in Jerry's second decade with BYTE. If you're not reading Jerry, do yourself a favor: Check out this month's column. ■

# New FoxPro

## Shifting the Balance Of Power in Database Management

There's a new leader in the relational database management world. Its name is FoxPro.

FoxPro is the first and *only* microcomputer database management system that combines astonishing performance with a sleek interface of amazing power and beauty.

- FoxPro offers all the elegance and accessibility of a graphic-style interface, yet operates at the stunning speeds possible only with character interfaces.
- FoxPro is so easy to learn and use, even beginners can become productive immediately; yet it's powerful and sophisticated enough to satisfy the needs of the most demanding developers and power-users.
- FoxPro gives you choices instead of limits: use a mouse or a keyboard; type commands or use the object-oriented interface; run in one window, or hundreds.
- FoxPro is so efficient, it runs in a 512K PC-XT, yet it's able to take advantage of the speed, expanded memory and extended video modes of the most advanced machines available. You don't even need a graphics card or special windowing software.



### Nothing is Faster

Fox Software products are famous for their unmatched execution speed. FoxPro extends that tradition.

FoxPro is up to eight times faster than dBASE IV—more than 15 times faster than dBASE III PLUS!

And that blazing speed translates into unprecedented power. Now you can efficiently process gigantic databases with hundreds of thousands—even millions—of records.

### Protecting Your Investment

With FoxPro, your existing FoxBASE+ or dBASE III PLUS programs will run perfectly—first time, every time, no excuses. And FoxPro is language-compatible with dBASE IV. But FoxPro doesn't stop there. It has over 140 language enhancements not found in any version of dBASE. We've outdone ourselves by adding more than 200 language extensions you won't find in FoxBASE+.

Best of all, FoxPro opens up whole new worlds for your applications by letting you move them onto a variety of different platforms.

### The Tradition Continues

Fox Software is committed to excellence—our products prove it.

We've been producing superb database management software since 1983. And our products for both the PC and the Macintosh continue to win awards worldwide.

We've taken everything we know about software engineering, databases and interface design, and focused it into one remarkable product—FoxPro.

### FREE Demo Disk

Shift the balance of power in *your* favor by trying FoxPro for yourself.

Call (419) 874-0162 now to get your free demo disk. Or ask for the FoxPro dealer nearest you. See for yourself: *Nothing Runs Like The Fox.*

**System Requirements:** FoxPro operates in 512K RAM (640K recommended) with MS PC-DOS 2.0 or greater and an 8086, 8088, 80286 or 80386 mic coprocessor. For optimum performance, FoxPro takes complete advantage of any available EMS (expanded memory) or a math coprocessor.

Trademark/Owner: FoxPro, FoxBASE+ Fox Software; dBASE III PLUS, dBASE IV Ashton-Tate.

## Fox Software

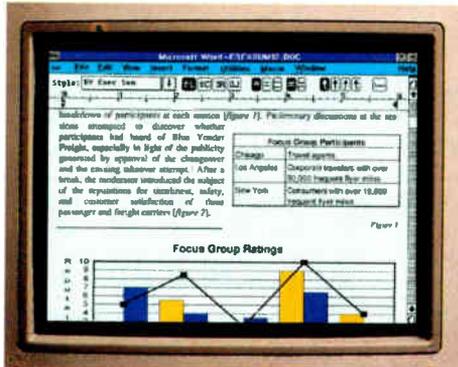
*Nothing Runs Like The Fox.*

Fox Software, Inc. (419) 874-0162  
134 W. South Boundary FAX: (419) 874-8678  
Perrysburg, Ohio 43551 Telex: 6503040827 FOX

Circle 141 on Reader Service Card



# Word for Windows redef

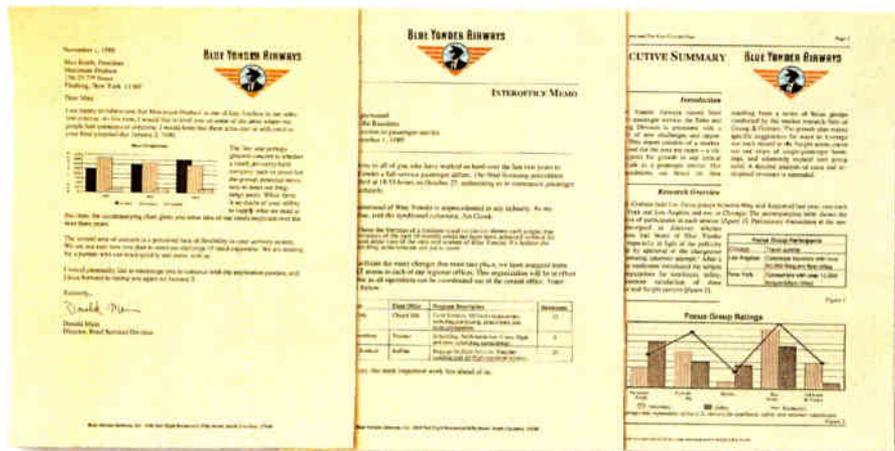


See what you do.  
 With editable WYSIWYG, you can see  
 and edit text and graphics formatting.  
 Virtually everything for that matter.  
 Right on your computer screen.

Don't get tied up.  
 Tables make it easy to format  
 numbers and words into rows  
 and columns. All without  
 using the tab key.



Cut corners.  
 Cut and paste words, graphics,  
 whatever. On your screen. Without  
 an endless string of commands.



Look like a professional.  
 Because we've taken the hard work out of the process,  
 it's easy to create professional-looking documents.  
 Making something else look professional. Like you.

# ines the word processor.



Just say the word.  
*Microsoft® Word for Windows.\* The best thing to happen to word processing in quite a while. Check it out.*

Save time.  
*Document Templates make it quick and easy to create standard letters, memos and more. Ensuring consistency. As well as company standards.*

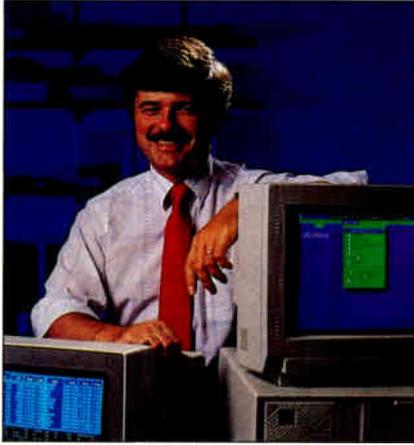


Something for nothing.  
*Get a full-featured Working Model free.\* Call (800) 541-1261, Dept. M99.*

Tailor your documents.  
*With a point and click, icons on the Ribbon and Ruler allow you to fashion formats from basic to sophisticated. You can even save these formats as a personal style or company standard.*

**Microsoft**  
Making it all make sense™

Microsoft Corporation \*The first Working Model you select is free during our Windows Computing Promotion, Sept. 15 through Dec. 31, 1990. One free Working Model per person. Each additional Working Model is \$99.50, applicable sales tax not included. Offer good while supplies last and only in the 50 United States.



# LAPTOP TROUBLES AND TRIUMPHS

Business practice—  
not technology—is now  
the impediment

**I** love laptops. Given enough funds, I'd go for laptops the way Imelda Marcos went for shoes.

The list of portables I've owned or used stretches back to the days when (figuratively speaking) computers were made out of animal bones and plant fiber. In fact, before there were portables, I routinely went on the road with an Atari 800, two external floppy disk drives, an acoustic coupler, a dictionary-size "interface box," and a shopping bag full of cables and brick-size power supplies. I had more than one chat with hotel security when maids panicked at the sight of the wires and boxes covering a room's spare bed.

## A Winner

Things got simpler with the first true portables and then, some years later, with the first laptop—the Tandy Model 100. I still have my original M100, and I use it on trips where I am unwilling to risk loss or damage to more recent equipment, or where power supplies are a problem.

## Other Contenders

I've had other memorable machines, too. The almost-compatible DataVue, for example, stands out because it kept me up and running during the power outages of hurricane Gloria some years back. But the DataVue's idiosyncrasies meant that I couldn't telecommunicate the work I'd done, thus negating one of the prime reasons for having a laptop.

## Also-Rans

Way back when, I had a brief flirtation with the almost-legible DG One, but I

decided that I really needed to be able to see what I was working on. Very recently, I tried lugging a 12-pound VGA laptop, but decided my arms were already long enough. Other machines had great screens but nonstandard micro-floppy disks, or powerful CPUs but pricey ROM-card software.

Still other laptops seemed great in office settings, but they turned out to be useless on planes unless the person in front of me sat perfectly upright—if he or she tilted the seat back, it would fold the computer's screen shut. Palmtops were either too tiny to type on or too limited in use to fully replace a "real" computer, even though they may excel at replacing paper-based pocket diaries, agenda booklets, and to-do lists. (And "excel" they do: A pocket computer such as the Sharp Wizard can be a perfect accompaniment to a full-blown portable.)

## No More Compromises

This theme—having to make substantial compromises when computing outside a traditional office setting—has been constant. Until now.

Starting late last year, laptops shed their last real technological hurdles. Smaller than ever, lighter than ever, faster than ever, today's laptops (yes, I'm including the subclasses of notebook and palmtop computers) now truly can offer full-function portable computing with very few compromises. (Check out the cover story on the Compaq 386s/20 and this month's review of the Texas Instruments TravelMate.)

But there's still one persistent catch. If the new crop of laptops is making you think of taking the plunge, it's something you should be aware of.

It's human behavior—specifically, office decorum and the etiquette of business meetings. Take notes on a piece of paper, for example, and no one cares; take notes on a laptop, and the novelty of it can cause a commotion; the mere act of computerized note taking can pull a

meeting off track—your use of a portable computer actually decreases productivity instead of increasing it.

If you are making a presentation, there is a similar problem: Speak from notes, and your audience will listen to your message—but refer to notes on a laptop screen, and for a few minutes, at least some in your audience will pay more attention to how you're delivering your message than to the message itself. That's a sure way to torpedo a presentation.

While those can be serious problems, there are smaller snags, too: Working on a plane, if you write a memo in longhand, your concentration will be undisturbed. Try typing on a laptop, and you can expect friendly interruptions ("Hey! What is that?") from your seatmate and from people walking by in the aisle.

## Problems Become Moot

Of course, handwritten notes always can be rekeyed later. A speech given from note cards may well be better than one delivered from a laptop, because you'll be able to walk around instead of being tied to a podium. And answering the questions of curious airline seatmates helps spread the word about computers and introduces a new set of users to these amazing machines.

As more laptops move out into the world, the curiosity factor will diminish, and computers will become as accepted in boardrooms, on podiums, and in public transport as they now are on desktops. But for now, the relative novelty means there will be some inconvenience, and you may not immediately get all the time and productivity gains you hope for.

Personally, I think it's a small price to pay for the huge gains that are to be had. I can't imagine traveling without a laptop—and once you've tried one of today's slick new machines, neither will you.

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

Limited time offer to owners of Microsoft C

# Borland's Turbo C++ Professional

## "Everything you always wanted in a C compiler and more"

—Reprinted from *PC Magazine*, August 1990  
Copyright © 1990 Ziff Communications Company

### Special upgrade offer for Microsoft® C owners!

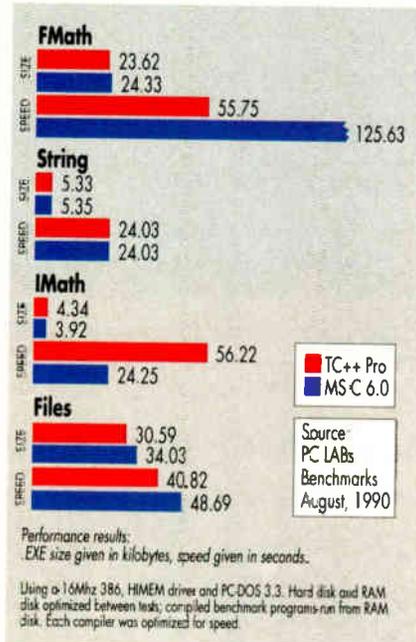
Are you ready for an upgrade that conforms 100% to ANSI C, gives you C++, doesn't skimp on documentation, features a fast, reliable programming environment, and provides the complete toolset necessary to maximize your productivity? Then it's time to make the move to Borland.

And the time to move is now. We're offering Turbo C++ Professional to owners of Microsoft C or any PC-based C or C++ compiler for only \$149<sup>95</sup>.\*

### Compare the features.

COMPILER	MSC 6.0	TC++ Pro
C++	NO	YES
Full ANSI C	NO	YES
Transparent overlay manager	NO	YES
Complete printed documentation	NO	YES
<b>ENVIRONMENT</b>		
Overlapping windows	NO	YES
Mouse support	YES	YES
Integrated debugging	NO	YES
<b>TOOLS</b>		
Debugger	YES	YES
Profiler	NO	YES
Macro assembler	NO	YES

### Turbo C++ Professional beats Microsoft C 6.0.



"... if you want an excellent ANSI compiler with integrated environment, overlay linkage, profiler, assembler, and an award-winning debugger—not to mention C and C++ support—look no further: Turbo C++ Professional is here."

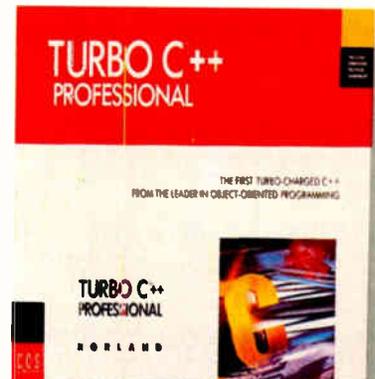
—PC Magazine, August 1990

### Step up now to Turbo C++ Professional for only \$149<sup>95</sup>

That's half the suggested retail price of \$299<sup>95</sup>.

If you're not convinced that Turbo C++ Professional is the best upgrade to Microsoft C 5.1, just return the product for a full refund.

To order  
**SEE YOUR DEALER**  
(bring proof of ownership)  
or call now  
**1 (800) 331-0877**



# B O R L A N D

Makers of Turbo C++, Turbo Pascal®, Paradox®, Quattro® Pro and Sidekick®

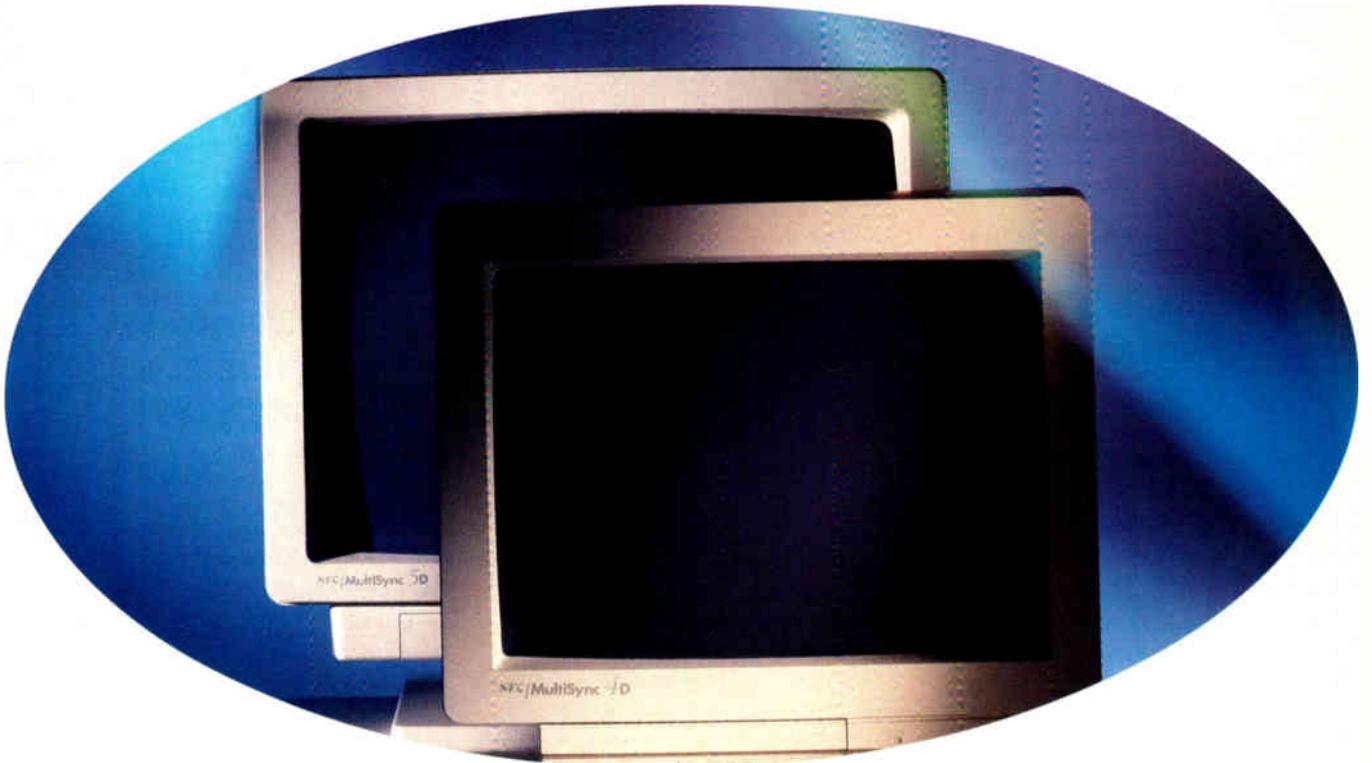
Code: MC13

\*100% of ownership (an on-line manual page or disk from any version) is required. Offer expires December 31, 1990. Offer good in U.S. and Canada only. Special discounts for registered Turbo C++ owners are available from Borland. Mail orders to Borland International, Inc., P.O. Box 660001, Scotts Valley, CA 95067-0001. Add \$5.00 for shipping and handling. Residents in CA, CT, GA, IL, MA, MI, NY, OH, PA, TX, VA, and WA please add appropriate sales tax. For orders outside the U.S., call (408) 438-5300. Turbo C++ and Turbo C++ language are trademarks of Borland International, Inc. Copyright © 1990 Borland International, Inc. All rights reserved. BI 138Z

Circle 53 on Reader Service Card (RESELLERS: 54)

World Radio History

# Fly in bigger skies.



*The 16" MultiSync 4D and 20" 5D monitors.*

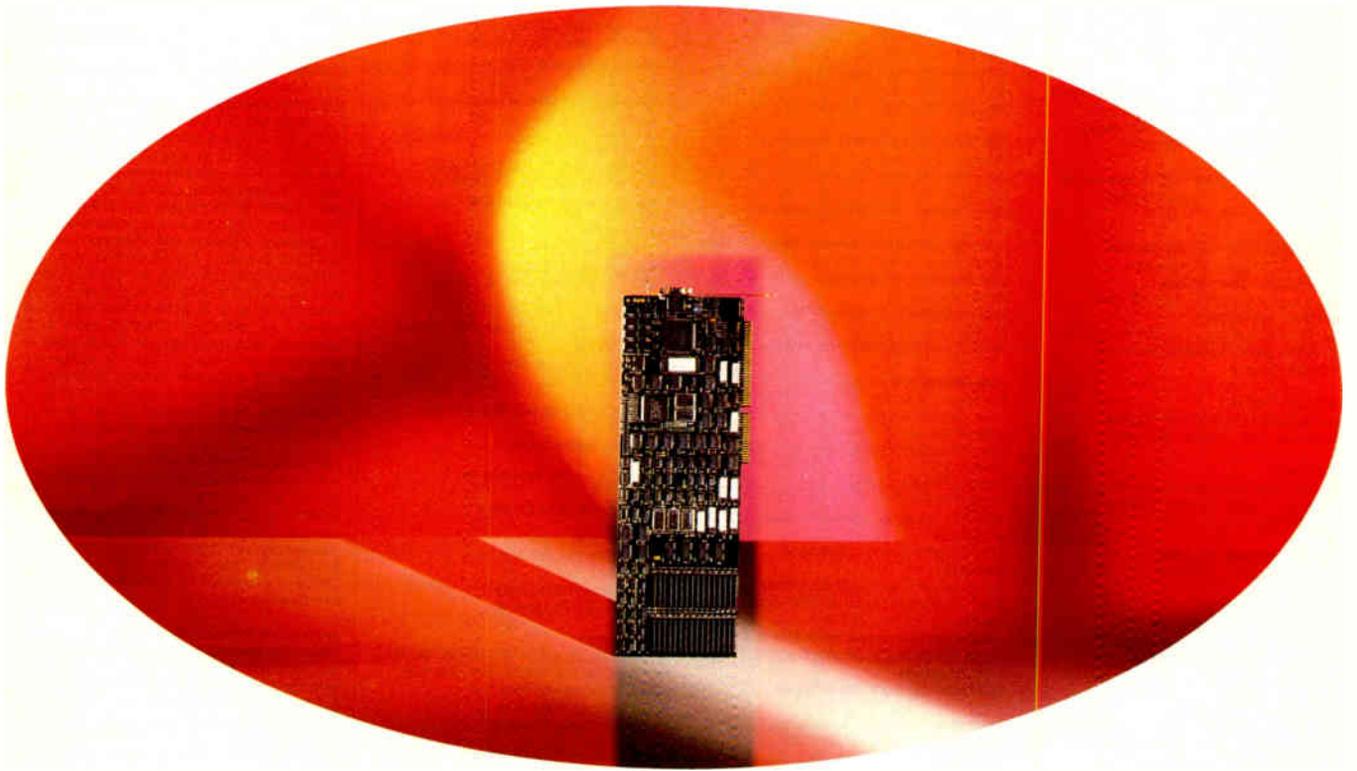
*Our largest high-resolution color monitors. Digitally controlled, the 4D supports VGA through 1024 x 768, the 5D, up to 1280 x 1024.*

It's a matter of space. And pace.

Your ideas could use as much of both as they can get. Which is why you should consider upgrading to one of our larger MultiSync® monitors. Then you can add the best graphics accelerator you can find. The MultiSync Graphics Engine™ Board, to name one prime example.

Together, they'll increase your system's productivity immensely, by

On afterburner.



*The MultiSync Graphics Engine Board. Uses 50MHz TMS 34010 graphics processor to accelerate software applications as much as 900%.*

allowing you to put far more information on your screen, far faster.

We're talking more windows. More words. More detail.

Above all, more speed.

Interested? Call 1-800-FONE-NEC for technical information. Or

1-800-826-2255 for literature. In Canada, 1-800-268-3997. We'll show

you how to give your productivity a major boost.

**NEC**

Circle 254 on Reader Service Card

# BYTE

**EDITOR IN CHIEF**  
Frederic S. Langa

**MANAGING EDITOR**  
Anne Fischer Lent

**NEWS**  
New York: *Managing Editor:* Rich Malloy  
*Associate News Editor:* Andrew Reinhardt  
Peterborough: *Senior Editor, Microbytes:* D. Barker, *Senior Editor, New Products:* Stan Miastkowski  
*Associate News Editors, What's New:* David Andrews, Martha Hicks  
*Editorial Assistant:* Amanda Waterfield  
San Francisco: *News Editor:* Owen Linderholm  
*Associate News Editor:* Jeffrey Bertolucci  
London: *Senior Editor:* Colin Barker

**BYTE LAB**  
*Managing Editor:* Michael Nadeau  
*Technical Director:* Rick Grehan  
*Senior Editor:* Dennis Allen  
*Technical Editors:* Alan Joch, Robert Mitchell, Tom Yager  
*Testing Editors/Engineers:* Stephen Apiki, Stanford Diehl, Howard Eglowstein, Stanley Wszola

**STATE OF THE ART**  
*Senior Editor:* Jane Morrill Tazelaar  
*Technical Editor:* Robert M. Ryan

**FEATURES**  
*Senior Editor:* Kenneth M. Sheldon  
*Technical Editors:* Janet J. Barron, Ben Smith

**SENIOR EDITORS, AT LARGE**  
Tom Thompson, Jon Udell

**SPECIAL PROJECTS**  
*Senior Editor:* Gene Smarte

**SENIOR CONTRIBUTING EDITOR**  
Jerry Pournelle

**CONTRIBUTING EDITORS**  
Bill Catchings, Don Crabb, David Fiedler, Hugh Kenner, Mark J. Minasi, Wayne Rash Jr., Mark L. Van Name

**CONSULTING EDITORS**  
Jonathan Amsterdam, Nick Baran, Laurence H. Loeb, Trevor Marshall, Stan Miastkowski, Dick Pountain, Phillip Robinson, Peter Wayner

**COPYEDITING**  
*Chief Copy Editor:* Lauren A. Stickler  
*Copy Administrator:* Cathy Kingery  
*Copy Editors:* Susan Colwell, Jeff Edmonds, Judy Grehan, Nancy Hayes, Margaret A. Richard, Warren Williamson

**EDITORIAL ASSISTANTS**  
*Office Manager:* Peggy Dunham  
*Assistants:* Linda C. Ryan, June Sheldon

**ART**  
*Director:* Nancy Rice  
*Assistant Director:* Joseph A. Gallagher  
*Art Assistant:* Jan Muller  
*Technical Artist:* Alan Easton

**BIX** BYTE INFORMATION EXCHANGE

**DIRECTOR**  
Stephen M. Lalberte

**MANAGING EDITOR**  
Tony Lockwood

**MICROBYTES DAILY**  
*Coordinator:* D. Barker  
*Editor:* Peterborough, Rich Malloy  
*Editor:* New York, Nicholas Baran  
*Editor:* Sandpoint, ID, Jeffrey Bertolucci  
*Editor:* San Francisco, Laurence H. Loeb  
*Editor:* Wallingford, CT, Stan Miastkowski  
*Editor:* Peterborough, Wayne Rash Jr.  
*Editor:* Washington, DC, David Reed  
*Editor:* Lexington, KY, Andrew Reinhardt  
*Editor:* New York, Jan Ziff  
*Editor:* Washington, DC

**PRODUCTION**  
*Director:* David R. Anderson  
*Senior Editorial Production Coordinator:* Virginia Reardon  
*Editorial Production Coordinators:* Barbara Busenbark, Denise Chartrand

**TYPOGRAPHY**  
*Systems Manager:* Sherry Fiske  
*Applications Manager:* Donna Sweeney  
*Typesetter:* Christa Patterson

**ADVERTISING SERVICES (603) 924-8448**  
*Director of Advertising:* Lisa Wozmak  
*Assistant:* Christine W. Tourgee  
*Customer Service Supervisor:* Linda Fluhr  
*Senior Account Coordinator:* Lyda Clark  
*Account Coordinator:* Dale J. Christensen  
*Materials Coordinator:* Karen Cilley  
*Advertising Assistant:* Roxanne Hollenbeck  
*Creative Services Manager:* Susan Kingsbury  
*Production Artist:* Lillian J. Wise  
*Quality Control Manager:* Wai Chiu Li  
*Production Coordinator:* Rod Holden

**ADMINISTRATION**  
*Publisher's Assistant:* Donna Nordlund

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

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

**CIRCULATION**  
*Director:* Glyn Standen  
*Subscriptions Manager:* Paul Ruess  
*Assistant Manager, Subscriptions:* Margaret Liszka  
*Subscriptions Assistant:* Holly Zilling  
*Newsstand Manager:* Vicki Weston  
*Distribution Coordinator:* Karen Desroches  
*Back Issues:* Louise Menegus  
*Direct Accounts Coordinator:* Ellen Dunbar  
*Direct Accounts Telephone Sales Representative:* Karen Carpenter

**BUILDING SERVICES**  
Cliff Monkton, Gary Graham, Ed Codman

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

**EXCHANGE EDITORS**  
*Macintosh Exchange:* Laurence H. Loeb,  
*IBM Exchange:* Barry Nance, *User Group Exchange:* David Reed, *Interactive Game Exchange:* Richard Taylor, *Amiga Exchange:* Joanne Dow, *Writers Exchange:* Wayne Rash Jr., *Tojerry Exchange:* Jerry Pournelle, *Telecommunications Exchange:* Stephen Satchell

**PUBLISHER**  
Ronald W. Evans

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

*Administrative Assistant:* Carol Cochran

*Eastern Advertising Director:* Arthur H. Kossack (312) 616-3341  
*Sales Assistant:* Julie Watson  
*Western Advertising Director:* Jennifer L. Bartel (214) 701-8496  
*Sales Assistant:* Susan Vernon

**NEW ENGLAND**  
ME, NH, VT, MA, RI, CT, ONTARIO, CANADA, & EASTERN CANADA  
Daniel D. Savage (617) 880-6344

**EAST COAST**  
NY, NYC, NJ, DE, PA  
Kim Norris (212) 512-2645  
Ariane Casey (212) 512-2368

**SOUTHEAST**  
NC, SC, GA, FL, AL, TN, VA, MS, AR, LA, DC, MD, WV, KY  
John Schilin (404) 843-4782

**MIDWEST**  
IL, MO, KS, IA, ND, SD, MN, WI, NE, IN, MI, OH  
Kurt Kelley (312) 616-3328

**SOUTHWEST, ROCKY MOUNTAIN**  
CO, OK, TX  
Alison Keenan (214) 701-8496

**SOUTH PACIFIC**  
SOUTHERN CA, AZ, NM, LAS VEGAS, UT  
Ron Cordek (714) 557-6292  
Alan El Faye (713) 480-5243

**NORTH PACIFIC**  
HI, WA, OR, ID, MT, NORTHERN CA, WY, NORTHERN NV, WESTERN CANADA  
Bill McAfee (408) 679-0381  
Roy J. Kops (415) 954-9786  
Leslie Hupp (408) 679-0381

**CATALOG SHOWCASE/OUTSERTS**  
Scott Gagnon (603) 924-2651

**INSIDE ADVERTISING SALES**  
*Director:* Liz Coyman  
*Administrative Assistant:* Susan Boyd  
*Sales Secretary:* Vivian Bernier

**NATIONAL ADVERTISING SALES**  
Mary Ann Goulding (603) 924-2664  
Patricia Payne (603) 924-2654  
Jon Sawyer (603) 924-2665

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

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

**REGIONAL ADVERTISING SECTIONS**  
James Bail (603) 924-2533  
Barry Echavarría (603) 924-2574  
Larry Levine (603) 924-2637

**BYTE POSTCARD DECK MAILINGS**  
**BYTE DECK**  
Ed Ware (603) 924-6166  
**COMPUTING FOR ENGINEERS DECK**  
Ellen Perham (603) 924-2598

**INTERNATIONAL ADVERTISING SALES STAFF**  
See listing on page 455.

**BUSINESS AND MARKETING**  
*Secretary:* Patricia Bausum, *Marketing Services Coordinator:* Denise A. Greene, *Billing Services Coordinators:* Tammy Burgess, Donna Healy, *Editorial Assistant:* Brian Warnock

**TECHNOLOGY**  
*Programmer/Analyst:* John Spadafora,  
*Programmer:* Peter Mancini, *Systems Consultant:* Gary Kendall

**EDITORIAL AND BUSINESS OFFICE:**  
One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.

**West Coast Branch Offices:** 425 Battery St., San Francisco, CA 94111, (415) 954-9718; 3001 Red Hill Ave., Building #1, Suite 222, Costa Mesa, CA 92626, (714) 557-8292.  
**New York Branch Editorial Office:** 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.

**BYTEnet:** (617) 861-9764 (set modem at 8-1-N or 7-1-E; 300 or 1200 baud).  
**Editorial Fax:** (603) 924-2550. **Advertising Fax:** (603) 924-7507.

**SUBSCRIPTION CUSTOMER SERVICE:** Outside U.S. (609) 426-7676; inside U.S. (800) 232-BYTE. For a new subscription—(800) 257-9402 U.S. only, or write to BYTE Subscription Dept., P.O. Box 555, Hightstown, NJ 08520. 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. All other countries, U.S. \$150 for fast surface delivery. Air delivery to selected areas at additional rates upon request. 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.

**EDITORIAL CORRESPONDENCE:**  
Address editorial correspondence to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Unacceptable manuscripts will be returned if accompanied by sufficient postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE.

**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 0360-5280/90, \$1.50. Copying done for other than personal or internal reference use without the permission of McGraw-Hill, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to the publisher. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London WC1R 4EJ, England.

**OFFICERS OF MCGRAW-HILL, INC.:**  
Joseph L. Dionne, Chairman, President and Chief Executive Officer; Robert N. Landes, Executive Vice President, General Counsel and Secretary; Walter D. Serwatka, Executive Vice President; Frank D. Penglase, Senior Vice President, Treasury Operations; Robert J. Bahash, Executive Vice President and Chief Financial Officer; Thomas J. Sullivan, Executive Vice President, Administration; Mary A. Cooper, Senior Vice President, Corporate Affairs, and Executive Assistant to the Chairman; Ralph R. Schulz, Senior Vice President, Editorial.

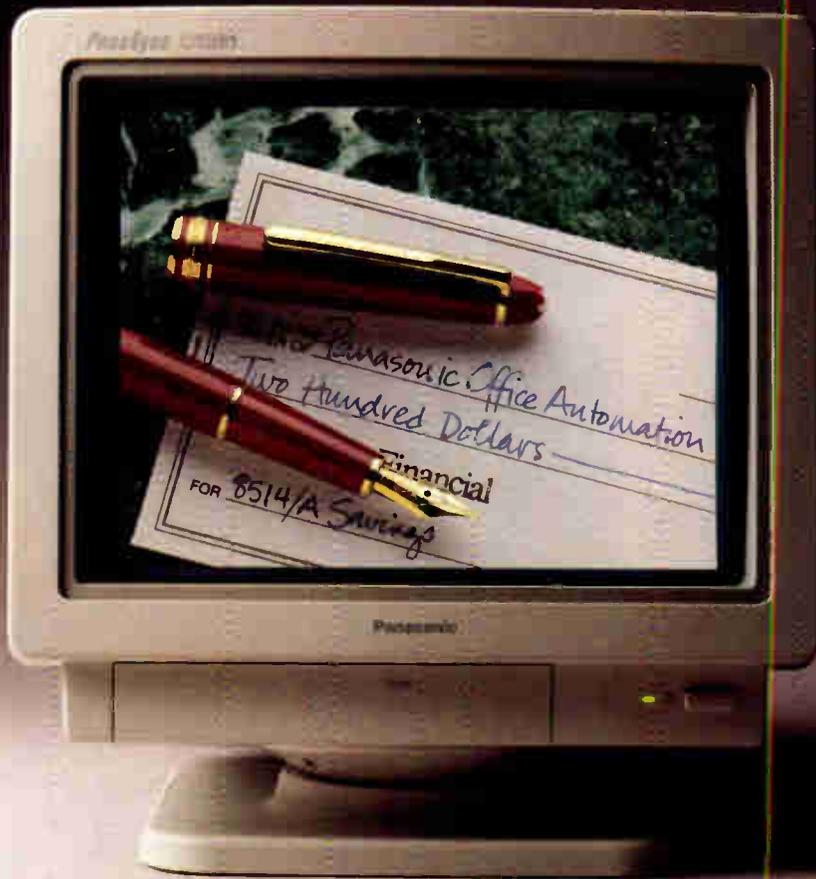
Founder: James H. McGraw (1860-1948).

Copyright © 1990 by McGraw-Hill, Inc. All rights reserved. BYTE and BIX are registered trademarks of McGraw-Hill, Inc. Trademark registered in the United States Patent and Trademark Office.

 Member  
Audit Bureau of Circulation

*Introducing the PanaSync™ C1381 Monitor*

# 8514/A resolution. VGA® price.



If you want the ultimate VGA graphics standard, and you've resigned yourself to paying a premium of hundreds of dollars to get it, you'll find our newest monitor pleasant viewing indeed.

The PanaSync C1381 gives you a sharp 1024 x 768 pixels, with 0.28 dot pitch. And virtually infinite color resolution.

It's compatible with the most popular VGA boards, as well as analog RGB, MCGA, SuperVGA, and — of course — 8514/A standards.\*

It's comfortable in virtually any IBM-compatible or Mac II environment.\*\*

And it's a masterpiece of ergonomics. With front-mounted controls, tilt/swivel stand, plus a non-glare tinted black-matrix screen.

All this at a suggested retail price comparable to many of the ordinary VGA monitors on the market right now. For more information, simply call toll-free **1-800-742-8086**.

*Peripherals, Computers, Printers,  
Copiers, Typewriters and Facsimiles*

**Panasonic**  
Office Automation 

PanaPro™ Monochrome Desktop Publishing Monitors with Video Adapters.



(Mac SE)

(Mac II)

(IBM XT/AT & PS/2 Model 30)

PanaSync™ Multiscanning Color Monitors.



- \* VGA, MCGA and 8514/A are trademarks of International Business Machines Corp.
- \*\* IBM XT, AT and PS/2 are registered trademarks of International Business Machines Corp. Macintosh is a registered trademark of Apple Computer Inc. An optional cable is required for Macintosh.

# Don't look now, but moving on

Suddenly, IBM Personal System/2<sup>®</sup>s with Micro Channel<sup>™</sup> on desks everywhere are exhibiting some pretty wild and wonderful tendencies. They're creating incredible on-screen presentations. Interactive tutorials with full-motion video and stereo sound. Graphics, text and animation in harmonious coexistence. What makes it all possible is the multimedia capability of the IBM PS/2<sup>®</sup> with Micro Channel.

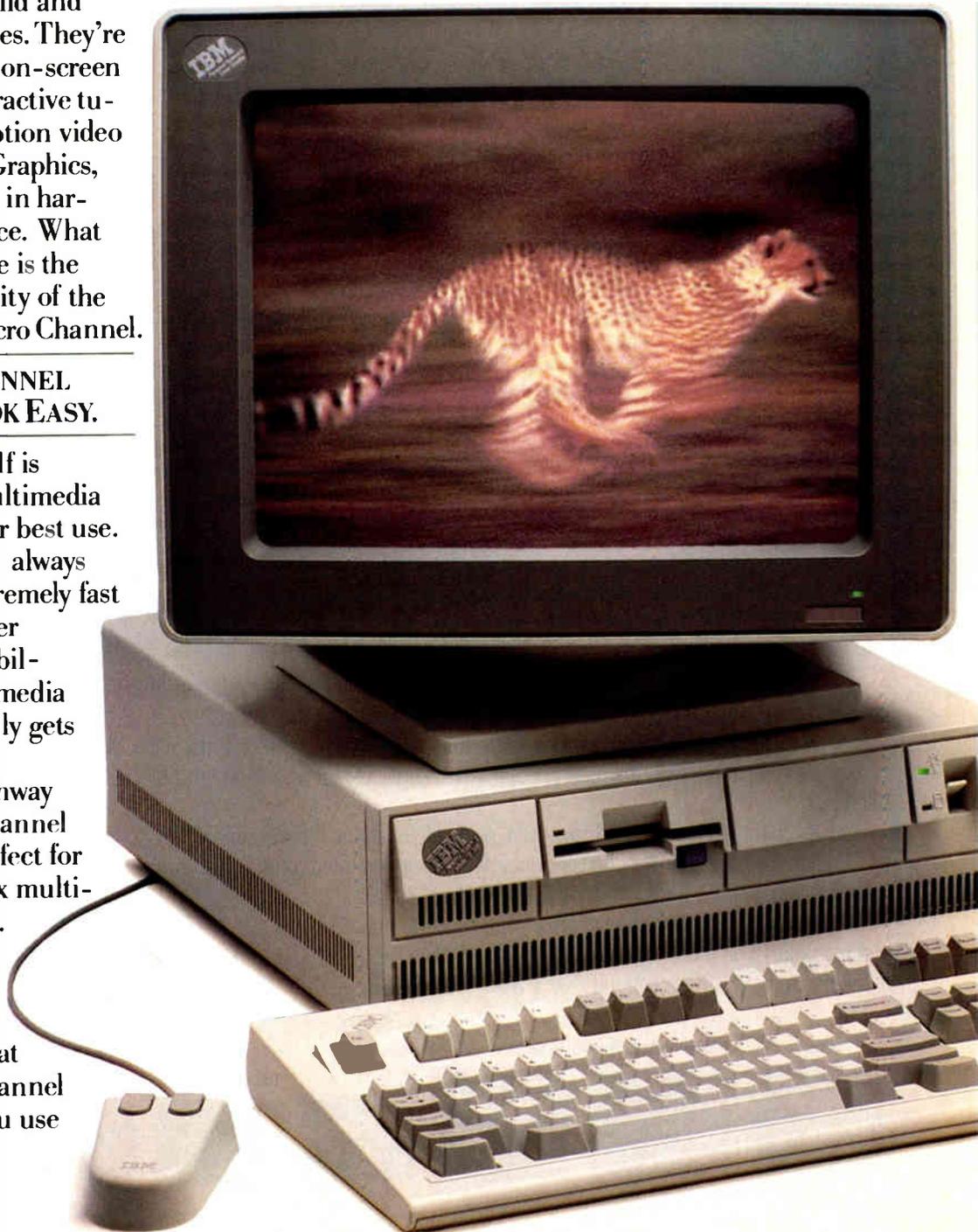
---

## MICRO CHANNEL MAKES IT LOOK EASY.

---

The PS/2 itself is designed to put multimedia applications to their best use. Micro Channel has always given the PS/2 extremely fast data rates and better multitasking capabilities. But in multimedia applications, it really gets a chance to shine. The multilane highway design of Micro Channel Architecture is perfect for processing complex multimedia applications. Most conventional PCs just don't have the power or the data paths to do it at all. Plus, Micro Channel in the PS/2 lets you use

the new IBM CD-ROM that gives you the storage equivalent of over 400 diskettes on



# there's something your desk.

a single CD, so you can have access to all kinds of data-intensive material like clip art and digital stereo sound.

## DO IT ALL. ALL AT ONCE.

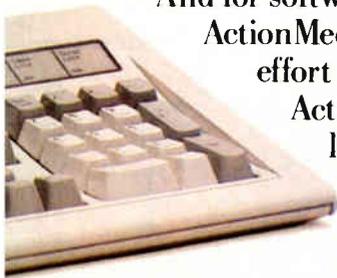
With a PS/2 with Micro Channel, you can start using some hot products right now. One is IBM's Audio Visual Connection™. It's both a software and a hardware tool that allows your PS/2 to import high-quality audio, dazzling still images, even special effects, as well as text, graphics and other data. Then, you can edit and present it in any combination you like right on your PS/2 screen, share it with a network or project it on a wall. It's impressive, but don't take our word for it—IBM's Audio Visual Connection received *PC Magazine's* Technical Excellence Award for 1989.



Another exciting multimedia product is the IBM M-Motion Video Adapter/A™. Coupled with the power of Micro Channel, it lets you incorporate full-motion video and high-quality sound from sources like video disks, VCRs and video cameras, digitize them, and display them in an endless array of formats.

And for software developers, there are ActionMedia™ cards, a collaborative effort between IBM and Intel.

ActionMedia cards use the latest DVI™ Technology, which allows full-motion video and analog sound



to be compressed, digitized, stored on a hard or optical disk and played back in real time, with incredibly sharp resolution.



## YOU'VE ALREADY GOT THE BEST SEAT IN THE HOUSE.

Best of all, you can do it all today with the Micro Channel PS/2s you've already got. No special monitors to buy. And you'll be perfectly poised for tomorrow's most exciting multimedia technology, like interactive touch displays and much more.

Contact your IBM Authorized Dealer or IBM marketing representative. For a free demonstration videocassette or a dealer near you, call 1 800 255-0426, ext. 20.

Your desk will never be the same.

For a free PS/2 MultiMedia demonstration videocassette call 1 800 255-0426, ext. 20 or send this completed coupon to: IBM Corporation P.O. Box 92835, Rochester, NY 14692

Name \_\_\_\_\_

Title \_\_\_\_\_ Phone \_\_\_\_\_

Company \_\_\_\_\_

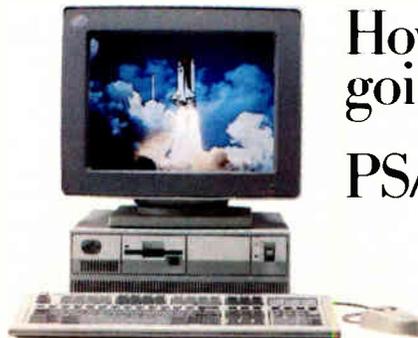
Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

If you are a software developer, check here.

## How're you going to do it?

## PS/2 it!



IBM, Personal System/2 and PS/2 are registered trademarks and Micro Channel, Audio Visual Connection and M-Motion Video Adapter/A are trademarks of International Business Machines Corporation. DVI and ActionMedia are trademarks of Intel Corp. © 1990 IBM Corp.

Circle 168 on Reader Service Card

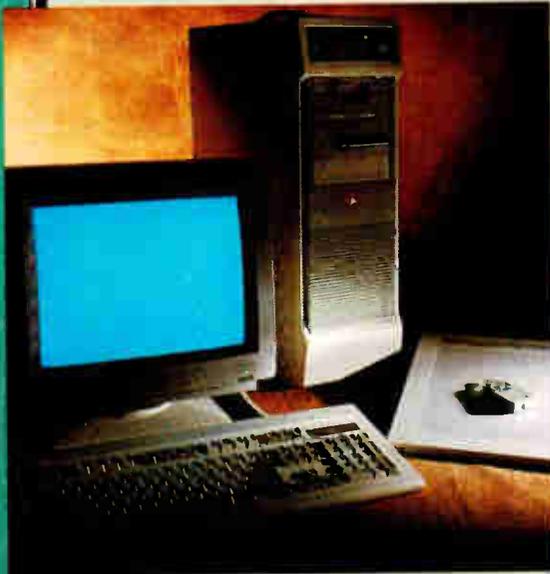
THE RIGHT DECISION



# The 486 Champ

"...THIS COMPUTER DESERVES YOUR ATTENTION."

PC MAGAZINE - SEPTEMBER 11, 1990



On the September 11, 1990, 24 of the industry's hottest 486 powerhouses went head to head for the honor of winning *PC Magazine's* coveted *Editor's Choice Award*. Tri-Star delivered knock-out punches in speed, price and virtually every other important category.

Once again the choice is clear. If you or your company demands the most performance for the money, the highest quality components and unrivaled 486 power, Tri-Star is more than the right decision - *it's the only decision.*

"...probably has the best mix of support, service, and customer satisfaction policies of all the computers in this review."

PC MAGAZINE - July, 1990

"Support Policies - Excellent."

INFOWORLD - MAY 7, 1990

## FLASH CACHE 486/25 \$5295

Complete with Intel's 80486 CPU, 64K RAM Cache, 4MB RAM, 1.2MB Floppy, 1.44MB Floppy, 200MB Hard Drive, 1024 x 768 SVGA Color Combo, Parallel & Serial Ports, and 101 Keyboard.

## FLASH CACHE 386/33 \$3695

Complete with Intel's 80386 CPU, 64K RAM Cache, 4MB RAM, 1.2MB Floppy, 1.44MB Floppy, 200MB Hard Drive, 1024 x 768 SVGA Color Combo, Parallel & Serial Ports, and 101 Keyboard.

## FLASH CACHE 386/25 \$2995

Complete with Intel's 80386 CPU, 64K RAM Cache, 4MB RAM, 1.2MB Floppy, 1.44MB Floppy, 104MB Hard Drive, 1024 x 768 SVGA Color Combo, Parallel & Serial Ports, and 101 Keyboard.

### CAD WORKSTATIONS

All Tri-Cad Systems include the Flash Cache 386/486 complete with Math Co-processor, Nanao 16" non-interlaced display and a 12 x 12 Digitizer.

TRI-CAD PROFESSIONAL  
325  
\$4695

TRI-CAD ADVANCED  
333  
\$5495

TRI-CAD EXPERT  
425  
\$6495

### UPGRADES:

RENDITION II/256 V  
\$695

20" HITACHI MONITOR  
\$995

"...THOSE OF YOU WHO WORK IN THE CAD ENVIRONMENT SHOULD INQUIRE ABOUT ITS (TRI-STAR'S) BUNDLED SYSTEMS."  
PC MAGAZINE



### ALL FLASH CACHE COMPUTER SYSTEMS INCLUDE:

- ◆ 60 Day Money Back Guarantee ◆ 2 Year Warranty Parts & Labor ◆ 12 Month TRW On-Site Service
  - ◆ Lifetime Toll-Free Technical Support
  - ◆ Air Express Parts Replacement
- Circle 354 on Reader Service Card

All prices and specifications subject to change without notice. Money Back guarantee does not include shipping charges. All systems have been verified or certified to comply with part 15 of the FCC rules for a Class A or Class B computing device.

**TRI-STAR**  
COMPUTER CORPORATION

**1.800.678-2799**

707 West Geneva, Tempe, Arizona 85282

Tech Support 1.800.688-TECH  
Telephone 602.829-0584  
Fax 602.345-0110

Monday - Friday 7:00am-7:00pm MST  
Saturday 9:00am-4:00pm MST

# MICROBYTES

Research news and industry developments shaping the world of desktop computing  
Edited by D. Barker

## Minimalist Architecture Promises Speed, Chips That Can Mimic Others

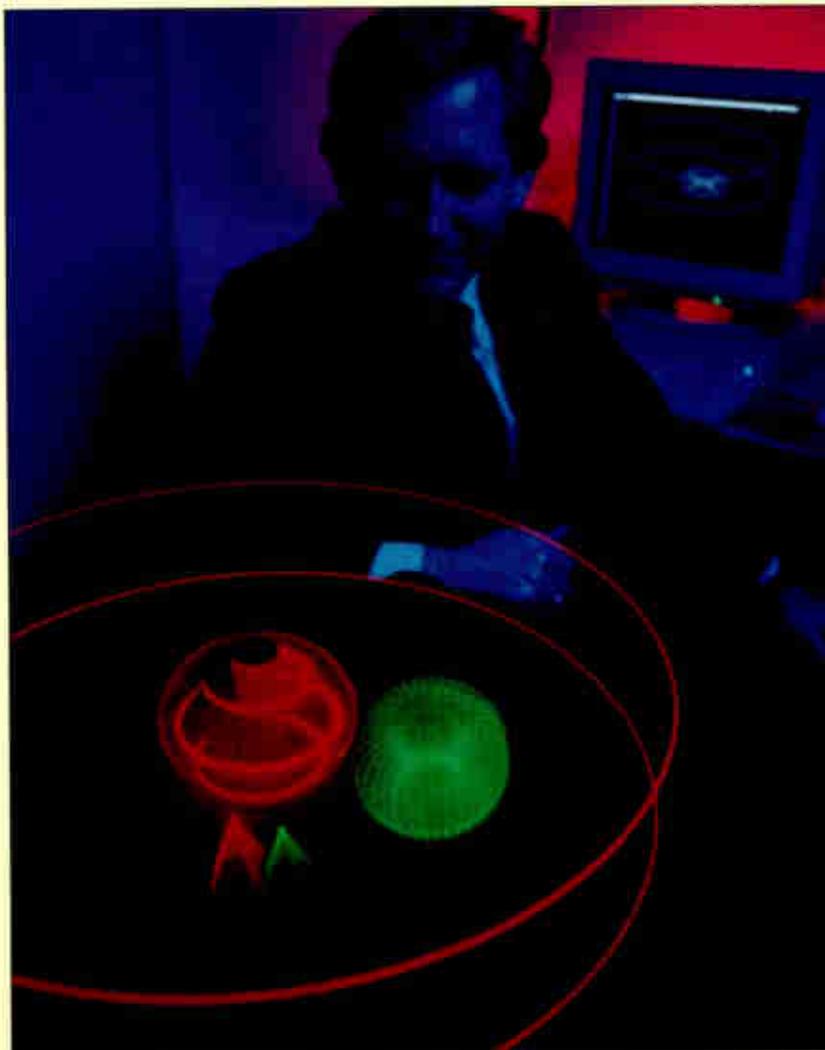
**A** new minimalist microprocessor architecture being developed by Teraplex (Champaign, IL) could lead to systems that not only are faster but can emulate other processor architectures as well. Teraplex's Minimum Instruction Set Computer design uses, as its name implies, the minimum number of instructions possible to build a basic computer architecture. MISC uses long instruction words to fetch more than one operand at a time, and, according to Teraplex officials, it processes data significantly faster than most current

desktop computers.

Perhaps an even greater benefit than speed is the MISC chip's ability to imitate other processors by mimicking their instructions with combinations of its own. Because of its high speed, the processor can do this quickly enough to attain very good performance, the designers say. According to Teraplex staffers, they've built systems that can directly execute MS-DOS programs at about 4½ times the speed of a 386-based machine running at 33 MHz.

The instructions used in the MISC

system are as basic as possible (e.g., add, multiply, logic shift, escape, and trap). MISC handles instructions that are common on current microprocessors, such as move, by reading a data operand, shifting it by 0, and storing it to the instruction-fetch register. The design also uses a novel approach to floating-point operations: It fetches the numbers, unpacks them into exponent and mantissa, aligns them, passes them through the integer unit, and then realigns and repacks them. Teraplex president Philip McKinney says that this



*Put away those 3-D glasses. Texas Instruments has prototyped a laser-based display system for projecting three-dimensional images that can be viewed from any angle. As in real life, the visual perspective of the image changes with the viewing angle. Don Williams, a development engineer at TI's Computer Systems Laboratory, is shown here with the OmniView display, described in the company's patent application as "a real-time, auto-stereoscopic, multiplanar 3-D display system." The display surface is a translucent double-helix disk that's mounted on a rotating shaft. As the disk spins (at 600 rpm), a low-power laser beam passes over it. This beam scans the disk in two dimensions, but, as TI explains it, the eye of the beholder "fuses the discrete points of light painted on the disk" into a 3-D image. The spinning disk can be adjusted to change the size and shape of the display space, either short and wide or tall and thin. Resolution of the laser scanning system is about 750 by 750 pixels. The prototype as currently configured can display full-color images generated with a Sun workstation. TI is seeking partners to develop applications that use the new display technology.*

## NANOBYTES

This won't be the year for the debut of the certified **50-MHz i486**, as it turns out. **Intel** officials have conceded that the top-speed model of the i486 processor won't be ready until next year. The original target date for the i486/50 was "by the end of 1990." An Intel spokesperson said it now looks like "sometime in 1991." That means announcements of 50-MHz i486 machines should begin any day now.

So while Intel keeps working on the 50-MHz i486, a young California company is chilling out. **Velox Computer** (Santa Clara, CA) claims that it can speed up an i486 just by **refrigerating it**. Velox says its Ice Cap module allows i486s to run 50 percent faster than their rated speeds. A 33-MHz i486 can run reliably at 50 MHz, according to Velox president Mel Snyder. The Ice Cap is a refrigeration module, about 3 inches tall, that fits on top of the processor in a conventional microcomputer and cools it to 0°C. It uses a solid-state thermionic element to combat the effects of heat. Active cooling has been used in mainframes for years, but it's rare in microprocessor applications. So far, Snyder says, his company has sold modules to about 40 firms, including Digital Equipment and Everex. **Everex** isn't planning any products that use the cooling tower, but a spokesperson said it's playing with it "to see what 50 MHz does."

The techno-legal morass of **cloning Intel's 386 CPU** has bewitched and bewildered some chip makers. But **Integrated Information Technology** (Santa Clara, CA), which already makes its own versions of Intel's math coprocessors, confirms that it is working on a replicant of Intel's top-of-the-line CPUs. "We do have an R&D program to do a 386/486-compatible product," IIT president Chi-Shin Wang told BYTE. It will be a stand-alone CPU that's code-compatible with Intel's, Wang said. Although Wang would not say when that chip will be ready, sources say that it's likely to appear sometime in 1991. As for potential legal problems, Wang said, "In our design, we can get around [Intel's] patents."

technique on the Teraplex 32-bit CMOS design is about as fast as on a MIPS R3000 RISC processor with an FPU.

One advantage to using such basic instructions is that they can be combined easily to form more complex instructions. As a result, the MISC design can emulate other processors. Teraplex officials say they have checked this with a system running MS-DOS programs and have test systems that can run MIPS and SPARC programs. Teraplex is also investigating running Motorola 68000 code.

One of the big advantages of the MISC design is that it doesn't require instruction decoding. Unencoded instruction words directly control the hardware of the chip. The current 32-bit design from Teraplex uses a long instruction word (LIW) technique that fetches 128 bits at a time. The first 64 bits tell the control unit and universal functional unit what to do with the other 64 bits, which are two operands. The benefits of this technique include the elimination of microcode and decoding circuits, as well as the ability to process larger amounts of data more quickly. The current design is capable of operating at about the equivalent of 60 VAX MIPS, according to McKinney.

The MISC approach minimizes the use of clock cycles, which helps to eliminate waiting periods required to make sure that all signals are ready before issuing a clock. The control and functional units that handle processing are designed to filter instructions through without rigidly timing them. McKinney describes this design as a "big Pachinko machine," after the

Japanese arcade machines that filter and bounce hundreds of ball bearings through metal pins.

Teraplex programs its chip using compilers and a language called Teraplex Intermediate Language Interface. This is a high-level assembly-like language for an imaginary serial processor. It is expanded by the TILI compiler into direct machine instructions. Higher-level languages like C are first compiled into TILI for execution.

Teraplex plans to begin prototype production of chips by the end of the year and hopes to have commercial workstations and desktop computers based on the chip in the fourth quarter of 1991. Company officials say they're dealing with several third parties to design computer systems around MISC.

Teraplex is not the only company involved in research in this area. There are a few VLIW SPARC systems in the works, and British computing pioneer Clive Sinclair is rumored to have developed a similar processor with a 96-bit instruction word, a design that sources say can emulate existing microprocessors.

Some experts have predicted that architectures using long (and very long) instruction words might supersede RISC designs. By combining this technique with a minimal instruction set, Teraplex is attempting to bring about two design revolutions: raising speed limits, and developing processors that can imitate other processors. The latter goal of processors that can share binary code could herald true interoperability among computers of different designs.

—Owen Linderholm

## Montana Researcher Claims Optical Processor

**A** researcher at the Rocky Mountain Research Center (Missoula, MT) says he has developed the first working optical logic device, capable of performing the Boolean operations that are basic to the electronic transistor. According to John Hait, he has designed a hologram—a photographic recording of a pattern of light beams—that can accept two beams of light as an input signal and return a single light beam as an output. This forms the basis for an inverter or amplifier that can perform exclusive-OR and OR operations, among others.

Hait told BYTE that "a patent search has not turned up" any comparable devices. Although some researchers have written off the possibility of

performing logic operations entirely with optics, Hait claims that his invention forms the basic building block for designing purely optical computers. Hait's "optical transistor" performs the logic functions optically, thereby eliminating the need for expensive electronic logic devices such as gallium arsenide substrates, which are nevertheless slower than the equivalent optical device. Hait says his optical transistor could form the basis for optical RAM systems, registers, multiplexers and demultiplexers, and other standard computer components.

Hait says he demonstrated his logic hologram in a laboratory at Montana State University in Bozeman. According to a letter from an MSU physics

# It takes less to crack C and Assembler than you'd think.



With new Microsoft® QuickC® and QuickC with QuickAssembler,™ mastering the hard-core stuff is so easy it's almost criminal. You see, the Quick environment includes what we call the QuickAdvisor, an interactive, hypertext manual that furnishes answers on demand. As in on-line. While you're programming QuickC Compiler and QuickC with QuickAssembler also include the new language features found in the Microsoft C 6.0 Professional Development System. So you'll find yourself in quite a powerful



position. And, at the same time, you'll be assured of upward compatibility with both of these products' professional counterparts.

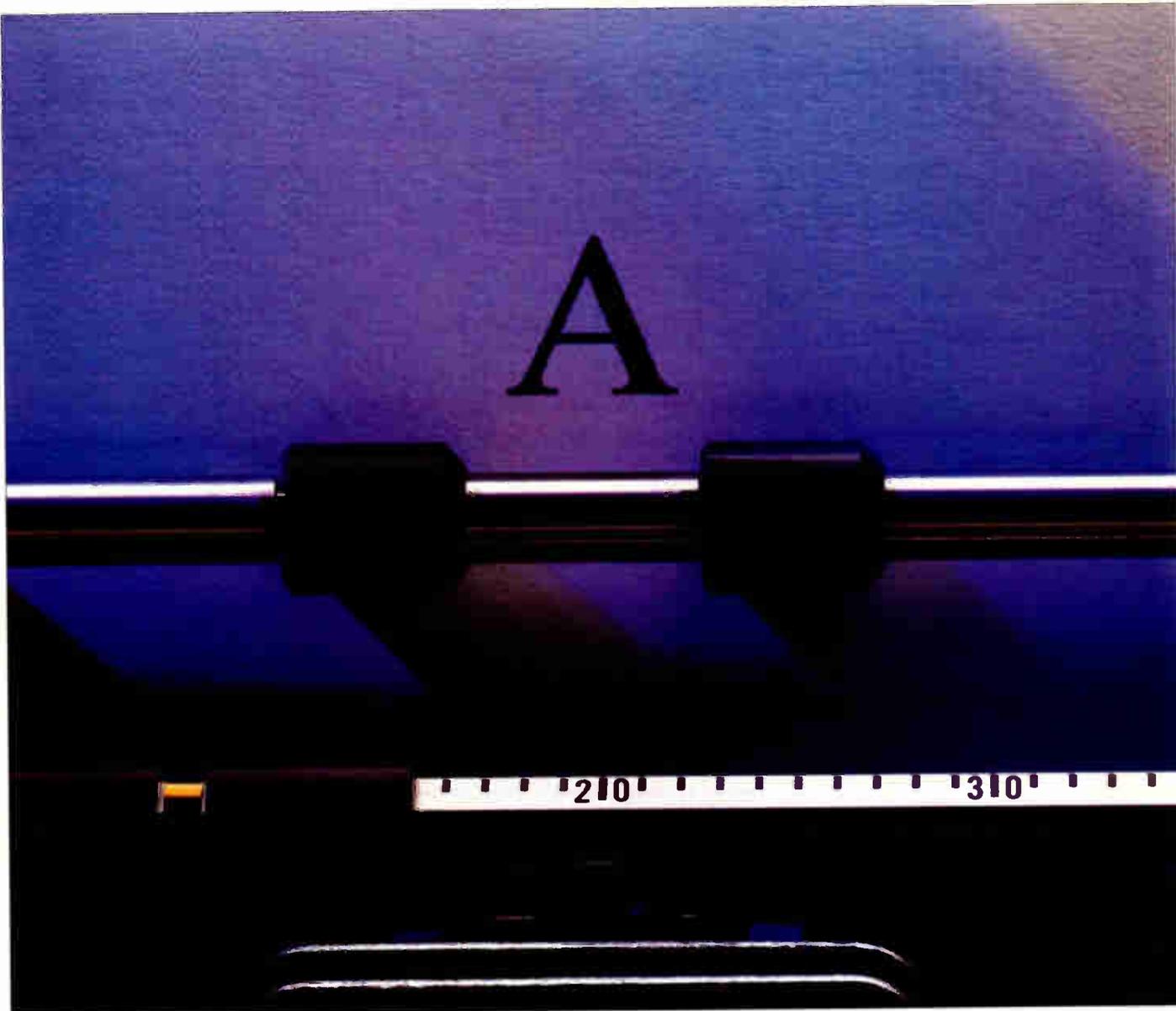
Which means there's no need to trash any of your existing code.

Plus, with the QuickC with QuickAssembler Development System, C and Assembler are totally integrated. Ensuring easy access to the features you need to develop powerful applications.

To find out how easy it is to tap C and Assembler or to upgrade, call (800) 541-1261, Dept. L91. You'll find we offer the right combination.

**Microsoft**  
Making it all make sense™

Customers inside the 50 United States, call (800) 541-1261, Dept. L91. In Canada, call (416) 673-7638. Outside the U.S. and Canada, call (206) 882-8661. © 1990 Microsoft Corporation. All rights reserved. Microsoft, the Microsoft logo and QuickC are registered trademarks and Making it all make sense and QuickAssembler are trademarks of Microsoft Corporation.



# Do anything and you would

For 25 years, Epson® printers have placed ink on paper with fine-crafted precision and ever-increasing speed. Each character as impressive as the last. A feat that Epson 24-pin printers have



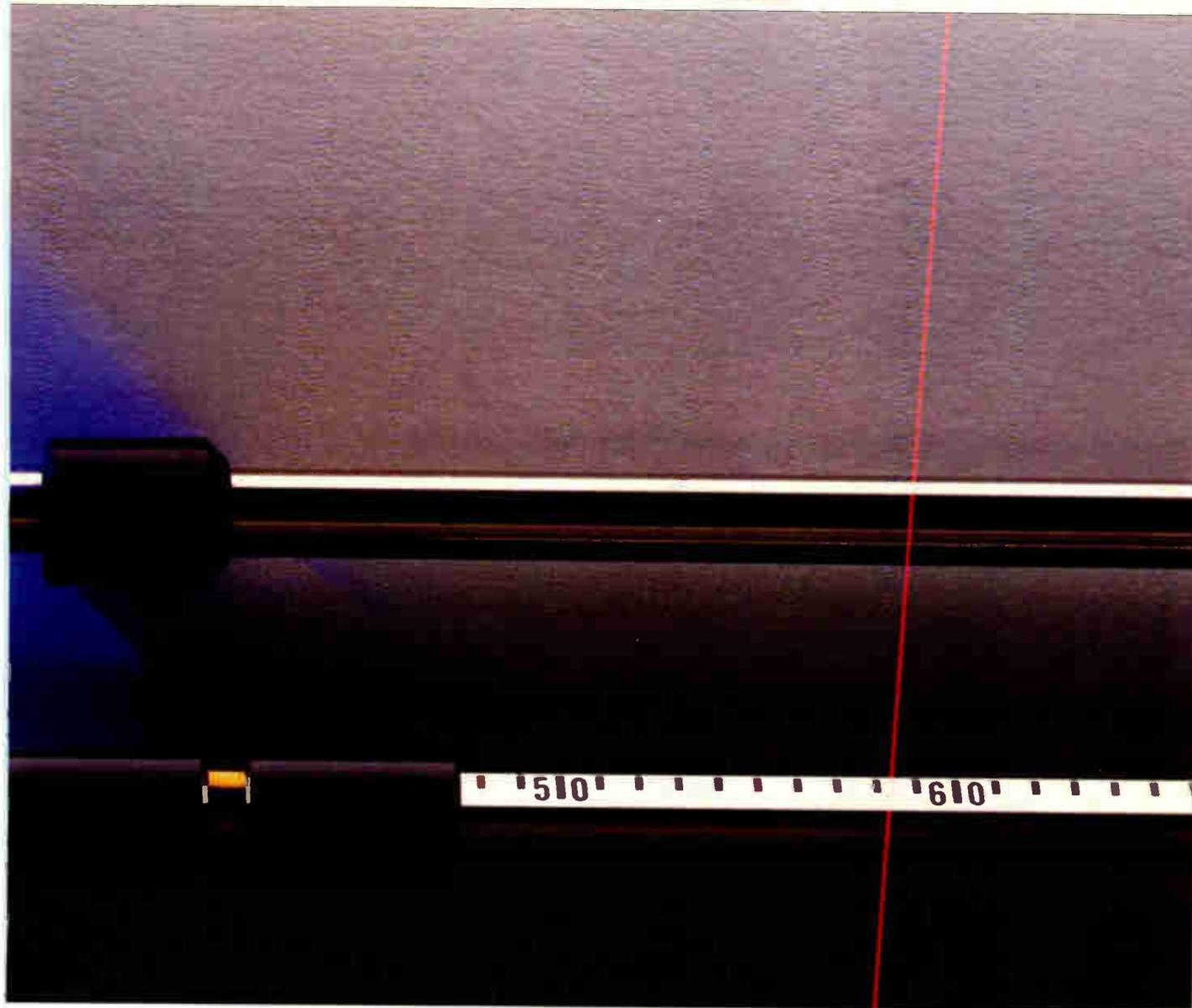
## **2 Year Warranty**

*Just one more measure of how dependable your Epson printer will be.*

accomplished 15 trillion times over.

Today, dot matrix is the most widely used printing technology in business. Of course, the most widely used dot matrix printers are made by Epson. The very

Two year warranty available on all Epson printers, except the LQ-2550 and DFX Series which offer a one-year limited warranty. Epson is a registered trademark of Seiko Epson Corporation. SmartPark and



# 15 trillion times be good at it, too.

company that invented them two decades ago.

Epson printers—from dot matrix to laser to inkjet—are the epitome of reliability. But where there is brawn, there is also a brain. Consider Epson's ingenious SelecType™ control panel and

skillful SmartPark™ paper handling. These and other conveniences make operating an Epson as flawless as the printing.

We could go on. But you already have 15 trillion reasons to choose an Epson.

Engineered For The Way You Work.™



SelecType are trademarks of Epson America, Inc. ©1990. Epson America, Inc., 2780 Lomita Blvd., Torrance, CA 90505 (800) 922-8911.

## NANOBYTES

**Dell Computer** (Austin, TX) has developed a new **disk drive controller card** that's aimed squarely at a similar device announced by Compaq last November at its SystemPro introduction. The Dell Drive Array card features the Intel i960 32-bit RISC chip, a 256K-byte static RAM cache, and connectors for 10 Intelligent Drive Electronics hard disk drives. The card can read and write simultaneously from five disk drives, a company executive said. Dell officials claim that using the controller with four disk drives will yield a system with not only four times the storage capacity but approximately three times the performance. The company is still working on the code for the i960 chip, trying to bring the controller up to this level of performance. When we spoke with them, Dell officials hadn't decided on a price yet for the Drive Array, but they estimated that it could be somewhere around \$1200.

Mac upgrade or Mac clone? **Texas MacExpress** (Austin, TX) has designed an "upgrade" for owners of the Mac Plus, SE, and Mac 512KE that the company claims will give them the performance of a Mac IICI for only \$2299—about half the cost of the genuine Apple product. The System 30 comes in a box that looks like an IBM-type PC. "The Apple ROMs that are used in the product have been bought by the customers, who disable their old machines when they are taken out," explained Kevin Cochran, president of Texas MacExpress, a subsidiary of Cork Computers. The system is supposed to ship this month, Cochran said. "We've had a team of programmers working for the last six months in-house to produce our own **proprietary operating system that bypasses Color QuickDraw**. It's copyrighted software. That's how a Mac Plus user with ROMs that don't have Color QuickDraw in them can upgrade to color," Cochran told BYTE. The System 30 has three NuBus slots, runs a 68030 at 25 MHz, and has a built-in paged memory management unit and 8-bit video, along with a 1.44-MB FDHD floppy disk drive that uses the Apple File Exchange utility.

professor, Hait demonstrated "several optical digital devices," including "exclusive-OR, OR, amplification, and inverter."

According to Hait, his hologram can be manufactured "synthetically" using software for designing holograms. Hait is looking for a major research lab or company to license his technology and to interface the necessary design software to existing hologram programs. Major improvements in hologram design software are needed to make his invention a viable product, he concedes.

Optical computing devices have made great progress in storage and

connection applications (e.g., fiber-optic connections and optical disk drives), but they have proved to be inaccurate when used for computation. Therefore, most research in optics has been devoted to the development of hybrid "electro-optical" computers, which use optics for storage and data transfer and employ electronic semiconductors for performing logic operations. Researchers at AT&T's Bell Labs, British Aerospace, Fujitsu, and other R&D centers have focused on linking optics to high-speed gallium arsenide logic devices.

— Nick Baran

## IBM, Metaphor to Build Platform for Portability

**M**oving application programs to different operating systems, and getting them all to work together, is one of the biggest challenges facing software developers today. Now IBM and Metaphor say they're going to try to make it easier. The two companies have formed a joint venture, called Patriot Partners (Mountain View, CA), to create a new applications software environment that they hope will offer an object-oriented development system for building easily portable programs.

The environment will be independent of current operating systems in that it will ride above the operating-system kernel, but the resultant applications will be able to run on OS/2 and Unix machines, the companies said. An application written for a particular processor architecture will run on that processor, without being modified, regardless of operating system; for other processors, applications will only have to be recompiled, a Metaphor official said. Initial hardware targets are 386-based machines running OS/2 or Unix

and IBM's RS/6000 running AIX. Current applications and these new applications are expected to be able to share information through Dynamic Data Exchange. Although the Macintosh isn't currently a target of the project, a Metaphor spokesperson said that it could be in the future.

The planned graphical user interface for these new applications will be different than existing GUIs but will most likely resemble, and will incorporate a superset of, Presentation Manager and Motif. The Patriot programs will operate on the major PC network systems, such as Novell NetWare, and will possibly have distributed object capabilities.

The new venture hopes to release a specification for its environment next year and a toolkit in 1992.

It's an ambitious project, and IBM and Metaphor officials concede that it will take them two or three years to get it all working. Patriot expects to have its software working sometime in 1993.

— D. Barker

## TI's New Printer Technology Does It with Mirrors

**M**any printer designs, such as those in most laser printers, involve the use of mirrors. But Texas Instruments has developed a new type of printer technology that is taking this approach to something of an extreme. The company's new technology uses multiple mirrors—hundreds, in fact. What's more amazing is that all these mirrors fit on a single silicon chip.

TI's novel printer technology is based on a new type of chip called a deformable mirror device (DMD). It consists of an array of several hundred microscopic

mirrors that can swivel, in seesaw fashion, on a tiny axle. By varying the electrical charge around the mirror, TI can change the orientation of the mirror, moving it to one of three positions. The mirror can be completely horizontal or tilted slightly to one side or the other.

TI produces the DMD chip in a new three-dimensional chip-manufacturing process. First a base layer is put down, followed by a layer of aluminum that functions as the mirror. This layer is etched in such a way that the aluminum is arranged in tiny squares, with small

## NOW YOUR SOFTWARE CAN TEST ITSELF.

NOW AVAILABLE IN  
**VGA**

**Y**our customers expect software that works. All the time. The key to software quality is exhaustive testing. It's also an engineer's worst nightmare. But it doesn't have to be. Because now you can automate your software testing.

Introducing the Atron Evaluator. The first and only non-intrusive automated PC-based software testing tool.

The Atron Evaluator automatically runs your software regression testing programs. All of them. All day. All night. Giving you thoroughly tested, higher quality software.

The Atron Evaluator is hardware-based. And since it's non-intrusive, software behavior is tested without the risk of alteration. Once your tests have run, you can refer to automatically generated test reports to double-check test results.

The Atron Evaluator saves time. And time makes you money. Development cycles are shortened, so your software gets to market sooner. And while your test programs are running, you can be more productive. Start a new project. Or go home.

For more information about the Atron Evaluator, call us at (401) 351-2273. And put an end to your worst nightmares. Automatically.

## CADRE

Cadre Technologies  
19545 N.W. Von Neumann Dr.  
Suite 200  
Beaverton, OR 97006

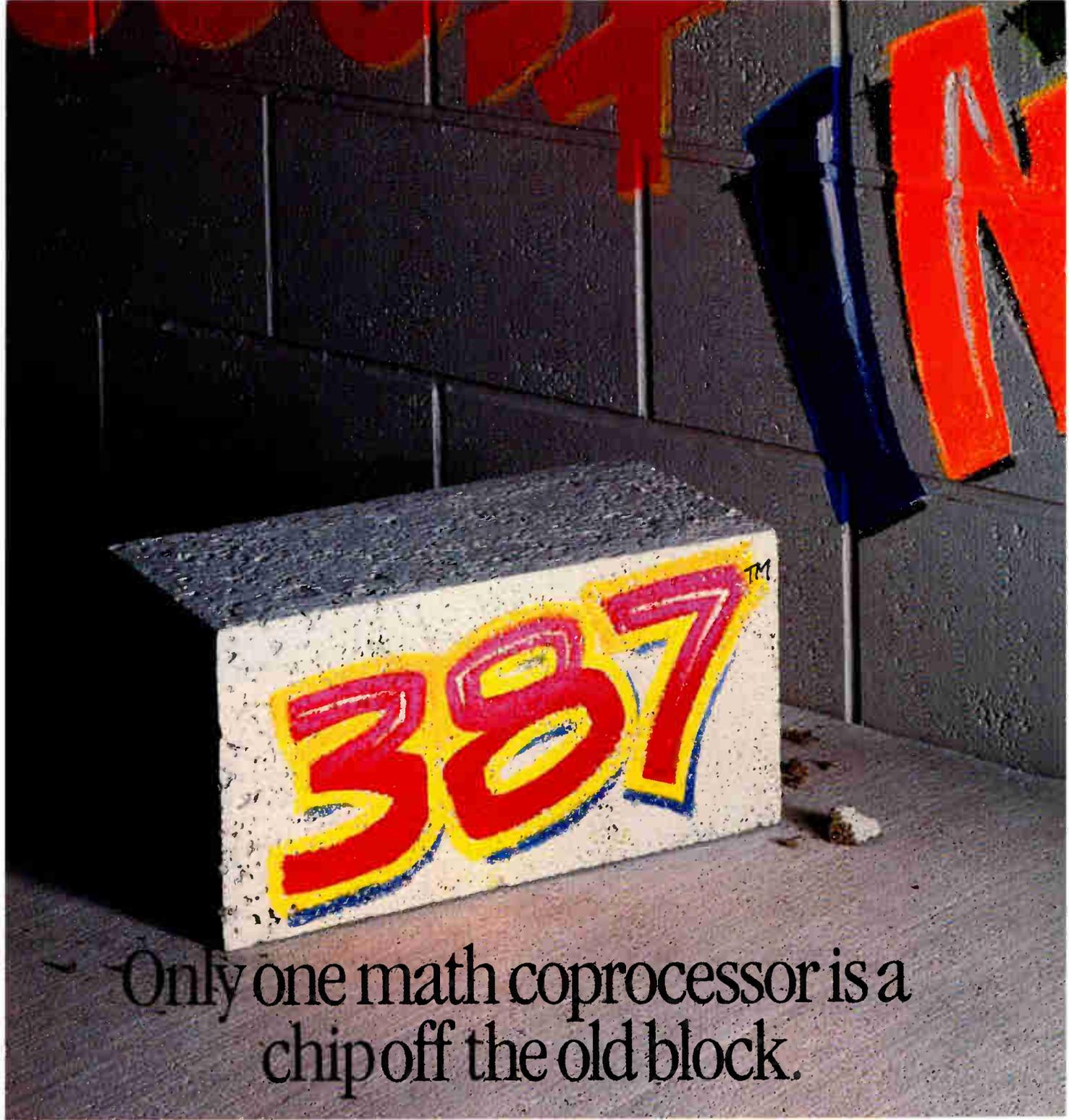
Circle 66 on Reader Service Card

**In Europe, contact:**

Elverex Limited, Enterprise House  
Plassey Technology Park, Limerick, Ireland  
Phone: 061-538177

QA Training Limited, Cecily Hill Castle  
Gloucester, Gloucestershire, GL1 2EF, England  
Phone: (0285) 5888

AND  
**PS2!!**



Only one math coprocessor is a chip off the old block.



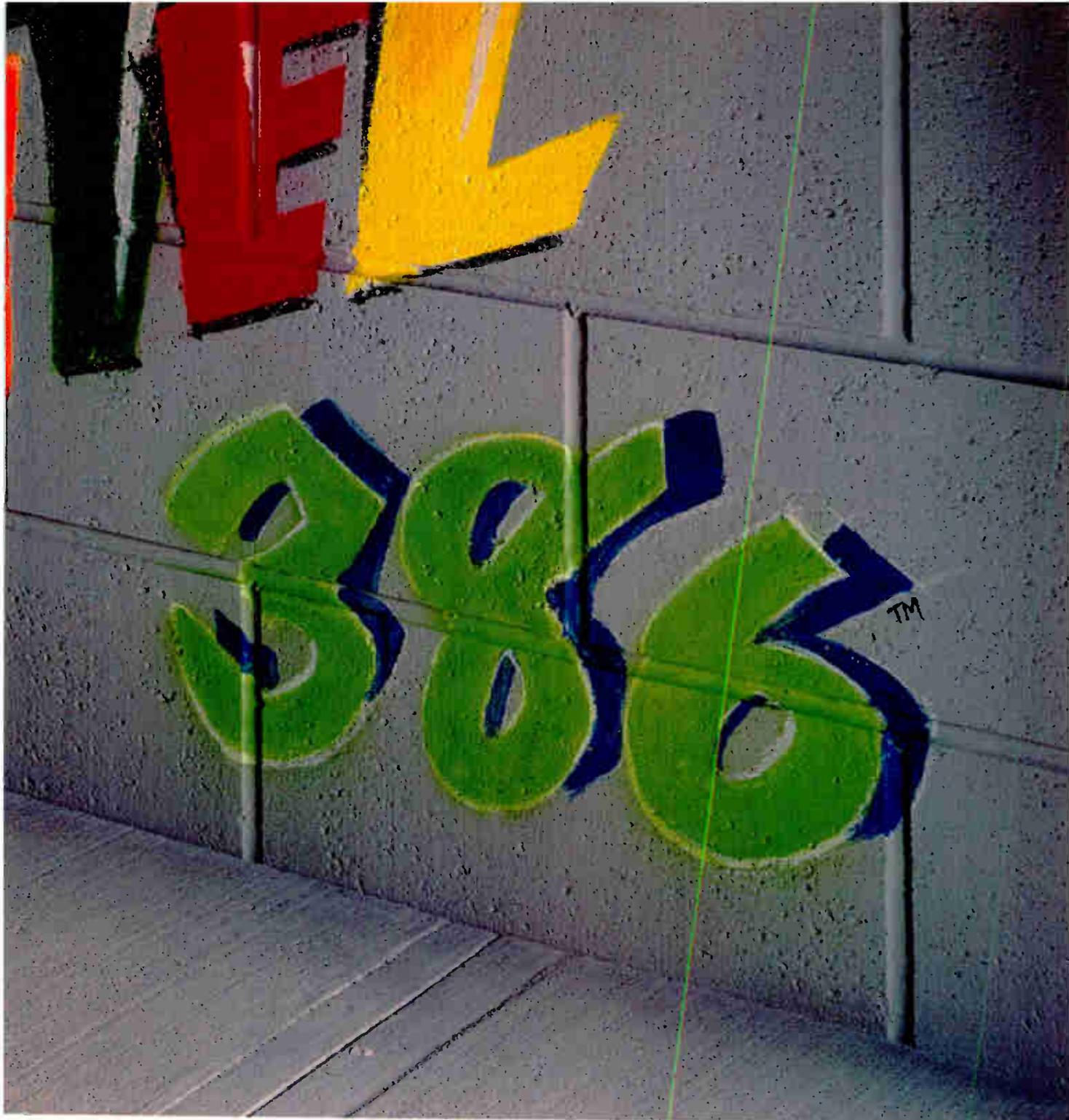
That's Intel's. And our new family of Math CoProcessors is faster—up to 50% for the 287XL.

In fact, working side by side with the Intel microprocessor already inside your computer, an Intel Math CoProcessor can increase the speed of your spreadsheet, graphics, CAD and

database programs by as much as 500%. That's good to know.

And the fact that it's made by Intel is also good to know.

Because Intel developed the first Math CoProcessor in 1982, and we've shipped millions since then. Each one is manufactured by Intel in the world's most advanced logic



facility, and then tested and retested against an exacting set of criteria.

And we can guarantee that every Intel Math CoProcessor lives up to the industry hardware standards we helped develop, delivering the same results regardless of what type of computer you're doing calculations on.

So call Intel at (800) 538-3373. Ask for

Literature Packet #F6 on Intel's new and improved Math CoProcessors. And put an Intel Math CoProcessor inside your computer. It's the only one with the Intel name to live up to.

**intel**<sup>®</sup>

The Computer Inside.™

©1990 Intel Corporation. 386 and 387 are trademarks of Intel Corporation.

Circle 175 on Reader Service Card (RESSELLERS: 176)

World Radio History

## NANOBYTES

Eager to get the software development ball rolling, **Quarterdeck** has provided "key developers" with alpha toolkits for **Desqview/X**, which combines the company's DOS multitasking system with the X Window System. The two available kits support development for Desqview/X using standard X11 libraries and OSF Motif libraries. They are "stable enough" for developers to begin application development cycles, Quarterdeck said. The company plans to soon release a kit for Xview, based on Sun's Open Look. Desqview/X is supposed to be commercially ready in early 1991.

Japanese companies are apparently planning to produce the **next two generations of DRAM chips** on 8-inch silicon wafers. Because bigger wafers yield more parts, this should result in faster production of 4- and 16-Mb DRAMs through bigger volumes. An 8-inch wafer of silicon has nearly twice as much surface area as the 6-inch wafers now commonly used. According to reports from Japan, **Toshiba** is expected to start its 8-inch line for 4-Mb DRAMs soon. **NEC** plans to start testing this year or early next year and expects to have its 8-inch line operational by 1992.

According to figures from the Japan Electronic Industry Development Association, half of the 327,000 laptop computers sold in Japan this spring (April to June) were of the **notebook** variety.

Incompatibilities between applications running under various Intel-based versions of Unix should be eliminated by the **new edition of the Intel Binary Compatibility Specification**. Intel, AT&T, and The Santa Cruz Operation say they'll collaborate on a new specification that will enable developers to write but one version of an application instead of one for each Unix variant. Developers working with AT&T Unix System V/386 release 3.2 or 4.0, SCO Xenix System V/386, SCO Xenix 386, or Open Desktop will be able to have their applications run under any 386- or i486-based operating system that complies with the new binary specification.

axles projecting from two opposite corners. Then TI uses a combustion process to remove the material under the main body of the mirrors. The result is that the mirrors are supported only at two corners and can swivel freely. TI officials admit that this manufacturing process is complex, but the company hopes to eventually produce 2-D arrays containing thousands of mirrors. These could be used in a new type of video display.

TI's first application of the technology will be in a printer. The company has created a chip that contains 840 mirrors arranged in a linear array. The DMD chip will be used somewhat like an LCD array in some page printers, selectively letting tiny beams of light hit a xerographic print drum. TI says that a DMD printer will have 10 percent fewer moving parts than an equivalent laser printer. TI also claims that the DMD

chip will be cheaper to manufacture than a large LED or LCD array.

Because it can shorten the amount of time that a mirror is "on" for each pixel, the DMD chip will enable a printer to generate variable-size pixels, thus producing true gray scales. By contrast, a laser beam must scan across an entire row of pixels and conceivably has less time on each pixel in which to vary its brightness.

The first DMD printer will be used in one of TI's most successful printer markets: the airline industry. The device will be used to print the new ATB (automated ticket/boarding) tickets, which look somewhat like computer punch cards. TI claims that such a printer will be able to output 40 tickets per minute at a resolution of 240 dpi. TI officials say they're not sure when this new printer will be available.

— *Rich Malloy*

## AMD Accelerates RISC Line with FPU

**A**dvanced Micro Devices says its new 32-bit RISC processor, the Am29050, will significantly speed up such devices as color laser printers, graphics boards, optical character recognition scanners, X Window System terminals, and imaging systems. To create the new chip, AMD has essentially added a pipelined FPU to its 29000 processor, currently embedded in many graphics-intensive products, including Apple's Macintosh Display Card 8•24 GC, in which it accelerates QuickDraw screen-drawing operations.

Running at its peak of 40 MHz, the 29050 can perform arithmetic operations (IEEE-compatible single- and double-precision) at a top speed of 80 MFLOPS, AMD claims, putting it in the same MFLOPS league as Intel's i860.

The new chip is code- and pin-compatible with the 29000, so applications tailored to that processor will be able to run on the 29050 without any changes, AMD says. In "floating-point-intensive situations," those applications will be faster "by a factor of four," according to

an AMD spokesperson. The chip has a 64-entry memory management unit, a 1024-byte instruction cache, support for burst-mode access, and a three-address instruction architecture. The processor will be available in 20-, 25-, 33-, and 40-MHz models.

Although Apple hasn't yet committed to using the new AMD chip, a member of the graphics hardware design department said that the company would like to have the floating-point capabilities that such a processor will offer. "With floating-point, we could do some of the transforms for 3-D drawing faster," he said. "QuickDraw is 100 percent integer right now, but if we wanted to go to 3-D coordinates, if we wanted QuickDraw to have a 3-D architecture, floating-point would be necessary." Apple officials have said one reason they put the 29000 on the 8•24 card is its "growth path"; in other words, because they're plug-compatible, future members of the 29000 family could easily replace the current chips.

— *D. Barker*

## Intel Designs an SX for Laptop Computers

**I**ntel (Santa Clara, CA) has developed a new version of its 386SX processor that's built for laptops and other portable computers. The new 386SL Microprocessor SuperSet is essentially a microprocessor with a chip set to back it up. The 386SL includes critical design

changes that extend the 386 architecture to add advanced power management features at the processor level.

The SuperSet consists of the 386SL processor and the 82360 I/O chip. The chips operate at 20 MHz only, matching the highest speed of the 386SX, which

# DR DOS 5.0. WE COULDN'T HAVE SAID IT BETTER.



So what's all the hoopla about? MemoryMAX™ for one thing. A breakthrough in memory management that can give you more than 620K so you can run today's memory-intensive applications, including, for example, dBASE IV, on Novell NetWare™.

In fact, John Dvorak calls MemoryMAX nothing short of "amazing."

The Press goes on to mention that because DR DOS 5.0 is fully DOS compatible, you can run all your current DOS applications. And because it is easy to install and requires no hard disk reformat-

ting, upgrading to DR DOS is simple. Since DR DOS 5.0 also includes ViewMAX™, a graphical interface, DOS is easier than ever to use.

Now if we could just get a word in edgewise, we would simply like to add that DR DOS 5.0 is available now. Call your local dealer today.

## DR DOS 5.0

 Digital Research®  
WE MAKE COMPUTERS WORK

For Laptop and Notebook manufacturers, DR DOS 5.0 is fully executable from either RAM or ROM. And, it's available with BatteryMAX™, a battery-saving feature that can increase battery life 2-3 times (dependent upon OEM implementation).

Digital Research is a registered trademark, and the Digital Research logo, DR DOS, MemoryMAX, ViewMAX, and BatteryMAX are trademarks of Digital Research Inc. Copyright © 1990, Digital Research Inc.

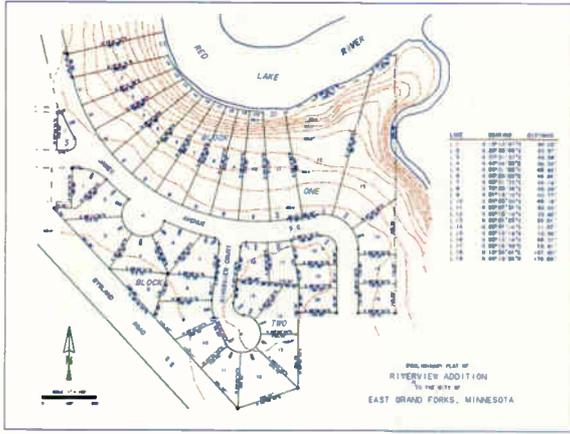
Reprinted from PC Week May 14, 1990. Copyright © 1990 Ziff Communications Company.  
Reprinted with permission from The San Francisco Examiner. Copyright © 1990 The San Francisco Examiner.

Circle 109 on Reader Service Card

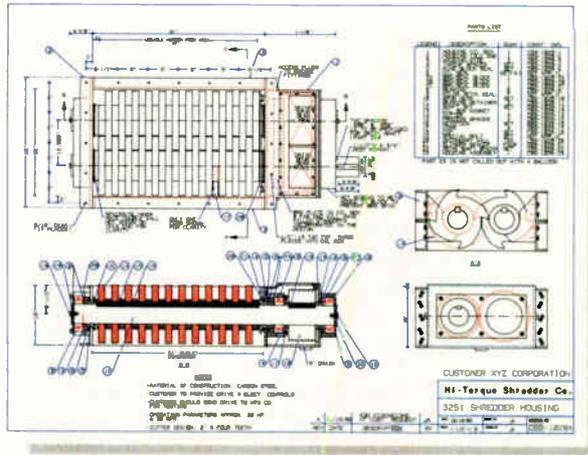
World Radio History



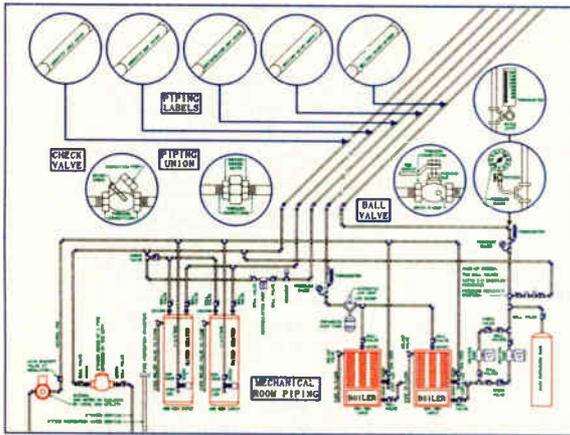
# A BEST SELLER SELLER?



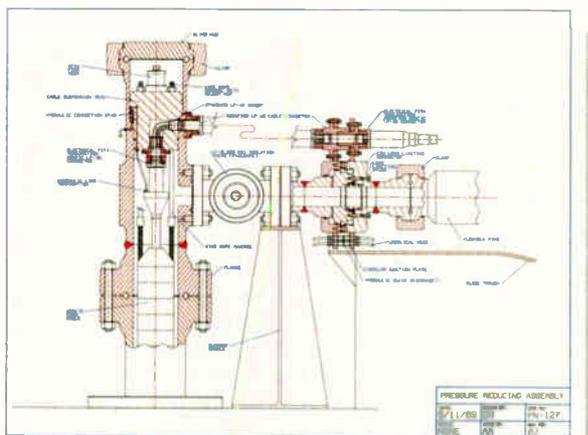
Whether it's millimeters or miles, count on Generic CADD for floating point precision at any scale.



Deadline pressure is a thing of the past. Designs can be quickly edited and annotated to produce final working drawings.



Generic CADD 5.0 supports plotters as well as dot matrix and laser printers, including PostScript® printers.



Any way you look at it, CADD is a natural tool for bringing clarity to complex ideas and designs.

# PLOT.

Call us at 1-800-228-3601 for our free full-color CADDalog® and portfolio of CADD drawings.

You'll see every plot has a great ending.



**Generic**  
SOFTWARE  
An Autodesk Company

**IT DOESN'T GET ANY EASIER.**

Circle 143 on Reader Service Card (RESELLERS: 144)

World Radio History

## NANOBYTES

**National Design, Inc.** (Austin, TX), plans to bring out this month a **TMS34020-based VGA card** with the lowest price we've seen yet on a board using Texas Instruments' latest graphics processor. The new Volante board will sell for \$995, according to an NDI official. The card is designed to work in different graphics environments, including Windows, 8514/A, TIGA, the X Window System, and CGI. The boards will also ship with AutoCAD drivers from Panacea.

Share or LAN? The **Multiusers DOS Federation** is promoting multiuser PCs as an alternative to LANs. One MDOS member says it's "a myth" that LANs are the only way for groups of computer users to work together. The organization hopes to establish standards for multiuser computing. Among the charter members are representatives of Digital Research, Theos Software, SunRiver, DigiBoard, Alloy, and Viewport International.

The **National Institute of Standards and Technology** says its **Computer Security Bulletin Board** is now much easier to access and navigate. The board is a source of information on computer security, from bibliographies of articles to listings of seminars. The NIST also posts information on incidents such as virus attacks. To connect with the BBS, dial (301) 948-5717 (at 2400, 1200, or 300 bps; 8 data bits; no parity; 1 stop bit). To connect with the help squad, dial (301) 975-3359.

**Paper** is still the primary **information storage medium**, according to a survey of information managers conducted by Du Pont (Wilmington, DE). Almost half the polled attendees at the Association for Information and Image Management conference said they use hard copy as their main means of storing documents and drawings. About half that many said they use microfilm and aperture cards. Only 11 percent use optical disks, but 40 percent said they see rewritable optical disks as the next big thing in storage. As for their biggest management challenge, almost half said it's finding the information they're looking for.

the 386SL closely resembles in performance terms. Intel has added a hardware-level interrupt and a new memory-address space. These are reserved for a new interrupt, called the system management interrupt (SMI). Using a system management handler, hardware companies will be able to access reserved system management memory and I/O addresses.

The SMI allows suspend and resume operations, peripheral standby, CPU speed control, uninterruptible power supply capabilities, and programmed extensions by OEMs to cover almost any other imaginable power management activity. Despite this extra logic that can remove processor time from the operating system, Intel claims that the 386SL outperforms a 386SX.

The 386SL includes a main-memory subsystem controller with a 32-MB address space, an EMS 4.0 memory controller, an AT bus controller, a full cache controller, and support for the 80387SX math coprocessor. The companion device, the 82360SL,

supports CPU, memory, and peripheral functions, as well as providing programmable features to manage power to prolong battery life. Intel provides a set of low-power support logic chips.

The 386SL and 82360SL are sold separately and cost \$176 and \$45, respectively, in quantities of 1000.

The new SL line signifies that Intel is starting to attack the chip set market.

Several companies currently sell chip sets that offer many of the power management features of the 386SL in support logic devices designed to be used with the 386SX. However, Intel has something those companies don't: the ability to tie those features into the processor itself. Intel says its approach to power management is inherently safer than that of the chip set manufacturers because the 386SL isn't having to continually fight for control of memory, interrupts, and the CPU with the operating system and applications. The new chip set should lead to laptops with longer battery lives by late next year.

— Owen Linderholm

## New Material Could Ease Pains of Chip Making

**T**hey're called arylated poly (p-phenylene sulfide) (APPS) polymers, and they could change the way microcircuits are made. Researchers at the University of California at Berkeley say these new materials could greatly reduce the time and complexity involved in fabricating chips.

Building microchips is a tedious process that takes as many as nine steps, including coating silicon slices with silicon oxide and a photoresist polymer, masking off the areas that are to become electrically conductive from those that aren't, printing the circuit pattern onto the silicon, exposing this sandwich to light (*photolization*), etching away the nonconductive silicon oxide, and stripping off the photoresist.

But with these new polymers, that process can be simplified "to two or three steps," says Berkeley chemistry professor Bruce Novak. The new polymers normally function as insulators, but the Berkeley team led by

Novak discovered that when the materials are exposed to light, they become semiconductors; masked-off areas remain insulators. Thin films made of APPS can be laid over a circuit pattern and turned into microcircuits, with the exposed areas working as conducting wires. The thin film basically becomes a microcircuit after being photolyzed, so no additional processing is necessary, Novak says. Because the photolyzed films are capable of conducting electricity, chip makers would no longer have to use silicon wafers; APPS films could be put down on different kinds of materials.

APPS films could also end up on your computer screen. Because the films are so thin (0.25 micron) and optically transparent, they could be painted directly on the screen, like a coat of microcircuits. Current running through the circuits would generate visual patterns, Novak says.

— D. Barker

**ARE YOU AN INNOVATOR?** *If you, your company, or your research group is working on a new technology or developing products that will significantly affect the world of microcomputing, we'd like to write about it. Phone the BYTE news department at (603) 924-9281. Or send a fax to (603) 924-2550. Or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. Or send E-mail to "microbytes" on BIX or to "BYTE" on MCI Mail. An electronic version of Microbytes, offering a wider variety of computer-related news on a daily basis, is available on BIX.*

## In Redondo Beach, California . . .

You'll find breathtaking ocean views, sensational surfers and Gateway 2000 computers.

Dive 'N Surf, famous for Body Glove® fashions and watersports equipment, is a



*Graham Pask, Computer Systems Manager for Dive 'N Surf, and his Gateway 2000 25 MHz 386 network server.*

member of the growing family of Gateway 2000 customers in California. Dive 'N Surf Computer Systems Manager Graham Pask chose a Gateway 25 MHz 386 machine for his network server. The system runs point-of-sale, inventory control, word processing and desktop publishing software.

"I decided to buy a Gateway 2000 system because they had everything I wanted for a good price," said Graham. "But what really impressed me was the service. I had a problem with my 3 1/2 inch drive so they sent me a new drive the very next day."

Graham said he was so happy with his Gateway system at work that he bought a Gateway 2000 25 MHz 386 Cache machine for his home.



*Until well after sunset, surfers ride the big waves on the Pacific Ocean near Redondo Beach, California.*

## And In Barrow, Alaska . . .

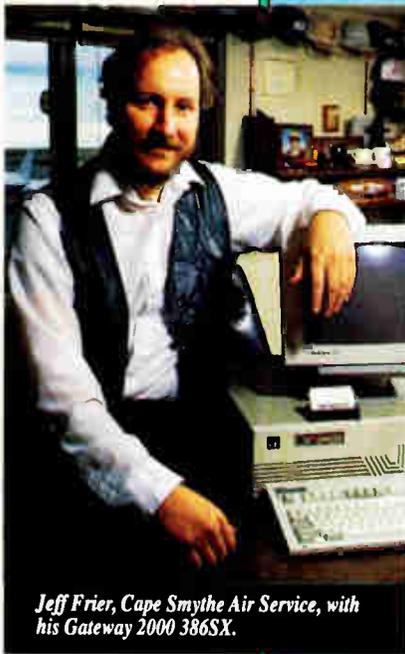
Over 300 miles north of the Arctic Circle, you'll find polar bears, seals, whales, walrus, lemmings, snowy owls and what appear to be the largest mosquitoes in existence. On a summer afternoon you'll also see parka-clad tourists walking among local residents in shorts. And of course you'll find a good Mexican restaurant and Gateway 2000 computers.

Cape Smythe Air Service, a regional commuter airline serving Barrow, Kotzebue, Nome and remote villages in Alaska, has one of several Gateway 2000 computers operating in Barrow. Jeff Frier, Cape Smythe's accountant, chose a Gateway 2000 386SX to run spreadsheet, data base and accounting applications.

"I was trying to decide between Gateway 2000 and a competitor," Jeff commented, "so I talked to a person who owns the competitor's system. He was disgruntled about the service he received from them. Then I talked to another person in Barrow who has a Gateway and she was happy with the product and service. The choice was pretty obvious -- when you're doing business in a remote area, the most important things a vendor can offer are reliability and good service."

Jeff said he also appreciated Gateway's features and price. "When you have to pay \$6 a gallon for milk, it's nice to find a bargain somewhere." Jeff plans to buy another Gateway 2000 computer in a few months .

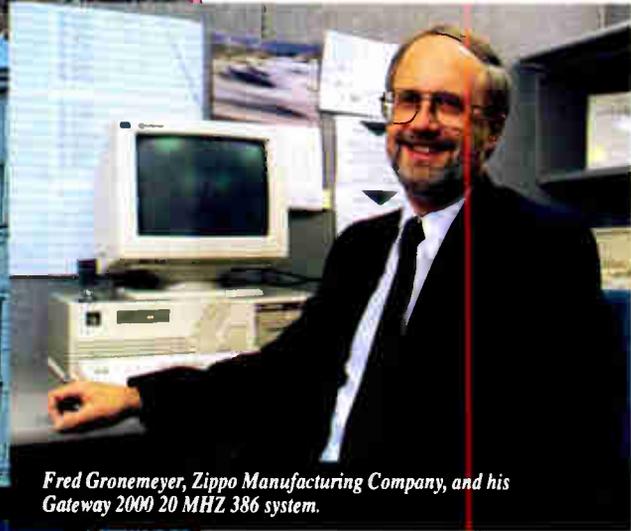
*On a mid-July day in Barrow, Alaska, fishing boats weave in and out of icebergs on the Chukchi Sea.*



*Jeff Frier, Cape Smythe Air Service, with his Gateway 2000 386SX.*

## In Bradford, Pennsylvania . . .

You'll find a charming small city nestled in the Allegheny National Forest. The city's most prominent local business is the Zippo Manufacturing Company, where you'll find 18 Gateway 2000 computers in use.



*Fred Gronemeyer, Zippo Manufacturing Company, and his Gateway 2000 20 MHz 386 system.*

Zippo is known around the world for its windproof lighter made famous during the second World War, although today the company's product line includes many other specialty advertising items. Fred Gronemeyer, Systems Analyst for Zippo, chose Gateway 2000 as the company's standard PC.

"We needed to set standards for PC's and software to make the most efficient use of these tools," Fred remarked. "We started out with PC's from different manufacturers, but once I tried Gateway I was convinced we could get the highest quality, most reliable machines at the best price from Gateway 2000. I was also impressed by my salesman and the tech support people I've dealt with at Gateway."

Fred said by the end of the year Zippo will be running every system Gateway 2000 makes, from 286's up to a 486 and everything in between.

*Main Street, U.S.A., is located in Bradford, Pennsylvania.*

## And In New York City . . .

You'll find your senses overwhelmed by the countless sights and sounds of this one-of-a-kind city. And of course you'll find thousands of Gateway 2000 computers here.

One New York City Gateway 2000 owner is



*Jim Rondinelli, independent record producer and engineer, with his Gateway 2000 386SX.*

independent record producer and engineer Jim Rondinelli. Jim uses his Gateway 2000 386SX with a sophisticated player piano sequencer to compose music.

"The software I use is written for the Mac and for IBM compatibles," Jim said, "but it runs much better on IBM compatibles. And it runs best of all on my Gateway. I travel often and I've used my software on a lot of other machines. They don't even compare with my Gateway 2000."

Jim said he bought his Gateway 2000 because it was equipped for the real world with ample hard drive capacity and RAM, both sizes of disk drives and color VGA graphics.

"It's the fastest file transfer computer I've ever used," continued Jim, "plus it ran right out of the box. One afternoon and I was fully functional on a brand new system."

*The streets of Manhattan are a constant blur of activity.*



## Near Camp Verde, Texas . . .

You'll find the magnificent Hill Country of Texas with rattlesnakes, prickly pear cactus and huge cattle ranches. You'll also find Larry Mahan and his Gateway 2000 computer.

Larry Mahan is to rodeo what Jack Nicklaus

is to golf. He is Six Times World Champion All-Around Cowboy and is a member of the Cowboy Hall of Fame. But Larry also runs a cattle and horse ranch and is involved in a western apparel manufacturing company and a new Southwestern foods company. His Gateway 2000 20 MHz 386 system is an integral part of his business operations. "We run cow and calf software for



*Larry Mahan, rodeo star, and his Gateway 2000 20 MHz 386 system.*

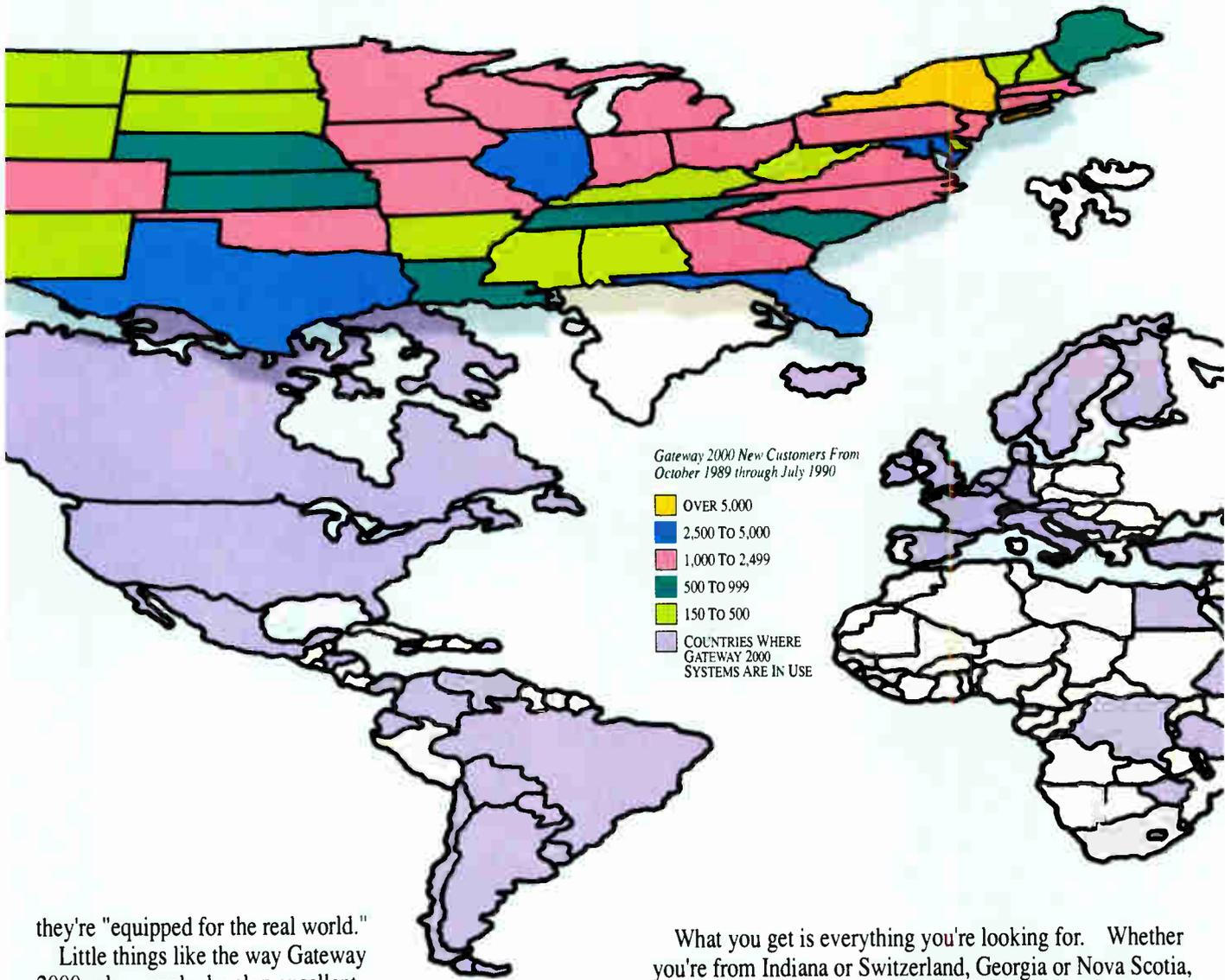
our Longhorn cattle herd," Larry said. "You can't really manage a livestock business efficiently without it. Plus we do accounting, spreadsheets and word processing on our Gateway 2000 computer."

Asked why he chose Gateway 2000, Larry said, "They had the best features and price – and I thought a computer company that puts pictures of cattle in their ads had to be my kind of people. And I was right. The people I've talked with at Gateway 2000 are honest-to-goodness nice folks. It's a pleasure doing business with them."

*Larry Mahan raises registered Texas Longhorn cattle.*



# AND AROUND THE WORLD, GATEWAY 2000!



they're "equipped for the real world."

Little things like the way Gateway 2000 sales people develop excellent business relationships with their customers.

Fred Gronemeyer tried his first Gateway because he was impressed by his sales person. Eighteen systems later, Fred is still impressed by his sales person.

And the biggest little thing of all is the feeling you get when you deal with the people at Gateway 2000. As Larry Mahan said, "they're honest-to-goodness nice folks."

Compare prices, quality and service. Then add up the little things you get from small town people running an old-fashioned, high-tech business.

What you get is everything you're looking for. Whether you're from Indiana or Switzerland, Georgia or Nova Scotia, you've got a friend in the business at Gateway 2000.



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

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

610 Gateway Drive • N. Sioux City, SD 57049 • 605-232-2000 • Fax 605-232-2023

# GATEWAY 2000 SYSTEMS

## 12MHZ 286VGA

- 80286-12 Processor
- 2 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 40 Meg 28ms IDE Drive
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

**\$1695.00**

## GATEWAY 386SX

- 2 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 40 Meg 17ms IDE Drive
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

**\$1995.00**



## 20MHZ 386VGA

- 4 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 80 Meg 17ms IDE Drive
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

**\$2595.00**



25 MHZ 386 VGA  
**\$2695.00**

## 25MHZ 386CACHE

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 110 Meg ESDI Drive
- ESDI Cache Controller
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

**\$3395.00**



## 33MHZ 386VGA

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 150 Meg ESDI Drive
- ESDI Cache Controller
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

**\$3695.00**



## 25MHZ 486VGA

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 150 Meg ESDI Drive
- ESDI Cache Controller
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

**\$5295.00**

## CACHE SPECIAL

■ Same features as our PC Mag Editor's Choice 25 MHZ 386 Cache system except this machine has an 80 Meg 17ms Drive instead of the 110 Meg EDSI Drive.

**\$2995.00**

## STANDARD FEATURES AND SERVICES

- Microsoft® WINDOWS™ with all 386 and 486 systems
- 30-day money-back guarantee
- One-year warranty on parts and labor
- New leasing options now available
- Toll-free technical support for the life of the machine
- Free on-site service to most locations in the nation
- Free overnight shipment of replacement parts
- Free bulletin board technical support

*If our standard configurations don't fit your needs, we'll be happy to custom configure a system just for you. Due to the volatility of the DRAM market, all prices are subject to change.*



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

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

610 Gateway Drive • N. Sioux City, SD 57049 • 605-232-2000 • Fax 605-232-2023

# LETTERS

and Ask BYTE

## Computer-Aided Independence

As a disabled computer user, I would like to thank you for "Opening Doors for the Disabled" by Joseph J. Lazzaro (August). Lazzaro provides an invaluable service by making more people—both disabled and nondisabled—aware of the full scope of adaptive technology.

He and I both have a vital interest in this area, since without adaptive technology neither of us could function as independently as we do. I am a quadriplegic, and I work (and play) on a computer 8 hours a day using the Magic Wand Keyboard, a miniature IBM-style keyboard that my husband originally designed for me. This keyboard works with a wand and requires no strength or dexterity. We now sell the keyboard, and earlier this year, our company was awarded a grant for \$30,000 from the New York State Science and Technology Foundation for projects relating to the keyboard's use as an educational/vocational tool.

Anyone interested in obtaining information on adaptive computer technology should contact the Trade Center in Madison, Wisconsin, at (608) 262-6966, and the IBM National Support Center for People with Disabilities in Atlanta, Georgia, at (800) 426-2133.

More articles like Lazzaro's are needed to reveal exactly what is available and how profoundly computers can affect a disabled person's life. At stake are not spreadsheet performance and networking capabilities, but basic needs of self-realization.

Susan Crouch  
Spring Valley, NY

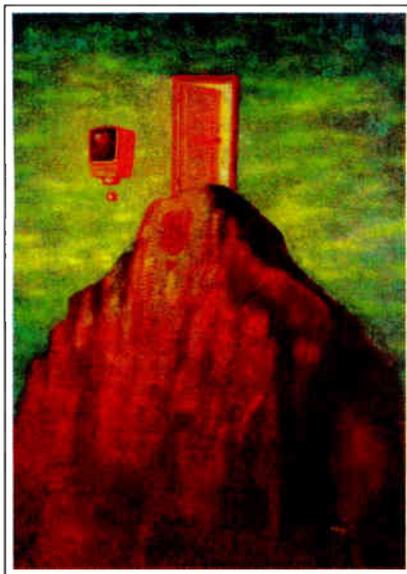
## Wolf in Fly's Clothing

I enjoyed "The Flight of the Bee Wolf" by Ben Smith (June).

I would like to suggest one correction. The bee wolf is not a fly, which would be found under the order *Diptera*. It is found in the order *Hymenoptera*, which contains sawflies, parasitic wasps, ants, wasps, and bees.

The bee wolf, taxonomically, is located under the family *Sphecidae*, subfamily *Philanthinae*, tribe *Philanthini*, which contains 29 species in North America. They are also known as bee-killer wasps.

I do not want to take away from your efforts to produce interesting articles. I



just wanted you to know that entomologists do read BYTE through to the last page. I have a great fascination for both insects and computers.

Harry L. McMenemy  
Memphis, TN

## IBM Bashing?

Am I the only one who finds Joel S. Moskowitz's Stop Bit ("Quest for a Mouseball," July) just a wee bit strange?

First, he blackmails IBM into giving him a brand-new mouse—just because he lost the parts of his old one—or else he'll write a big exposé about the fact that this part does not have a part number! For the nuisance value and for gracious customer relations, IBM accedes to his "request."

And then he writes the article anyway. This, from a lawyer? First blackmail, then breach of contract? No wonder the world delights in telling jokes about the

WE WANT TO HEAR FROM YOU. Please double-space your letter on one side of the page and include your name and address. Letters two pages in length or under have a better chance of being published in their entirety. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. You can also send letters via BIXmail c/o "editors."

Your letter will be read, but because of the large volume of mail we receive, we cannot guarantee publication. We also reserve the right to edit letters. It takes about four months from the time we receive a letter until we publish it.

greed and venality of the legal "profession."

Lucien R. Greif  
Chappaqua, NY

## Bridge Work

In Jon Udell's review of a program called Bridge ("Windows Shopping: 3.0 Applications Take Shape," July), he states that the program "activates the clock, . . . resizes it, and moves it to the lower right-hand corner of my screen. . . . There's no straightforward way to do this on a Mac or in any of the Unix graphical user interfaces."

This, at least with respect to Unix, is false. Put the following line in your login or profile file:

```
xclock -display unix:0.0 -geometry 50x50-50-50 &
```

This line will load an xclock, using Unix-domain sockets, on screen zero of display zero, with a window size of 50 by 50 pixels and the window placed in the lower right-hand corner of the screen. If xclock follows the *Inter-Client Communications Conventions Manual* (and as an X Consortium-distributed demo, it ought to), then it will pop up under any compliant X11R4 window manager without your intervention.

Garrett A. Wollman  
South Burlington, VT

*What you say is true: An X Window System manager can indeed control the initial size and location of an application's window. My clock example, in retrospect, wasn't well chosen. (Even under Windows, there is no need to resize the clock's window, since the clock can update its display while running as an icon.) The more interesting capability of Bridge, as I pointed out, is its ability to launch and interact with a collection of graphical applications under programmatic control. A Bridge program can, for example, launch a spreadsheet and a word processor and then cut a range of numbers from the spreadsheet and paste them into the word processor. Bridge uses graphical programs as components of meta-applications, just as Unix shell scripts and DOS batch files use command-line programs.*

*Nothing precludes the invention of such*

a graphical scripting language for X Window, but it's my understanding that it hasn't happened yet. I have no doubt that resourceful X Window aficionados will soon bring graphical user interface scripting to Unix. And, of course, Mac users are anxiously awaiting the scripting features promised for System 7.0.

—Jon Udell

### ESDI Explanation

I am curious as to how author Roger C. Alford arrived at the conclusion that no one uses hard sectoring ("The Evolution of ESDI," June).

Where I work, we use large ESDI drives from Fujitsu and Micropolis, and controller cards from SMS Technologies and PSI Technologies (HyperStore), and everything we buy is hard-sectored at the factory. In fact, on the SMS Omti8640 and the HyperStore, no option exists for soft sectoring.

Although soft sectoring is preferable, hard sectoring seems to be the norm.

Dave Harrison  
Los Angeles, CA

*My statement that hard sectoring is not generally used in ESDI implementations is incorrect. As you point out, hard sectoring is still common in modern ESDI implementations. The important thing to note is that ESDI supports both soft and hard sectoring. I apologize for any confusion this may have caused.*

—Roger C. Alford

### Corvus Responds to Review

BYTE reviewed our ReadyNet in its Product Focus "Networks of Peers" (June). We would like to address the complaints of your editors.

In the cabling connections for the 1-megabit-per-second ReadyNet, you open a tap box and insert pretinned wires into a punch-down block. While this is more difficult than plugging the cable directly into the tap box (as you do with the 4-Mbps version), it is no more difficult than plugging in a stereo speaker.

In the version that BYTE tested, it is true that ReadyNet did not support sector sizes larger than 512 bytes for volumes larger than 32 megabytes. This has been changed in the latest version, which shipped in June.

If you type in connections from the command line, the syntax has one more parameter than the standard MS-NET syntax that most other systems use. However, the ReadyNet manual in no way advises users to type in connection strings from the command line. ReadyNet provides a simple menu program called

Quick Connect that eliminates typing in command-line strings. And since Quick Connect provides the option of automatically making the connections after every reboot, there is no need to generate batch files for connection loading. The BYTE editors seem to have overlooked Quick Connect.

It is false that there is no way to change node or user names. You can change them using NetView, another network management program that the BYTE editors overlooked.

It is incredible that the BYTE editors did not notice the print spooler. The print spooler is automatically set up on the first server, and it can be set up using Quick Connect on any other node as well. The queue manager was left out of the original ReadyNet 1-Mbps version, but it has always been available from Corvus on the technical-support BBS. It is currently available in the 4-Mbps and the new 1-Mbps versions.

ReadyNet is designed for use in a small office environment by people not familiar with network operation. I am sure that the BYTE editors try very hard to be fair in their evaluations, but perhaps their technical proficiency led them to overlook some of the features that have been included for the novice.

Janel Killheffer  
Marketing Manager  
Corvus  
San Jose, CA

*We agree that you don't need an electrical engineering degree to install ReadyNet's 1-Mbps tap boxes. Still, these were the only nonmodular connections that we encountered in the review. We don't understand why the entry-level version of a network advertised as "self-installing" does not supply modular connectors.*

*We are glad to hear that the latest version of ReadyNet can work with non-512-byte sectors and volumes larger than 32 MB. More and more vendor versions of MS-DOS have such characteristics; it is critical to support them.*

*It is true that Quick Connect automates connections, and that you can specify those connections by way of a menu system. However, you use that menu system to piece together connection strings expressed in terms of concepts (i.e., plugs, sockets, and modules) that confused us and that we think will confuse novices even more.*

*We didn't say that ReadyNet won't let you change the default user names—it will. We did not find a way to change the names of workstations and printers. We raised this question with a Corvus repre-*

*sentative. He told us that printer names are indeed fixed and that workstation names can be modified only by means of a workaround.*

*We are glad that the 1-Mbps version of ReadyNet now includes the queue manager. It was, as you say, left out of the original 1-Mbps version, and we did not receive a supplementary copy by press time.* —Jon Udell and Rob Mitchell

### The Problem with Toner

We would like to clarify two points about the Kyocera F-1000A laser printer reviewed in your July Product Focus, "Laser Printers Get Personal."

From the article's narrative, it is clear that the first toner was installed incorrectly. The toner is never opened and poured into the hopper as described. As instructed on the top of the cartridge, you place the cartridge in the developer and keep it there until it is empty. Once the cartridge is locked in place, you pull a Mylar strip from the right to release the toner into the developer.

We strongly believe that by manufacturing the entire printer, including the engine, we can maintain the highest level of quality in our products, for which Kyocera has been recognized for over 30 years. This quality has also been recognized by both Unisys and Mannesmann Tally, which chose to use our printer engines.

Michelle Christian  
Marketing Communications Manager  
Kyocera Unison  
Alameda, CA

*We did follow the procedure you describe. We locked the toner into place, pulled the Mylar strip, and released the toner into the developer. We were then required to remove the toner receptacle before replacing the hopper. At that point, we were exposed to any loose toner left in the receptacle. That was the difference. Printers using the Canon engine eliminated the need to deal with the toner at all. Even among those printers requiring separate toner, the Kyocera Unison model was the only one that didn't leave the toner receptacle attached to the toner cartridge. With the other printers, you attach the toner and pull the strip, and the dirty work is done.*

*We can see the advantages of manufacturing the entire printer. We just think that buyers should make sure that expendables (e.g., toner and drum) and upgrades are readily available. In general, third-party support adds value to any product.*

—Stanford Diehl and Stan Wszola

*continued*

# We slash interface development time. (and we can prove it!)

## C-PROGRAMMERS: See for yourself how Vermont Views™ can help you create user interfaces the easy way.

If you want to start saving a *tremendous* amount of time and effort, call for your free Vermont Views demo kit and put us to the test. Vermont Views is a powerful, menu-driven screen designer that comes with a C library of over 550 functions. Which means you can create user interfaces in just a fraction of the time it takes to write the code yourself!

Why try to reinvent the wheel when Vermont Views lets you interactively create pull-down menus, window-based data-entry forms (with tickertape and memo fields), scrollable form regions, choice lists, context sensitive help, and a host of other interface objects.

Vermont Views combines the convenience of a fourth generation language with the power, flexibility, and blinding execution speed of native C code.

### Turn your prototype into the application.

Let's face it. With most systems, you have to throw away your prototype when coding begins. Which means you waste precious time

and effort. With Vermont Views, things are a lot different. In fact, the prototype actually *becomes the application*. So menus and data-entry forms are usable in the final application without change. Names of functions for retrieving, processing, and storing data can all be specified as the prototype is created. And that's just for starters.

**Here's a truly universal solution.** When you create an interface with Vermont Views, you can port it among PC-DOS, OS/2, UNIX, XENIX, and VMS.

Vermont Views can be used with any database that has a C-language interface (most do), and will create interfaces for any roman-based language. Our form-locking version lets you develop quickly and safely on networks and multi-user operating systems, too.

If you need DOS graphics in your applications, we also have the answer. Vermont Views™ GraphEx allows all Vermont Views' windows, menus, and forms to work in CGA, EGA, VGA, and Hercules graphics modes. So you can use your favorite graphics package to create charts, graphs, and other images to enhance text displays.



**Vermont  
Creative  
Software**

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



**Call for your FREE  
demo kit!**

**800-848-1248**

(Please mention "Offer 074")

Don't take *our* word for it. Put Vermont Views to the test by calling for your personal, free demonstration kit. Or fax us at (802) 848-3502.



© Copyright 1990  
Vermont Creative Software

There are  
three ways  
to get  
everything  
you expect  
from a laser  
printer.

*Printers. Computers. Peripherals.  
Copiers. Typewriters and Facsimiles*

**Panasonic**  
Office Automation 

When you want corporate-size features in a desk package.

Speed, fonts, flexibility. Everything you want in a personal laser printer, in a package that fits comfortably in your office or home. The KX-P4420 prints at a fast 8 letter-sized originals per minute — up to twice the speed of some personal laser printers. And its standard features include a large-capacity paper cassette, 22 internal fonts available in 25 symbol sets (including legal), plus 512K of memory, expandable to a full 4.5MB. The 4420 personal laser printer. Corporate-size features. Personal price.

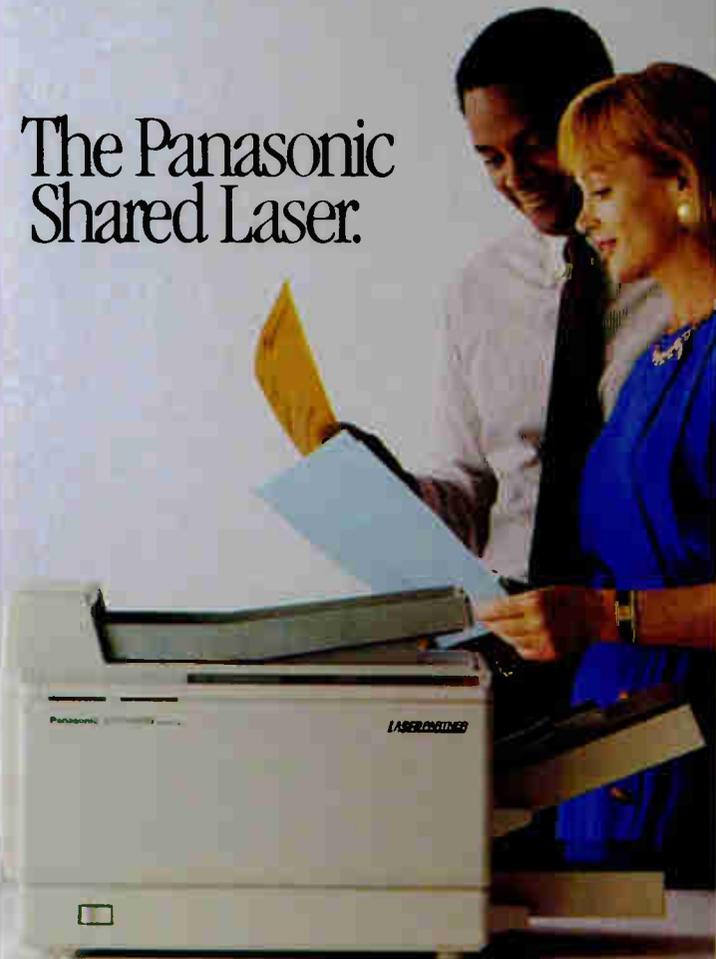
The Panasonic®  
Personal Laser.



When you have several people in your department, you need a printer that can handle them all.

Lots of speed, lots of capacity, lots of emulations. The KX-P4450i is meant for the whole department. It has dual-bin, high-capacity paper cassettes. And does a full 11 pages per minute even if every page is different. Each page will be crisp and clear, no matter which of the 28 internal fonts you're using. And the 4450i emulates LaserJet Series II, as well as popular dot matrix and daisy wheel printers.\* This is one laser everyone will be happy to share.

The Panasonic Shared Laser.



What makes the company look good makes you look good.

When appearance is all, choose the KX-P4455 with Adobe PostScript. With it, you can dramatically enhance every document with multiple fonts, varied type sizes, even images rotated and scaled to fit. At 11 pages per minute, and with superb print quality. The features you want most are standard. From 39 Adobe fonts, to dual-bin, high-capacity paper cassettes. Plus a wealth of optional typefaces. And its interfaces work beautifully with MS-DOS, UNIX or Apple environments.\* With the 4455, you don't just print your documents, you publish them.

The Panasonic PostScript\* Laser.



FOR FURTHER INFORMATION, SEE THE PRODUCT SPECIFICATIONS ON THE NEXT PAGE, OR CALL TOLL-FREE 1-800-742-8086.

# Three great laser printers. Designed specifically for the ways people do business.

## The KX-P4455 Panasonic PostScript Laser.

**Printing Speed:** 11 pages per minute.\*\*  
**Compatibility:** Adobe PostScript, HP LaserJet Series II and Diablo 630 emulations.\*  
**Fonts:** 39 Adobe Fonts.\*  
**Paper Handling:** Two 250-Sheet Cassettes.  
**Resolution:** 300 Dots Per Inch.  
**RAM:** 2MB Standard, expandable to 4MB.  
**Interfaces:** RS-232C/422A Serial, Centronics Parallel and Appletalk.\*



## The KX-P4420 Panasonic Personal Laser.

**Printing Speed:** 8 pages per minute.\*\*  
**Compatibility:** HP LaserJet Series II emulation.\*  
**Fonts:** 22 Internal Fonts-11 available in both portrait and landscape. Two slots for optional font cards.  
**Paper Handling:** 250-Sheet Cassette with Manual Feed. Face-up and face-down output.  
**Resolution:** 300 Dots Per Inch.  
**RAM:** 512K Standard, expandable to 4.5MB.  
**Interfaces:** Centronics Parallel; Optional RS-232C Serial.



## The KX-P4450i Panasonic Shared Laser.

**Printing Speed:** 11 pages per minute.\*\*  
**Compatibility:** HP LaserJet Series II, Panasonic, Epson, IBM and Diablo emulations.\*  
**Fonts:** 28 Internal Fonts-14 available in both portrait and landscape. Two slots for optional font cards.  
**Paper Handling:** Two 250-Sheet Cassettes with Manual Feed.  
**Resolution:** 300 Dots Per Inch.  
**RAM:** 512K Standard, expandable to 4.5MB.  
**Interfaces:** Centronics Parallel and RS-232C Serial.

*Printers, Computers, Peripherals,  
Copiers, Typewriters and Facsimiles*

**Panasonic**  
Office Automation 

\* HP and LaserJet Series II, Epson, IBM, Diablo, Adobe and PostScript, MS-DOS, UNIX and Appletalk are registered trademarks or trademarks of Hewlett-Packard Co., Seiko Epson Corp., International Business Machines Inc., Xerox Corp., Adobe Systems Inc., Microsoft Corp., AT&T, and Apple Computer Inc., respectively. \*\* Letter size, text mode, 5.5% image area, all originals. [Specifications are subject to change without notice.]



### Like, Squaresville, Man

I am wondering if all present computer systems divide the display into so many square pixels. If high resolution is important, as in animation and CAD, then the square tessellation of the display does not seem to be the best choice.

There are only three regular tessellations of a planar surface: covering the surface with squares, with regular triangles, or with regular hexagons. In any of these cases, circles can be inscribed within each of the polygons of a given tessellation. This results in three different methods of uniformly packing circles on the plane. The sizes of the square, the regular triangle, and the regular hexagon can be chosen so that the circles are the same size for all three methods of circle packing. It is then fairly easy to show that, for a given area of reasonable size, the hexagonal tessellation leads to the greatest number of circles of a given radius.

These circles inscribed within the regular polygons correspond to the beam of electrons that activates each pixel of the CRT (when the brightness is adjusted properly). A circle inscribed in a regular hexagon covers over 90 percent of the area of the hexagon. The same circle inscribed within a square will cover less than 79 percent. Thus, the hexagonal tessellation leads to about 15 percent more pixels for a given area. This should indicate a slightly better resolution for graphics work. (The method of grouping the pixels for the creation of a character set is another matter.)

Thank you for any explanation that you can give.

Lem Chastain  
Brooklyn, NY

*This is really a question for people who design graphics systems, but I will join you in supposition.*

*Perhaps the reason behind the rectilinear pixel arrangement has to do with the history of the most common display medium: the CRT. The beam is sweeping left to right in horizontal strokes. If the pixels were shaped as hexagons, the beam wouldn't be able to sweep smoothly across the display. Early TV grew from black and white to color, and then computers began painting pictures on TV displays through graphical display drivers. We have always thought of display coordinates as straight Cartesian (x, y) coordinates, and making the changeover to hexagons might freak people out. Still,*

*the increased resolution might be useful.*

*With display technology changing on a daily basis, it would be relatively easy to implement your approach in LCD, plasma, or electroluminescent display technologies. Electronically, we drive the displays from banks of memory anyway, so it's just a matter of addressing the data to the right cell. The only real difficulty would be to get programmers to think in hexagons. We would have to rewrite all the line- and circle-drawing algorithms, get new versions of Microsoft Windows and Macintosh Toolbox drivers, and so on. Do any display manufacturers have thoughts on this? It's an interesting idea, and I hope that people remember that they read it here first. Lem, if we receive any royalty checks, we'll be sure to pass them along to you.—H. E.*

### A Storm in the Port

With IBM XT compatibles, it is a simple matter to switch the turbo mode on or off by reading a port (often at address 62 hexadecimal) and resetting 1 or more bits, depending on the type of board.

I recently purchased an AT compatible with the Texas Instruments AT chip set and Award 286 Modular BIOS 3.03HD. I would like to be able to switch the machine into and out of turbo mode using this technique. Unfortunately, I do not have any information on the speed setting. Do you have any ideas on the subject?

R. D. B. Fraser  
Tewantin, Queensland, Australia

*Unfortunately, you haven't given me enough information to completely answer your question. The software control over the turbo function is often handled by the keyboard controller/microprocessor on a PC-compatible machine. As you pointed out, it's usually a matter of twiddling a bit or two at an I/O port, usually in the range 62h to 6Fh. According to Award, the company has never made a version of its BIOS for the Texas Instruments AT chip set. Because of that, there's no way that Award can tell you where the I/O port is on your machine; that information would have to come from the motherboard manufacturer. If you want to send your letter anyway, you can reach Award at 130 Knowles Dr., Los Gatos, CA 95030, or by fax at (408) 370-3399.*

*All is not lost. If your BIOS supports speed-changing through the keyboard (often Ctrl-Alt-+ and Ctrl-Alt-— or Ctrl-Alt-1 and Ctrl-Alt-2), you can find the port by tracing through the BIOS in the debugger. The address of the keyboard handler (INT 09h) is 0000:0024. Get that*

*address (probably in the F000 segment) and disassemble the code. If you are lucky, you'll find an OUT instruction to a port in the 60h-6Fh range. When you find something interesting, write a short test program to twiddle the bits, and see what happens.*

*Finding that I/O port is a good rainy-day activity, one that should keep you entertained for hours. Be prepared to reboot often; it's likely that if you tweak the wrong bit on the keyboard controller, you'll totally mess up your machine.*

—H. E.

### Frantically Foraging for Fractint

Would you please let me know how or where I can obtain information on a program named Fractint?

Arthur Trantolo  
East Hartford, CT

*Fractint is a public domain fractal display program by Bert Tyler and a few other hotshot programmers. Source code and executable copies are available on BIX, CompuServe, and many BBSes; its latest release is version 14.0.*

*If you have trouble obtaining the program on-line, contact the author at Tyler Software (124 Wooded Lane, Villanova, PA 19085).—S. A.*

### Missing Manuals

In July 1989, I bought a 20-MHz Arch Tech 386 Tower Computer from Tech Center in Boulder, Colorado, and the system has worked great. My problem is that not all the manuals were in the boxes. I thought you might be able to give me some good ideas on how best to address the problem.

For the last year, I have been trying to get the manuals from the people at Tech Center, but I have had no response from them. I guess that's because they know I am a foreigner, and they think that there is no marketing benefit in helping me. I have thought of addressing Arch Tech directly to purchase the manuals, but I do not want the company to think that I want the documentation to duplicate its system here. Also, I do not have Arch Tech's address.

How should I address this problem?

Francisco Bascunán Noguera  
Santiago, Chile

*I'm glad to hear that you're enjoying your new machine. Unfortunately, without more information, I can't help you track down manuals for it. The Boulder phone book doesn't list any business under the name Tech Center, and I ended up speaking with several people who work for*

companies with similar-sounding names (thanks to all who helped!). If that's the correct and full company name, perhaps it's out of business now.

I'm more concerned about the name on your computer. No one seems to have heard of a computer built under the name Arch Tech. Perhaps your machine is from Arche Technologies? In that case, you can reach Arche at 48881 Kato Rd., Fremont, CA 94539, (415) 623-8100. Be specific with the exact configuration and model numbers of your system components. I'm reasonably convinced that your experience was simply the result of bad communication, not because you're a foreigner. Companies that do business that way simply don't stay around very long.—H. E.

### More on Fractint

A number of years ago, I obtained a disk displaying Mandelbrot fractals from BYTE. Now I have obtained Fractint version 12.0, but I have a problem.

I have an Olivetti M24 computer that I understand is equivalent to an AT&T 6300 computer. Mine is fitted with CGA and a color monitor. The computer has been upgraded using Sota 286i and is also fitted with an 80287 math coprocessor.

My problem: Using Fractint, I get only four colors. With WordStar, Turbo Pascal, Paradox, Quattro Pro, and GW-BASIC, I can obtain all the colors I desire on the screen.

By the way, I am having the same problem using Flight Simulator 3, but not using the American version of Tetris. I have been a subscriber to BYTE for the last four years, and I have become aware of your sympathetic approach to reader problems.

J. Yodaiken  
Cape Town, South Africa

Unfortunately, CGA graphics capability hits its peak at four colors. The other applications that you mention are text-mode programs and provide more colors by using characters to make up the screens. Quattro Pro will also run in graphics mode, but it will then give you the same four-color limitation.

I am not familiar with the Tetris program that you mention, but again, I suspect it is a text-mode application. Obviously, text mode is not appropriate for detail-intensive programs like Fractint and Flight Simulator.

If you spend any time at all running graphics software, you may want to look into upgrading to a VGA system; the difference will be startling.—S. A.

### I Just See Stars

I recently bought a new machine, and I was a bit dismayed to find my spreadsheet files full of stars when I tried to use them. All the labels were there intact, but no numbers. It didn't take too long to figure out the cause; I had to deal with similar problems on my old machine as well. The software thinks the machine has a numeric coprocessor, but it doesn't, so all the numbers are garbage.

Most software packages with the capability to use a coprocessor run a short routine at start-up that asks the coprocessor to store the control word (FSTCW) or the status word (FSTSW) into memory. If this works (i.e., if the value in the memory location is changed or is a valid value), then the software assumes you have a coprocessor and uses it thereafter to do numeric operations.

Both the machines that I have owned will return values when asked to do one or other of the above operations, and I know several other people who have run into this type of problem. Where does the fault lie?

Why do software companies include such flimsy and potentially fallible checks for the 80x87 in their software and compilers? I started getting weird numbers in my spreadsheets one time because the 80287 was half out of its socket after I'd been messing around putting in a board. It still passed the check for presence, even though half the pins were not connected. Why doesn't the routine check the results of a division or a multiplication?

Jon Waterhouse  
St. John's, Newfoundland, Canada

If your spreadsheet software (whose name you fail to mention) checks for a coprocessor in the way you describe, then you're right to feel dismayed. Most software will look for a coprocessor via the BIOS equipment check interrupt (11 hexadecimal). This interrupt returns a word full of flags that is set by your machine's power-on self test routines. How the POST routine does its job probably varies from BIOS to BIOS. Some machines require you to install a jumper whenever you install a coprocessor, and in that case the BIOS may simply look for the presence of that jumper. Also, AT-class machines expect a flag set in the nonvolatile CMOS RAM indicating the presence of a coprocessor. Have you checked your machine for either of these possibilities?

Finally, if you want to know how software can detect and identify an 80x87 coprocessor, look for BYTE's March 1988 issue. Prakash Chandra of Intel shows

assembly language source code in his article "Programming the 80387 Coprocessor."—R. G.

### PostScript Preview

I'm trying to find a PC program that will let you preview, one page at a time, the contents of a text file as it would appear when printed on a LaserWriter Plus.

This program would be used by students of the Chisolm Institute of Technology to print their assignments. At present, we have a program that converts files from various word processing programs to PostScript. This transformed file is then sent to the LaserWriter Plus for printing.

There is a shortcoming with this arrangement. After you've committed the text file to laser printing, there is no turning back. Consequently, students can lose a lot of money on wasted printing.

Graham Brown  
Dromana, Victoria, Australia

Most word processing programs these days will support PostScript. You should call the vendors of the various word processing programs and ask for a PostScript driver. At the same time, ask if the program has a preview mode. Many word processors will either show you what the printed output will look like on-screen or will print the output to a disk file. As long as you have a PostScript driver installed, the preview should look exactly like the final printed output. If you can find drivers, this would be your best bet.

Another solution is a PostScript interpreter. The primary purpose of a PostScript interpreter is to convert PostScript files so that they can be printed on non-PostScript printers. Although you would not need one for this purpose, a PostScript interpreter might include a preview mode as well, so you could use such a program to see how the final printed page will appear. LaserGo (9369 Carroll Park Dr., Suite A, San Diego, CA 92121, 800-955-3668) should be able to help you. The company's GoScript program will display PostScript on EGA or VGA monitors. It will also display TIF and PCX files.—S. D.

### FIXES

In "Faster Gets Smaller" (August), Compaq inadvertently provided BYTE with the wrong FCC rating for the Desktop 386/25e. The correct rating is FCC Class B, not Class A. ■

# Here's what they say about Zortech C++

*"Zortech is a truly fine compiler...If you've been waiting for a major player to offer a professional C++ development system for OS/2 and Windows, as well as DOS, wait no longer... Zortech has it!"*

Richard Hale Shaw, PC Magazine, p.38, March 13, 1990

*"Zortech has done a commendable job with C++ 2.0 and I recommend it highly...The debugger is impressive...Get the Developers version...it's worth the money."*

Bruce Eckel, Micro Cornucopia, pp. 8-17, March 1990

*"Zortech C++ is one of the best MS-DOS products I've had the luck to use....I can highly recommend the Zortech 2.0 release."*

Scott Robert Ladd, Dr. Dobbs Journal, pp. 64-73, January 1990

*"We have devoted virtually a full issue to evaluation of C Compilers... it's an easy choice. We pick ZORTECH."*

J. D. Hilderbrand, Editor, Computer Language, p. 7, May 1990

## AT&T™ C++ V2 Specification

- ✓ Multiple Inheritance
- ✓ Type Safe Linkage
- ✓ Pointers to Members

## Compiler Features

- ✓ Native code compiler with separate global optimizer
- ✓ Improved MSC Source Level Compatibility
- ✓ MS Windows™ Compatible
- ✓ CodeView™ Compatible
- ✓ Fast Graphics Library with C++ interface
- ✓ Easy to use TSR functions
- ✓ Standard Library Source Code included with Developer's Edition
- ✓ Seamless LIM/EMS Support via new handle pointers or directly via EMS library functions.
- ✓ Full MS Mouse Library
- ✓ OS/2 Compiler Option
- ✓ 99% ANSI C Compatible
- ✓ Improved code size/speed

## C++ Source Level Debugger

- ✓ Also Debugs C
- ✓ Assembler Debugging with access to registers and memory.
- ✓ 16 Debugging Windows
- ✓ Multiple Statement Lines
- ✓ Break/Trace/Watchpoints
- ✓ Dual Monitor Support
- ✓ Full C++ name unmangling for easy use
- ✓ Block memory write protect

## C++ Tools Classes

- ✓ 25 C++ Classes with full source code
- ✓ Includes new Text User Interface Classes
- ✓ Event Queue, 8CD Maths, Linked Lists, Money, DOS error handling classes, text windows and editing classes, virtual arrays, time and date handling, directories and filenames, interrupt vectors, etc...

## PRICES

- C++ Compiler \$199.95
- C++ Debugger \$149.95
- C++ Tools \$149.95
- Library Source \$149.95
- Save \$200 - Get the Developer's Edition for only \$450 (includes all the above items).
- OS/2 Option \$149.95
- C++ Video \$499.95

**USA:** Zortech Inc.  
4-C Gill Street  
WOBURN MA01801  
Voice: 617-937-0696  
Fax: 617-937-0793

**EUROPE:** Zortech Ltd.  
106-108 Powis Street  
LONDON SE18 6LU  
Voice: 44+ 81-316-7777  
Fax: 44+ 81-316-4138

## "ANNOUNCING V2.1" 640K Memory Barrier Smashed!

- **New** VCM™ (Virtual Code Manager) technology
- **New** Rational DOS Extender technology for compiling/debugging massive programs
- **New** Virtual C++ Source Level Debugger requires only 4k RAM!
- **New** Remote Debugging via serial port
- **New** Powerful Environment with Browser
- **New** Completely Revised & Expanded C++ Tools
- **New** Improved Compiler Optimization

### Zortech VCM™ for DOS

With Zortech's Virtual Code Manager (VCM) you can compile standard MS-DOS applications containing up to 4Mb of code. VCM is a sophisticated virtual memory system that dramatically improves performance over conventional overlay methods. Naturally, our debugger understands VCM tool

### Rational™ DOS Extender Technology...

Version 2.1 incorporates this new technology for compiling and debugging really big programs on 286, 386 or 486 based PC's. You can also use V2.1 together with Rational Systems DOS Extender (purchased separately) to produce your own applications which can access memory beyond the 640k DOS limit.

### C++ Debugger in 4k RAM!

Zortech's Virtual C++ Source Level Debugger can now locate itself in extended memory on 386 machines. This requires only 4K of conventional RAM!

## STOP PRESS - NEWS FLASH

386 Compiler/Debugger Option (using Phar Lapp DOS Extender), UNIX 386 Compiler and OS/2 Debugger all available soon. Also new C++ Classes and Addison Wesley ZTC++ book.

**ORDER/UPGRADE HOTLINE 1-800-848-8408**

# 386SX Multi-Task Force

Launch and run two, three, four or more programs simultaneously. Blast the 640K memory barrier to cut even the most massive programs down to size. And, rocket through spreadsheets, word processing, desktop publishing and more with lightning-fast 16MHz, 32-bit speed. With this new BSR 386SX computer and your FREE bonus Microsoft Windows 3.0, you'll infuse your computing with the time- and work-annihilating might of true multi-tasking and 386SX power. PLUS, you get \$2,850 worth of FREE NAME-BRAND software. Plus, as an added Super Bonus, you also get \$495 Quattro Pro. You'll be armed and ready to assault any business, learning and creative project, all for DAK's industry-busting price of just \$1,799.

By Drew Kaplan

Get ready to unleash breakthrough computing power. Imagine writing a sales report with your word processor while simultaneously recalculating a spreadsheet.

Imagine running massive desktop publishing programs with plenty of RAM to spare. And, imagine blazing through all your computer work with lightning-fast 16MHz 32-bit speed all for just \$1,799.

Sound like a fantasy? With most computers it would be. But, not with this new

BSR 16MHz 386SX Computer with 1 full megabyte of RAM, massive 28 millisecond hard drive and .31 dot pitch VGA monitor.

It's the most powerful, fully-loaded computer DAK has ever offered.

Plus, with the included Microsoft Windows 3.0 and \$2,850 worth of additional FREE bonus software (including WordStar 5.5), you'll be armed to make short work of any computer project.

Read on and together we'll explore all the amazing feats you'll accomplish with

this work-vanquishing, time-saving, productivity-enhancing 386SX computer.

## ANATOMY OF A 386SX

At the heart of this new BSR 386SX computer is the latest 386SX microprocessor.

Unlike a 286 microprocessor (found in AT computers), which processes information in 16-bit chunks, a 386SX can process information in 32-bit chunks. So, it can handle more than twice the information a standard 286 can, in less time. Wow!

Plus, you'll be able to run the latest 386 programs and all PC/AT compatible programs.

This 16MHz, 0-wait state speed demon can calculate spreadsheets, reformat desktop publishing documents and run any of the FREE programs in record time.

But, if you're like me, you use your computer mostly for word processing. So you might not be too concerned with speed. I wasn't either, until I pitted my old 286 against the BSR 386SX.

I spell-checked the same 50-page report on both computers. I was astounded to discover that the 386SX spell-checked the document over a minute faster.

A single minute may not seem like much, but when you think of how many reports, letters and proposals you spell-check in one week, those minutes add up.

Plus, just wait till you see how quickly this 386SX boots up, and how fast you'll run through complex spreadsheets like



## INCLUDED BONUS SOFTWARE

	Retail Price
Microsoft Windows 3.0	\$149
Quattro Pro	\$495
WordStar 5.5 Professional	\$495
Reflex 2.0	\$249
Gem Desktop Publisher	\$299
Gem Graph	\$299
Gem Draw Plus	\$299
Gem WordChart	\$199
SideKick	\$ 89
Key FormDesigner	\$179
KeyMailer	\$149
Three-Button Mouse	\$ 99
Grammatik IV	\$ 99
PC Paintbrush	\$ 99
PC USA	\$ 69
Keyboard/Keypad Trainer	\$ 69
KeyDictionary	\$ 99
WordFinder	\$ 59

It's \$3,494 worth of BONUS software included with your BSR 386SX computer!

Quattro Pro. But, speed is just one small part of the sheer might of this fantastic 386SX.

## DOWNTIME DECIMATOR

The true power of this BSR 386SX is its astounding memory handling capability. It shatters the 640K RAM barrier which shackles 286 computers.

No longer will you be limited to the old DOS standard of 640K RAM. Sure, some 286



With your FREE included three-button mouse you'll zoom through databases, desktop publishing and word processing at meteoric speed.

computers have 1 meg or more of RAM. But, most programs don't actually use it.

But, with your 386SX and a memory-managing program like the incredible Microsoft Windows 3.0, (yours absolutely FREE), you'll use all of this computer's 1 full meg of RAM (or 2 full megs with optional upgrade for just \$79<sup>90</sup>).

Now you can run high-performance business spreadsheets, (like your just-released Quattro Pro bonus), huge databases (such as Reflex 2.0) and desktop publishers (like the included GEM Desktop Publisher, complete with Gem Graph, Gem Draw Plus and Gem WordChart) with ease.

And, look at this. With your 386SX and Microsoft Windows 3.0, you'll be able to multi-task. That means you can run several programs simultaneously and transfer information between most programs.

For example, you can work on a sales report with the included WordStar 5.5 and then instantly pull up Quattro Pro to double check your sales figures without exiting WordStar. It's a real time-saver.

You can even 'cut' figures directly from Quattro Pro and automatically 'paste' them into your report, on-screen.

And, wait till you discover multi-tasking. With Microsoft Windows 3.0 this 386SX computer can do the work of several ordinary computers, concurrently.

Forget having your computer tied up while it recalculates a spreadsheet or formats and prints out a complex desktop publishing document. Your 386SX obliterates downtime forever.

### THE COMPUTER OF THE FUTURE

The experts like PC Magazine and Info-world agree that the 386 is the future standard. And, most of the new programs developed over the next few years will be created for 386-compatible computers.

So, with your BSR 386SX you'll already

by prepared for the future of computing with full 386 compatibility. Plus, you'll have complete 286 compatibility too.

### LOADED WITH COMPUTING POWER

This awesome computer comes fully-armed with an arsenal of work-annihilating features. With other computer companies, most of these features are optional. But, they're all standard on your 386SX.

**14" VGA Monitor (Standard).** With its phenomenal 640 X 480 (.31 dot pitch), slide-like resolution, this easy-on-the-eyes, non-glare 14" color VGA monitor is the most brilliant I've ever seen.

Plus, just wait till you see how the palette of 256,000 colors can make all your graphs, charts, paintings and even word processing and spreadsheets explode off the screen with sharp, vivid power.

And, with the included tilt swivel monitor base, you can easily adjust the monitor to the perfect viewing angle for you.

**40-Megabyte Hard Drive (Standard).** The powerbase behind your work-vanquishing 386SX is a mammoth super-fast, 28-millisecond, 16-bit, 40-megabyte hard drive.

You'll have the informational storage power of over 110 traditional floppy disks to save all of your creations and programs with plenty of room to spare.

And, if you're running a company or need all the storage space you can get, you can upgrade to a colossal 80-megabyte hard drive for just \$199<sup>90</sup>.

**1 Full Megabyte of RAM (Standard).** You'll have plenty of power to run even the most massive memory-devouring programs with the included 1 megabyte of high-speed RAM (expandable to up to 8 megabytes on the motherboard), complete with LIM 4.0 emulation capability.

And, you can upgrade to 2 megabytes of RAM for virtually unlimited multi-tasking power for just \$79<sup>90</sup>.

**Both 5¼" AND 3½" Floppy Drives (Standard).** You get two floppy drives with your BSR 386SX computer.

First, there's a 1.2MB, high-density 5¼" floppy disk drive. You can store nearly 4 times more information on a 1.2MB floppy than you can on a standard 360K floppy.

And, you can still use and exchange 360K floppies with less sophisticated computer users than yourself.

Plus, there's also a 1.44MB high-density 3½" floppy disk drive, so you can easily

switch floppies between your 386SX and the latest IBM computers and even 1.44MB and 720K laptop computers.

**4 Expansion Slots.** With its 4 expansion slots (3 available), your 386SX is engineered to grow with your computing needs.

You'll have plenty of room to add a fax card, a scanner card or a voice-mail card.

**NOTE:** This computer's advanced 386 motherboard requires only a cool-running 145 watt power supply, so you'll have plenty of power for expansion cards.

**Serial, Parallel and Mouse Ports (Standard).** You'll have two serial ports to use with serial devices. You get a parallel port for printer hook-up.

And, there's a mouse port for your included 3-button bus mouse (more later).

**101-Key Extended Keyboard (Standard).** Virtually all interaction with your computer is through the keyboard. That's why this breakthrough computer comes with the newest extended keyboard complete with separate arrow/cursor keys.

You'll never have to hunt through the number keys to find the cursor keys again.

Plus, the solid feel of the sculptured keys ends finger fatigue forever. Whether you 'hunt & peck' or type 90 words-per-minute, you'll really appreciate the tactile feedback of this high-quality keyboard.

**MS DOS 3.31 and GW-Basic (Standard).** It amazes me how many retailers sell computers without DOS and Basic. At DAK, you get everything to have your computer up and running right away.

**Special Note:** DOS 3.31 breaks the 32 meg hard disk size limitation, so you can use your 40 meg (or optional 80 meg) hard drive without cumbersome partitions.

**Clock/Calendar with Battery Back-Up and More.** Plus, this extraordinary computer has a clock/calendar with battery back-up, a front panel reset switch and 80387 math co-processor socket, 8MHz/16MHz switching and dozens more features.

### ON-SITE SERVICE

With a lot of companies, once you buy a computer, you're on your own. If you're lucky, they'll give you a 90-day warranty.

But, your BSR 386SX computer is backed by a 12-month, on-site standard limited warranty. You'll receive in-home or in-office service anywhere in the continental United States. You're totally protected.

(Next Page Please . . .)

## Multi-Tasking Explained

It's called multi-tasking. And, it's revolutionizing the way we work with computers. What 'multi-tasking' means is you can run several programs at the same time. For example, you can have a spreadsheet program like Quattro Pro run calculations while you use a word processor like WordStar 5.5 to write a letter or report. Plus, you can 'pull-up' other programs WITHOUT exiting the program you're working in. It's a real time-saver if you switch programs a lot. Here's just one example of how you can use multi-tasking to blast through your work.



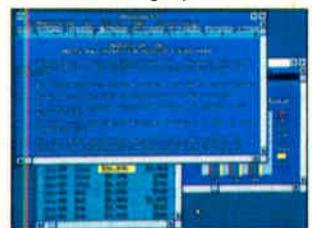
1. Let's say you're the sales manager for a company or you own your own business. You're writing a report with WordStar 5.5. As you work, you decide to double-check some figures in your Quattro Pro spreadsheet.



2. Without exiting WordStar, you pull up Quattro Pro in another window. Now you can check your spreadsheet and even cut figures from Quattro Pro and paste them directly into your WordStar report.



3. Next, you decide to check the performance of your sales people. Without exiting WordStar or Quattro Pro, you pull up Reflex 2.0 in a third window. Now you can easily scroll through your sales database.



4. After you've confirmed all your figures, (and cut and pasted just the ones you need into your report), with a click of your mouse, you pull the WordStar window to the front of the screen and finish writing your report.

... 386SX Multi-Task Continued)

Plus, you get DAK's own toll-free software support lines, manned with helpful, knowledgeable DAKonians ready to answer all of your software questions.

#### WHY BSR?

DAKonians know about BSR through their audiophile stereo equipment. But, what most people don't know is that BSR was one of the world's leading manufacturers of computer power supplies.

And, this new BSR 386SX follows in that same industry-leading tradition. Plus, because of DAK's direct-from-the-factory purchase, I got a fantastic price.

Now you can command all the computing muscle of a fully-loaded 386SX for less than the price of many 286 computers.

And, let's not forget your Super Bonus \$495 Quattro Pro. Plus, Microsoft Windows 3.0 and the \$2,850 worth of brand-name computer software (including WordStar 5.5, Gem Publisher, Key FormDesigner and more) you get absolutely FREE.

#### COMMAND A 386SX MULTI-TASK FORCE RISK FREE

Wait till you experience the blinding speed of 16Mhz, 32-bit computing. Wait till you cut and paste information between two different programs with ease. And, wait till you work on two, three, four or even more programs concurrently.

If you're not completely thrilled simply return it to DAK in its original box within 30 days for a courteous refund.

To order Your Work Annihilating 16MHz, 32-Bit 386SX Multi-Task Force complete with Massive 40-Megabyte, Super-Fast 28-Millisecond, 16-Bit Hard Drive, 1 Full Meg of RAM (upgradable to 8 Megs), 1.2 Megabyte 5¼" Floppy Drive, 1.44 Megabyte 3½" Disk Drive, 14" Slide-Like .31 Dot Pitch Color VGA Monitor with Tilt Swivel Base, Advanced DOS 3.31 and GW-Basic, PLUS Microsoft Windows 3.0, PLUS \$495 Quattro Pro, PLUS \$2,850 worth of the Name Brand Software Bonuses AND 12-Month On-Site Service Warranty, call toll free or send your check for DAK's industry-busting price of just \$1,799 (\$69 P&H). Order No. 6335. CA res add tax.

#### Options

##### RAM BREAKTHROUGH OPTION

Turbo-charge your 386SX with even more multi-tasking power by upgrading to a full 2-megabytes RAM for just \$79<sup>00</sup> (\$0 P&H). Order No. 6336. Note: The RAM upgrade must be ordered with your computer.

##### 80-MEGABYTE HARD DRIVE OPTION

Now you can have an enormous 80 megabytes of hard disk space to store all your work and programs for just \$199<sup>00</sup> (\$0 P&H). Order No. 6337. Note: The hard disk upgrade must be ordered with your computer.

You'll command the power to run two, three, four or even more programs concurrently. And, with the \$3,494 worth of included name-brand software you'll be armed and ready to vanquish any computing task. ☐



**DAK INDUSTRIES  
INC.**

Call Toll Free For Credit Card Orders Only  
24 Hours A Day 7 Days A Week

**1-800-325-0800**

For Toll Free Information, Call 6AM-5PM Monday-Friday PST  
Technical Information ..... 1-800-888-9818  
Any Other Inquiries ..... 1-800-888-7808  
8200 Remmet Ave., Canoga Park, CA 91304

*Here's a preview of just a few of the name-brand software programs included with your BSR 386SX computer.*



Quattro Pro combines BIG corporation spreadsheet power with vivid graphics. You can analyze, forecast and print out your data in numbers and 3-D charts.

WordStar 5.5 has over 300 work-saving enhancements, including easy-to-use Pull-Down Menus that obliterate keyboard commands.



With Reflex 2.0 database, you can organize, analyze and even display your crucial business data in 6 different ways including Form, List, Graph and Crosstab views.

You can easily create reports, proposals, newsletters and more with charts, drawings, graphs and multiple font styles with the Gem Desktop Publishing System.



Gem Graph's vivid 3-D bargraphs, pie charts, symbol graphs and line charts will infuse your reports, proposals and presentations with explosive visual power.

With the touch of a hotkey, KeyDictionary with 115,000 on-line, full definitions, gives you instant answers to questions about word meanings, spelling, usage and hyphenation.



KeyMailer's fill-in-the-blank format is the easy way to create extensive mailing-list data bases and thousands of personalized letters complete with address labels.

It's a cinch to illustrate any graphic from a professional organization chart to a Mojave Desert Sunset with PC Paintbrush's icons and pull-down menus.



# Just Look

Let's take a quick look at the \$3,494 worth of name-brand software programs included with your BSR 386SX computer.

#### SUPER BONUS Quattro Pro (\$495 Value)

Now all of us small businessmen can take advantage of BIG corporation spreadsheet power without needing a degree in accounting.

Top-rated Quattro Pro can effortlessly lay out a financial strategy for you. And, you'll see it in numbers, dollars and 3-D graphs on-screen or printed out.

Plus, Quattro Pro's new VROOMM (Virtual Realtime Object-Oriented Memory Manager) reads and writes even the largest Lotus files without translation.

#### FREE BONUS #1 Microsoft Windows 3.0 (\$149 Value)

We've already explored the incredible memory managing, multi-tasking, and 'cut & paste' abilities of Windows 3.0. But it can do so much more.

It obliterates complex DOS commands with an easy-to-use icon-based environment. You can launch any installed DOS or Windows-based program merely by double-clicking your included mouse on an icon. It's a real time-saver.

Plus, you also get a file manager, a print manager and much more to help you finish all your computer work easier, faster and better than ever before possible.

#### FREE BONUS #2 WordStar 5.5 (\$495 Value)

WordStar 5.5 has over 300 new features and enhancements to make writing powerful letters, reports and proposals a breeze.

The instant you fire-up WordStar, you can type a letter, add bold, italics and underline. It's easy with the Pull-Down Menus.

With Editing Windows, you can edit two documents simultaneously. You can even copy and move text between them.

Plus, you can view up to 32 pages at once with the Advanced Page Preview. So, you can check page centering, margins and layout before you print.

#### FREE BONUS #3 Reflex 2.0 (\$249 Value)

It's the easiest and most powerful flat-file database I've ever used. Now you can store and organize all your critical business, club or personal data quickly and easily.

Plus, top-rated Reflex can also turn your raw data into attention-grabbing pie, line bar and scatter graphs that instantly give you the meanings behind the numbers.

And, you can instantly cut and paste information from Reflex directly into your word processor or spreadsheet. Reflex is a quick and easy way to compare, summarize and analyze all your vital data.

#### FREE BONUS #4 Key FormDesigner (\$179 Value)

Create any type of form from simple personalized appointment book pages to complex inventory control forms. Imagine easily designing purchase orders, employment applications, ledger sheets and more.

With Key FormDesigner, you can custom-tailor forms to your EXACT needs. In minutes, you can produce new, more efficient forms for the whole company, for your department, or just for you.

And, you can print out your customized forms on any dot-matrix, ink jet or laser printer. Best of all, you'll never need to wait

# At All You Get FREE

weeks or pay for custom forms again.

## **FREE BONUS #5 Sidekick (\$89 Value)**

Sidekick is a powerful desktop organizer that puts 4 essential business tools right at your fingertips. You get an electronic notepad so you can take down notes easily.

There's an on-line, pop-up calculator and a perpetual calendar/appointment scheduler, too. Plus, with Sidekick's phone book, you can store all your frequently called modem numbers in an on-line directory that dials the numbers for you.

## **FREE BONUS #6 Gem Desktop Publisher (\$299 Value)**

Now you can create spectacular brochures, multi-columned newsletters, graphic-packed manuals, mind-grabbing reports and even your own magazines right at your desk.

With just the click of a mouse, you'll insert maps, diagrams, schematics, artwork, logos and graphs into any document. And, you'll compose eye-catching professional reports, articles and academic papers.

## **FREE BONUS #7 Gem Graph (\$299 Value)**

Now you can easily create dazzling reports, proposals and brochures filled with attention-grabbing 3-D graphs and charts.

Wait till you see all the two and even three dimensional bar graphs, pie charts, and comparative line charts that jump off the page with sit-up-and-take-notice power.

You can choose from a huge selection of graph and text styles (including striking 3-D), to add that extra amount of punch to really drive your point home.

## **FREE BONUS #8 Gem WordChart (\$199 Value)**

What Gem Graph does with numbers, Gem WordChart does with words. Create extensive fact tables for sales reports.

Make bullet charts to add graphic impact to your presentations and proposals. And, even make eye-grabbing sale fliers for your business that will have customers streaming in. It's a cinch to create everything from party invitations to menus.

## **FREE BONUS #9 Gem Draw Plus (\$299 Value)**

You can effortlessly design anything from simple floor plans to complicated electrical schematics. Create graphics for club newsletters. And, you can even draw flow charts and organizational charts with ease.

There's also a full library of pre-drawn clip art that you can insert directly into your documents. Plus, Gem Draw Plus is object-oriented. So, for example, if you overlay a circle with a square, they mix on the screen but are kept separate in the memory.

Gem Draw Plus is the easy way to transform your ideas into vivid drawings.

## **FREE BONUS #10 PC USA (\$69 Value)**

You'll command a wealth of vivid graphics and fact-filled tables packed with current and historical information on all the 50 states and even Puerto Rico.

You'll have instant access to beautifully detailed state maps showing elevations, cities and geographical features. You'll easily pinpoint distances between cities.

And, you'll effortlessly access statistics on population and age distribution, health, crime, tourist attractions, climate trends, taxes, state histories and much more—all

with a touch of a button.

## **FREE BONUS #11 KeyMailer (\$149 Value)**

With KeyMailer's menu-driven, fill-in-the-blank format, anyone can create an extensive mailing-list database.

Now you can print out envelope labels, telephone directories and even merge your data with WordStar to effortlessly make and send 100, 1,000 or even 10,000 personalized letters for your business or club.

## **FREE BONUS #12 Keyboard/Keypad Trainer (\$69 Value)**

Here's an easy way to increase your typing speed and finish your work 25%, 50% or even 100% faster.

This amazing breakthrough program uses Artificial Intelligence (AI) to tailor exercises to your learning needs. Plus, you'll have customized AI lessons for your computer's numeric keypad, too.

## **FREE BONUS #13 Grammatik IV (\$99 Value)**

Grammatik IV uses 42 grammar rules to automatically check all your reports, essays and everything you write.

You'll never worry about incomplete sentences, punctuation errors or using 'it's' instead of 'its,' 'they're' instead of 'their,' or 'two' instead of 'too.' Grammatik IV never changes your writing. Whether you use its advice or not is completely up to you.

## **FREE BONUS #14 KeyDictionary (\$99 Value)**

With 115,000 full, on-line definitions complete with hyphenation and usage rules, this awesome electronic dictionary makes writing captivating documents a breeze.

You can instantly define words, in or out of word processing, with just the touch of a hot key. Plus, you can even define words within definitions and spell-checker and thesaurus suggestions.

## **FREE BONUS #15 WordFinder (\$59 Value)**

Infuse (penetrate, instill, inject) the power of WordFinder's instant-access 220,000-word Thesaurus into your reports, proposals and contracts. It's great.

Now everything you write, from 50-page reports to 1-page memos will be filled with passionate (enthusiastic, fiery, intense) persuasion to really get your ideas across.

## **FREE BONUS #16 PC Paintbrush (\$99 Value)**

With PC Paintbrush, you'll unleash your creativity with computer-generated shapes, designs, patterns and drawings.

You'll have 5 different brush shapes, a paint roller, computerized air brush, and a palette of up to 16 colors to create and print-out everything from breathtaking landscapes to company logos.

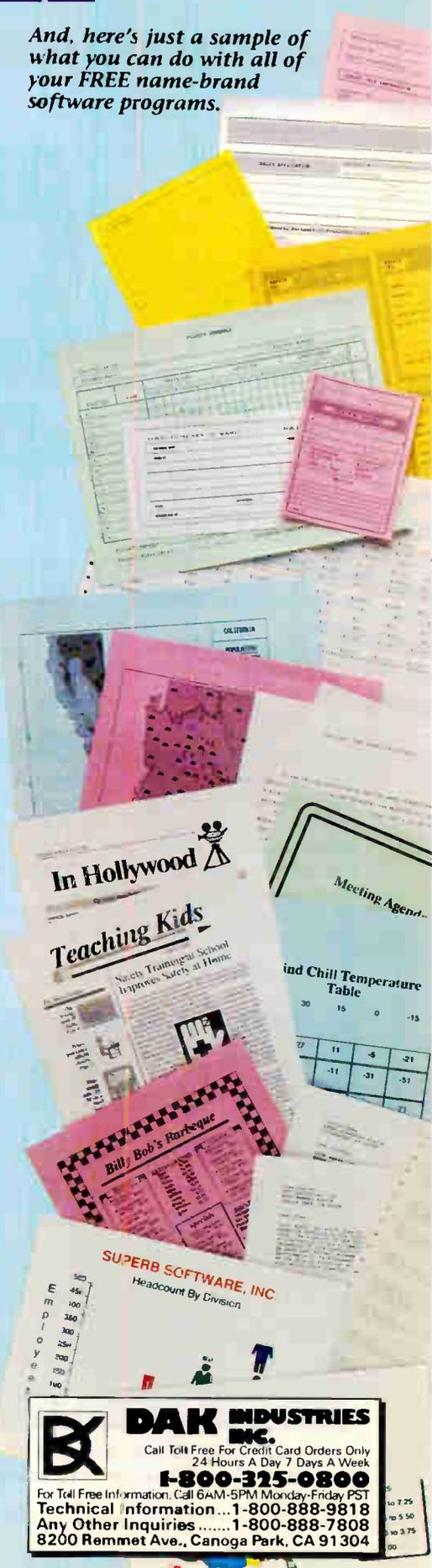
## **FREE BONUS #17 Three-Button Mouse (\$99 Value)**

Obliterate clumsy keyboard commands. From drawing and painting to accessing menus and windows to controlling the cursor, you'll do it all infinitely easier and faster with the new BSR 3-button bus mouse.

## **\$3,494 Of Software FREE**

You get it all, a total of \$3,494 worth of software and hardware (including Microsoft Windows 3.0, PLUS \$495 Quattro Pro), PLUS the BSR 16Mhz 386SX Computer with VGA monitor for just \$1,799.

And, here's just a sample of what you can do with all of your FREE name-brand software programs.



**DAK INDUSTRIES INC.**  
Call Toll Free For Credit Card Orders Only  
24 Hours A Day 7 Days A Week  
**1-800-325-0800**  
For Toll Free Information, Call 8AM-5PM Monday-Friday PST  
Technical Information... 1-800-888-9818  
Any Other Inquiries..... 1-800-888-7808  
8200 Remmet Ave., Canoga Park, CA 91304

# WHAT'S NEW

HARDWARE • SYSTEMS

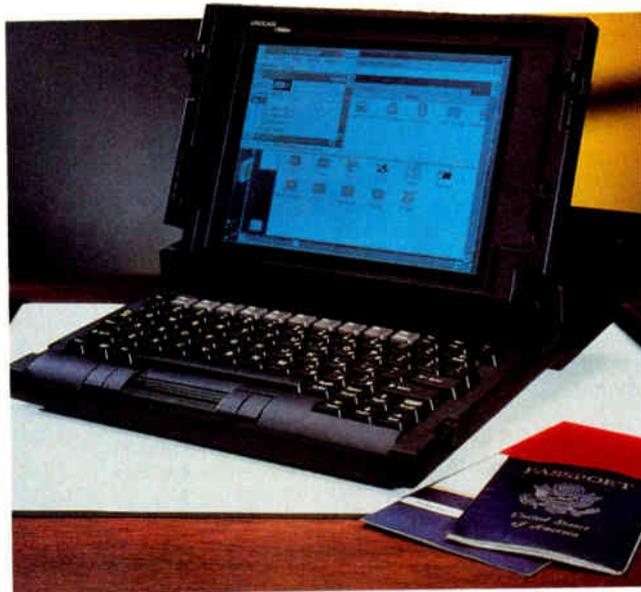
## Isopoint Device Makes a Case for GRiD

The GRiDCase 1550sx is the first PC-compatible laptop to use the built-in Isopoint device. Also unique to the 20-MHz 386SX laptop is a 60-MB hard disk drive with Windows 3.0 installed.

The Isopoint device takes the place of a mouse and is built into the keyboard below the space bar. The Isopoint buttons are accessible to both right- and left-handed users.

The hard disk drive has an access time of 16 ms and a 64K-byte memory cache. Also standard on the 12-pound laptop are 2 MB of RAM and a 3½-inch 1.44-MB floppy disk drive. The screen is a film-twisted-nematic backlit LCD VGA. The internal/external battery has a rated life of 2 hours and charges in 2½ hours, according to GRiD. The system measures 11½ by 15 by 2½ inches.

Options include a 120-MB



The 1550sx is the latest in GRiD's line of laptops. This one features the rolling Isopoint device shown here.

hard disk drive, a 600-MB CD-ROM drive, a 2400-bps modem, an 80387SX math coprocessor, and an external rechargeable battery.

**Price:** Base system, \$6295.  
**Contact:** GRiD Systems Corp., 47211 Lakeview Blvd., P.O. Box 5003, Fremont, CA 94537, (800) 222-4743 or (415) 656-4700.  
**Inquiry 1290.**

## Things Are Getting Small in Texas

The new Tandy 1500 HD, a notebook computer that weighs 6 pounds, comes standard with a 1.44-MB floppy disk drive and a 20-MB hard disk drive for less than \$2000.

The 1500 HD, which measures 10 by 12½ by 1⅞ inches, has a backlit screen, a 10-MHz NEC V-20 processor, and 640K bytes of RAM (expandable to 1.64 MB). The system also comes with DOS 3.3 and Tandy's DeskMate graphical user interface installed on the hard disk drive.

The blue-on-white LCD screen provides a resolution of 640 by 200 pixels (CGA). The removable nickel-cadmium battery weighs ¾ pound and recharges in as little as 4 hours, according to Tandy. An AC adapter is also included

with the 1500 HD.

**Price:** \$1999.

**Contact:** Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102, (817) 390-3011.

**Inquiry 1291.**

The CompuAdd Companion, which measures 8½ by 11 by 1⅞ inches, has a 12-MHz 286 processor with 1 MB of RAM (expandable to 3 MB), a 20-MB hard disk drive, and a backlit VGA screen that measures 8 by 6 inches and displays 16 gray scales.

LapLink software is installed in ROM, as well as DOS 4.01 and diagnostics. The system also has an 80287 math coprocessor socket. A rechargeable battery pack and an AC adapter are included.

**Price:** \$2895.

**Contact:** CompuAdd Corp., 12303 Technology Blvd., Austin, TX 78727, (800) 627-1967 or (512) 250-1489.

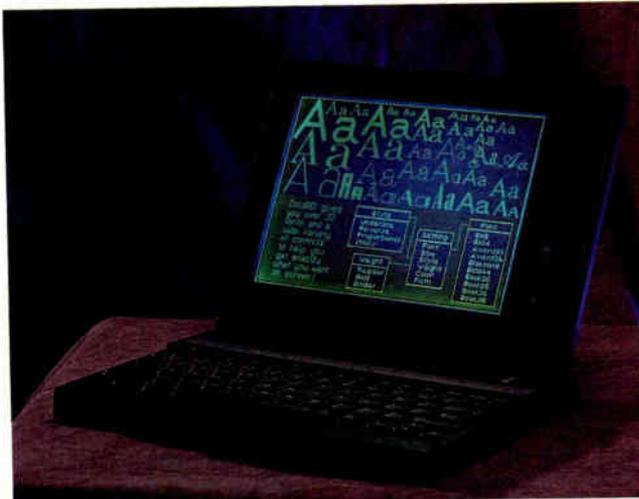
**Inquiry 1292.**

## The Peregrine SX Has Landed

The Peregrine 20/32cSX is a 20-MHz 386SX with 2 MB of RAM, a 1024- by 768-pixel Super VGA display, a choice of floppy disk drives, a Microsoft Mouse, Windows 3.0, and DOS 4.01.

Hard disk drives are available in 40-, 80-, 105-, or 200-MB configurations, and the system will support an 80387SX math coprocessor. **Price:** \$1769; with 40-MB hard disk drive, \$2159. **Contact:** Peregrine Computers, 110 East Canal St., Troy, OH 45373, (800) 326-7015, ext. 3119 or (513) 339-3151.

**Inquiry 1293.**



CompuAdd's notebook-size Companion weighs less than 5 pounds and has a VGA screen that displays up to 16 levels of gray scales.

## 24-wire Serial Printers in Wide and Narrow Versions

The MT130/24 and MT131/24 printers cost less than \$1000 each and were tested to operate for over 7800 hours before failure, which is 30 percent longer than the nearest competitor, according to Mannesmann Tally.

The 24-wire serial printers operate at 300 cps in draft mode, 150 cps in near-letter-quality mode, 100 cps in letter-quality mode, and 12 cpi in all modes.

Paper-handling capabilities include single sheets, continuous forms, and four-part forms. The printers also have the ability to print single sheets without removal of continuous forms and to print continuous forms without removal of the optional sheet feeder.

**Price:** Narrow-carriage MT130/24, \$899; wide-carriage MT131/24, \$999.  
**Contact:** Mannesmann Tally Corp., 8301 South 180th St., Kent, WA 98032, (206) 251-5500.  
**Inquiry 1294.**

## PostScript Laser Printer Crosses Bounds

NEC's Silentwriter2 Model 90 is a PostScript laser printer that is compatible with Macintosh and DOS environments and sells for less than \$2500.

The 6-page-per-minute printer provides 2 MB of RAM (expandable to 4 MB). It has



*Mannesmann Tally offers low-cost wide- and narrow-carriage printers.*

a Motorola 68000 processor with a built-in 16.7-MHz Adobe PostScript interpreter that provides 35 resident scalable typefaces. The printer also provides 13 resident fonts in Hewlett-Packard LaserJet IIP emulation.

The Silentwriter2 Model 90 prints at a resolution of 300 by 300 dpi. It weighs 44 pounds.

To hook it up to DOS or Mac systems, it comes with standard parallel, serial, and AppleTalk/RS-422 interfaces. It also comes with a software kit that shows you what the screen fonts will look like in printed documents. The software runs on Macs or under Windows in DOS environments.

A 250-sheet-capacity paper tray is included that holds up to 24-pound letter or legal-size paper, envelopes, or transparencies. The toner and optical photoconductor are in replaceable cartridges said to last for 6000 pages.

**Price:** \$2495.  
**Contact:** NEC Technologies, Inc., 1414 Massachusetts Ave., Boxborough, MA 01719, (508) 264-8000.  
**Inquiry 1295.**

## SPREAD THE WORD

*Your new product is important to us. Please address 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.*

## Compact Bernoulli Drives

Omega has announced its Universal family of Bernoulli removable disk subsystems. The family includes two portable Bernoulli subsystems: The Transportable is the smallest, lightest Bernoulli subsystem, according to Omega; the Portable is a battery-powered version of the AC-powered Transportable.

All the subsystems in the Universal family work with the IBM PC, the Macintosh, and in networking environments. They all use the SCSI standard and also have optional interface kits available.

**Price:** Transportable, \$1399; Portable, \$1699.

**Contact:** Iomega Corp., 1821 West 4300 South, Roy, UT 84067, (800) 456-5522 or (801) 778-1000.

**Inquiry 1297.**

## HSD Now Scanning the Mac Market

Like Scan-X for the NeXT machine, Scan-X Professional for the Macintosh features image-enhancement technology, which HSD Microcomputer calls Gray Spectrum Enhancement, that allows you to produce 256 shades of gray with superior quality, according to the company.

The Macintosh scanner supports resolutions of up to 1500 dpi for line art and 300 dpi for gray-scale images. It comes with Enhance software from MicroFrontier. The Enhance software offers 80 real-time filters, real-time gray-level manipulation and color painting, cropping, scaling from 25 percent to 800 percent, rotating, brushing, masking, text entry, processing, colorization, and ghosting.

**Price:** \$1995.  
**Contact:** HSD Microcomputer U.S., Inc., 1350 Pear Ave., Suite C, Mountain View, CA 94043, (415) 964-1400.  
**Inquiry 1296.**

## An IOcomm-Crafted Monitor

IOcomm, maker of the Wave keyboard, has introduced the CM-4210, a 14-inch Super VGA monitor. It features a .28 dot pitch and operates at 45 MHz with a resolution of 1024 by 768 pixels (interlaced). The monitor has a nonglare screen and meets worldwide safety regulations.

While the CM-4210 is not inexpensive, IOcomm says that it offers brighter colors, sharper details, and firmer picture stability than its competitors.

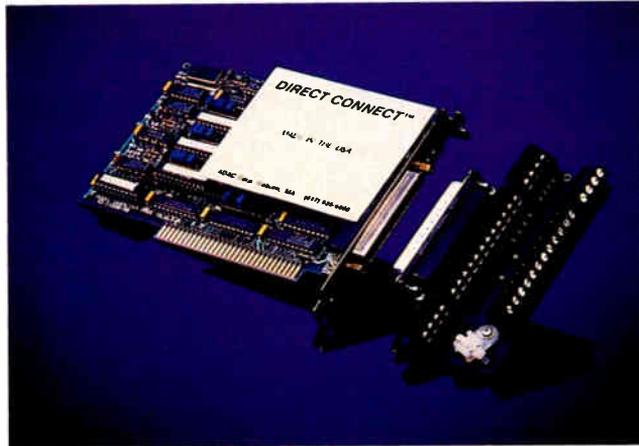
**Price:** \$549.  
**Contact:** IOcomm, 12700 Yukon Ave., Hawthorne, CA 90250, (213) 644-6100.  
**Inquiry 1298.**

## 16-bit Data Acquisition

The 5508HR is a half-size analog input module for PCs and laptops that includes detachable screw terminations. The board has eight differential and 16 single-ended analog inputs and a choice of 15- or 50-kHz A/D throughputs.

The detachable-screw-termination design allows you to wire analog and digital signals directly to the rear of the computer, eliminating cabling and external screw-terminal panels. The board measures  $3\frac{1}{10}$  by 6 inches. **Price:** 15-kHz model, \$895; 50-kHz model, \$1295. **Contact:** Adac Corp., 70 Tower Office Park, Woburn, MA 01801, (800) 648-6589 or (617) 935-6668.

**Inquiry 1299.**



Adac's Direct Connect 5508HR data acquisition board.

## Rapid Prototyping with Protosystem AT

Protosystem AT is a wire-wrap prototype card for rapid prototyping of circuits for the IBM AT, according to Cana Group.

The manual wire-wrap

card has pins soldered in place on every signal line, along with bypass capacitors on every power line. According to Cana, it holds more than 100 16-pin IC sockets.

For ease of use, the signal pins are never closer together than  $\frac{1}{8}$  inch. The signal lines are grouped onto address, data, and control buses. For quick troubleshooting, each signal pin has a label on each side of the board.

**Price:** \$149.95. **Contact:** Cana Group, Suite 402, 100 Walnut St., Peoria, IL 61602, (800) 747-2262 or (309) 674-9009. **Inquiry 1300.**

## Shift Your LaserJet into High Gear

An expandable memory board for LaserJet IIP and III printers, the LaserGo Memory Board lets you add up to 4 MB with one board. You can install the board with just a screwdriver, according to LaserGo, and it automatically senses whether it's in a LaserJet IIP or III. The board, which comes with 1 MB, is expandable to 4 MB and is compatible with Hewlett-Packard memory boards al-

ready installed.

**Price:** \$295.

**Contact:** LaserGo, Inc., 9369 Carroll Park Dr., Suite A, San Diego, CA 92121, (800) 955-1132 or (619) 450-4600.

**Inquiry 1301.**

## Graphics Controllers Do Unix, DOS, and OS/2

Using a 10-MIPS processor, the Info SGX graphics controller is 60 percent faster than other graphics processors, according to Nissei Sangyo America. You can further speed up the board with an optional coprocessor with dedicated program memory.

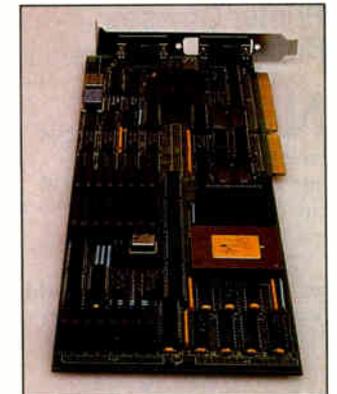
The Info SGX family of boards supports a range of resolutions of up to 1600 by 1280 pixels, including 8514/A, Super VGA, and VGA. All models support single- and dual-screen modes.

The graphics boards install in a single card slot and come with drivers for major DOS applications. Drivers for OS/2 Presentation Manager and the X Window System are also available.

**Price:** \$4295 and up.

**Contact:** Nissei Sangyo America, Ltd., 800 South St., Waltham, MA 02154, (800) 441-4832 or (617) 893-5700.

**Inquiry 1302.**



## Multimedia for Windows 3.0

VideoWindows digital video board comes with multimedia software that runs under Windows 3.0. The board and software combination lets you position windows of full-motion, full-color video anywhere on a VGA display, according to New Media Graphics. You can scale, reposition, crop, and zoom the video in real

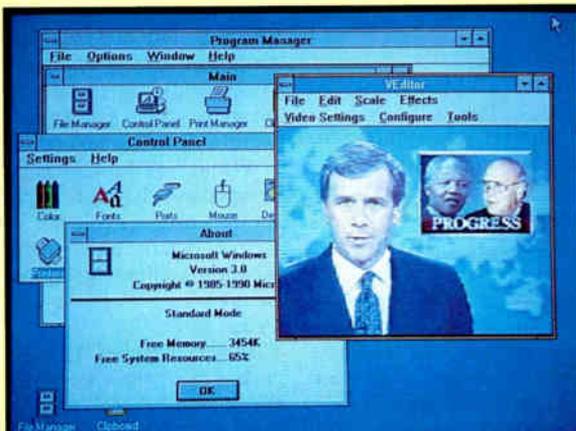
time. And image-capture capabilities are also included.

VideoWindows works with any NTSC or PAL video source, and you can overlay graphics on the video.

**Price:** \$2390.

**Contact:** New Media Graphics Corp., 780 Boston Rd., Billerica, MA 01821, (508) 663-0666.

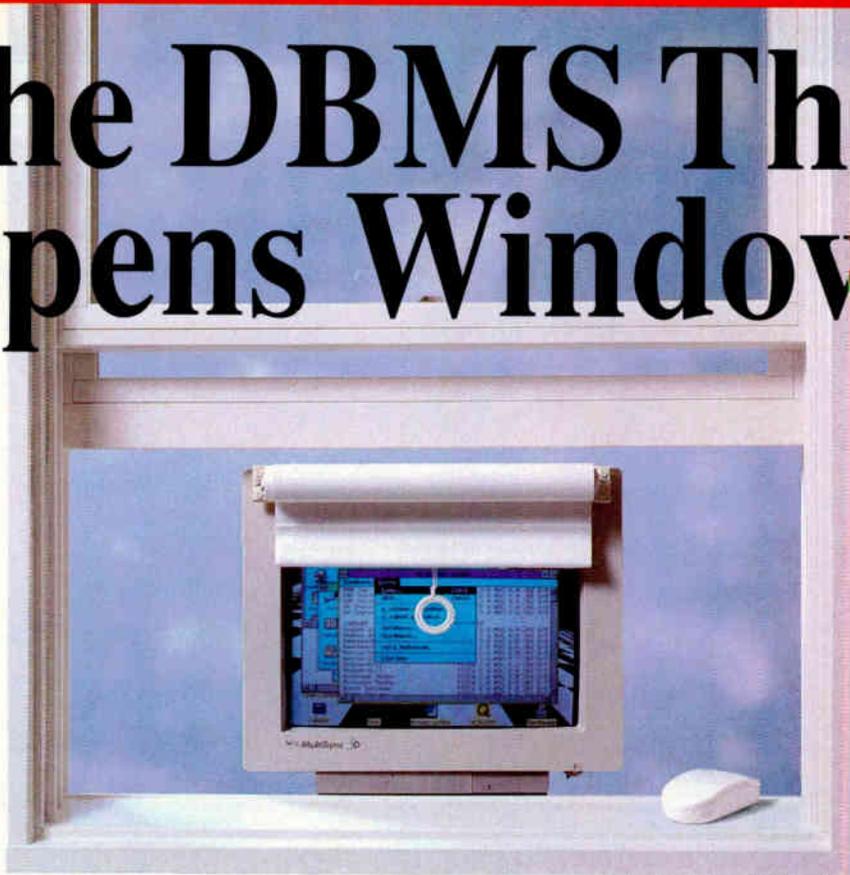
**Inquiry 1303.**



continued



# The DBMS That Opens Windows™



See us at  
**COMDEX/Fall '90**  
November 12-16, 1990  
Las Vegas, Nevada

## Get High Performance Under Microsoft Windows 3.0™ With db\_VISTA III DBMS.

Develop Windows applications that are better, faster, and more profitable. db\_VISTA III combines speed, flexibility, and productivity into one DBMS tool for C and Windows programmers. Add db\_VISTA III's high-speed SQL retrieval to your application and watch your users enjoy power they've never experienced before.

**Built For Windows.**  
db\_VISTA III for Windows 3.0 follows all of the Microsoft

## db\_VISTA III™ Database Management System

guidelines for memory use. Dynamic linked libraries (DLL), multi-tasking, and multi-user environments are all supported. For even faster development, use db\_VISTA III with products like ToolBook®, Windowcraft®, or Actor®.

### No Other DBMS Opens Windows Like db\_VISTA III!

- **Speed.** Benchmarks show db\_VISTA III significantly outperforms any DBMS under Windows.
- **No Royalties.** Increase your profits; decrease your overhead.
- **C Source Code Available.** For total programming flexibility.
- **Portability.** db\_VISTA III supports most environments.

### Special \$195 Developer's Edition

For a limited time only, you can get your hands on db\_VISTA for Windows for only \$195. Call today and ask about our Developer's Edition and experience how db\_VISTA III can open Windows for you. Developer license only; not for distribution.

**Call 1-800-db-RAIMA**  
**(1-800-327-2462)**

In Washington state call: (206) 747-5570

**Full Raima Support Services - Including Training.** Develop your applications even faster with Raima Training Classes:

- |                  |                   |
|------------------|-------------------|
| Nov. 19, 1990    | - Taiwan          |
| Nov. 26-30, 1990 | - The Netherlands |
| Nov. 26-30, 1990 | - Sweden          |
| Nov. 28-29, 1990 | - United Kingdom  |
| Dec. 10-14, 1990 | - San Diego, CA   |
| Dec. 17-18, 1990 | - Taiwan          |

**Specifications:** Single & multi-user. Automatic recovery. Automatic referential integrity. Relational and network data models supported. Relational SQL query and report writer. Complete revision capability. C source code is available. No royalties. **Supports:** MS Windows, MS-DOS, OS/2, VMS, UNIX, BSD, QNX, SunOS, Macintosh.

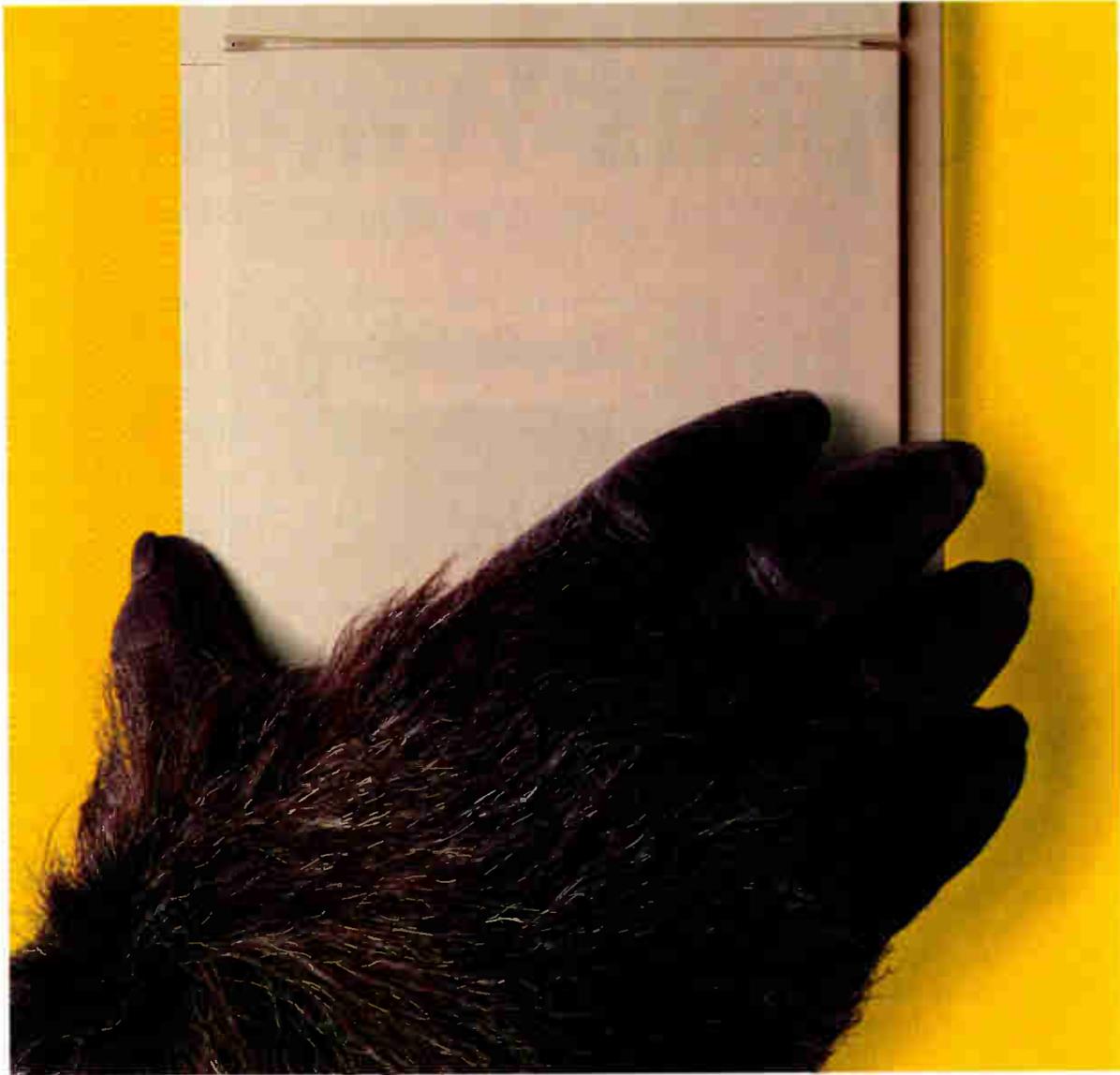
Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA (206)747-5570 Telex: 6503018237 MCI UW Fax: (206)747-1991  
International Distributors: Argentina: 54 1 313 5371 Australia: 61 2 419 7177 Austria: 43 33 43 81861 Brazil: 55 11 829 1687 Central America: 506 28 07 64 Denmark: 45 42 887249  
France: 33 1 46092784 Italy: 39-45 584711 Japan: 81 3 865 2140 Mexico: 52 83 49 53 00 The Netherlands: 31 02159 46 814 Norway: 47 244 8855 Sweden: 46 013 124780 Switzerland: 41 64 517475  
Taiwan: 886 2 552 3277 Turkey: 90 1 152 0516 United Kingdom: 44 0992 500919 Uruguay: 598 2-92 0959 USSR: 01 32 35 99 07; 812 292 19 65; 0142 437952 West Germany: 49 7022 34077

Copyright ©1990 Raima Corporation. All rights reserved. db\_ is registered in the U.S. Patent and Trademark Office. Windows 3.0, ToolBook, Windowcraft, and Actor are trademarks of their respective companies.

Circle 298 on Reader Service Card  
World Radio History

**RAIMA™**  
CORPORATION

# THE ONLY COMPETITION FOR OUR NEW HANDHE



**N**ew ScanMan® Model 256 puts professional gray scale scanning within everyone's grasp. It does almost everything a big, expensive scanner can do, for a fraction of the price. **N**ew ScanMan Model 256 lets you capture the subtlest details in your originals, in 256 shades of gray. Special retouching software tools let you enhance difficult originals and preview the results. You can dramatically improve the contrast and brightness of any image. So you always give your monitor and printer the best possible image to work with. **W**hat really sets ScanMan Model 256 apart is its ingenious Ansel™ software (Windows™ 3.0 compatible). Ansel lets you scan



# OLD SCANNER REQUIRES A MUCH BIGGER HAND.



and print 8" x 11" images by effortlessly stitching two 4" x 11" images together. You can instantly re-align, resize, flip or rotate images to create special effects. **T**he possibilities are endless. You can scan photos, line art, illustrations or logos and create magazine quality layouts. With optional CatchWord™ Intelligent OCR software you can scan text in most any typeface. **N**ew ScanMan Model 256 comes with Logitech's™ legendary quality and lifetime warranty. All for only \$499 (Micro Channel version, \$599). For more information call Logitech Customer Sales: in California (800)552-8885; in Canada (800)283-7717; in Europe ++41-21-869-9656.

®/TM: Trademarks of registered owners.

Circle 206 on Reader Service Card (RESELLERS: 207)

Outside CA call:  
800-231-7717 ext. 348



Tools That Power The Desktop.





## Power for the Road

**Z**irco's PowerTrip lets you power up a computer, fax machine, or any other AC device from an automobile cigarette lighter.

PowerTrip provides 100 W of continuous 115-V AC power. It features a low-battery alarm, a power switch, a safe-power light, and surge suppression—and it's small enough to fit in your shirt pocket, according to Zirco.

PowerTrip also comes in an international version, which converts power from a vehicle cigarette lighter to 100 W of 220-V AC power.

**Price:** \$199.95.

**Contact:** Zirco, Inc., 10900 West 44th Ave., Wheat Ridge, CO 80033, (303) 421-2013. **Inquiry 1304.**

## Brackets for Your Hardware Keys

**A**re your hardware keys forming a key chain behind your computer? If so, you might need an adapter bracket.

Software Security has such a device, which fits into an empty slot in your PC and keeps your hardware keys out of the way. The company claims that the device is difficult to remove, so it adds even more security than the hardware keys alone.

**Price:** \$15.

**Contact:** Software Security, Inc., 1011 High Ridge Rd., Stamford, CT 06905, (800) 333-0407 or (203) 329-8870. **Inquiry 1305.**



*PowerTrip gives you AC power on the road.*

## Safeguarding Intellectual Property with Hardware Keys

**S**entinelScribe is an execution control device designed to help software developers safeguard application programs from unauthorized use.

Rainbow Technologies says that it is the first field-writable memory-based hardware key. The key contains 120 bytes of EEPROM, which is enough to protect more than one software program, according to Rainbow. "Field writable" means that your software applications have the ability to write to

SentinelScribe's memory.

The key connects to the computer's parallel printer port. It operates transparently but must be present for the software to run. It executes a password system customized by the software developer.

**Price:** \$39.

**Contact:** Rainbow Technologies, 9292 Jeronimo Rd., Irvine, CA 92718, (800) 852-8569 or (714) 454-2100.

**Inquiry 1306.**

## Extend Yourself with the SCSI Plus

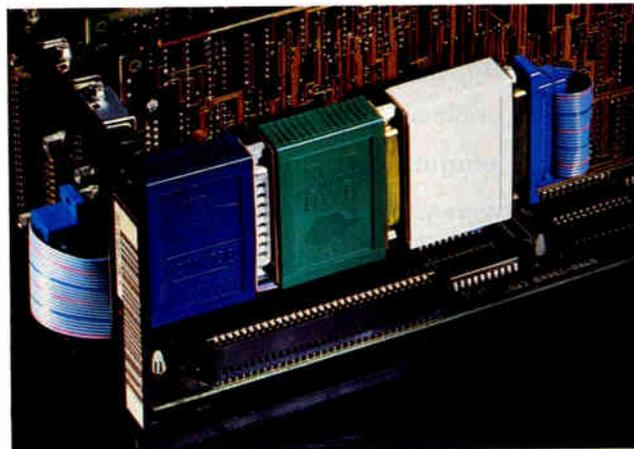
**I**f your SCSI devices are too far apart, the SCSI Plus Bus Repeater will give you an additional 19 feet of extension, or you can daisy chain them to any desired length.

Applied Concepts says that the SCSI Plus is easy to install. It hooks directly into standard SCSI adapters. It's completely transparent to the user, according to the manufacturer, and supports 5-Mbps data transfers over a distance of 19 feet.

**Price:** \$350.

**Contact:** Applied Concepts, Inc., 5350-H Eastgate Mall, San Diego, CA 92121, (619) 453-0090.

**Inquiry 1307.**



*Software Security's adapter brackets hold a line of hardware security keys in place.*

## A Friendly Programmer from Xeltek



**T**he Logic Universal Programmer for programmable logic devices works with PLDs from all manufacturers, according to Xeltek. The Programmer offers an interface that combines pull-down menus, windows, and a command line.

**Price:** \$395.

**Contact:** Xeltek, 764 San Aleso Ave., Sunnyvale, CA 94086, (800) 541-1975 or (408) 727-6995.

**Inquiry 1308.**

## 12-V Battery Tester

**T**he Performance Universal 12 Volt Battery Tester determines the condition of lead-acid batteries, including maintenance-free types such as sealed, recombination, and gel cells. It subjects the battery to an 80-amp load for 10 seconds and indicates whether the battery is good, weak, or bad. Pin jacks on the tester accommodate an auxiliary voltmeter that allows precise measurements during testing. The 2½-pound tester resides in a thermoplastic case.

**Price:** \$239.

**Contact:** Performance Technological Products, P.O. Box 947, Roswell, GA 30077, (404) 475-3192.

**Inquiry 1309.**

# WHAT IS THIS SMALL BOX ?

## A UNIX HOST!

## A LAN SERVER!

## A WORKSTATION .....



The Carry-1 9300 80386SX 4M byte RAM 80M byte Hard disk  
One Expansion Slot VGA

Carry-1: the World's Smallest Original 180Khz Age-Dependent Computer

The Carry-1 9000 series comes complete with 80386SX/80286-16/80286-12 microprocessor (Co-Processor optional), 1024x768 VGA/MGA & CGA display interface, 1/2 4 MB RAM, one 3.5" 1.44 MB FDD or one FDD plus one 40/80 MB HDD, one 8 bit expansion SLOT, one parallel and two serial I/O ports, and one 30W auto range switching power adapter, all in the traditional 240mmx185mmx45mm (9.4"x7.3"x1.8") casing of Carry-1. Each package includes two mini-tower stands and a carry bag. The 82 key mini keyboard and 9 inch color or monochrome VGA monitor are optional.

Other Carry-1 products include the 8000 series XT & AT book-size personal computers and the 6000 series XT and AT book-size LANstations, ETHERnet pocket LAN adapter and Carry Mouse.

#### DISTRIBUTOR

• CANADA BUDGETRON INC TEL# 416-564-7800 FAX# 416-564-2679 • FRANCE: M3C L INFORMATIQUE DU SUCCES TEL# 1-48271976 FAX# 1-42155916 • ISRAEL MLL COMPUTERS SYSTEMS LTD TEL# 3-7515511 FAX# 3-7516615 • ITALY PRIMA COMPUTER TRADING ITALIA TEL# 522-518599 FAX# 522-518599 • MALAYSIA COMMUNICATION TECHNOLOGY SDN BHD TEL# 03-2748888 FAX# 03-2749988 • NETHERLAND KOPIEERSYSTEMEN NEDERLAND B.V. TEL# 2968-84141 FAX# 2968-97436 • NORWAY: SECUS DATA A/S TEL# 2-722510 FAX# 2-722515 • SINGAPORE COMMUNICATION TECHNOLOGY SDN. BHD TEL# 4754408 FAX# 4713803 • SOUTH AFRICA. PC MART COMPUTER GROUP TEL# 11-8043355 FAX# 11-8024153 • SPAIN AT ELECTRONIC S A TEL# 1-5645434 FAX# 1-4110869 • SWITZERLAND ESS SOFTWARE TRADING SA TEL# 022-622020 FAX# 022-615650 • UNITED KINGDOM CENTERPRISE INTERNATIONAL LTD TEL# 256-463754 FAX# 256-843174 • WEST GERMANY MACROTRON AG TEL# 89-4208233 FAX# 89-423745 • BELGIUM CELEM S.A. TEL# 41-676434 FAX# 41-676515

World Radio History

# CARRY-I

A Refreshing Idea....

A New Standard....

Computing Goes Better With CARRY-I



FLYTECH TECHNOLOGY CO. LTD.

HEAD OFFICE

2HL NO 8 LANE 50, SEC 3, NAN-KANG

RD TAIPEI TAIWAN R.O.C.

TEL# 886-2-7852556 FAX# 886-2-7852371 7837970

W.G.

TEL# 49-69-746081 FAX# 49-69-749375

See us at  
COMDEX/Fall '90  
Nov. 12-16, 1990  
Sands Hotel  
Booth: N4028

U.S.A.

TEL# 1-408-7277373/4

FAX# 1-408-7277375

H.K.

TEL# 852-3051268

FAX# 852-7968427

Circle 138 on Reader Service Card

## Remote-Control VGA Displays

**N**etwork Technologies' SM-8x4-15V video matrix switch lets you connect up to four VGA displays to up to eight computers and remotely control the displays from up to 1000 feet away with the SM-RMT-8x4 remote unit.

The system comes in two parts: the matrix switch and the remote-control unit. The remote unit has 32 backlit and touch-activated switches for choosing which VGA to control. Each VGA source on the control unit can be connected to one or all four VGA displays.

The remote-control unit connects to the matrix switch via a 5-pin DIN connector. It comes with a 25-foot cable for connecting to the switch.

The matrix switch comes with eight 6-foot VGA cables for connecting to the eight systems. It measures 8½ by 11½ by 12 inches.

**Price:** Matrix switch, \$2450; remote unit, \$525.

**Contact:** Network Technologies, Inc., 19145 Elizabeth St., Aurora, OH 44202, (800) 742-8324 or (216) 543-1646.

**Inquiry 1310.**



*You can remotely control up to four VGA displays from eight systems with Network Technologies' matrix switch (bottom) and remote-control unit (top).*

## Low-Priced LAN Control

**L**AN Command is LAN management software that combines database management with low-level network analysis. It loads on one cli-

ent workstation, requiring 260K bytes of RAM. From that workstation, LAN Command can monitor and control your entire Novell or NetBIOS-based network.

The relational database system tracks node data (including user name, location, phone number, address, and

node name) and more than 50 additional fields. Portions of the database are populated automatically by the network-monitoring commands to build a traffic history for every node.

A report generator provides standard and custom reports using Boolean operators on any field in the record. For example, the administrator might request a custom report for every Ethernet node on the fourth floor that uses a server named Accounting and has been rebooted more than five times in the last week.

Other monitoring features include packet activity, collisions, ring faults, bridge failures, router failures, bandwidth use, traffic errors, and data loss. And you can monitor single stations, sets of stations, or the entire network across bridges and routers from any single DOS or OS/2 workstation.

A TSR program called Snooper lets you perform remote administration of the client computer.

**Price:** \$395.

**Contact:** Dolphin Software, Inc., 6050 Peachtree Pkwy., Suite 340-208, Norcross, GA 30092, (404) 339-7877.

**Inquiry 1311.**

*continued*

## ISDN Communications with a PC

**T**he PC SNET Card is an ISDN terminal adapter board that provides ISDN basic rate access. It allows simultaneous voice, data, and image transmission.

One card has an aggregate throughput of 144,000 bps. This is made up of transparent data transmission at 64,000 bps over two B channels and 16,000-bps packet signaling over the D channel, OST reports. You install the card in a full-size expansion

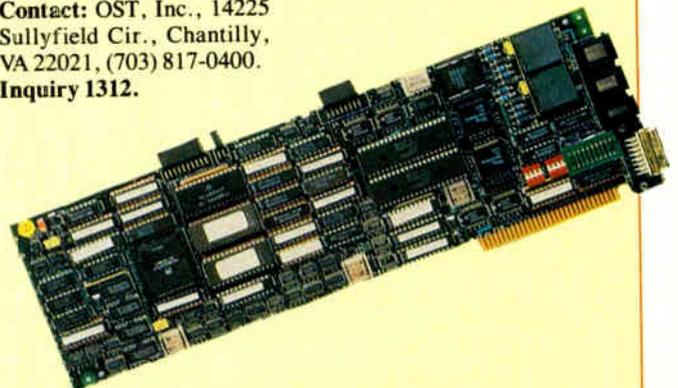
slot in the PC. It operates under DOS, Unix, or Xenix.

The card provides the standard S-type connection along with an audio jack, an RJ-11 modular telephone jack, and a 15-pin serial connector. Internal connections include a parallel connector, a private bus connector, and a bus interrupt connector for use in installing multiple PC SNET Cards in a single PC.

**Price:** \$1695.

**Contact:** OST, Inc., 14225 Sullyfield Cir., Chantilly, VA 22021, (703) 817-0400.

**Inquiry 1312.**



UNIX WORLD  
TOP • 10  
PRODUCT  
OF THE YEAR  
1 • 9 • 8 • 9



# INSTANT WORKSTATION. JUST ADD OPEN DESKTOP.

Take a look at the vast majority of graphical workstations developed over the past decade and you'll see something they all have in common:

An integrated UNIX® System environment.

Now take a look at the vast majority of businesses that have put computing power directly onto their office desktops over the past decade, and you'll see something they all have in common: Industry-standard personal computers.

It doesn't take a computer to forecast the platform that's going to put graphical workstations on the vast majority of business and engineering desktops in the next decade:

An integrated UNIX System environment for industry-standard personal computers.

And that's what Open Desktop™ is all about.

Open Desktop is the complete graphical operating system that's built on the most popular UNIX System platform of all time—SCO™. And it lets you create your own networked, icon-driven workstation environment using the industry-standard 386 or 486 computers and peripherals of your choice.

In a single, easy-to-use, fully supported—and completely integrated—package, Open Desktop delivers:

- the full 32-bit, multitasking computing power of SCO UNIX System V/386
- compliance with POSIX™ and X/Open® standards
- an OSF/Motif™-based, Presentation Manager-compatible, graphical user interface
- distributed SQL database management services
- compatibility with existing DOS, XENIX®, and UNIX System applications and data files
- NFS™, TCP/IP, and LAN Manager networking facilities

And all at an unbelievably affordable price.

Discover the complete graphical operating system that leading companies worldwide are choosing as their development platform for the '90s—and using to turn their 386 and 486 PCs into instant workstations today.

Open Desktop from SCO.

 **OPEN  
DESKTOP.**  
*The Complete Graphical Operating System*

**COME SEE US  
AT COMDEX,  
ROOM B-1!**

**SCO**   
THE SANTA CRUZ OPERATION

For more information, call SCO today and ask for ext. 8400

**(800) SCO-UNIX (726-8649) (408) 425-7222 FAX: (408) 458-4227 E-MAIL: . . . !uunet!sco!info info@SCO.COM**

SCO, the SCO logo, Open Desktop, and the Open Desktop logo are trademarks of The Santa Cruz Operation, Inc. UNIX is a registered trademark of AT&T in the USA and other countries. POSIX is a trademark of The Institute of Electrical and Electronics Engineers (IEEE). X/Open is a registered trademark of X/Open Company Ltd. OSF/Motif is a trademark of The Open Software Foundation, Inc. XENIX is a registered trademark of Microsoft Corporation. NFS is a trademark of Sun Microsystems, Inc. © 1989 The Santa Cruz Operation, Inc. All Rights Reserved. The Santa Cruz Operation, Inc., 400 Euclid Street, P.O. Box 1900, Santa Cruz, California 95064 USA. The Santa Cruz Operation, Ltd., Crowley Centre, Hitters Lane, Watford WD11 8YN, Great Britain. +44 (0)923 866344, 10/89 FAX: +44 (0)923 817780, TELEY: 91732 SCOLONG

Circle 307 on Reader Service Card  
World Radio History

# Eight Top Databa Out On dBAS

**ADAM GREEN**

President, Adam Green Seminars, Lexington, MA:

*"It's significantly faster in some very important areas, especially in the fancy, attractive user interface... It's a very stable product, very reliable. I can safely recommend it."*

**PAT ADAMS**

President, DB Unlimited, Brooklyn, NY:

*"With standardization on the dBASE IV language, we have our database standard, which makes life easier for me, for my clients, and every other dBASE user... It's a solid, reliable product that performs the same way every time."*

**BOB DAVIES**

President, SBT, Sausalito, CA:

*"Memory utilization is much better than either dBASE III PLUS or dBASE IV version 1.0—a very substantial improvement. This means we are able to run our products, which require lots of memory and the need for a network, in a dBASE IV 1.1 environment."*

**SCOTT ROBERTSON**

President, Champion Business Systems, Golden, CO:

*"We think that it's solid. We think it's reliable. We think it's an excellent foundation for future development. The great thing about dBASE IV is that it has a flexible language and a good user interface. With dBASE IV version 1.1, end-users can take the product and tailor it so it fits their exact needs."*

After running their own extensive tests, these independent experts have come to some very favorable conclusions on dBASE IV® version 1.1. We think you will, too.

dBASE, dBASE III PLUS, dBASE IV, Ashton-Tate and the Ashton-Tate logo are registered trademarks of Ashton-Tate Corporation. Other company or product names mentioned may be trademarks of their respective companies.

# se Experts Speak E IV V Version 1.1.

## TONY LIMA

Author of "Inside dBASE IV," President, Pacific Systems Design Workshop Inc., San Carlos, CA:

*"Version 1.1 should dominate the market. Its added features make it the best development environment available for PC database products ... None of the other products have the power and ease of the dBASE IV Control Center."*

## HOMER BRANCH

Programmer Analyst, Chevron CEPS, New Orleans, LA:

*"I'm using version 1.1 to develop applications right now... It's much easier to use than either dBASE III PLUS or 1.0... Because of the Control Center, version 1.1 allows my users to do queries and get their reports without calling me."*

## RICHARD BRENNER

President, Westar Systems, Colorado Springs, CO:

*"I'm now taking on some major consulting jobs that I wouldn't do before dBASE IV and its multiuser capabilities... I'm excited about the way they've gone through and enhanced just about every one of the new features within the program and the programming language."*

## SAM GILL

President, DataWiz International, Foster City, CA:

*"dBASE IV version 1.1 is significantly faster... Memory management has really been improved. We can now load and run a system very comfortably in 640K bytes... Features like the form, report and application generators allow us to cut down development time."*

Call 1-800-437-4329, ext. 1403, for more information. Better yet, call 1-800-2ASHTON for an immediate upgrade.



**Ashton-Tate®**

© 1990 Ashton-Tate Corporation. All rights reserved. GTSI's GSA Schedule #: GS00K90AGS5216

Circle 34 on Reader Service Card (RESELLERS: 35)

World Radio History

## Wireless Communications

The DR 96 is an asynchronous/synchronous half-duplex modem that offers portable and wireless data transmission. Both the radio and the modem are contained in the same 15½-ounce package.

The DR 96 uses the radio frequency band of 470 MHz and has a sensitivity of .35 microvolts. The unit also offers 10-ms RTS (request to send) and CTS (clear to send) signaling times.

A rechargeable 7½-V battery pack that comes with the modem can operate it for from 4 to 10 hours. A recharger is also included that can recharge the batteries in 3 hours, according to UDS. **Price:** \$1295. **Contact:** UDS, 5000 Bradford Dr., Huntsville, AL 35805, (205) 430-8000. **Inquiry 1313.**

## Modem with a Memory

The Visionary 2400XT is a direct-connect 2400-bps modem with battery-backed internal memory and a real-time clock/calendar to control when you send and receive messages. A blinking message-waiting light lets you know when you have messages. You can even send and receive messages when the host computer is turned off. All this internal intelligence is controlled by an 8085 microprocessor.

In addition, you can store dozens of phone numbers and messages for distribution at various times. Other features include redialing on busy or



*The DR 96 is a wireless, battery-powered modem for portable communications.*

no answer, auto-answer during particular times only, automatic log-on, data retrieval, XMODEM file transfer, remote access, and password security. The modem also has a printer port and a nickel-cadmium battery.

The modem is available in three versions: 8K-byte, 256K-byte, and 1-MB. It measures 5¾ by 8¾ by 1½ inches. **Price:** 8K-byte unit, \$495; 256K-byte unit, \$595; 1-MB unit, \$745. **Contact:** Visionary Electronics, Inc., 141 Parker Ave., San Francisco, CA 94118, (415) 751-8811. **Inquiry 1314.**

## Notework Moves Out into the Field

Notework recently announced Notework Remote, a remote version of its 5K-byte Notework E-mail program. Remote allows laptop users or branch offices to pop up Notework over the phone line. The software automatically makes the connection and does the uploading or downloading of mail.

Like the original Notework for Novell NetWare, Remote takes up only 5K bytes of RAM, employs the same user interface, and lets you pop into it without leaving

your application.

Notework alerts you with a tone when you receive mail, and you see a flashing symbol in the upper-right corner of the screen. Other features let you attach files, print notes, confirm notes, and import and export ASCII files.

Notework offers a gateway to Message Handling Service.

The most recent version of Notework now supports multiple NetWare 386 servers without requiring additional gateways or mail servers. Version 1.1.4 supports up to 3500 users on a single inter-network, according to Notework.

**Price:** \$99; installation kit, \$99; two-user authorization disk, \$99.

**Contact:** Notework Corp., 72 Kent St., Brookline, MA 02146, (800) 767-6683 or (617) 738-5295. **Inquiry 1315.**

## Linking Buildings via Infrared Light

Building-to-Building Photolink lets you connect computers in adjacent buildings up to 600 feet away, according to Photonics.

Two versions of Photolink

are available: AppleTalk/LocalTalk for the Mac, and an interface for systems equipped with RS-232C ports.

At the end of each connection is a Photolink transceiver that communicates with its corresponding unit. Photonics says that the device can operate through two panes of standard office window glass.

Photolink can connect to existing cable-based systems and is compatible with AppleTalk routers and bridges. It transmits at 230,400 bps. The RS-232C version transmits up to four channels simultaneously at 9600 bps. **Price:** \$3390 per connection for both versions. **Contact:** Photonics Corp., 200 East Hacienda Ave., Campbell, CA 95008, (408) 370-3033.

**Inquiry 1316.**

## Modem Sharing for Networks

Modem Assist lets you share up to 20 modems connected to a LAN. It eliminates the need for a dedicated communications server and the cost of rerouting all modem phone lines, according to Fresh Technology Group.

The software works with multiport serial cards that support up to 16 modems on a single workstation. It requires less than 10K bytes of RAM and runs in the background on any workstation with the modem.

Modem Assist requires PCs running on NetBIOS or NetWare networks with DOS 3.0 or higher.

**Price:** \$495 for up to five modems; \$995 for six to 20 modems.

**Contact:** Fresh Technology Group, 1478 North Tech Blvd., Suite 101, Gilbert, AZ 85234, (602) 497-4200. **Inquiry 1317.**

*continued*

# Programmer's Paradise has the Utilities that you need!

(800)  
445-7899

## A WINNING COMBINATION!

MERRILL  
& BRYAN  
ENTERPRISES, INC.

- T**URBO EMS - Memory Manager
- Supports PC, XT, AT, PS/2, and 386 systems
  - Ability to relocate TSRs and device drivers
  - Automatic installation and configuration on 386 systems
  - Windows 3.0 support

FAXcetera #2273-0001

List: \$99.95 Ours: \$89



- I**nfoSpotter - Diagnostic tool
- Detailed description about memory and system configuration
  - Displays TSRs and device drivers loaded between 640KB and 1 MB
  - Ability to edit AUTOEXEC.BAT, CONFIG.SYS and batch files
  - Special MicroChannel support

FAXcetera #2273-0002

List: \$79.95 Ours: \$69

## HIJAAK RELEASE 2.0



**H**ijaak 2.0 is a graphics conversion and capture utility that translates more than 36 graphics file formats. Hijaak provides batch conversion capability from the DOS command line or from the user interface.

Supported formats: GEM, PICT I&II, GCM, HPGL, PIC, DXF, PCX, MAC, TIF, and support for more than 16 group 3 fax devices. A 5K pop-up provides capture function of text screens, graphics screens, and laser printer output.

FAXcetera #1976-0002

List: \$199 Ours: \$139

  
Inset Systems

## SQUISH PLUS



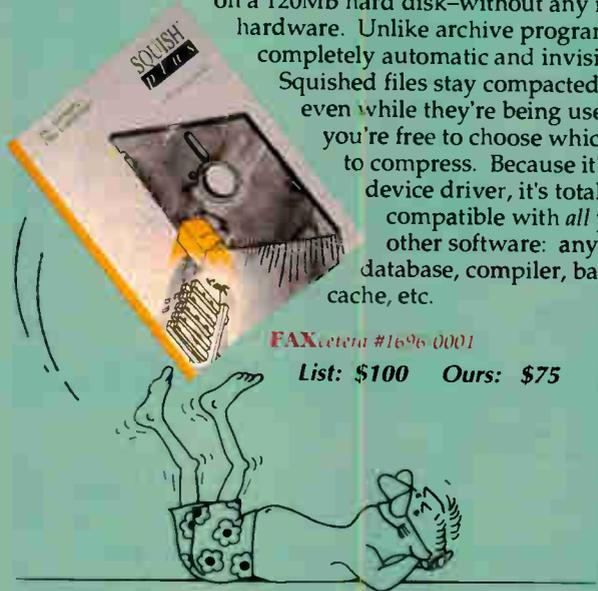
Sundog Software Corp.

**S**quish Plus can enlarge the capacity of all your disks—hard, floppy, or silicon. By compressing data, it can get up to 240MB on a 120MB hard disk—without any new hardware. Unlike archive programs, it's completely automatic and invisible.

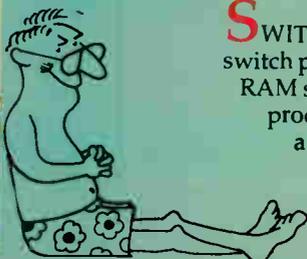
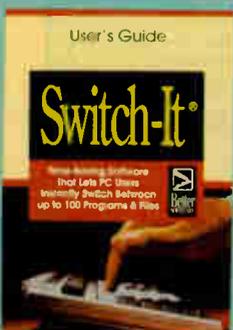
Squished files stay compacted on disk even while they're being used, and you're free to choose which files to compress. Because it's a device driver, it's totally compatible with *all* your other software: any database, compiler, backup, cache, etc.

FAXcetera #1696-0001

List: \$100 Ours: \$75



## SWITCH-IT



**S**WITCH-IT is a task-switching package that allows users to switch programs (up to 100) to their EMS or hard disk, freeing up RAM space to run large applications. The easiest to use of any product of its kind, SWITCH-IT offers automatic installation, a customizable menu, a cut & paste feature, complete network compatibility *and* SWITCH-IT only uses 26K of RAM.

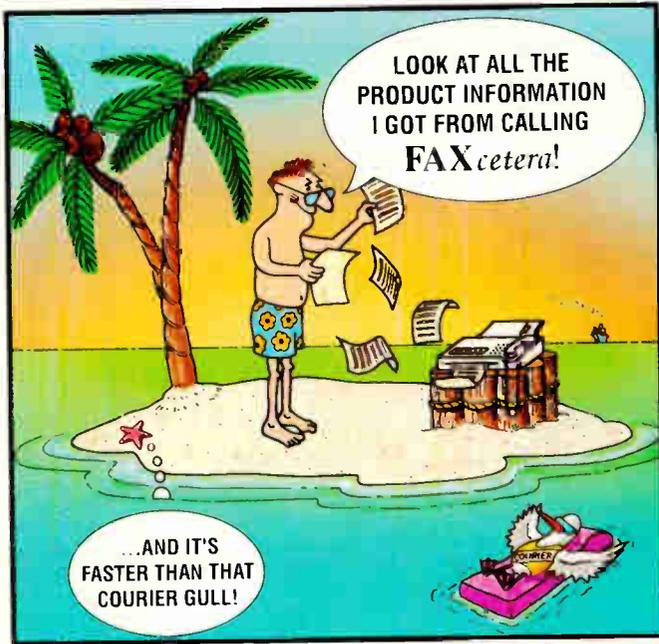
FAXcetera #5396-0001

List: \$100

Ours: \$69

 Better  
SOFTWARE

# Programmer's Paradise<sup>®</sup> ...



**We'll Beat The Competition's Advertised Prices!**

	LIST OURS		LIST OURS
<b>386 CONTROL PROGRAMS</b>			
DESQview 386 w/ QEMM	220 169		
MicroSoft Windows 3.0	150 99		
Vx/386	245 209		
Vx/386 MultiUser	895 839		
VM/386 MultiUser Starter	395 339		
<b>386 DEVELOPMENT TOOLS</b>			
386 AsmLinkLoc	1295 1145		
C-Terp 386	239 189		
Lahey 177L-EM/32 (w/ OS/386)	1290 1035		
MetaWare High C 386	895 849		
Novel C Network Compiler 386	995 799		
Paradox 386	895 629		
P-C-Im 386	239 179		
Phar Lap 386 ASM/LINK	495 435		
WATCOM C 8.0/386 Prof.	1295 1099		
w/ Phar Lap 386 ASM/LINK	1790 1399		
WATCOM C 8.0/386 Standard	895 719		
<b>ADA</b>			
Academic IntegrAda	249 225		
Ada Scope Debugger	495 445		
Ada Training Environment	895 809		
Adgraphics	695 629		
Integr Ada	795 719		
Meridian AdaStudent	50 45		
Meridian Ada Developer's Kit	1195 1095		
<b>ASSEMBLY LANGUAGE</b>			
Advantage Disassembler	295 279		
ASMFox	99 89		
Dis Doc Professional	250 225		
M5 Macro Assembler	150 105		
OPTASMA	150 129		
Re Source	150 129		
Sourcer w/ Pre-Processor	170 149		
Synataneous Assembly	395 189		
Turbo Debugger & Tools	150 105		
Visio Computer: 80286	100 89		
<b>BASIC COMPILERS</b>			
MS BASIC Prof. Dev. System	495 349		
Power BASIC	129 89		
QuickBASIC	99 69		
<b>BASIC LIBS/UTILITIES</b>			
Graph!ak Professional	149 129		
P.D.O.	129 115		
ProBas	159 149		
ProBas Toolkit	99 94		
QBAs w/ QuickScreen	149 125		
QuickComm	149 119		
QuickFax Professional	169 149		
QuickWindows Advanced	149 119		
<b>C COMPILERS</b>			
Lattice C 6.0	250 155		
Microsoft C 6.0	495 339		
w/ Objective-C	699 539		
MS QuickC 2.5	99 69		
MS QuickC w/ QuickAssembler	199 139		
Turbo C 2.0	99 69		
WATCOM C 8.0 Professional	495 419		
WATCOM C 8.0 Standard	395 335		
		<b>C++</b>	
		C++/Views	495 419
		NDP C++	495 479
		Rogue Wave Math++	200 179
		Rogue Wave Tools.h++	200 179
		Turbo C++	200 139
		Turbo C++ Professional	300 205
		Competitive Upgrade	150 139
		Zinc Library	200 179
		Zortech C++ Debugger	150 129
		Zortech C++	200 165
		Zortech C++ Developer's Edition	450 399
		Bundled w/ C++/Views	945 595
		Zortech C++ Tools	150 129
		Zortech C++ Video Course	500 449
		<b>C-COMMUNICATIONS</b>	
		Breakout II	249 189
		C Async Manager 3.0	189 139
		Essential Communication	329 259
		Greenleaf Comm Lib	359 287
		Greenleaf ViewComm	399 319
		SilverComm C Async Library	249 209
		View-32	189 149
		<b>C-FILE MANAGEMENT</b>	
		AccSys for dBASE or Paradox	395 349
		Btrieve Dev's System	595 449
		Codebase IV	295 219
		C-tree	395 315
		dBc III Plus	500 439
		db FILE Bundle	295 249
		Essential B-Tree w/ source	198 149
		FairCom Toolbox - Prof. Edition	1095 789
		FairCom Toolbox - Special	695 509
		Paradox Engine	495 349
		<b>C-GENERAL LIBRARIES</b>	
		Blackstar C Function Library	99 79
		C TOOLS PLUS/6.0	149 109
		C Utility Library	249 199
		Greenleaf Functions	229 179
		Greenleaf SuperFunction	299 239
		Turbo C TOOLS'2.0	149 109
		<b>C SCREENS</b>	
		C-Worthy	395 319
		Greenleaf DataWindows	399 315
		Panel Plus	495 395
		QuickWindows Advanced (C)	169 149
		Vermont Views	495 395
		Vitamin C	225 165
		VC Screen	149 125
		<b>C-UTILITIES/OTHER</b>	
		Bar Code Library	389 319
		Clear +	200 169
		C Shroud	198 149
		DIVVY	229 209
		Hoop Expander	80 70
		MKS LEX & YACC	249 197
		Objective-C	249 225
		PC-link	139 105
		PC/MAC Professional	495 459
		TimeSlicer	295 279

	LIST OURS		LIST OURS
<b>CASE TOOLS</b>			
EasyCASE Plus	295 265		
Professional Pack	395 335		
Personal CASE	199 179		
<b>COBOL LANGUAGE</b>			
Micro Focus:	1800 1499		
COBOL/2 w/ Toolset	149 129		
Personal COBOL	900 629		
MS COBOL	995 849		
Realia COBOL	995 849		
<b>CODE GENERATORS</b>			
Logic Gem	99 69		
Matrix Layout 2.0	200 159		
PRO-C	399 339		
<b>DATABASE DEVELOPMENT</b>			
Clarion 2.1	CALL CALL		
Clipper 5.0	795 519		
Data Junction Advanced	299 269		
dBASE IV	795 489		
dBfast/PLUS	345 295		
dGE	295 249		
Dr. Switch ASI	100 89		
Facelt	99 90		
FlashTools!	89 79		
Flipper	195 169		
Force 2.1	695 589		
FoxPro	795 489		
FUNCTION Library	195 179		
R&R Report Writer	150 129		
R&R Code Generator	150 129		
Say What?!	50 39		
SilverComm C Interface	99 89		
SilverComm Library 2.0	249 209		
Tom Rettig's Library	100 80		
UL2 Version Two	595 479		
<b>DEBUGGERS (DOS)</b>			
MultiScope	179 135		
Periscope 1/512K	595 475		
Periscope II w/ switch	225 179		
Periscope IV/16, 25 MHz	CALL CALL		
Trapper	200 179		
w/ optional cable	240 219		
Turbo Debugger & Tools	150 105		
<b>DOCUMENTING/ FLOWCHARTING</b>			
allCLEAR	300 229		
Clear+	195 169		
C-Clearly	130 115		
Flow Charting 3	250 199		
Interactive Easyflow	150 125		
Paginate	100 79		
Source Print	99 74		
The Documentor	295 245		
Tree Diagrammer	99 74		
<b>EDITORS</b>			
BRIEF 3.0	249 CALL		
EDI+	295 269		
EMACS	325 265		
Epsilon	195 159		
KEDIT 4.0	150 125		
MKS Vi	149 129		
PI Editor	195 175		
Sage Professional Editor	295 249		
SICK Editor	195 154		
SIP/PC	245 199		
SYNDIE	495 399		
VEDIT PLUS	185 CALL		
<b>EMBEDDED SYSTEMS</b>			
Link & Locate ++	395 349		
Link & Locate ++ Extended	479 395		
Paradigm Locate	295 265		
<b>FORTRAN LANGUAGE</b>			
Grammatic	135 119		
Lahey F77L	595 535		
Lahey Personal FORTRAN 77	99 89		
MS FORTRAN	450 299		
Plotmatic	135 119		
RM/FORTRAN	595 499		
WATCOM FORTRAN 77/386	1095 CALL		
<b>GRAPHICS LIBRARIES</b>			
Baby Driver	250 199		
Essential Graphics	399 319		
Font-Tools	150 119		
Graph! Drive Plus Developer's	299 269		
Graphic 3.0	395 319		
GSS Graphics Dev. Toolkit	595 509		
GX Graphics	149 135		
HALO	395 279		
HALO Professional	595 419		
HALO Window Toolkit	595 419		
Icon-Tools/Plus	150 119		
Menuet	325 279		
MetaWindow	250 209		
MetaWindow Plus	325 289		
PCX Effects	99 89		
PCX Programmer's Toolkit	195 175		
PCX Text	149 135		
PaintPaint	129 109		
Slate w/ graphics	448 415		
Turbo Geometry Library	200 179		
<b>LINKERS/LIBRARIANS</b>			
Overlay Toolkit	395 369		
Plink86+	395 335		
Plink/TO	495 419		
PolyLibrarian	249 209		
.RTLlink	295 265		
.RTLlink/Plus	495 419		
<b>OBJECT-ORIENTED TOOLS</b>			
Objective-C	249 225		
Smalltalk/V	100 85		
Smalltalk/V 286	200 169		
<b>OS/2 TOOLS</b>			
Brief	249 CALL		
CASE:PM for C	1495 1420		
Epsilon	195 159		
MKS LEX & YACC	349 279		
MS OS/2 Pres. Manager Toolkit	500 349		
MultiScope for OS/2	449 345		
PCYACC	695 625		
PI Editor	249 225		
Smalltalk/V PM	495 369		
Vitamin C (OS/2)	345 279		
<b>PASCAL LANGUAGE</b>			
Asynch PL US	149 115		
B-tree Filer	125 109		
MS QuickPASCAL	99 69		
Object Professional	150 109		
Power Tools PL US/5.0	149 109		
Topaz	99 89		
Topaz Multi-user	149 135		
Turbo Analyst	99 89		
TurboMAGIC	199 179		
Turbo Pascal 5.5	150 105		
Turbo Pascal 5.5 Professional	250 175		
Turbo-Plus 5.5	199 159		
Turbo Professional 5.0	125 109		
<b>SOURCE MAINTENANCE</b>			
Codan	395 345		
Code Check	495 469		
MKS Make	149 119		
MKS RCS	189 149		
MKS Software Mgmt. Team	299 239		
PolyMake	179 149		
PVCS Professional	495 419		
SMS	99 89		
SOURCEDOC	139 109		
TLIB	419 339		
5 Station LAN	419 339		
<b>WINDOWS (MS) TOOLS</b>			
Actor 3.0	895 719		
Asymetrix Toolkit	395 CALL		
Bridge Toolkit	695 659		
Case/W	795 759		
C-Talk/Views	450 375		
dBFast/Windows	395 335		
DialogCoder	499 435		
Graphics Server SDK	495 419		
MS Windows Development Kit	500 349		
MultiScope for Windows	379 289		
ObjectGraphics	445 365		
ProView	695 625		
Windows/MAKER	595 535		
WinTrieve	395 339		
WNDX GUI Toolbox	499 449		

## SPECIAL DEALS!!

### Microsoft Buy One, Get One FREE

Buy any MS Quick language or a Microsoft Mouse, and get one of the following FREE: MS Flight Simulator, PC Tools, or Sign Designer. (Mail included coupon directly to Microsoft.)

### Zortech C++ Developer's Edition 2.1, C++/Views Bundle

Get the first and only native C++ compiler supporting MS Windows, plus over 60 C++ object classes for a special low price of \$595!

### Borland's Turbo C++ Professional Competitive Upgrade

Ready to switch from your C compiler to Borland's Turbo C++ Professional? It's easy and inexpensive—just \$139 at Programmer's Paradise. Call for details.

### Objective-C

For Microsoft C programmers interested in gaining the benefits of object-oriented technology without losing the familiarity, efficiency & portability of C. Augments C with an object data type, a message expression and a class definition mechanism.

List: \$249 Ours: \$225

# Guaranteed Best Prices!

(800)  
445-7899

## FAXcetera

Want more product information on the items in the gold box to the right? Try FAXcetera!! Just pick up your FAX phone and dial 201-389-8173. Enter the FAXcetera product code listed below each product description—information will be faxed back to you instantly!

	LIST OURS		
<b>XENIX/UNIX</b>			
BLAST UNIX/XENIX	495	395	
Epsilon	195	169	
Interactive Products	CALL	CALL	
LPI-COBOL	1495	1199	
LPI-FORTRAN	995	799	
MetaWare High C	895	849	
Microport Products	CALL	CALL	
MKS RCS	395	335	
MKS Trilogy	119	105	
PI Editor	349	319	
SCO Products	CALL	CALL	
VEDIT PLUS	285	249	

	LIST OURS		
<b>ADDITIONAL PRODUCTS</b>			
APL+PLUS	695	549	
Dan Bricklin's Demo II	199	159	
dBx/dBPort	600	459	
Guido	249	CALL	
Lattice RPG	1600	1285	
MKS AWK	99	79	
Opt-Tech Sort/Merge	149	119	
PC Scheme	95	79	
Personal Rexx	150	139	

## APPLICATION SOFTWARE

	LIST OURS		
<b>COMMUNICATIONS</b>			
BLAST II	250	225	
Carbon Copy Plus	199	129	
Laplink III	150	99	
PC Anywhere III	145	99	
Procomm Plus	99	63	
SideTalk	120	99	

	LIST OURS		
<b>DESKTOP PUBLISHING</b>			
Adobe Products	CALL	CALL	
Corel Draw!	595	399	
HALO DPE	195	139	
PageMaker	795	509	
Ventura Publisher	895	549	

	LIST OURS		
<b>MATHEMATICS</b>			
Derive	200	179	
MathCAD	495	315	
Mathematica 386	695	625	

	LIST OURS		
<b>SCIENCE &amp; ENGINEERING</b>			
AutoCAD Release 10	3000	CALL	
AutoSketch	150	95	
ChiWriter	150	129	
CSS	495	469	
DADiSP	895	759	
Design CAD 3-D	400	292	
Drafix Windows CAD	695	CALL	
EXACT	475	380	
Generic CADD Level 3	350	289	
LABTECH Acquire	195	179	
LABTECH Notebook	995	779	
MICRO-CAP III	1495	1269	

## SCIENCE & ENGINEERING (continued)

	LIST OURS		
Orcad PCB	1495	CALL	
PC-MATLAB	695	625	
PC TEX	249	229	
SCHEMA III	495	449	
Systat w/ Sygraph	895	759	
Tango PCB Series II	595	559	
TECH*GRAPH*PAD T1	395	319	
	595	479	

## SPREADSHEETS

	LIST OURS		
Lotus 1-2-3	595	389	
Microsoft Excel	495	319	
Quattro Professional	495	329	
SuperCalc5	495	319	

## UTILITIES

	LIST OURS		
386MAX5.0	130	99	
above DISC	119	64	
AboveMEM	80	72	
Bootcon	60	55	
Cache 86	50	39	
FASTBACK Plus	189	109	
HeadRoom 2.0	130	109	
Hijaak	150	105	
Hold Everything	199	159	
InfoSpotter	80	69	
MACE 1990	149	129	
Magellan	195	CALL	
MKS Toolkit	249	199	
MOVE'EM	89	79	
Norton Commander	149	99	
Norton Utilities 5.0	179	129	
PC Tools Deluxe 6.0	149	95	
Pizazz Plus	149	79	
PreCursor	96	79	
SitBack	99	90	
Software Carousel	90	72	
SpinRite II	89	75	
Squish Plus	100	75	
Switch-It	100	69	
Tree 86	90	69	
Turbo EMS 5.0	100	89	
UpShot	95	89	
XTreePro Gold	129	109	
ZENO	269	239	

## WORD PROCESSING

	LIST OURS		
Ami	199	129	
Microsoft Word for Windows	495	349	
WordPerfect 5.1	495	CALL	

## SOFTWARE FOR SUN WORKSTATIONS

	LIST OURS		
Basmark QuickBASIC	CALL	CALL	
C Programmer's Toolbox/ Sun	495	449	
Edix	425	339	
EMACS for Sun	395	369	
Informix	CALL	CALL	
Lotus 1-2-3 for Sun	CALL	CALL	
Mathematica for Sun	CALL	CALL	
MetaWare High C	895	849	
NeuralWorks Professional II	4095	CALL	
Panel Plus (Sun 3)	1595	1355	
WordPerfect for Sun	495	CALL	

## Programmer's Policies

**Phone Orders**  
Hours 8:30 AM-7 PM EST. We accept MC, Visa, AMEX. Domestic shipments, please add \$5 per item for shipping/handling by UPS ground. For domestic COD shipments, please add \$3. Rush service available.

**Mail or FAX Orders**  
POs are welcome. Please include phone number.

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

**Dealers and Corporate Accounts**  
Call for information.

**Unbeatable Prices**  
We'll beat the competition's advertised prices. Prices subject to change without notice.

**Return Policy**  
30 days. Due to copyright laws, we cannot take back software with the disk seal broken unless authorized by the manufacturer. Returned product must include R.A. number.

LIST OURS



## Menuet - The GUI Development Toolkit

Menuet is a sophisticated, simple solution for Graphical User Interface (GUI) development that provides over 400 callable functions and supports most all GUI constructs. It is currently available in versions for use with MetaWINDOW, from Metagraphics Software Corporation, and GSS\*CGI, from Graphics Software Systems. Other Ithaca Street products include: UpShot, PiXelPrint, Font-Tools, Icon-Tools, and Baby Driver.



List: \$325 Ours: \$279 FAXcetera #2263-0003

## WindowsMAKER

WindowsMAKER is a code generator that builds complete Windows 3.0 applications. Prototype the entire user interface (menus, icons, buttons, controls, etc.) in a WYSIWYG editor, then generate Microsoft C code for MS-Windows. Custom code is preserved during regeneration. WindowsMAKER handles message processing, memory management, child windows, debugging, compiler settings, MDI and much more. Generates excellent C code. Port DOS programs to Windows in record time. A must if you are writing applications for Windows in C. 30 day money-back guarantee.



Candlelight Software

List: \$595 Ours: \$535 FAXcetera #2602-0002

## WATCOM C8.0/386

WATCOM C8.0/386 is a 100% ANSI C optimizing compiler and run-time library for the Intel 80386 architecture generating applications for 32-bit protected mode. With C8.0/386, you can go beyond the 640K DOS limit. Library and source code compatibility with Microsoft C simplifies many porting projects. Significant features include: protected mode version of the compiler; VIDEO full-screen source-level debugger; Microsoft library and source compatibility; execution profiler; high-performance linker; graphics library.



Standard List: \$895 Ours: \$719  
Professional List: \$1295 Ours: \$1099

FAXcetera #1683-0001

## WATCOM

## Spontaneous Assembly

An assembly language library that lets you produce the fastest, tightest possible programs with the same ease you'd expect from a high-level language. It includes an impressive collection of over 700 functions and macros for high-speed text windowing, heap management, array searching and sorting, critical error management, 32/64 bit integer math, and much more! Comprehensive 750+ page manual. Full source code. No royalties. Easy integration with C.



"If you program in assembly language, you gotta have Spontaneous Assembly."  
- Michael Abrash

basetwo  
DEVELOPMENT

List: \$395 Ours: \$189 FAXcetera #2614-0001

International: 201-389-9228  
Customer Service: 201-389-9229  
Fax: 201-389-9227

Corporate: 800-422-6507  
Canada: 800-445-7899  
FAXcetera: 201-389-8173

Call or Write for Latest Free Catalog!

1-800-445-7899

Programmer's  
Paradise

A Division of Voyager Software Corp  
1163 Shrewsbury Ave., Shrewsbury, NJ 07702

Circle 289 on Reader Service Card

World Radio History

## Our Guarantee...

Products listed here are backed by the following guarantee\*:

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

### Terms of Offer:

- Offer good through November 30, 1990
- Applicable to pricing on current versions of software listed; Nov. issue prices only.
- Offer does not apply towards obvious errors in competitors' ads.

\* Subject to same terms and conditions.

## Unix Programming Environment Has All the Tools

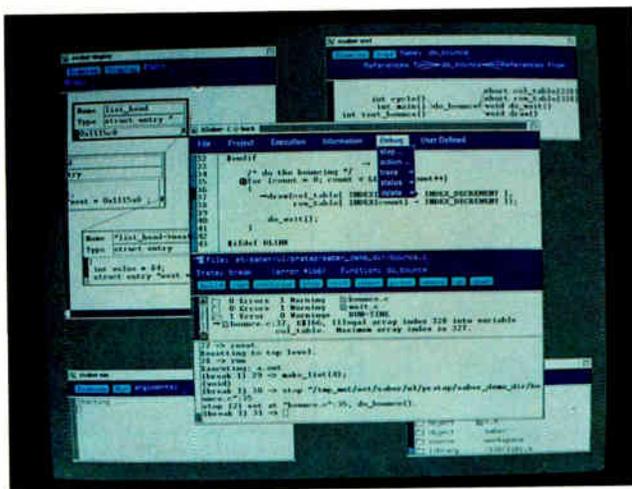
**S**aber Software has brought its environment for Unix workstations up to speed to support all phases of C programming, including development, debugging, testing, and maintenance. Saber-C 3.0 lets you debug code handled by the interpreter, object code produced by the compiler, or libraries. You can use Saber-C to set breakpoints and to step, trace, and debug object and source code modules.

Saber-C includes a multiwindow graphical interface that you can customize by defining commands and new buttons. Saber-C automatically detects more than 250 static and run-time errors.

Saber-C runs on Sun-3 and Sun386i workstations, SPARCstations, DECstations running Ultrix, and ASCII and X Window System terminals.

**Price:** \$2495.

**Contact:** Saber Software, Inc., 185 Alewife Brook Pkwy., Cambridge, MA 02138, (617) 876-7636. **Inquiry 1271.**



*Saber-C 3.0 combines an incremental linker, static and run-time error detection, source-level debugging, and a multiwindow interface in one system.*

## Zinc Releases Class Library for C++

**W**ith Zinc's user interface class library for Borland's Turbo C++ you can create a user interface for a DOS application without having to develop the interface from scratch. The Zinc Interface Library 1.0 lets you write applications that run in true graphics and text modes, including on dual monitors, from one set of source code without recompiling or re-

linking, the company says.

The library also supports 20 input field types with built-in cut-and-paste and full Undo and Redo.

By calling the Zinc BBS, you can download additional capabilities for Zinc 1.0, including support for both the MetaWindows Graphics Library and Borland's Graphical Interface.

Other features on the BBS include enhanced scroll-bar support to provide both vertical and horizontal scroll bars in the window object, in addition to vertical scroll-bar support for text and matrix objects. Zinc has also added a new List object with full insert, delete, and modify capabilities.

The library exploits C++ features such as virtual functions, class inheritance, operator overloading, and multiple inheritance.

**Price:** \$199.95; source code, \$200.

**Contact:** Zinc Software, Inc., 405 South 100 East, Suite 201, Pleasant Grove, UT 84062, (800) 638-8665 or (801) 785-8900; BBS, (801) 785-8997.

**Inquiry 1272.**

## New MitemView Supports the MacIRMA Family

**V**ersion 1.1 of MitemView, the HyperCard development tool that lets you create graphical user interfaces for accessing IBM mainframe applications, supports Digital Communications Associates' MacIRMA products, including coaxial and LAN-based System Network Architecture gateways. Mitem says 1.1 uses DCA's MacIRMA application programming interface to provide connectivity to the host.

MitemView simplifies the connection to VAX and

IBM 3278 and 3279 mainframes, providing easier access and information retrieval for local processing without requiring modification of the host code. MitemView already supported TriData's NetWay and Avatar's MacMainFrame products.

**Price:** Developer's toolkit, \$995; MacIRMA driver, \$495.

**Contact:** Mitem Corp., 2105 Hamilton Ave., Suite 190, San Jose, CA 95125, (408) 559-8801.

**Inquiry 1275.**

## High-Level Routines for the Mac User Interface

**M**acInterface 1.1 automatically implements many segments of the Mac interface. The library supports the Undo and Redo of Edit menu commands without requiring coding on your part. It provides automatic support for the dragging, growing, and zooming of modal and modeless dialog boxes.

The program is compatible with Lightspeed C and Pascal, MPW C and Pascal, and several Modula compilers.

**Price:** \$295.

**Contact:** Holder, Egan & Co., Inc., 4148 Spring Hill Rd., Midland, MI 48640, (800) 782-9976 or (517) 636-7373.

**Inquiry 1273.**

## Structured Design Analysis for Windows

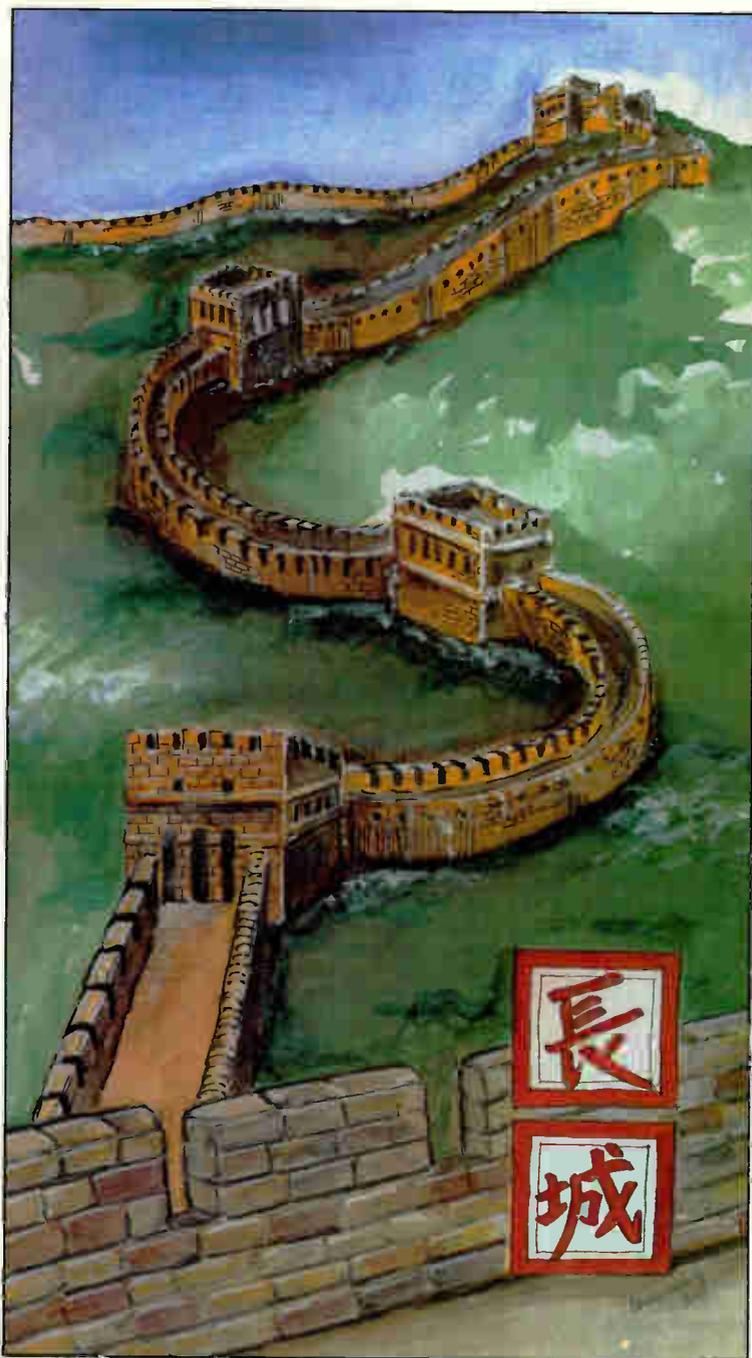
**S**ystem Architect 2.1, the CASE tool for structured design analysis that runs under Microsoft Windows, lets you take an entity model similar to that of the IBM Repository and expand it graphically to show both key and nonkey data. It supports supertype and subtype relationships and provides for automatic synchronization of any two data dictionary types.

System Architect runs on an IBM AT with Microsoft Windows 3.0. An OS/2 Presentation Manager version is scheduled to ship by year's end.

**Price:** \$1395; Booch Object Diagramming option, \$495.

**Contact:** Popkin Software & Systems, Inc., 11 Park Place, 19th Floor, New York, NY 10007, (212) 571-3434.

**Inquiry 1274.**



## Times Change. The Need To Protect Doesn't.

### RAINBOW TECHNOLOGIES

9292 Jeronimo Road, Irvine, CA 92718  
TEL: (714) 454-2100 • (800) 852-8569 (Outside CA)  
FAX: (714) 454-8557 • AppleLink: D3058  
Rainbow Technologies, Ltd., Shirley Lodge, 470 London Road  
Slough, Berkshire SL3 8QY. TEL: 0753-41512 • FAX: 0753-43610

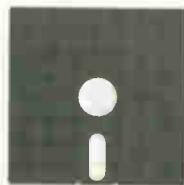
Software and data protection from Rainbow Technologies. Information on how you can have a little piece of the Great Wall to protect your software and data worldwide is as close as a toll-free call.

Copyright © 1990 Rainbow Technologies, Inc.



Whether you're protecting frontiers and temples in Manchuria, or software and data on the PC or Mac, the Great Wall is a lesson Rainbow Technologies has learned very well.

Software developers must deal daily with the consequences of



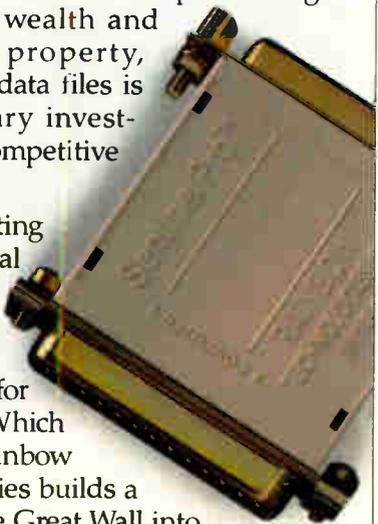
unauthorized copies and millions of dollars in lost revenue. At the same time, both individual and corporate users

must be able to make and distribute copies within legal guidelines.

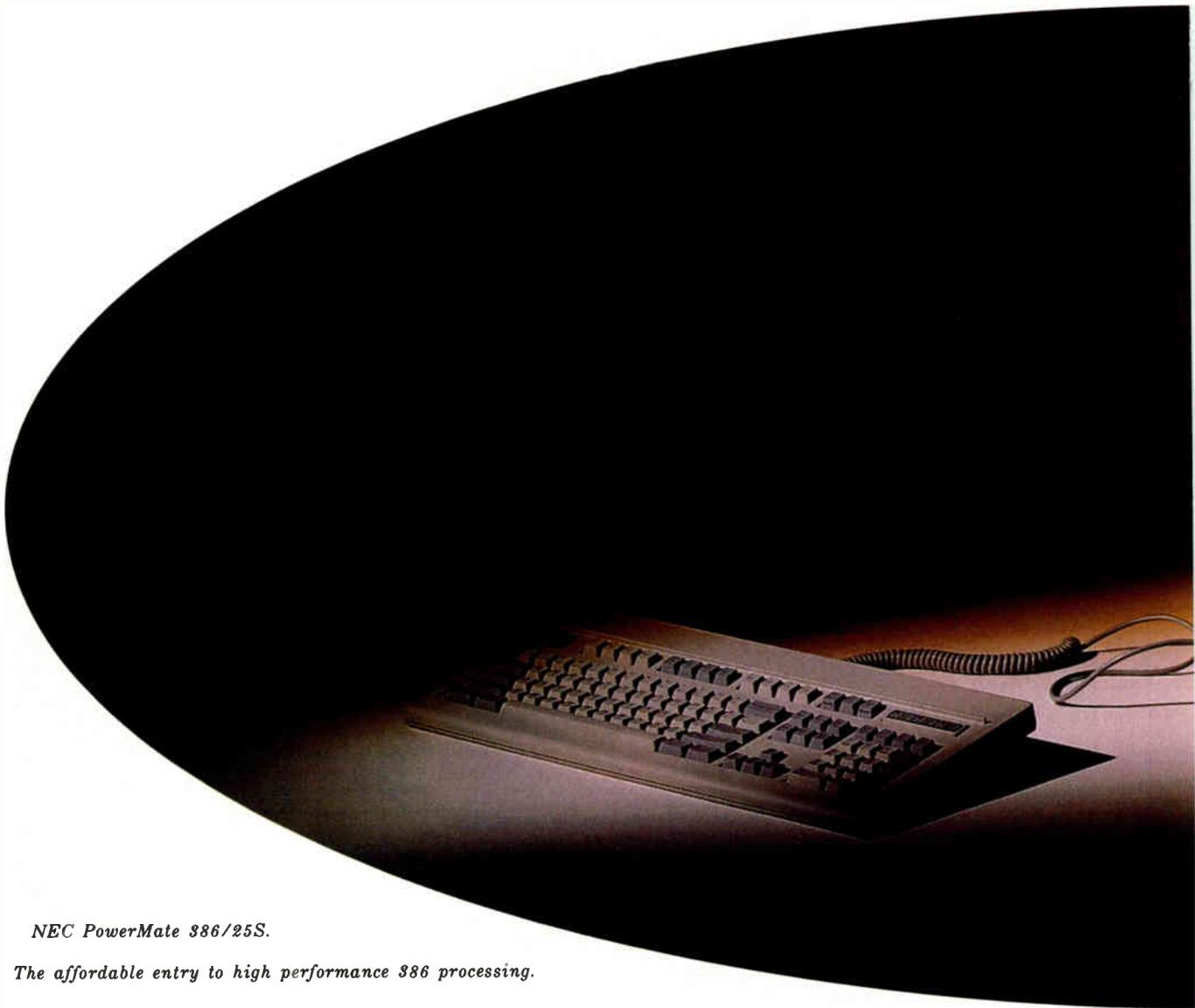
Today's information-driven companies must secure their data files against theft and unauthorized access. No less than protecting personal wealth and tangible property, guarding data files is a necessary investment in competitive survival.

Protecting "intellectual property" is the security challenge for the '90s. Which is why Rainbow Technologies builds a little of the Great Wall into every key it makes.

For developers, the Software Sentinel™ family of keys protects IBM, PS/2 and compatible software, while Eve™ guards software for the Mac. Rainbow's DataSentry™ is the solution for PC data protection.



# How to make the work go fast



*NEC PowerMate 386/25S.*

*The affordable entry to high performance 386 processing.*

For advanced applications like CAD/CAM, presentation graphics or financial modeling, you can't go wrong with the PowerMate® 386™/25S.

For far less than comparable 386 systems, you get 25MHz speed, 2MB

**C&C**

Computers and Communications

ter and the money go slower.



of RAM (easily expandable to 16MB via SIM modules) and a 32K memory

386 is a trademark of Intel Corporation

cache. You also get something you can't get from anyone else at any price:

PowerMate is a registered trademark of NEC Corporation

NEC. For more information call 1-800-NEC-INFO.

© 1990 NEC Technologies, Inc.

**NEC**

*Circle 255 on Reader Service Card*

World Radio History

## Occam Says, Go Ahead, Ask Me

Even with the best graphical user interface, it can still be difficult to find the right data in an acre-size spreadsheet and graph it appropriately.

Occam is addressing this problem with its new program for the Mac, called Muse. Muse lets you perform data retrieval, manipulation, and interpretation using English language through the keyboard or other input device such as the Voice Navigator. The program also lets you pull only the data you need from vast data sets and graph it immediately on your command.

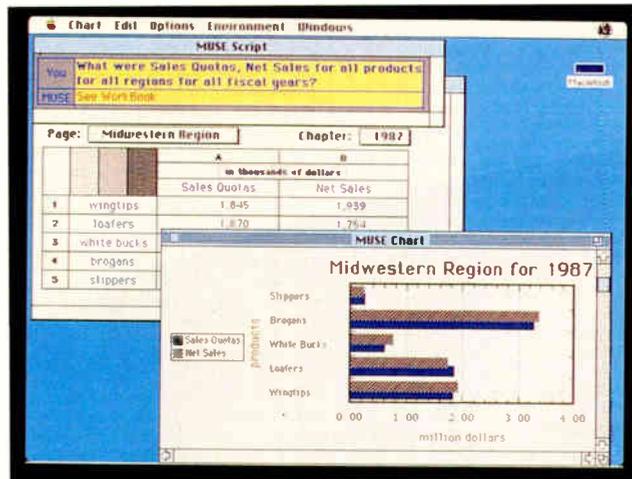
Muse can import data in flat files, ASCII, DBF, WKS, and several other formats. The program organizes data in databooks, which you can set up to reflect company divisions such as personnel, manufacturing, or sales. As you ask or type questions in English, Muse retrieves the relevant data and puts it into a workbook with the level of detail you need. When you want to graph a workbook, you simply type or say, "Graph that," and Muse does the rest, automatically numbering graphs by titles, legends, axis identification, and data identification. Graphs can be 2-D, 3-D, or animations.

Occam is releasing Muse to a number of corporate sites this fall, with general distribution targeted for 1991.

**Price:** \$695.

**Contact:** Occam Research Corp., 85 Main St., Watertown, MA 02172, (617) 923-3545.

**Inquiry 1276.**



*Ask and you shall receive is one of Muse's concepts. Another is to provide only the data that you need.*

## Generate Database Applications with PAM

**P**AM (for Program Automated Method) 2.0, the relational DBMS that includes an application generator and natural user interface, adds new data types, new relational capabilities, matrix table processing, expanded database capacity, and many other features, while running in less than 256K bytes of RAM on the IBM PC.

Designed for nonprogrammers, PAM 2.0 lets you design applications with built-in field verification. Support for transaction processing allows multiple fields in multiple databases to be updated in a single screen. PAM 2.0 also supports mathematical operations for multiple fields in databases from one numeric entry, allowing for easy update.

Advanced relational capabilities link one database to multiple records in another database without the need for common fields.

## Put an International Business Expert in Your PC

**F**or companies seeking to learn more about how to enter and succeed in the world marketplace, GateWaze has developed x-prime World Trader. The program's four integrated database modules let you look at information in a variety of ways through the use of hyperlinking.

The Market Analyst module provides a set of tools for analyzing the 50 major trading partners of the U.S.; the World Atlas module gives up-to-date information on 125 countries; the Info-Deck supplies a directory of

international contacts; and the Export Reference Guide offers information on the exporting process. Other features include currency, weight, and measures information; time-zone calculations; and an international glossary.

The program runs on the IBM PC with 512K bytes of RAM.

**Price:** \$289.

**Contact:** GateWaze, Inc., 66 Summer St., P.O. Box 743, Manchester, MA 01944, (800) 752-4711 or (508) 526-7406.

**Inquiry 1279.**

Version 2.0 supports Hewlett-Packard laser printers and mail merge.

**Price:** \$145 to \$345.

**Contact:** Software Composers, Inc., 4500 Newcombe Dr., Plano, TX 75093, (214) 985-8018.

**Inquiry 1277.**

## EASI Puts Forms and Database in One Package

**F**ormType 3.0 provides a forms creator and dBASE-compatible relational database in one package, letting you use the information that's collected in day-to-day operations to help you make business decisions.

FormType 3.0 supports form fill-in and report generation. A LAN version is available.

With FormType 3.0, you can link several different form types to the same database. This lets you store common information such as name, address, or sales history in one place, although it is used repeatedly in various office forms, Easy Automation Systems says.

You can perform relational database operations and integrate and transfer common information among the forms, saving keystrokes and reducing input errors.

FormType 3.0 runs on the IBM PC with 640K bytes of RAM. A run-time version lets value-added resellers and OEMs insert a company logo and application name into shrink-wrapped form sets.

**Price:** \$229.95; run-time version, \$99.95; LAN version, \$695 per server.

**Contact:** Easy Automation

Systems, Inc., 5555 Triangle Pkwy., Suite 440, Norcross, GA 30092, (800) 627-3274 or (404) 840-0474.

**Inquiry 1278.**

*continued*

D M P - 6 0 D L S E R I E S



CalComp<sup>®</sup> 1023

Houston Instrument  
DMP-61 DL

Hewlett Packard  
DraftPro<sup>™</sup> DXL

# Simply stated, we beat the pants off the competition.

See us at  
**COMDEX/Fall '90**  
Booth #4224

O.K., let's settle this performance thing once and for all. **SPEED.** In a recent comparison of throughput for the three top selling plotters, the Houston Instrument DMP-61 DL came out on top. One-third faster than the CalComp 1023. Over three times faster than the HP DraftPro DXL. In



## SCAN-CAD<sup>™</sup> Option

Turn your HI DMP Series plotter into a scanner with SCAN-CAD. This exclusive option attaches to your plotter to scan up to E-size drawings—all at a fraction of the cost of a stand-alone scanner.

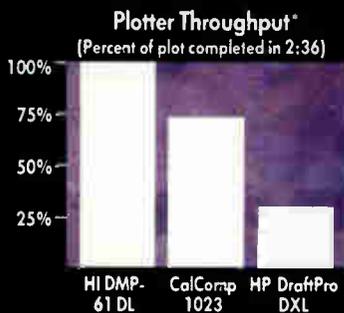
and superior same pen repeatability.

**VERSATILITY.** Only the Houston Instrument plotters offer Quick Scale<sup>™</sup> where any size drawing can be

easily scaled and plotted at the current media size, plus the capability to save up to six different user configurations in memory—all standard.

**PRICE.** Best of all, the HI DMP-60 DL Series helps you beat the pants off your competition all at a very competitive price. For more information on the DMP-60 DL Series plotters call 1-800-444-3425.

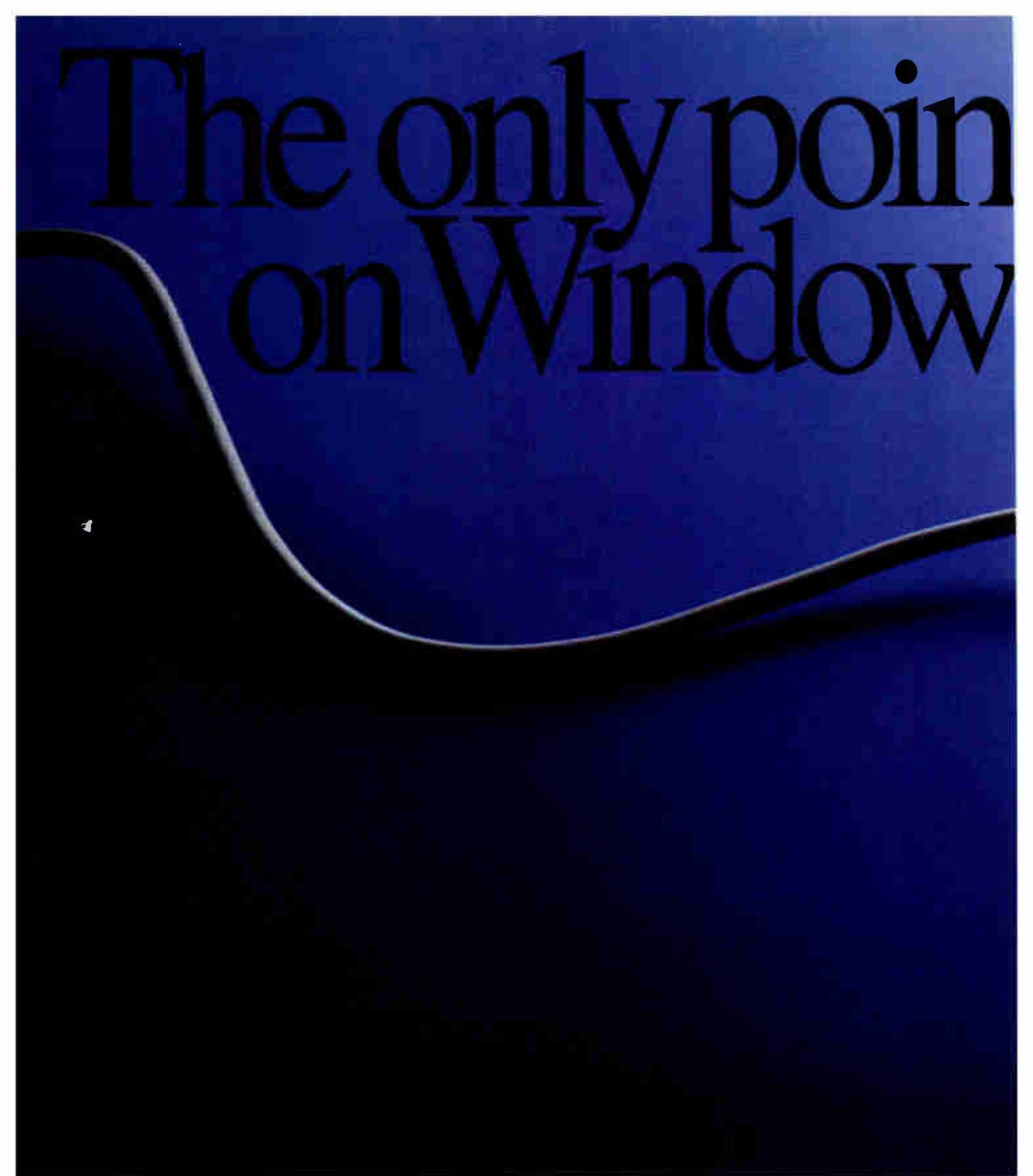
other words, whatever you plot in one hour with us could take you all afternoon with them. **QUALITY.** We also deliver unsurpassed quality with identical mechanical resolution to CalComp and HP,



**HOUSTON INSTRUMENT<sup>™</sup>**  
A Summagraphics Company

\* D-size Columbia plot using AutoCAD<sup>®</sup> Release 10 with the HP 7585 driver on a COMPAQ<sup>®</sup> 386 16 MHZ computer with math coprocessor. Plotters were set to manufacturer's recommended settings for pen and media combinations used for check plot and final plots. © 1990 Summagraphics Corporation, Seymour, CT 06483. All rights reserved.

For IBM/Compatible information circle 163, For Macintosh information circle 164, For Reseller inquiries circle 165 on Reader Service Card.



# The only point on Windows

As the people responsible for the Microsoft® Windows™ environment, we believe we're in a good position to offer some very sound advice on Windows Computing. And that,

as you've probably guessed by now, is the Microsoft Mouse.

You see, the Mouse allows you to navigate the Windows environment and applications with untold ease.

For more information, call (800) 541-1261, Dept. M29. Outside the U.S. and Canada, call (206) 882-8661. In Canada, call (416) 673-7638. © 1990 Microsoft Corporation. All rights reserved. Microsoft and Windows are registered trademarks of Microsoft Corporation.

# After you'll need Microsoft Computing.



As well as unparalleled accuracy.

Furthermore, we've made the decision to buy a Mouse even easier. Now it's available either with software, or on its own for the purist.

Visit a dealer and check it out for yourself. We think you'll see our point.

**Microsoft**  
Making it all make sense

The Microsoft logo are registered trademarks and Windows and Making it all make sense are trademarks of Microsoft Corporation. The Microsoft Mouse design is patented. (Design Patent #302, 426.)

## Visualize Protein Structures on the IBM PC

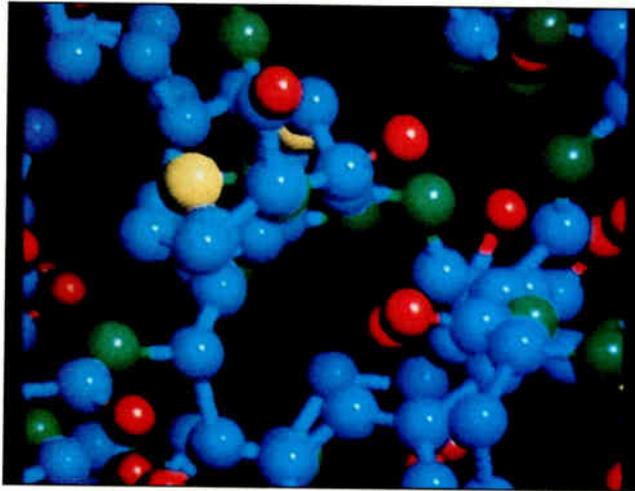
**A** molecular graphics tool called the Protein Visualizer lets you visualize how different chemicals and other substances interact with various molecules. The program lets you create 3-D models of complex protein structures and rotate, separate, and otherwise manipulate molecules for further study.

With the program, you can overlay up to four mixed-mode models at the same time. The overlays can show the interaction of substrates in an active-site cleft or hormones and their receptors, and capture the results.

Protein Visualizer features zooming, full-color space filling, and all-atom or main-chain display of up to 5000 atoms.

The program requires a 286 with VGA capability and 640K bytes of RAM. A hard disk drive is recommended. **Price:** \$495.

**Contact:** Synthetic Genetics, 10455 Roselle St., San Diego, CA 92121, (619) 587-0320. **Inquiry 1280.**



*The Protein Visualizer lets molecular biologists and immunologists visualize protein structures in 3-D.*

## Real-Time Process Modeling with OS/2

**W**ith RT-Graphics, you can create and edit graphical symbols and integrate them with sensor monitoring, simulation, and other real-time applications running under OS/2 Extended Edition and Presentation Manager.

Animated presentations can be in the form of histograms, dials, fluid levels, or other graphics. You can set up an application so that a change in the graphical display of a process is reflected in

the related alphanumeric text. This capability lets the program display numeric representations of sensor output values with their associated graphics symbols.

**Price:** \$1100; developer's library, \$800.

**Contact:** Commercial Software Dept., Farradyne Systems, Inc., 3206 Tower Oaks Blvd., Rockville, MD 20852, (800) 828-7863 or (301) 468-5568.

**Inquiry 1281.**

## What-If CAD Analysis

**O**nce you've completed a mechanical, architectural, or other drawing in VersaCAD, Claris CAD, PICT, or DXF format on the Mac, you can use vPower to describe the motion and rotation of objects. This what-if tool for CAD lets you see how your design works. A spreadsheet lets you assign up to eight value sets to an unlimited number of variables.

vPower runs on the Mac Plus with a recommended hard disk drive.

**Price:** \$799.

**Contact:** Vision Software, 3160 De La Cruz Blvd., Suite 104, Santa Clara, CA 95054, (408) 748-8411.

**Inquiry 1282.**

## Digital Elevation Model Data on CD-ROM

Two companies recently released digital elevation data from the U.S. Geological Survey on CD-ROM.

**R**ocky Mountain's CD-ROM set of 3-arc-second terrain elevation data has the contiguous U.S., Hawaii, and Puerto Rico.

**Price:** Complete set of five CD-ROMs, \$3000; one CD-ROM, \$1000.

**Contact:** Rocky Mountain Communications, Inc., 12844 West Iliff Ave., Lakewood, CO 80228, (303) 988-3395. **Inquiry 1283.**

**M**icro Map & CAD's CD-ROMs are available in two grids: a 3-arc-second grid and a 30-arc-second grid for the entire U.S.

**Price:** Complete set of six CD-ROMs, \$5000; one CD-ROM, \$1000.

**Contact:** Micro Map & CAD, P.O. Box 621135, Littleton, CO 80162, (303) 973-2768.

**Inquiry 1284.**

## Solve Math and Thermophysical Problems

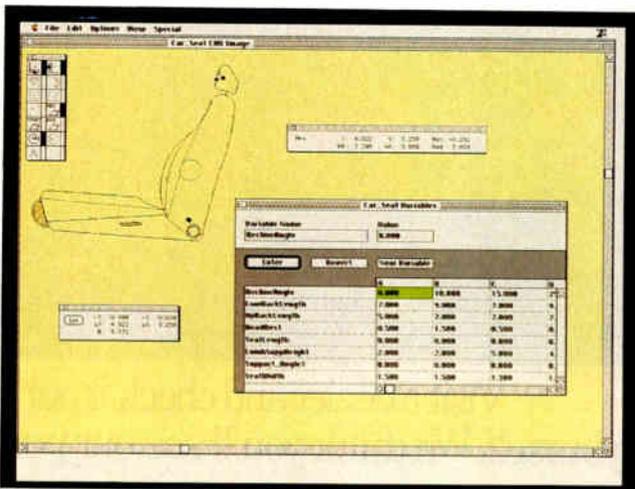
**I**n addition to solving algebraic and initial-value differential equations, the Engineering Equation Solver (EES) has a physical-property database to help you solve problems in the thermal sciences.

EES runs on the Macintosh with 1 MB of RAM and supports a math coprocessor if you have one.

**Price:** \$400.

**Contact:** F-Chart Software, 4406 Fox Bluff Rd., Madison, WI 53562, (608) 836-8536.

**Inquiry 1285.**



*In addition to showing how your Mac CAD drawings will work, vPower can revise a drawing with new specifications and parameters, making multiple versions of the same drawing.*

# We've got a new 2MB W.O.R.M.

## Now we're fishing for ideas from you.



Introducing the Optical Card, the remarkable new personal data storage and retrieval medium from Canon. An IBM AT-compatible RW-10 Reader/Writer uses a laser to read and write up to two Megabytes of digitized text, graphics or sound on the Optical Card (shown here actual size). Data can be added, but not erased, and isn't susceptible to magnetic or electrostatic fields.

The Optical Card and RW-10 combine speed, high reliability and convenience that just cry out for the development of entirely new systems applications. And that's where you come in.

Don't let this "big one" get away. Find out more about the Optical Card by calling Bruno Dosso at Canon at 516-488-6700, ext. 4535.

© 1990 Canon U.S.A., Inc., One Canon Plaza, Lake Success, NY 11042

**Canon**

Circle 67 on Reader Service Card

## Glue for Multimedia on the Mac and the IBM PC

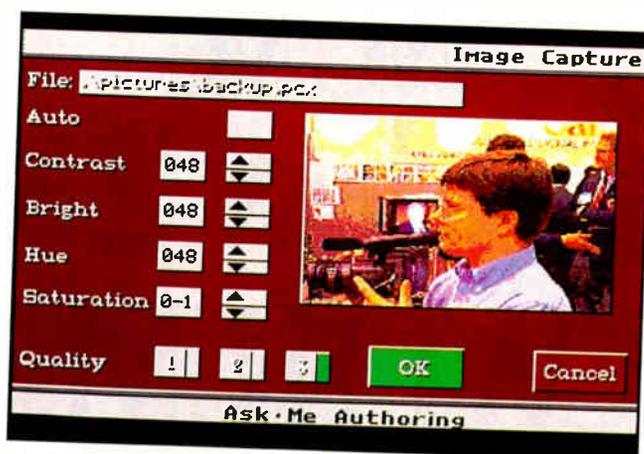
Two new programs help you combine video with sound, graphics, and animation. One runs on the IBM PC, the other on the Mac.

**A** new version of Ask\*Me—a program that integrates animation, voice, sound, graphics, and images into multimedia presentations—supports PCX image separation and manipulation and the ability to pan across images larger than your screen.

With Ask\*Me 2000 and its English-like programming language called Stratos, you can combine images from Autodesk Animator, video capture boards, PCX-compatible paint programs, and bit-mapped font packages that are in the GEM format with voice and sound to create interactive presentations. The program also supports looping, for canned, repetitive presentations. While the program includes Stratos, no programming experience is needed to create most applications.

Ask\*Me uses its own graphical user interface and comes in two versions: Ask\*Me 2000, for the casual user, and Ask\*Me Professional. The professional version includes a multiuser customizable image database that can open up to 256 files at once and supports full-motion video. This version also has an optional Display program for distributing run-time presentations. Run-time capability is standard with Ask\*Me 2000.

Ask\*Me requires at least a



Once you've captured a photo with Ask\*Me, you can manipulate image hue, contrast, and other attributes.

286 with a 28-ms or faster hard disk drive, 7 MB of free hard disk space, 640K bytes of RAM, and VGA graphics. **Price:** \$495 for regular version; \$1795 for professional version; \$195 for professional run-time license.

**Contact:** Ask\*Me Information Center, a division of Innovative Communication Systems, 2534 26 Ave. S, Fargo, ND 58103, (701) 293-1004. **Inquiry 1286.**

**U**nlike MacroMind's Director, which is a tool for creating professional-quality animation on the Macintosh, the company's MediaMaker is for nontechnical people who want to create relatively simple video presentations.

MediaMaker is divided into two parts: collections and sequences. Collections are media databases, snippets of video, compact-disk audio, Mac audio, graphics, and animations. You play back the

media selections by double-clicking on a picon, MacroMind's term for a visual cue of an image.

To create video presentations, you drag picons from the collection window to the sequence window, arranging and rearranging the media in desired order and editing the length of each clip. You can also synchronize other media such as CD audio and graphics. To use the program, it's best if you can tap into existing video libraries, the company says.

To use MediaMaker, you should have a Macintosh with support for color, a videodisk player, CD-ROM audio, a digitizing board, and a videotape recorder. A color Mac is not required.

**Price:** \$495. **Contact:** MacroMind, Inc., 410 Townsend St., Suite 408, San Francisco, CA 94107, (415) 442-0200. **Inquiry 1287.**

## Hand Recognition for Windows and the Mac

**D**atacap, developer of the Paper Keyboard handwriting recognition program for the Macintosh, now has a version for Microsoft Windows 3.0 that reads handwritten characters on paper forms directly from an off-the-shelf scanner. It recognizes names, addresses, dates, numbers, and multiple-choice check boxes without having to convert written characters to typed or printed text.

Datacap says that Paper Keyboard encounters, on the average, one character out of every 20 that it can't identify. When that happens, the correction portion of the program kicks in. With corrections, the program recognizes about 20 to 25 characters a second. Paper Keyboard also supports automated verification.

Datacap claims 99.9 percent accuracy with a target confidence of 9 (you can choose target-confidence levels from a scale of 1 to 10).

On the Mac or IBM PC with Windows 3.0, the program requires 2 MB of RAM, a hard disk drive, and a forms layout package. You also need an optical scanner. **Price:** \$895.

**Contact:** Datacap, Inc., 5 West Main St., Elmsford, NY 10523, (914) 347-7133. **Inquiry 1288.**

## Protect Your Unix Data from Power Loss

**W**ith their complex file structures and file buffering mechanisms, Xenix and Unix systems are susceptible to data loss when power is removed from the computer before it can write the buffers to disk. A program called PowerMon monitors signals from your

UPS and, when it detects a power loss, issues messages to users that the system may have to shut down if power isn't restored. If the power does not return within a certain number of minutes, PowerMon flushes everything in the system's buffers to disk, preventing data loss.

PowerMon runs on SCO Unix, SCO Xenix, and Unix systems from Sun, DEC, and IBM.

**Price:** \$149. **Contact:** Systems Enhancement Corp., 761 Spirit of St. Louis Blvd., Chesterfield, MO 63005, (314) 532-2855. **Inquiry 1289.**

**MANCHESTER  
EQUIPMENT COMPANY**



**HEWLETT  
PACKARD**

**A NEW  
BREAKTHROUGH IN  
LASER PRINTER  
TECHNOLOGY!**

**THE  
HEWLETT-PACKARD  
LASERJET III PRINTER**

**NEW FEATURES:**

- HP LaserJet Printer Compatibility
- 8 Page Per Minute Laser Printer
- Faster Graphic Throughput
- Resolution Enhancement Technology Creates Breakthrough Print Quality
- 600 dpi Emulations
- 8 Scalable Typefaces
- 14 Bitmapped Fonts
- Special Effects Such As Shadowing, Mirror Imaging and Multiple Print Directions



*Authorized HEWLETT-PACKARD Dealer*

**MANCHESTER EQUIPMENT CO., INC.**

*"The Computer Supply and Equipment Experts"*

SYSTEMS INTEGRATION ■ NETWORKING ■ CONNECTIVITY ■ CAD/CAM ■ DESKTOP PUBLISHING

**50 MARCUS BOULEVARD ■ HAUPPAUGE, NEW YORK 11788**

**(516) 435-1199 ■ (516) 434-8700 ■ FAX (516) 435-2113**

New York City  
(212)629-6969

Boca Raton  
(407)241-7900

Tampa  
(813)962-8088

Boston  
(617)739-1555

For additional information, ask for Dan Kalata

# WHAT'S NEW

METRO NEW YORK • NEW ENGLAND

## Use a Mac to Draw Etch-A-Sketch Images

The Mac, sometimes referred to by its detractors as a toy itself, has been adapted to draw images on that childhood favorite, the Etch-A-Sketch.

At the kickoff party held at the Boston Computer Museum for SPLash, a new users group sponsored by Symantec and geared toward Think programmers, inventor John Goodman unveiled his one-of-a-kind creation.

About 150 curious programmers and other guests crowded around an Etch-A-Sketch screen that was encased in a metal housing and featured a slot for a 3½-inch

floppy disk. By linking the metal housing to a Mac Portable, lent by Berkeley Macintosh Users Group director Raines Cohen, and inserting a demonstration disk, the Portable scribed the message "Happy 30th Birthday, Etchy" on the toy's LCD. The Mac also drew a picture of Etchy, the company's mascot for the toy.

The setup consisted of a serial-to-parallel interface that takes data from the Mac and sends it to two stepper motors attached to the knobs of the Etch-A-Sketch. Goodman later said he'd used a larger-scale version of the device to test software he wrote for a machine that moves according to x,y coordinates to cut pieces of wood. When used as a test machine, the Etch-A-Sketch provides a visual indication of

the reliability of the furniture-cutting software without having to actually test it on the bigger machine.

Goodman points out that one of the hardest things to do on the Etch-A-Sketch, draw a diagonal line, is easy to do with his device. "It's difficult to draw diagonals [on the Etch-A-Sketch by hand] because you have to turn both knobs at a consistent speed." The program can turn the Etch-A-Sketch knobs in increments of 0.005 revolution.

Goodman said he wrote the software for the program using Lightspeed Pascal. He probably won't further pursue the Etch-A-Sketch device, but he is investigating ways to further use the Mac in his work as a furniture builder.

—Kandy Arnold

## MacWorld Expo Features Databases

The Mac continues to be a platform favored by graphic artists and desktop publishers, but judging from products introduced at the MacWorld Expo in Boston, it will soon be as well known for serious business products, especially in the fast-emerging database sector.

Networking is another area that saw many new developments: There was a growing sense at the show of the interconnected, multiplatform nature of today's computing, and with it a lessening of the so-called religious war that has traditionally divided Mac and DOS partisans.

Oracle made a big splash at

**IME COMPUTERS** EST. 1981 ASK ABOUT OUR VOLUME DISCOUNTS!

*Quality Products at Liquidation Prices*

AT IME COMPUTERS, we buy only top quality excess inventory at below-wholesale prices. In addition to the lowest prices around, we provide courteous, knowledgeable sales assistance and support. Our supplies are limited and products tend to move fast! So call today to place your order or to get on our mailing list!

**NEW! Hi-Res Interface Boards PEPPER PRO 1024**  
 Made by Number Nine Computer  
 ■ On-board TI-TMS3410 graphics processor  
 ■ Up to 1024 x 768 pixels, non-interlaced  
 ■ 2-year manufacturer's warranty  
 ■ Works with popular software  
**\$799**  
 (List \$2495.00)

**XEROX 19" 2-PAGE SCREEN**  
 ■ Res. up to 1216 x 925  
 ■ Paper-white screen  
 ■ CGA, HGA & MDA  
 Includes adapter card, utility drivers, manual. 30-day IME warranty.  
 New. (List \$1,995.00)  
 For CAD, DTP, spreadsheets. **IME Price: \$349**

**15" Amdek Hi-Res Monitor**  
 ■ Monochrome—paper-white  
 ■ WYSIWYG—Res. to 1280 x 800  
 ■ Automatic mode switching  
 Includes drivers for all popular software, display card. 30-day IME warranty. New.  
 (List Price \$999.00) **IME Price: \$179**

**NEW! LAPTOP SIZE! Kodak Diconix 150 INK JET PRINTER**  
 Goes anywhere—fits in briefcase!  
**\$199**

**PC FLOPPY DISK DRIVES**  
 3½" • 1.44MB I/O Cards  
 AVAILABLE IN BEIGE SERIAL/PARALLEL ADAPTERS  
 \$69 EACH 10 FOR \$549

**THE MOST... ..FOR THE LEAST!**

**FUJITSU 7300 High-Speed Laser Printer**  
 ■ 18 pages per minute  
 ■ Installation included  
 List Price: \$9000. Our Price? Too unbelievable to publish! (It's under \$2000!) CALL US!

**XEROX 2700-II Heavy-Duty Laser Printer**  
 ■ 60,000 pages-per-month duty cycle  
 ■ Includes installation by Xerox-authorized rep.  
 Original List Price: \$27,000. Our Price? The lowest imaginable! (It's under \$1000!) CALL US!

**WY-150—14" Flat Screen Data Terminals—\$249**  
 PRIVATE LABEL MADE BY WYSE, LARGEST MFR. OF TERMINALS Labeled "Amdek", these terminals will substitute for: (ASCII) WY-50 or 50+, TeleVideo TVI-925 or 910+, ADDS Viewpoint A2; or (ANSI) DEC VT-52 or 100.  
 ■ Res. up to 1188 x 416 ■ ASCII 101-key keyboard  
 ■ RS-232C, 50-38.4Kbps ■ Tilts/swivel base  
 ■ 78Hz flicker-free amber display  
 ■ Overscanned video for full-screen image  
 ■ 24K high-speed static CMOS RAM

**ARCHIVE 2150S 150MB Internal Tape Drive** **NEW ITEM!**  
 GREAT FOR WORKSTATIONS AND NETWORKS  
 ■ SCSI interface (QIC-02/150 standard)  
 ■ Uses standard ¼" data tape cartridges  
 ■ Can be used with Sytaso software  
 ■ NEW! (List \$1100.00) **\$499**

**COMPLETE AMDEK 286 PC SYSTEMS**

Including: CPU, Hard Drive, Monitor and Keyboard

**INSTALLED & TESTED BY IME**

■ Amdek 1280 15" High-Resolution Monitor  
 ■ 1 Parallel Port & 1 Serial Port  
 ■ 7 Expansion Slots  
 ■ MS-DOS 3.3  
 ■ 1.2MB Floppy Drive  
 ■ 102-key Keyboard  
 ■ 90-day IME Warranty

**HI-RES AT LOW COST FOR THE POWER USER**  
**12.5MHZ-1MB-96MB \$1199**

**All New! Includes:**  
 ■ Private Label (CPT) 12.5MHz 80286  
 ■ 1MB RAM (16MB addressable)  
 ■ Rexon-Labelled Keyboard ■ Keyboard Lock  
 ■ 96MB Maxtor Drive ■ One Wait State  
 ■ DTC 3280 Controller ■ 3 Storage Bays

**OTHER AVAILABLE OPTIONS**  
 ■ CPU SYSTEM ONLY .....\$549  
 ■ 19" Xerox 2-Page Display...add \$170  
 ■ 13" EGA Color Monitor...add \$59  
 ■ 13" Zenith (Private Label) VGA Color Monitor...add \$189  
 ■ 3.5" 1.44MB Floppy Drive.....add \$69

**AT&T Model 455 Daisywheel Printer**  
 WIDE CARRIAGE • PARALLEL INTERFACE • 55 CPS  
 REFURBISHED—LIKE NEW **\$129**

**Microsoft Bookshelf**  
 CD-ROM 10-VOLUME REFERENCE LIBRARY  
 LIST \$299.00 **IME PRICE: \$79**

**MAXTOR LXT-100 HARD DRIVES** 96MB • 26ms  
 3.5" • HALF-HEIGHT • SCSI  
 1-Year IME warranty  
 Internal—\$449 External—\$549  
 Disk Manager software included!

**PLUS SUPER VALUES ON OTHER MAXTOR DRIVES**

Model# CONDITION	XT-3280 NEW or USED	EXT-4380	XT-8760E Recertified
Formatted	244MB	319MB	677MB
Unformatted	280MB	380MB	769MB
Interface	SCSI	ESDI	ESDI
Height	Full	Full	Full
Ave. Seek Time	30ms	27ms	16.5ms
IME Warranty	90 days (30 if used)	90 days	1 year
Last List Price	\$2,265.00	\$2,325.00	\$3,855.00
IME Price	\$699 or \$599	\$999	\$1799

EXT-4380 Drive + DTC 6280 Controller **IME Price: \$1199**

**Maxtor HD Kits w/ Controllers**

XT 8760E Drive + DTC 6280-15T Controller **IME Price: \$1999**

**Call (800) 999-1911**

INTERNATIONAL CALLERS: (617) 254-1700  
 FAX (617) 254-0392 BOSTON, MA

VISA MasterCard **NO SURCHARGE**

# INDUS

## AFFORDABLE POWER FOR A NEW GENERATION

### from CompuLynk! 2 YEAR WARRANTY

**The Indus Tall 386-25**

- 2 Megs RAM
- 1.2 or 1.44 Mb
- 80 Meg Hard Drive
- 1:1 Dual HD/FD
- 16 Bit VGA Card
- FCC
- 14" NEC VGA Color Multisync Monitor
- 1 Parallel & 2 Serial Ports
- 101 Enhanced AT Keyboard
- MS-DOS 3.3 or 4.01

**ONLY \$2695.**

**FREE**  
Microsoft  
Windows 3.0

**The Indus 386 SX**

- 1Meg RAM
- 1.2 or 1.44 Mb
- 40 Meg Hard Drive
- 16 Bit VGA Card
- 14" NEC VGA Color Multisync Monitor
- 1:1 Dual HD/FD
- 1 Parallel & 2 Serial Ports
- 101 Enhanced AT Keyboard
- MS-DOS 3.3 or 4.0
- FCC

**ONLY \$1795.**

**COMPLETE SYSTEMS**  
386-33 MHz \$2995 486-25 MHz \$4555

### READY-TO-GO Complete Pre-Installed Networked Systems For Multiuser/Multitasking Capabilities

**NOVELL ELS II 2.15**

- Hardware (3 Users)
- Software (5 Users)
- Cables

**ONLY \$2995.**

**SPECIAL PRICES**  
286, 386 Portables & Laptops

**VGA 1024X768 Monitor & Card \$489**

**ALLOY MULTWARE 386**

- Hardware (3 Users)
- Software (5 Users)
- Cables

**ONLY \$1995.**

#### System Upgrades

- Additional 1 MB RAM ..... \$95
- Additional 1.2 or 1.4 MB Drive ..... \$95
- 85 MB SCSI with Controller ..... \$250
- 100 MB IDE with Controller ..... \$350
- 110 MB RLL with Controller ..... \$375

- Send Fax/Modem ..... \$95
- 2400 Baud Modem ..... \$69
- Internal Tape Back-up Kit (60MB) ..... \$395
- External Tape Back-up Kit (60 MB) ..... \$595
- SPECIAL 42 MB Hard Drive with Disk Cache Software ..... \$195

TRW ON-SITE SERVICE

### Order Now Toll Free!

# 1-800-969-9889

"Call us for any of your software needs"

Hours: Mon.-Fri. 9 am-7 pm ■ Sat. 9 am- 3 pm  
Eastern Standard Time



COMMERCIAL LEASING  
AVAILABLE

Circle 368 on Reader Service Card (RESELLERS: 361)

# CompuLynk

"The Computer Solution Company"

180-B Turnpike Road • Westboro, MA 01581

International Orders Welcome

Tel. 508 898-3731 • Fax 508 898-2548

Registered Trademarks are proprietary to their respective manufacturers.



the beginning of the week by announcing the first Structured Query Language (SQL) client/server database that will run natively on the Mac. The Oracle Server for Macintosh isn't expected to ship until 1991, but it could legitimize the Mac as a database machine.

Oracle's introduction almost overshadowed upgrade announcements by Mac database leaders Acius and Odesta. Acius said it has begun shipping the new \$795 version 2.1 of 4th Dimension and a new \$995 four-dimensional compiler that improves performance by three to 1000 times, depending on the application.

Odesta announced a new release of Double Helix, which the company said will offer better performance, improvements to the interface, and

new data-viewing utilities. Double Helix 3.5 costs \$595.

Meanwhile, DOS database king Ashton-Tate introduced the first in an expected family of Mac database products. The company recently divested its dBASE Mac application—which was completely different from dBASE for DOS—to New Era Software, saying that it would instead focus on producing dBASE IV-compatible Mac products. The first of these, dBASE IV RunTime Plus, is a character-based application, intended for networked environments, that lets Mac users access and modify dBASE III Plus and dBASE IV files.

The new dBASE IV RunTime Plus runs in a Mac window but makes it look like a DOS screen, so that most existing dBASE applications

can run unmodified on the Mac. It requires an Apple-Share File Protocol-compliant network to run in multiuser mode. Ashton-Tate says the product was developed to satisfy the demand of many customers for a way to use existing dBASE programs on their Macs and in multiplatform networks.

Another odd but potentially important database announcement came jointly from Informix and Dupont Imaging Systems. Dupont makes the MacBlitz board, a \$10,000 NuBus add-in that contains an Intergraph Clipper RISC CPU and 8 to 32 MB of RAM. The board runs a full version of Unix System V 3.1. Informix and Dupont announced that versions of Informix SQL and Informix On-Line, the company's two

leading minicomputer-scale databases, will be available for the MacBlitz board. Although this is a far cry from Oracle's native-mode Mac SQL database, it is a viable if pricey use of the Mac as a database server.

Because MacBlitz lets you run Unix and the Mac OS on a Mac at the same time in parallel, Informix database users will now be able to use WingZ and its Datalink SQL querying tool to execute sophisticated database applications on a single Mac or across a Mac network. This development typifies the role that Informix has always believed WingZ should play as a flexible, configurable front end, preferably to the company's own SQL database systems.

—Andy Reinhardt

# MICRO DESIGNS

**HIGH PERFORMANCE  
CUSTOM COMPUTERS**

1117 SHIFTING SANDS DRIVE  
LAS VEGAS, NEVADA 89108

**702-646-8664**

**800-477-0245**

**FAX: 702-646-4976**

**HOURS: Mon - Fri: 9-7, Saturday: 12-6**  
**MasterCharge & Visa Accepted.** Prices may vary and are subject to change. Also subject to stock on hand. Prices are cash only. 4% charge for MasterCharge & Visa.

**AUTHORIZED MYLEX DEALER.** Dealer inquiries welcome. 1 years Parts/Labor Warranty on all Mylex boards.  
 Mylex boards, Mylex motherboards and configurations available.

## CONFIGURATIONS

### MICRO 286-12 SYSTEM

- Micro 286-12 Motherboard
- One Meg Ram
- Baby AT Case
- 200 Watt Power Supply
- TEAC 1.2 Meg Floppy Drive
- 20 Meg Hard Disk
- 1:1 Interleave Controller
- 12" Mono Monitor
- Mono Graphic Video Card
- 101 Key Keyboard
- 1 Parallel Port
- 2 Serial Ports
- 1 Year Warranty

\$750.

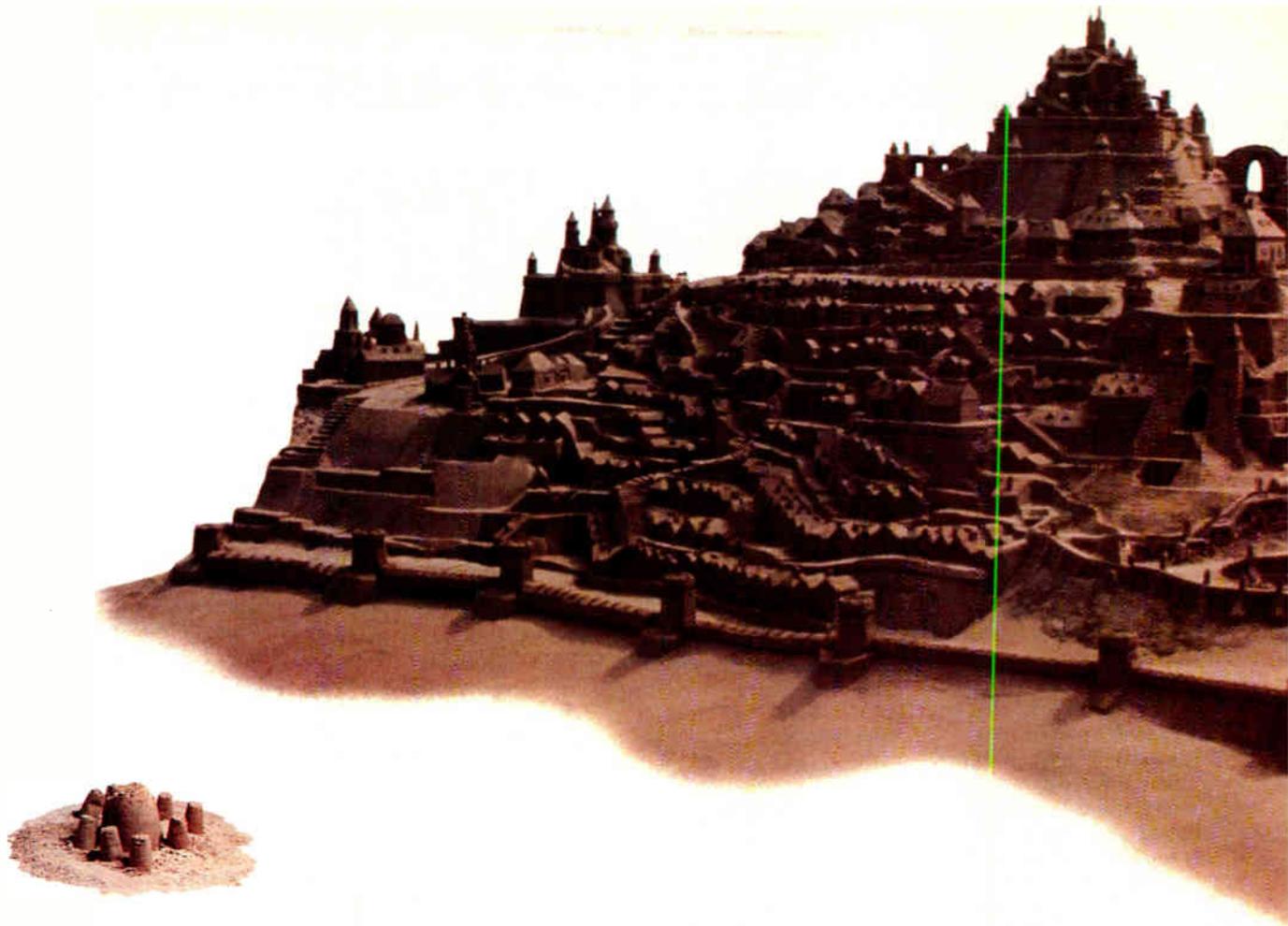
### MICRO 386-SX SYSTEM

- Micro 386-12 Motherboard
- One Meg Ram
- Baby AT Case
- 200 Watt Power Supply
- 1.2 Meg Floppy Drive
- 20 Meg Hard Disk
- 1:1 Interleave Controller
- 12" Mono Monitor
- Mono Graphic Video Card
- 101 Key Keyboard
- 1 Parallel Port
- 2 Serial Ports
- 1 Year Warranty

\$950.

## UPGRADES

- |                              |                              |
|------------------------------|------------------------------|
| VGA ..... \$325              | 65 Meg Hard Disk ..... \$175 |
| 40 Meg Hard Disk ..... \$100 | 1.44 Meg Floppy ..... \$ 69  |



## Now you can build more in a day.

HyperPAD® 2.0, a powerful software construction set for MS-DOS® systems, dramatically increases your productivity. Applications that might take months to build with tools like Pascal, C, or BASIC now take only minutes.

PC Week calls HyperPAD "the first PC program that can compare with HyperCard®." HyperPAD 2.0, now updated with over 100 new features and improvements, has almost limitless potential for creating and customizing tutorials, help systems, software prototypes, front ends to databases, networks, or CD-ROM devices, executive information systems, and dozens of other applications.

It's easy. HyperPAD's object-oriented environment gives you all the building blocks you need for maximum productivity. Its English-like scripting language is easy to use and learn, with dozens of samples to get you started.

It's flexible. HyperPAD will take you into the 90's with a full set of development tools. Its open architecture lets you easily use data stored in dBASE and ASCII files. If you need to, you can even write C or assembly language extensions.



It works on your PC. HyperPAD 2.0 is compatible with almost all PCs. You don't need a high-performance processor, multiple megabytes of memory, a graphics card, or a mouse. You get the benefits of a graphical user interface without investing in Microsoft® Windows™ or OS/2.

And now it's only \$59.95 for Pascal and BASIC users. Order before December 31, 1990, to get HyperPAD 2.0 for only \$59.95 directly from Brightbill-Roberts (suggested list \$149.95). Mention this ad and receive a royalty-free runtime module. 60-day money-back guarantee. VISA, MasterCard, American Express, or C.O.D.

Call 1-800-444-3490 today.

Try HyperPAD 2.0 on your next project. No one will ever know how much time you didn't spend.



120 E. Washington St., Syracuse, N.Y. 13202

HyperPAD is a registered trademark of Brightbill-Roberts & Company, Ltd. All other trademarks and registered trademarks are the property of their respective holders. Call for upgrade information. ©1990 Brightbill-Roberts & Company, Ltd.

Circle 554 on Reader Service Card

NOVEMBER 1990 • B Y T E 72NE-5

## Embeddable Graph Program, Executive Style

Developers can now incorporate Graph-in-the-Box Executive in their own programs, thanks to a new run-time version of the TSR graphing package. New England Software will license its pop-up data manipulator to developers on a royalty basis.

Graph-in-the-Box Executive is the latest version of the company's diminutive package for graphing, charting, and manipulating numeric data captured from other DOS applications. The program will convert information into 15 different chart types, including bar, pie, line, and spline. This version can generate three-dimensional charts and 14 types of text fonts. Data-manipulation functions include 57 statistical and mathematical procedures. A graph can contain up to 1000 data points.

Graph-in-the-Box cannot extract data from Windows applications because it reads screen memory, which has to be in character mode for the program to work with it.

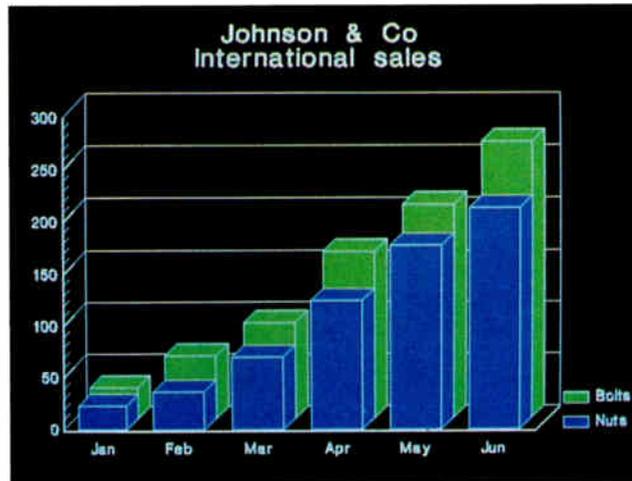
The Executive version occupies less than 10K bytes; when in use, it swaps into memory from the hard disk. The graphing package can be easily accessed with interrupt calls in the host program, the company says.

New England Software is "extremely flexible" in terms of licensing its programs, a company official said. Payments are based on volume expectations and whether or not you're developing a commercial application.

**Price:** Licensing arrangements.

**Contact:** New England Software, Greenwich Office Park 3, Greenwich, CT 06831, (203) 625-0062

**Inquiry 1179.**



*With the run-time version of Graph-in-the-Box Executive, you can embed graphing capabilities into your application.*

## Help for House Buyers

Home Buyer doesn't promise that it will keep you from taking out a mortgage on that frightful abode in *The Amityville Horror*, but it

is intended to help you through the process of purchasing a house. One of its primary functions is to assist in calculating the amount of money you'll be able to borrow. Fintech Software says that its PC program will sort through loan and payment options to determine which house and

which mortgage plan fit your financial situation.

The menu-driven software will evaluate most types of mortgages, from fixed- and adjustable-rate, to VA-guaranteed, to balloon payments. Home Buyer can figure closing costs, annual percentage rates, and amortization schedules. It will also help you evaluate personal preferences and define your dream house, Fintech says.

**Price:** \$69.95.

**Contact:** Fintech Software Corp., 201 Eagle Bay Dr., Ossining, NY 10562, (914) 923-4611

**Inquiry 1181.**

## Enhancements for Enhanced 1-2-3 Release 3.1

Lotus 1-2-3, in the form of release 3.1, finally runs under Windows, but it can't do everything. The spreadsheet program still relies on add-on software to handle some functions.

Intex is offering modified versions of Forecast!, Inventory Analyst, Rescue Plus, Trans, Financial Toolkit, Bond Calculations, Mortgage-Backed Calculations, and Option Price Calculations.

Intex also said that it will have a new version of its automatic backup program, Guardian, ready by the end of the year.

**Price:** Forecast!, \$145; Inventory Analyst, \$199.95; Rescue Plus, \$149.95; Trans for 1-2-3, \$95; Financial Toolkit, \$199.95; Bond Calculations, \$495 and up; Mortgage-Backed Calculations, \$495 and up; and Option Price Calculations, \$495.

**Contact:** Intex Solutions, Inc., 161 Highland Ave., Needham, MA 02194, (617) 449-6222

**Inquiry 1182.**

## HyperCard 2.0 Programming Made Easier with HyperTools

Trendware's two new add-on toolkits take advantage of—and improve upon—many of the features of HyperCard 2.0.

Version 2.0 of HyperTools #1 includes several tools that will appeal to programmers, such as a cross-reference function that searches for text strings, global definitions, or message handlers. The referencing tool lets you narrow a search to a specific card, background, or all cards. You can also use it to produce a variety of reports.

Other components include a cursor editor; group tools for moving objects and data to other cards, backgrounds, or stacks; tools for aligning and moving groups of fields and buttons; and several others. HyperTools

#1 also lets you create animations for use in training manuals and other applications.

HyperTools #2 provides a pattern mover, a protractor, and 14 other tools, including an airbrush that improves upon the one in HyperCard 2.0 by providing better control and a testing area for palettes, a tool for ensuring the correct entry of data into fields, a card sorter, and a utility for managing and assigning up to 60 HyperTalk scripts to 15 function keys on an extended keyboard. Trendware recommends 2 MB as a minimum system configuration.

**Price:** \$99.95 per toolkit.

**Contact:** Trendware Corp., P.O. Box 2285, Huntington, CT 06484, (203) 926-1116.

**Inquiry 1180.**

REGISTER TODAY FOR YOUR FREE E-MAIL BOX!

# INTEGRATE

Plug in to the networked trade show floor!

# YOUR

Test drive products on the INTERFACE/91 network!

# INFRASTRUCTURE

Get interactive at INTERFACE/91!

At INTERFACE/91, the focus is Corporate Networked Computing. The approach is "less talk, more action." *The entire exhibit floor will be networked*, enabling you to re-create your own computing environment and "test drive" a broad spectrum of products and systems. Hands on. In context!

You'll be able to stand on the INTERFACE/91 networked show floor and access detailed, on-line information on every thing from new products to Conference sessions to local restaurant listings! You'll also be able to locate products, systems, companies, and people because every pre-registered attendee will have an E-Mail box on The Network!

And don't miss the INTERFACE/91 Conference with its singular focus on applications and strategies for business. With special sessions for professionals in accounting, institutional investing, insurance, financial services, law, publishing, education, and government. There will be sessions dedicated to the more technical system design and integration issues, as well.

#### Attendees:

**Sign up today for your free E-Mail box at INTERFACE/91. Call (617) 449-8938, fax (617) 449-2674, telex 174273, or send in the coupon today.** (Remember, you *must* pre-register to get an E-Mail box at the Show.)

#### Exhibitors:

To exhibit at INTERFACE/91 in Atlanta, call (617) 449-6600, ext. 4023, fax (617) 449-6953, telex 174273, or send in the coupon

#### *Plug Me In To The Network At INTERFACE/91*

March 26-28, 1991 • Georgia World Congress Center • Atlanta, GA U.S.A.

- Reserve a free E-Mail box in my name, and sign me up for the Show. I have enclosed a check for \$25 made payable to INTERFACE/91.
- Please charge the \$25 to my credit card.
- Please send me Exhibitor information.

Card Name \_\_\_\_\_

Card Number \_\_\_\_\_ Expiration Date \_\_\_\_\_

Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip/Postal Code \_\_\_\_\_

Country \_\_\_\_\_

Phone (\_\_\_\_\_) \_\_\_\_\_

Fax (\_\_\_\_\_) \_\_\_\_\_ BM 11/90

Mail To: INTERFACE/91, Direct Marketing Services, 300 First Ave., Needham, MA 02194 U.S.A.

## INTERFACE®/91 EXPOSITION & CONFERENCE

CORPORATE NETWORKED COMPUTING

March 26-28, 1991 Georgia World Congress Center Atlanta, GA U.S.A.

Produced by The Interface Group • 1990 • 300 First Avenue, Needham, MA 02194 U.S.A.

# WE'LL TAKE ON

## *OUR 386/SX OR 386/25 DELIVERS THE POWER AND FEATURES YOU NEED.*

Known world-wide since 1986 for high performance systems and the SQUARE line of computers, Reason Technology introduces the new low-cost R/SX and R/325 computer systems. These systems are packed with a full 4 MB of RAM and a fast 105 MB hard drive to provide the power and performance needed for today's demanding applications. We have 4 years experience providing personal computers to the most demanding markets here and abroad, and 25 years experience in providing high performance/high quality products to the computer market. This combination of price, performance, quality and experience provides you with a computer, and a company, you can depend on.

*WE HAVE THE KNOCK-OUT  
COMBINATION OF FEATURES,  
VALUE, QUALITY AND SUPPORT  
THAT SAYS, "BUY TODAY!"*



**LEASING AVAILABLE**

Copyright 1990, Reason Technology, 80386 and 80386 SX are trademarks of Intel Corporation. Reason Technology reserves the right to change prices. Quantities may be limited.

# ANY CHALLENGER.

## **4 MB RAM AND 105 MB HARD DRIVES MAKE THESE SYSTEMS HEAVYWEIGHT CHAMPIONS.**

Whether for home or office, you can now afford a system with the memory and storage that will give you optimum performance today and equip you for new applications to come. With Reason, you don't have to settle for less.

## **FULL 14" COLOR VGA VIDEO INCLUDED WITH EVERY SYSTEM.**

A 16-bit 800 X 600 VGA display adaptor is mated to a high-resolution 14" VGA color display to provide a high-performance video system to meet today's demanding graphics applications.

### **386/SX**

- Intel 80386/SX 16Mhz processor
- 4 MB RAM
- 105 MB (25 MSEC) hard drive with 32k cache controller
- 1.2 MB floppy drive
- 16 bit—800 X 600 VGA adaptor
- High-res 14" color monitor
- 101-"click" keyboard

## **\$1,995**

40MB with 2 MB RAM  
\$1,595

### **386/25**

- Intel 80386-25 25 Mhz processor
- 4 MB RAM
- 105 MB (25 MSEC) hard drive with 32k cache controller
- 1.2 MB floppy drive
- 16 bit—800 X 600 VGA adaptor
- High-res 14" color monitor
- 101-"click" keyboard

## **\$2,495**

Call for 386/33  
and 486 pricing

## **BUY WITH CONFIDENCE FROM A SUPPLIER YOU CAN TRUST.**

### **ORDERING IS EASY**

- Visa, MasterCard, Discover—  
with NO surcharge
- Same day shipping (call for  
details)
- Courteous, no-pressure sales  
technicians

### **SATISFACTION GUARANTEED**

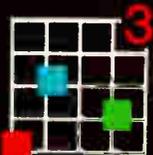
- 60-day money-back guarantee  
(call for details)
- 1-year full warranty
- Overnight parts replacement
- On-site service available

### **CUSTOMER SERVICE**

- Unlimited toll-free tech support
- Extended hours to serve your  
needs
- Custom configurations  
available

Circle 581 on Reader Service Card

**COMPARE THE OTHERS; CALL US LAST:**



# **REASON TECHNOLOGY**

# **1-800-542-2049**

290 Coon Rapids Boulevard, Minneapolis, MN 55433—612-786-4792, FAX 612-780-4797

## Fox Applications Without Writing Code

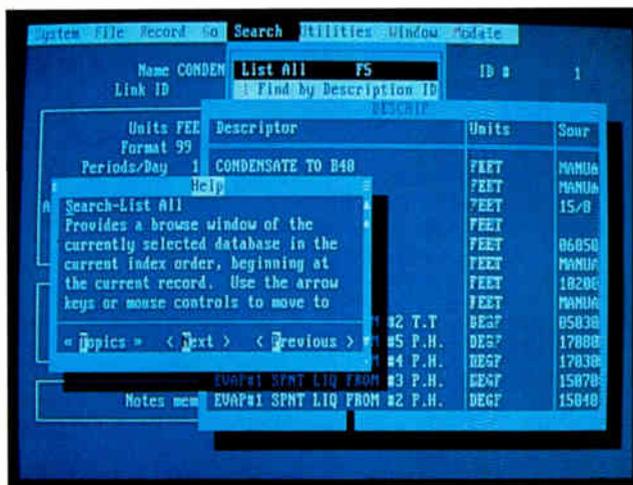
A new version of Plaid Software's application generator for FoxBase +/Mac and FoxPro eliminates the problems created when you change the code in your application but your screen generator isn't aware of it. Called Son of SnapApp, the program lets you lay out a data input screen and output code directly into a module created with SnapApp, letting you alter the screen by making changes to the code or by using the screen painter.

The original version of SnapApp supported pull-down menus, built-in multiuser code, on-line help, and the ability to index on the fly. Son of SnapApp supports all those features, plus the ability to define a scrollable pick list of items and lookup fields for multifile applications.

**Price:** \$139.95.

**Contact:** Plaid Software Group, 1417 Main St., Suite 2, Little Rock, AR 72202, (800) 776-0739 or (501) 375-6622.

**Inquiry 1171.**



*Son of SnapApp lets you create a file application with scrollable pick lists, multiple screens, automatic index generation, and multiuser record locking without having to write any FoxBase +/Mac or FoxPro code.*

## Music Notation Software for Windows 3.0

Coda Music Software, developer of the Finale PC music notation program for the IBM PC, says that its version for Windows 3.0 is up to five times faster for functions such as note entry, copying music, recalculating, and screen redraw than the previous version.

In addition to the speed increase, new features of Finale

PC 1.1 include drivers that let you use MIDI in standard mode, and the ability to specify inches, centimeters, picas, or points as the global unit of measurement. Other new features include a Hand Grabber tool, for moving around the page without having to use scroll bars, and a Zoom tool.

**Price:** \$599.

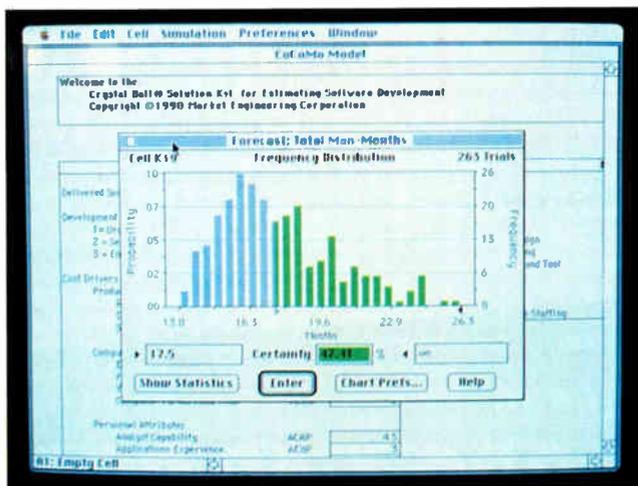
**Contact:** Coda Music Software, 1401 East 79th St., Bloomington, MN 55425, (612) 854-1288.

**Inquiry 1174.**

## Estimate Software Completion with Monte Carlo

CB CoCoMo combines the Constructive Cost Model and Monte Carlo simulation to let you estimate the cost, required working hours, and completion date of your software project, with worst case, best case, and most likely scenarios.

CB CoCoMo lets you assign a range of numbers with probabilities for each input variable (e.g., program size and programmer ability). Instead of one result, the program provides several estimates with varying degrees of confidence.



*With CB CoCoMo, you can forecast the number of programming hours necessary to complete a given project. The program also helps estimate cost and labor projections on the Mac.*

CB CoCoMo lets you obtain scheduling, staffing, and financial information on a development at any project stage. The program can also help estimate cost and labor projections. The program can produce several types of analysis graphs. It runs on the Mac SE or higher.

In addition to a specific version for software management, the company says it plans to release similar programs for oil and gas projects, inventory level, and general project management.

**Price:** \$495.

**Contact:** Market Engineering Corp., 1738 Wynkoop St., Suite 200, Denver, CO 80202, (303) 298-0020.

**Inquiry 1173.**

## Access Publishes a Paperless Novel

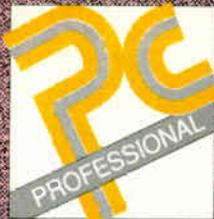
While we've all been waiting for the predicted paperless office to become a reality, a company in Littleton, Colorado, has come out with a paperless novel. Prospective authors can submit manuscripts in ASCII format, and Access Publishers will consider it for publication in the areas of mainstream, contemporary, and science fiction. If the company accepts the manuscript, it couples it with a program that lets the reader move from page to page and chapter to chapter. The novel will also include a computer bookmark to save your place.

The first computer novel, *Premie*, is available now. It is the equivalent of 320 pages.

**Price:** \$12.50.

**Contact:** Access Publishers, 1078 East Otero Ave., Littleton, CO 80122, (303) 797-2821.

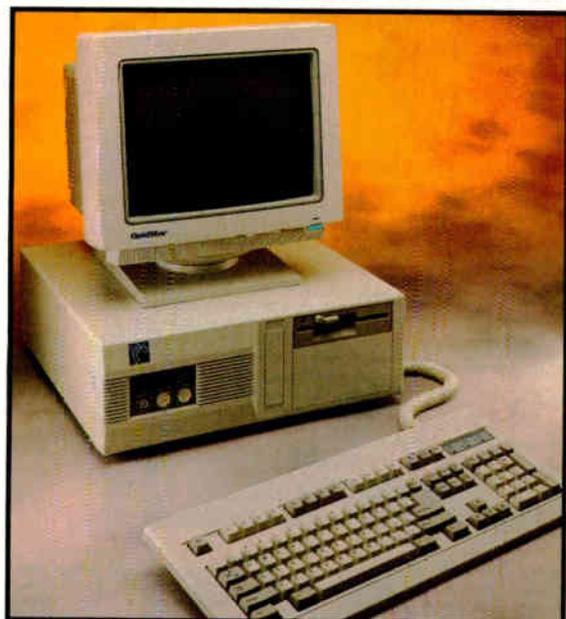
**Inquiry 1172.**



**Computer  
Sales  
Professional**

ORDER NOW (201) 563-9628—OR CALL TOLL FREE  
**1-800-950-6660**

# Unbeatable Performance



## The PRO-386SX \$719

If you're considering a 386 system, reexamine your options.

The PRO-386SX—with the storage, flexibility, multitasking and software capabilities of a 386—keeps you ahead of the times, without overdrawing your budget.

- Intel 80386SX Microprocessor running at 16MHz with zero-wait state.
- 1MB standard; expandable to 4MB on board (or to 16MB using 16-bit expansion board); Supports LIM/EMS 4.0
- Intel 80387SX coprocessor support
- Six 16-bit and two 8-bit expansion slots
- 5¼" 1.2MB or 3½" 1.44MB floppy disk drive
- Two serial, one parallel port
- Real Time clock / calendar with battery backup
- AMI BIOS
- 101-key enhanced keyboard
- Shadow RAM Support

	Landmark v.1.14	Norton SI v.4.5	386SX	VGA Mono	Super VGA
COMPAQ 386/16	20.6	17.6	40MB (IDE)	\$ 1249	\$ 1459
PRO-386SX	21.2	18.0	80MB (IDE)	\$ 1429	\$ 1669

## The PRO-286/16 \$569



- 80286 Micro-processor running at 16MHz with zero-wait state
- 1MB standard; expandable to 4MB on board (or to 16MB using 16-bit expansion board)
- Supports LIM/EMS 4.0
- Intel 80287 coprocessor support
- Shadow RAM Support
- Five expansion slots
- 5¼" 1.2MB or 3½" 1.44MB floppy disk drive
- Two serial, one parallel port
- Real Time clock / calendar with battery backup
- AMI BIOS
- 101-key enhanced keyboard

286/16	VGA Mono	Super VGA
40MB (IDE)	\$ 1109	\$ 1319
80MB (IDE)	\$ 1289	\$ 1529

## The PRO-386/25 \$1099



- Intel 80386 Micro-processor running at 25MHz
- 2MB standard Expandable to 4MB on board (or to 16MB using 32-bit expansion board)
- Supports LIM/EMS 4.0
- Intel 80387 coprocessor support
- Shadow RAM Support
- Five 16-bit, two 8-bit and one 32-bit expansion slots
- 5¼" 1.2MB or 3½" 1.44MB floppy disk drive
- Two serial, one parallel port
- Real-time clock/calendar with battery backup
- 101-key enhanced keyboard
- Intel 80386 Micro-processor running at 33MHz
- 2MB standard Expandable to 4MB on board (or to 16MB using 32-bit expansion board)
- Intel advanced 82C395 Cache
- Supports LIM/EMS 4.0
- Intel 80387 coprocessor support
- Shadow RAM Support
- Five 16-bit, two 8-bit and one 32-bit expansion slots
- 5¼" 1.2MB or 3½" 1.44MB floppy disk drive
- Two serial, one parallel port
- Real-time clock/calendar with battery backup
- 101-key enhanced keyboard

386/25	VGA Mono	Super VGA
80MB (IDE)	\$ 1839	\$ 2079
200MB (IDE)	\$ 2329	\$ 2569

## The PRO-386/33 Cache \$1699



- Intel 80386 Micro-processor running at 33MHz
- 2MB standard Expandable to 4MB on board (or to 16MB using 32-bit expansion board)
- Intel advanced 82C395 Cache
- Supports LIM/EMS 4.0
- Intel 80387 coprocessor support
- Shadow RAM Support
- Five 16-bit, two 8-bit and one 32-bit expansion slots
- 5¼" 1.2MB or 3½" 1.44MB floppy disk drive
- Two serial, one parallel port
- Real-time clock/calendar with battery backup
- 101-key enhanced keyboard

386/33 Cache	VGA Mono	Super VGA
80MB (IDE)	\$ 2439	\$ 2679
200MB (IDE)	\$ 2929	\$ 3169

### Quality.

**45-day no questions asked guaranteed.** Customer satisfaction is our first priority. So each CS PROFESSIONAL system is backed by a 45-day money-back guarantee. If you're dissatisfied, return your product for a full refund, no questions asked.

**Full one-year warranty.** Our products also come with a full one-year service warranty on parts and labor, return freight included. **Technical support.** Advice and technical support for your CS PROFESSIONAL product are always only a toll-free phone call away.



## Computer Sales Professional

764 Easton Ave. Somerset, NJ 08873

We accept Visa and MasterCard (no surcharge) or prepaid checks • Fortune 1000, government and university PO's are welcome • All name brand components other than CS Professional systems are backed by thirty-day money-back guarantee • All money-back guarantees do not include returned freight; shipping charge is non-refundable • All returned items must be with a return merchandise authorization (RMA) number and must be in original packaging • Prices and product descriptions subject to change without

# Why buy when you can rent?



*Now You Can Rent the Fastest!*

## **BITWISE RENTS** Computers, Printers and Networks

Not only can you purchase one of the fastest computers in the world from Bitwise but you can also rent one.

◆ We also rent a full line of letter quality and laser printers.  
◆ Need to take a workstation on the road, try renting the 486 Super Portable!

**A System Designed Just for You...**

Model	PROCESSOR SPEED	RAM	Hard Disk	1 Week	1 Month	3 Months
Model 212	286-12 Mhz	1 Meg	20 Meg	\$ 95	\$ 191	\$ 478
Model 212	286-12 Mhz	1 Meg	40 Meg	\$ 102	\$ 203	\$ 508
Model 216	286-16 Mhz	1 Meg	40 Meg	\$ 114	\$ 227	\$ 568
Model 316SX	386SX-16 Mhz	2 Meg	40 Meg	\$ 132	\$ 263	\$ 658
Model 320SX	386SX-20 Mhz	2 Meg	40 Meg	\$ 144	\$ 287	\$ 718
Model 325	386-25 Mhz	4 Meg	40 Meg	\$ 186	\$ 371	\$ 928
Model 325C	386-25 64K Cache	4 Meg	40 Meg	\$ 198	\$ 395	\$ 988
Model 333C	386-33 64K Cache	4 Meg	100 Meg	\$ 252	\$ 503	\$ 1,258
Model 425	486-25 128K Cache	4 Meg	200 Meg	\$ 492	\$ 983	\$ 2,458
Model 433	486-33 128K Cache	4 Meg	200 Meg	\$ 612	\$ 1,223	\$ 3,058

**Ask about our  
"Rent to Own"  
program!**

**All Systems Include:**

- ✓ Super VGA Monitor
  - ✓ Keyboard
  - ✓ DOS 4.01 or 3.3
  - ✓ Parallel, Joystick, 2 Serial I/O Ports
  - ✓ All Cables and Power Cords
  - ✓ Unlimited Toll-Free Support
- Custom Systems Available**

**Rental Hotline**

**1(800)367-5906**

**701 River Street  
Troy, NY 12180**





## 286-12

**\$1,499**

Landmark = 16 MHz

## 286-16

**\$1,599**

Landmark = 21 MHz

## 386-SX16

**\$1,799**

Landmark = 21 MHz

## 386-SX20

**\$1,899**

Landmark = 24 MHz

### All Systems Include:

- 100% IBM Compatible
- AMI BIOS
- 2 MB 0 Wait State RAM
- Math co-processor support
- Clock/Calendar w/battery
- Intel CPU running at true rated speed
- 8 expansion slots
- 1.2 MB 5¼" floppy drive
- 1.44 MB 3½" floppy drive
- 2 serial/2 parallel/1 game port
- 101 key enhanced keyboard
- UNIX/XENIX/NOVEL/OS2 Support
- 40 MB 24 MS Hard Drive
- 1024 x 768 16 bit VGA Card/ 512 K
- 1024 x 768 VGA Monitor

## 386-20

**\$1,999**

Landmark = 27 MHz

## 386-25 CACHE

**\$2,599**

Landmark = 45 MHz

## 386-33

**\$2,999**

Landmark = 58 MHz

## 486-25

**\$3,699**

Landmark = 113 MHz

### UPGRADES

65 MG Hard Drive .....	<b>\$55</b>
80 MG Hard Drive .....	<b>\$150</b>
120 MG Hard Drive .....	<b>\$395</b>
150 MG Hard Drive .....	<b>\$495</b>

Extra RAM .....	<b>\$95 per Meg</b>
Tape Backups .....	<b>CALL</b>

Call for information on Low Prices on

**MONITORS • HARD DRIVES**

• LAP TOP COMPUTERS

• BARE BONE SYSTEMS

• PRINTERS

& all other Computer Products

Many other configurations and upgrades available!!

No Sales Tax

No charge for VISA & MasterCard; American Express & Discover accepted. Prices may change without notice.

# MICROSPEED COMPUTERS

11 Manning Terrace  
Providence, RI

**800-258-5151**

7210 Jordan  
Canoga Park, CA 91303

## US Integrated Takes Aim at the Home Office

**U**S Integrated Technologies' all-in-one home office computer system comes with an implementation of Geos, GeoWorks' windowing environment that's similar to Microsoft Windows but runs well on a 286 processor. Both DOS and the graphical user interface are built into ROM. In addition to the interface, the system comes with office-automation software voice mail with call forwarding and support for up to 999 mailboxes and a notebook.

Called The Home Office, the system is based on a zero-wait-state 286 processor running at 16 MHz. The system has two serial ports and one parallel port. The Home Office comes with a built-in 9600-bps fax, answering machine, and 2400-bps modem. Other features of the base system include VGA graphics capability and a 40-MB hard disk drive. The on-board 16-bit VGA card supports 640- by 400-pixel resolution at 256 colors or 800- by 600-pixel resolution with 16 colors. The voice mail can handle up to 5 minutes of messages per MB.

You can also get the system configured with a desktop publishing system, a telephone, peer-to-peer networking, and color VGA graphics.

**Price:** Base system, \$1995; base system with VGA monitor, \$2395; system with peer-to-peer capabilities, \$2795; system with VGA monitor, \$3195.

**Contact:** US Integrated Technologies, 3023 Research Dr., Hilltop Industrial Park, Richmond, CA 94806, (415) 223-1001.

**Inquiry 1177.**



*For those who want the benefits of a GUI but don't want to upgrade to a 386, US Integrated Technologies bundled its Home Office 286 PC with the Geos windowing environment.*

## Landscaping Added to Home Design Series

**A**bracadata's Landscape program for the Design Your Own Home series of two-dimensional CAD programs for the Mac lets you see how various tree and shrub arrangements will look now and in the future. With this package, you can place pre-drawn trees, shrubs, and yard objects around your house from a top view. The program then automatically redraws the objects in four different side views. You can age the trees and shrubs to see how the

scheme will look in future years.

Design Your Own Home, Landscape, includes a library of three dozen common trees and shrubs. You can access information on the spread and height of different plants at different ages.

The program includes sample landscapes. Additional landscapes and five regional image libraries are optional. The Design Your Own Home series is also available for the Apple II and the IBM PC.

**Price:** \$99.95; additional libraries, \$29.95 each.  
**Contact:** Abracadata, P.O. Box 2440, Eugene, OR 97402, (503) 342-3030.  
**Inquiry 1176.**



*Play It By Ear, a self-paced, interactive ear-training program, can test your ability to recognize and play scales on your IBM PC.*

## Combine Database, Word Processing with Fill-in Forms

**P**owerForms 2.0 from g4 Corp. provides word processing and forms management with more than 20 commonly used business forms. The program doesn't let you create your own forms, but you can customize forms by adding a company logo.

The dBASE III Plus-compatible database allows browsing and searching for specific records, but you can't perform queries and sorts. To do so, you need to export to dBASE or a dBASE-compatible program.

Features of the program include mail merge, data entry, error checking, and multiline memo fields.

**Price:** \$139.95; five-user version, \$295.  
**Contact:** g4 Corp., 2633 Manhattan Beach Blvd., Redondo Beach, CA 90278, (800) 486-9552 or (213) 536-0937.  
**Inquiry 1178.**

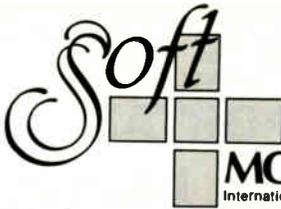
## Play It Again on the PC

**P**lay It By Ear lets you sharpen your musical skills by providing interactive melodic and harmonic exercises that you can practice using an on-screen guitar or piano or an actual piano or guitar that's MIDI-compatible.

The program tests your ability to recognize single tones, intervals, and chords.

Play It By Ear runs on the IBM PC. Optional equipment includes a MIDI card or a sound card.

**Price:** \$99.95.  
**Contact:** Ibis Software, 90 New Montgomery St., Suite 820, San Francisco, CA 94105, (415) 546-1917.  
**Inquiry 1175.**



**MORE** Subsidiary of  
International Computer Connections, Inc.

**1-800-338-9778** 8 am - 6 pm EST Mon-Fri  
**1-407-338-9886** 10 am - 2 pm EST Sat  
24-HOUR FAX

129 N.W. 13th Street, Unit A-25  
Boca Raton, Florida 33432

**Brand  
Names**

**More  
Means**

**Same  
Day  
Service**

**Great  
Prices**

**SOFTWARE**

**ACCOUNTING/FINANCE**

Business Works Bundle 7.0	\$ 408
Business Works Payroll 7.0	151
DAC Easy Accounting 4.1	87
DAC Easy Accounting Bonus	138
DAC Easy Payroll 4.1	60
Peachtree Complete III	149
Peachtree III w/Data Query	230

**CAD/DRAFTING**

Autoconvert 4.0	58
Auto Sketch 2.0 v3.0	154
Design CAD 3-D	204
Generic 3D Drafting	192
Generic CAD Level 3 v1.1	218
Generic Cadd Starter Kit	126
Generic Estimator	164
Generic Symbols Libraries	Call
Mathcad 2.5	324

**COMMUNICATIONS**

Carbon Copy Plus + Host	115
Crosstalk XVI	113
Crosstalk Mark IV	141
Hotwire	66
Laplink III	92
PC Anywhere IV	104
Procomm Plus	66

**DATABASE MANAGEMENT**

Clipper 5.0	538
Data Ease 4.2	481
Data Perfect	311
Dbase IV	488
Foxbase Plus	202
Foxpro	480
Paradox 3.0	458
Q&A	228
R:Base For DOS	558

**DESKTOP PUBLISHING**

Adobe Illustrator	305
Pagemaker 3.1	516
Printmaster Plus	42
Publish It!	120
The New Print Shop	38
Ventura Publisher Gold 3.0	573

**EDUCATION/TRAINING**

Alge-Blaster Plus	33
Algebra 1: 1st & 2nd Semester	43
Barron's ACT	52
Barron's SAT	34
Bank Street Writer Plus	53
Math Blaster Mistery	30
Math Blaster Plus	27
Math Rabbit	23

MS Learning DOS	\$ 35
MS Flight Simulator	40
Reader Rabbit	28
SAT Personal Trainer	33
Think Quick	29
Typing Tutor IV Plus	32
Word Attack Plus	28
Writer Rabbit	29
Writing and Publishing Center	41

**Carmen San Diego:**

Where in the USA	30
Where in the World	30
Where in Europe	30
Where in Time	30

**GRAPHICS**

Autodesk Animator	243
Colorix (VGA Paint)	106
Corel Draw v1.2	344
Designer v3.0	488
GEM Artline	287
GEM Draw Plus	171
Flowcharting II PLUS	132
Freelance Plus v3.01	344
Harvard Graphics v2.3	322
PC Paintbrush IV	60
PC Paintbrush IV Plus	115
Publishers Paintbrush	163
Statgraphics v4.0	551

**INTEGRATED SOFTWARE**

Enable OA	446
Better Working 8 in 1	46
Lotus Works	94
MS Works v2.0	98
PFS First Choice + Quicken	105

**LANGUAGES**

MS Basic Pro Development System	329
MS C Compiler 6.0	327
MS Cobol Compiler 3.0	594
MS Fortran Compiler 5.0	297
MS Macro Assembler 5.1	99
MS Pascal Compiler 4.0	198
MS Quick Basic 4.5	67
MS Quick C 2.0	67
MS Quick Pascal	67
Ryan McFarland Cobol	795
Ryan McFarland Fortran	385
Turbo Basic 1.1	70
Turbo C ++	85
Turbo C ++ Pro	144
Turbo Pascal Dev. Library	265
Turbo Pascal 5.5	99
Turbo Pascal 5.5 Pro Pack	170

**MONEY MANAGEMENT**

Money Counts	30
--------------	----

Money Matters	\$ 64
Money Plans	42
Quicken 4.0	37
Tobias Managing Your Money	127
Turbo Tax	49

**OCR SOFTWARE**

Readright v2.01 OCR	332
Readright Personal	166

**PROJECT MANAGEMENT**

Harvard Project Mgr v3.01	427
MS Project 4.0	327
Org + Advanced v5.0	67
Superproject Expert 1.1	454
Superproject Plus v3.0	258
Timeline 4.0	469

**SPREADSHEET**

Lotus 1-2-3 v2.2	350
Lotus 1-2-3 v3.0	429
Lucid 3-D v2.0	55
MS Excel for Windows v2.1	317
MS Multiplan 4.2	128
Plan Perfect 5.0	285
Quattro	89
Quattro Pro v2.0	345

**UTILITIES**

386 To The Max v5.0	44
Above Disk 4.0	65
Battery Watch v2.0	29
Check It	89
Copy II PC v5	24
Copy II Option Board	118
Desqview 2 v2.2	78
Desqview 386 v2.2	126
Direct Access 5.0	61
Disk Optimizer 4.05	44
Disk Technician Adv v6	96
Disk Technician Pro	41
Fastback Plus v2.1	108
Mace 1990	99
MS Windows 3.0	99
Norton Commander 3.0	99
Norton Advanced 5.0	118
Norton Editor	47
Norton Utilities 4.5	60
PC Quick Power Pack	77
PC Tool Deluxe 6.0	88
Print Q v4.0	79
Qemm 386 v5.0	60
Sidekick Plus v1.0	132
Software Bridge v4.1	80
Software Carousel v4.0	54
Spinwrite II v1.1	66
SQZ! Plus	64
XTree Professional	58
XTree Professional Gold	78

**WORD PROCESSORS**

AMI	\$124
AMI Professional	330
Gramatick IV	61
Multimate v4.0	279
Professional Write v2.2	155
RightWriter v3.1	56
Word for Windows (MS)	326
Word Perfect 5.1	260
Wordstar v6.0	286
XY Write III+	228

**HARDWARE**

**MICE**

Logitech Bus Mouse S9	84
Logitech Bus Mouse S9 + Paint	91
Logitech Serial Mouse S9	72
Logitech Serial Mouse S9 PS/2	84
Logitech Serial Mouse + Paint	97
MS Bus/Serial Mouse 1.0	91
MS Bus/Serial Mouse + Windows 3.0	164
MS Bus/Serial Mouse + Paintbrush	109

**PRINTERS**

**CITIZEN PRINTER**

GSX 140/80	329
HSP 550	468
Other Models	Call

**OKIDATA**

320	351
321	495
391 Plus	668
Other Models	Call

**PANASONIC**

1124	307
1191	248
Other Models	Call

**HARD DRIVES**

**SEAGATE**

Others	Call
--------	------

**HARD DISK CONTROLLERS**

**WESTERN DIGITAL**

WD1004A-27X RLL	47
WD1003V-MM2 MFM+FC	103
WD1003V-SR2 RLL+FC	114
WD1006V-MM2 MFM+FC	112
WD1006V-SR2 RLL+FC	128
WD1007V-SE2 ESDI+FC	165

**VIDEO MONITORS**

**GOLDSTAR**

1210A Mono 12" TTL (720x350)	75
1401A Mono 14" TTL (720x350)	106
1425+ VGA 14" Color (720x350)	306
1450+ VGA 14" Color (800x600)	372

**NEC**

Multisync 2A 14"	473
Multisync 3D 14"	659

**SAMSUNG**

Mono 12" Amber	79
VGA 14" Flat white	127
VGA 14" Color (41 dp)	299
Multi-scan 14" Color	462
Others	Call

**VIDEO BOARDS**

**PARADISE SYSTEMS**

VGA Plus	155
VGA Plus 16	199
VGA Professional	287

**ATI**

VGA Wonder plus 256	257
VGA Wonder plus 512	322

C.O.D.

VISA

MasterCard

Terms: Corporate P.O.s subject to credit approval. VISA/MasterCard accepted and charged only at time of shipment. We reserve right to ship partial orders. Florida residents add 6% sales tax.

Shipping: Via UPS Ground. Items under 6 lbs. add \$6.00 shipping/handling. UPS Blue (2nd day air), under 6 lbs. add \$9.50. C.O.D. - \$5.50 added. (C.O.D. limit \$1,000 unless preapproved.)

Mail Orders: Please verify prices, then send Money Order, Certified Check, Personal or Company Check to Soft + More (add 10 days to clear) to above address.

Policy: Prices, terms, availability subject to change without notice. All sales final. Products covered only by manufacturers' warranty. Machine compatibility not guaranteed. (Limited technical support available). Manufacturer guarantees, rebates, trial privileges or promotional programs do not apply.

Returns: No unauthorized returns. Call for Return Manufacturer Authorization Number (RMA) on defective hardware. Original packaging must be returned. Defective software replaced immediately. Merchandise subject to 15% restocking charge.

Circle 583 on Reader Service Card

# VGA PORTABLE

## 5 YEARS PORTABLE EXPERIENCE

*Color*

ALL SYSTEMS RUN UNIX, XENIX,  
LAN OS DOS AND OS/2.

LIGHTEST &  
SMALLEST  
CRT PORTABLE  
1024x768 RES, 256 COLOR



The BSI 386SX was the  
Fastest Machine  
in PC Magazine Review

See Aug. 1990 P. 109, 120

### 386SX 40MB SYSTEM (Desk Top)

- 386SX-16 MHz CPU, 1MB Memory (To 4MB)
- 200W P/S, 110/220V
- 101 Enhanced Keyboard
- 1:1 Interleave Cont. Card
- 1.2 MB or 1.44MB FDD
- 40MB, 23ms, SCSI IDE Hard Drive
- 2 Serial/1 Parallel/1 Game Port
- Mono Graphic Card w/Printer Port
- 12" Amber Monitor (720x348 Res.)

\$1,039  
On Sale

### 386-33 150MB SYSTEM (Desk Top)

- 386-33 MHz CPU, w/32K Cache Memory
- 64K Cache Memory Optional
- 1MB Memory on board (To 8MB)
- 150MB, 18ms, ESDI Hard Drive
- Other features the same as 386SX

\$2,309

HDD	286-12	386SX	386/25	386/33	486/25
40MB	819	1039	1399	1719	3399
65MB	879	1099	1449	1769	3449
80MB	1179	1419	1749	2069	3749
100MB	1189	1419	1749	2069	3749
150MB	1429	1669	1989	2309	3989
200MB	1509	1719	2069	2389	4069
345MB	2249	2459	2799	3119	4799

- (CGA + \$160, EGA + 320, VGA + 330)
- Mini Vertical Case + \$50
- Regular Vertical Case + \$100

PORTABLE SKD KITS AND BAREBONE SYSTEMS AVAILABLE CALL FOR PRICING	MOTHER BOARD ON SALE	286-12 MB	386SX MB	386-25 MB	386-33 MB	486-25 MB
		\$105	\$355	\$570	\$850	\$2300

- 386SX VGA 40MB LAPTOP LT54CC \$2400
- 386SX VGA 40MB LAPTOP LT5600 \$2450

Prices subject to change without notice  
Call for return policy



9440 Tejar Ave., #4, El Monte, CA 91731

For Order Only Call Toll Free  
1-800-872-4547

1-818-442-0020 Information  
Customer Support: (818) 442-7038

Fax: (818) 442-4527

### 386-33 100MB COLOR VGA PORTABLE

- Built-in SONY 8.5" Color VGA Monitor
- 0.26mm Dot Pitch,
- Speed Digital Display. 3 Drive Bays
- 220W P/S 110/220V. 4 Exp. Slots
- 86-Key Detachable Keyboard
- 386-33 MHz CPU, w/64K Cache Memory
- 1MB Memory on Board (To 8MB)
- VGA Graphic Card (512K, 1024x768 Res.)
- External Monitor Adaptor
- 1.2MB or 1.44MB FDD
- 100MB 25ms HDD (To 500MB)
- Serial/Parallel/Game Ports
- Carrying Bag, Weight 27 Lbs.
- Dimensions: 17.5(W) x 14.1(D) x 6.8(H)
- 7 expansion Slots Model Optional

\$3,549  
(Special)

HDD	286-12	386SX	386/25	386/33	486/25
40MB	2199	2459	2829	3179	4749
100MB	2569	2829	3199	3549	5119
150MB	2859	3119	3489	3839	5409
200MB	2929	3189	3559	3909	5479
345MB	3789	4049	4419	4769	6339

### VGA AMBER CRT PORTABLE 100MB AT

- Built-in 9" Amber VGA Monitor
- Speed Digital Display. 3 Drive Bays
- 205W P/S 110/220V. 4 Exp. Slots
- 86 Keyboard, Detachable Keyboard + \$30
- AT 12 MHz System, 1MB Memory (To 4MB)
- VGA Graphic Card (256K, 800x600 Res.)
- Run 48 Grey Scales VGA Internally
- Run Color VGA Externally
- 1.2MB or 1.44MB FDD
- 100MB 25ms HDD (To 500MB)
- Serial/Parallel/Game Ports
- Carrying Bag, Weight 26 Lbs
- Dimensions: 17.5 (W) x 14.1 (D) x 6.8 (H)

\$1,839

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1469	1729	2099	2449	4019
65MB	1569	1829	2199	2549	4119
100MB	1839	2099	2469	2819	4389
150MB	2129	2389	2759	3109	4679
200MB	2199	2459	2829	3179	4749
345MB	3059	3319	3689	4039	5609

### AMBER CRT PORTABLE 100MB AT

- Built-in 9" Amber Monitor
- Speed Digital Display. 3 Drive Bays
- 205W P/S 110/220V. 4 Exp. Slots
- 86 Keyboard, Detachable Keyboard + \$30
- AT 12 MHz System, 1MB Memory (To 4MB)
- Mono or Color Graphic Card
- Amber EGA Display (option) + \$100
- 1.2 MB or 1.44 MB Floppy Drive
- 100MB 25ms Hard Drive
- Carrying Bag Weight 26 lbs.
- Dimensions 17.5(W) x 14.1(D) x 6.8(H)

\$1,569

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1199	1459	1829	2179	3749
65MB	1299	1559	1929	2279	3849
100MB	1569	1829	2199	2549	4119
150MB	1859	2119	2489	2839	4409
200MB	1929	2189	2559	2909	4479
345MB	2789	3049	3419	3769	5339

### COLOR EGA CRT Portable Available

All order will be shipped by UPS COD casher's check. Company check on approval IBM PC XT/AT are registered trade marks of IBM Inc.

### 386-33 100MB VGA PLASMA PORTABLE

- 640x480 VGA Plasma Display
- Detachable 101-key Keyboard
- 200W P/S, 110/220V. 3 Drive Bays
- 386-33 MHz CPU, w/64K Cache Memory
- 1MB Memory on Board (To 8MB)
- 1.2MB or 1.44MB FDD
- 100MB 25ms HDD (To 500MB)
- Serial and Parallel Ports
- External Monitor Adaptor
- Carrying Bag, Weight: 26 Lbs.
- Dimensions: 16 \*(W) x 9.75\*(H) x 8.5\*(D)

\$3,079  
(On Sale)

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1749	2009	2379	2729	4299
65MB	1869	2129	2499	2849	4419
100MB	2099	2359	2729	3079	4649
150MB	2329	2589	2959	3309	4879
200MB	2459	2719	3089	3439	5009
345MB	3209	3469	3839	4189	5759

### CGA PLASMA PORTABLE 100MB AT

- 640X400 CGA Plasma Display
- Detachable 86-Key Keyboard
- External RGB Monitor Adaptor

\$1,769

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1419	1679	2049	2399	3969
65MB	1539	1799	2169	2519	4089
100MB	1769	2029	2399	2749	4319
150MB	1999	2259	2629	2979	4549
200MB	2129	2389	2759	3109	4679
345MB	2879	3139	3509	3859	5429

### 386-33 100MB VGA LCD PORTABLE

- 640x480 Res. Backlit LCD VGA Display with External Color Monitor Adaptor
- 200W 110/220V P/S, 5Exp. Slots
- Detachable 89-Key Keyboard
- 386-33 MHz CPU with 64K Cache Memory
- 1.2MB or 1.44MB FDD
- 100MB 25ms HDD (To 500MB)
- Serial/Parallel/Game Ports
- 9.45"(H) x 7.9"(D) x 15.7"(W), 23LBS

\$2,739  
Best Buy

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1369	1629	1999	2349	3919
65MB	1489	1749	2119	2469	4039
100MB	1759	2019	2389	2739	4309
150MB	1999	2259	2629	2979	4549
200MB	2109	2369	2739	3089	4659
345MB	2839	3099	3469	3819	5389

• LCD CGA 640X200 Res. Portable Less \$230

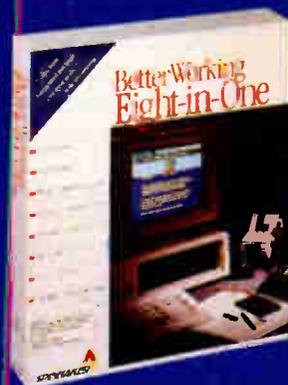
• LCD CGA 640X400 Res. Portable Less \$120

• LCD EGA Model Available ..... Call

See us at  
**COMDEX/Fall '90**

November 12-16, 1990  
Sahara Hotel  
Las Vegas, Nevada  
Booth S9606

# BET ON A DERBY WINNER...



## 386/33C-200 PRO

- Intel 80386-33, 32-bit
- 4 M RAM 64K Cache
- 200M Hard Drive 15ms

*New System*

**\$3,395.00**

## 286/12-40 KEY

- Intel 80286-12, 1M RAM
- 40M Hard Drive 28ms
- **Eight-In-One** by Spinnaker
- Dexxa Mouse w/ Paint

**\$1,495.00**

## 386SX-40 PRO

- Intel 80386SX
- 2M RAM
- 40M Hard Drive 28ms

**\$1,895.00**

## 386/25C-65PRO

- Intel 80386-25, 32-bit
- 4M RAM 64K Cache
- 65M Hard Drive 25ms

**\$2,695.00**

## 386SX-100 PRO

- Intel 80386SX
- 2M RAM
- 100M Hard Drive, 25ms

*New System*

**\$2,195.00**

## 286/12-65 KEY

- Intel 80286-12, 1M RAM
- 65M Hard Drive, 33ms
- **Eight-In-One** by Spinnaker
- Dexxa Mouse w/ Paint

**\$1,595.00**

## 386SX-65 PRO

- Intel 80386SX
- 2M RAM
- 65M Hard Drive 25ms

**\$1,995.00**

## 386/25C-100 PRO

- Intel 80386-25, 32-bit
- 4 M RAM 64K Cache
- 100M Hard Drive 25ms

**\$2,895.00**

## ALL DERBY COMPUTERS FEATURE

- 1.2M 5.25" and 1.44M 3.5"
- 2 Serial/Parallel/Game Ports
- MS-DOS v4.01/GW BASIC
- KEYS feature desktop cases
- 16-bit VGA 1024X768 w/512K
- VGA 1024X768 Color Monitor
- 101 Key Tronics Keyboard
- PROS feature mid-size towers

## 386SX-40 KEY

- Intel 80386SX, 2M RAM
- 40 M Hard Drive, 28ms
- **Eight-In-One** by Spinnaker
- Dexxa Mouse w/ Paint

**\$1,795.00**

## 386/25-65 PRO

- Intel 80386-25, 32-bit
- 4M RAM
- 65M Hard Drive 25ms

**\$2,495.00**

## 386/33C-65 PRO

- Intel 80386-33, 32-bit
- 4M RAM 64K Cache
- 65M Hard Drive 25ms

**\$2,795.00**

## 386SX-65 KEY

- Intel 80386SX, 2M RAM
- 65M Hard Drive, 33ms
- **Eight-In-One** by Spinnaker
- Dexxa Mouse w/ Paint

**1,895.00**

## 386/25-100 PRO

- Intel 80386-25, 32-bit
- 4M RAM
- 100M Hard Drive 25ms

**\$2,695.00**

## 386/33C-100 PRO

- Intel 80386-33, 32-bit
- 4 M RAM 64K Cache
- 100M Hard Drive 25ms

**\$2,995.00**

- 30 Day Money Back Guarantee
- 72 Hour Burn-in Testing
- All systems built in the USA
- Hours: 9:00 to 6:00 M-Sat Cen
- Shipping Charge: Keys: \$35.00
- Pros: \$45.00
- 100% IBM Compatible
- Toll Free Tech Support
- One Year Warranty
- We Accept (no surcharge):



Circle 564 on Reader Service Card  
(RESELLERS: 565)

**DerbyTech**  
  
**Computers**  
Inc.

# 1-800-24-DERBY

718 - 15th Avenue / East Moline / Illinois / 61244 / (309) 755-2662

World Radio History

**DerbyTech**  
  
**Computers**  
Inc.

## Kaos Automatically Creates Videowall Presentations

If you need to create videowalls (i.e., audiovisual presentations that combine several monitors at once) but don't have the time to learn the intricacies of a programming language, you might want to investigate Kaos. The package consists of an audio processing card and software that automatically mixes more than 120 visual patterns and a video source while projecting both in sync with the music. Kaos can trigger patterns and colors on the videowall according to specific intervals and intensities that you specify.

Through the use of the program's AutoLock feature, the videowall controller interprets the music and uses digital signal processing techniques to derive a numerical value for the beat of the music. It then divides the incoming audio into six frequency bands. You can set a peak level on each frequency band, which triggers patterns on the videowall.

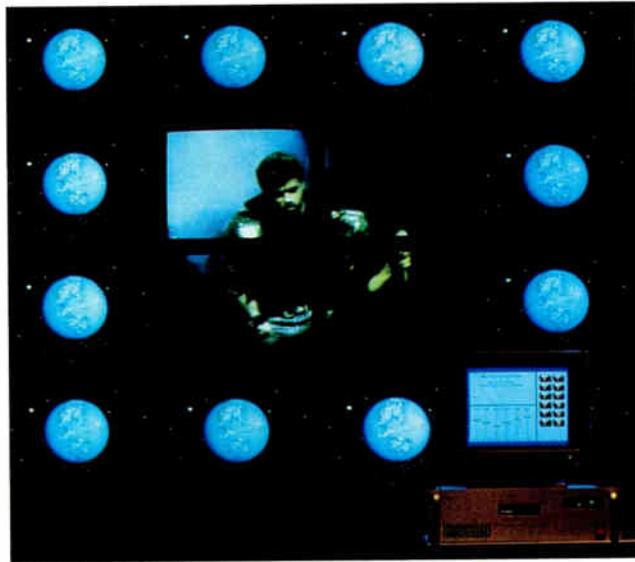
Kaos requires a 286 compatible or higher with an available 8-bit expansion slot, DOS 3.3 or higher, and 512K bytes of RAM.

**Price:** Kaos, \$1995; audio card, \$500.

**Contact:** Kimball Computer Video Technology, Six Dallas Communications Complex, 6221 North O'Connor Rd., Suite 100, Irving, TX 75039, (214) 869-0117.  
**Inquiry 1167.**

## Convert Data Between DOS and Mac Applications

DBMS/Copy Mac converts data among over 15 Mac applications (e.g., Excel, FoxBase +/Mac, and sev-



*Kaos 1.0 automatically generates colors and patterns and combines them with a video, while keeping it all in sync with the beat of the music.*

eral statistics packages) and over 65 MS-DOS applications. DBMS/Copy Mac directly reads and writes each program's native files. By doing so, it avoids problems with using other applications or the Mac Clipboard, both of which would require the re-formatting of files and editing of intermediate files.

You can use the program to transfer between the Mac and the IBM PC with formatting intact. You can also use it to transfer data among the Mac applications.

To run DBMS/Copy Mac in a DOS-Mac environment, your Mac needs a SuperDrive, Dayna Communications' DOS Mounter, or access to a network. The utility converts between dissimilar numeric and date types and handles null values. It works without requiring the supported programs to be present, except for Oracle, Informix, and Ingres.

**Price:** \$95.

**Contact:** Conceptual Software, Inc., P.O. Box 56627, Houston, TX 77256, (713) 667-4222.

**Inquiry 1169.**

## A Two-Slot SE Card Chassis for the Mac Portable

If you want to use a large-screen monochrome monitor with the Mac Portable, or connect the Portable to a mainframe computer system, you can use Second Wave's ExpanSE Home BaSE, a two-slot Mac SE card chassis.

The chassis serves as a base station for the Mac Portable, housing two standard Mac SE 68000 Processor Direct Slot cards. The Portable

sits on top of and connects to the chassis through an included interface card and two cable assemblies.

**Price:** \$995.

**Contact:** Second Wave, Inc., 9430 Research Blvd., Echelon II, Suite 260, Austin, TX 78759, (512) 343-9661.

**Inquiry 1170.**

## A User-Friendly Front End for Your LAN

With Saber Menu, you can create customized, intuitive front ends for all your applications running on a LAN. Because Saber Menu resides on the server, it doesn't require RAM on the client workstation. When a user logs in, the PC automatically receives the appropriate device drivers for the monitor, modem, pointing device, and other local devices.

Saber Menu works with Novell, 3Com, Banyan Vines, and other IBM PC-compatible networks running DOS or Windows.

**Price:** \$395; Windows version, \$495.

**Contact:** Saber Software Corp., P.O. Box 9088, Dallas, TX 75209, (800) 338-8754 or (214) 361-8086.

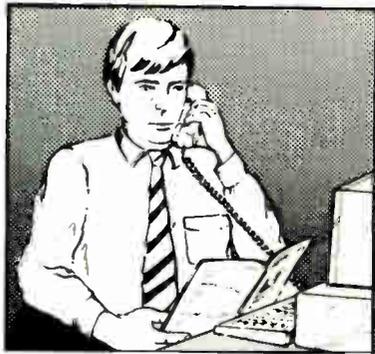
**Inquiry 1168.**



*Second Wave's ExpanSE Home BaSE gives your Mac Portable the power of a large-screen monitor.*

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

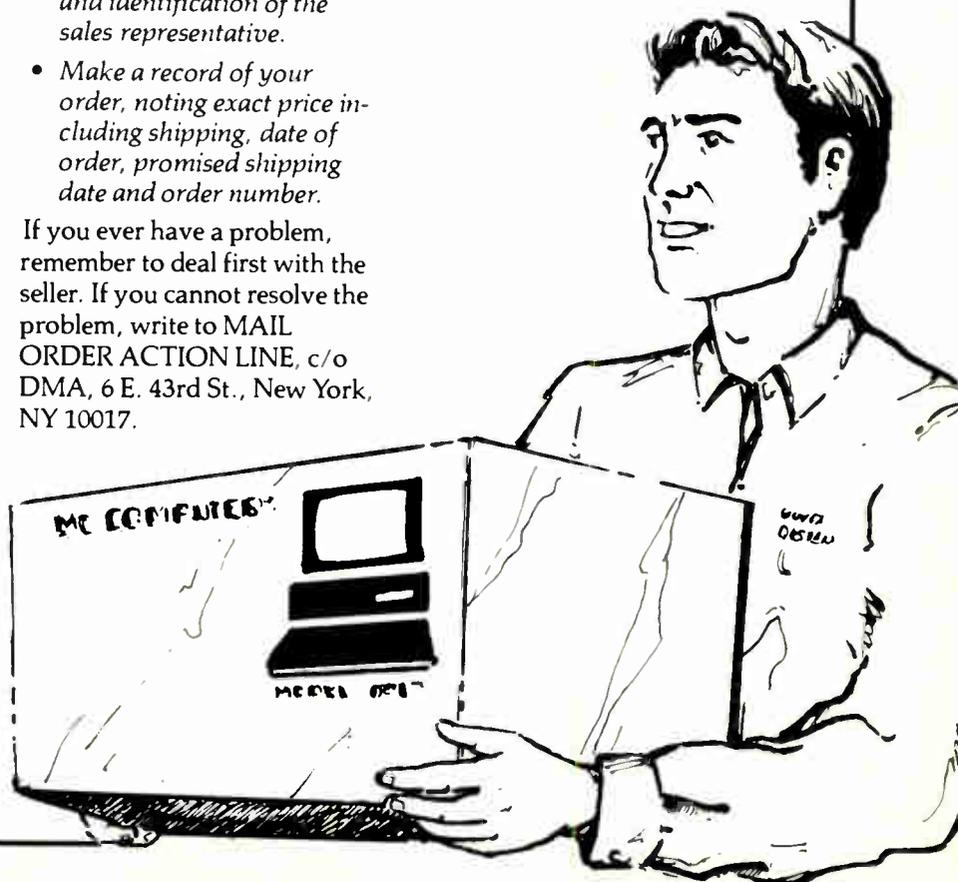
- State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.
- Establish that the item is in stock and confirm shipping date.
- Confirm that the price is as advertised.
- Obtain an order number and identification of the sales representative.
- 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.



# H. Co. Computer Products

Your #1 Source For All P.C. Memory Upgrades  
 Call Toll Free 1-800-RAM-CHPS Ext. 200

FULL TECHNICAL SUPPORT ★ LIFETIME WARRANTY ON ALL MODULES  
 BUY DIRECT ★ BEST PRICES ★ BEST SERVICE

Part # EQ	Works With	PRICE
30F5348 (512K)	30-286	\$ 49.00
30F5360 (2MB)	30-286	\$ 165.00
6450375 (1MB)	80-041	\$ 149.00
6450379 (2MB)	80-111, 311	\$ 239.00
6451060 (4MB)	80-A21, A31, 111, 311	\$ 559.00
6450603 (1MB)	502, 55SX, 70-EG1, 70-121, P-70	\$ 85.00
6450604 (2MB)	502, 55SX, 70-EG1, 70-121, P-70	\$ 160.00
6450606 (2MB)	70-A21, A61, B-21, B61	\$ 165.00
78X8955 (128K)	25	\$ 26.00
34F2833 (4MB)	55SX, 65SX	\$ 525.00
6450605 (2-8MB)	All 70's and 80's (Board)	\$ 525.00
6450609 (2-16MB)	50, 502, 55SX, 60, 65SX (Board)	\$ 599.00
1039136 (1MB)	Laser Printer 4019, 4019e	\$ 199.00
1039137 (2MB)	Laser Printer 4019, 4019e	\$ 325.00
1038675 (3.5MB)	Laser Printer 4019, 4019e	\$ 499.00

Call for Other IBM Upgrades

We Accept Purchase Orders from Qualified Firms, Universities and Government Agencies.

Trademarks are registered with their respective companies.

We will match or beat any advertised price.



NO SURCHARGE

Model	Memory Added	Part # EQ	PRICE
DESKPRO 386/33-486/25	2MB MODULE	115144-001	\$ 229.00
DESKPRO 386/20-25	1MB MODULE	113131-001	\$ 139.00
286e	4MB MODULE	113132-001	\$ 339.00
DESKPRO 386/20e-25e	1MB BOARD	113644-001	\$ 189.00
	4MB BOARD	113645-001	\$ 479.00
	1MB MODULE	113131-001	\$ 139.00
	4MB MODULE	113132-001	\$ 339.00
DESKPRO 386e	1MB BOARD	113633-001	\$ 189.00
	4MB BOARD	113644-001	\$ 479.00
	1MB MODULE	113646-001	\$ 139.00
	4MB MODULE	112534-001	\$ 339.00
PORTABLE III	512K KIT	107331-001	\$ 70.00
	2MB KIT	107332-001	\$ 165.00
DESKPRO 386/16	1MB BOARD	108069-001	\$ 355.00
	2MB BOARD	108069-W/71	\$ 525.00
	4MB BOARD	108070-001	\$ 850.00
	8MB BOARD	108072-001	\$1350.00
DESKPRO 386 PORTABLE	1MB KIT	107651-001	\$ 245.00
SLT/286	4MB BOARD	107653-001	\$ 799.00
LTE/286	1MB MODULE	110235-001	\$ 209.00
	1MB BOARD	117081-001	\$ 159.00
	2MB BOARD	117081-002	\$ 249.00

Ask About Other Compaq Upgrades

Model	Memory Added	Part # EQ	PRICE
MACII, Iix; Ilicx Ilicx & SE/30	1MB KIT	MO218	\$ 80.00
	2MB KIT	MO219	\$ 115.00
	4MB KIT	MO2707	\$ 225.00
	16MB KIT		\$1500.00
MACIicx	4MB KIT	MO292LL-A	\$ 225.00
	16MB KIT		\$1500.00
MAC SE & PLUS	1MB KIT	MO218	\$ 80.00
	2MB KIT	MO219	\$ 115.00
	4MB KIT	MO2707	\$ 225.00
MAC PORTABLE	1MB KIT	MO248	\$ 279.00
	2MB KIT	N/A	\$ 899.00
	3MB KIT	N/A	\$1299.00
	4MB KIT	N/A	\$1695.00
MACIix	4MB KIT	MO292LL-A	\$ 369.00
	16MB KIT	N/A	\$1695.00
LASER WRITER I/IX	1MB KIT	M6005	\$ 179.00
	4MB KIT	M6006	\$ 369.00

Model	Memory Added	Part # EQ	PRICE
BRAVO/286	128K KIT	500510-011	\$ 40.00
	512K KIT	500510-010	\$ 60.00
	2MB KIT	500510-002	\$ 170.00
	4MB KIT	500510-008	\$ 340.00
PREMIUM/286 ADVANCED	512K KIT	500510-001	\$ 60.00
	1MB KIT	500510-007	\$ 120.00
	2MB KIT	500510-002	\$ 170.00
	4MB KIT	500510-008	\$ 340.00
FASTBOARD /386	1MB KIT	500510-007	\$ 120.00
	4MB KIT	500510-008	\$ 340.00
PREMIUM WKST/286	512K KIT	500510-010	\$ 60.00
	2MB KIT	500510-002	\$ 170.00
PREMIUM WKST 386/SX	512K KIT	500510-010	\$ 60.00
	2MB KIT	500510-007	\$ 120.00
	2MB KIT	500510-002	\$ 170.00
	4MB KIT	500510-008	\$ 340.00
PREMIUM 386/16	1MB KIT	500510-007	\$ 120.00
	4MB KIT	500510-008	\$ 340.00
PREMIUM 386	1MB KIT	500510-003	\$ 160.00
	4MB KIT	500510-004	\$ 420.00
PREMIUM 386c	1MB KIT	500510-007	\$ 120.00
	4MB KIT	500510-008	\$ 340.00
PREMIUM 386/25/166x	1MB SIMM	500718-001	\$ 85.00
PREMIUM 386/33	1MB SIMM	500718-002	\$ 90.00

Model	Memory Added	Part # EQ	PRICE
Portable T1000SE & XE	1MB KIT	PC14-PA8311U	\$ 319.00
	2MB KIT	PC14-PA8312U	\$ 449.00
Portable T1200XE	2MB KIT	PC13-PA8306U	\$ 219.00
Portable T1600	2MB KIT	PC-PA8302U	\$ 219.00
Portable T3100c	512K KIT	PC-PA8340U	\$ 135.00
	2MB KIT	PC-PA8341U	\$ 219.00
Portable T3100SX	2MB KIT	PC15-PA8308U	\$ 219.00
	4MB KIT	PC15-PA8310U	\$ 659.00
Portable T3200ex	2MB KIT	PC-PA8307U	\$ 219.00
Portable T3200	3MB KIT	PC-PA7137U	\$ 359.00
Portable T5100	2MB KIT	PC-PA8301U	\$ 219.00
Portable T5200	2MB KIT	PC-PA8304U	\$ 219.00
DESKTOP T8500	2MB KIT	PC-PA8301U	\$ 219.00

Ask About Other Toshiba Upgrades

**Cyrix Math Co-Processor**  
 Up to 200% Faster Than Intel Math Co-Processor  
 100% Compatible — 5 Year Warranty

Part #	PRICE	Part #	PRICE
83D87-16	Call	83D87-33	\$ 485.00
83D87-20	\$ 325.00	83D87SX-16	\$ 275.00
83D87-25	\$ 385.00	83D87SX-20	Call

STANDARD SIMMS		DRAM	
Part#	PRICE	Part#	PRICE
256 X 8-12	\$ 17.00	1 X 1-100	\$ 5.75
256 X 9-10	\$ 18.00	1 X 1-80	\$ 6.00
256 X 9-80	\$ 19.00	1 X 1-70	\$ 6.45
256 X 9-12	\$ 17.00	256-150	\$ 1.75
256 X 9-10	\$ 18.00	256-120	\$ 2.00
256 X 9-80	\$ 19.00	256-100	\$ 2.15
256 X 9-70	\$ 24.00	256-80	\$ 2.35
256 X 9-60	\$ 26.00	256-70	\$ 2.55
1 X 8-10	\$ 52.00	256-60	\$ 3.35
1 X 8-80	\$ 53.00	256 X 4-10	\$ 6.25
1 X 8-70	\$ 60.00	256 X 4-80	\$ 7.60
1 X 9-10	\$ 57.00	4464-10	\$ 3.25
1 X 9-80	\$ 56.00	4464-80	\$ 3.50
1 X 9-70	\$ 63.00	4184-15	\$ 1.40
4 X 8-80	\$ 359.00	4184-12	\$ 1.85
4 X 9-80	\$ 399.00	4184-10	\$ 2.00

EPROM/CPU/SRAM/VRAM Also Available

Model	Memory Added	Part # EQ	PRICE
Power Mate SX Plus	1MB Board	APC-H850E	\$ 295.00
	2MB Board	N/A	\$ 495.00
	4MB Board	APC-852E	\$ 725.00
	8MB Board	N/A	\$1375.00

Model	Memory Added	Part # EQ	PRICE
LASER JET II & IID	1MB MODULE	H33443B	\$ 109.00
	2MB MODULE	H33444B	\$ 145.00
	4MB MODULE	H33445B	\$ 249.00
HP & III	1MB MODULE	H33474A	\$ 119.00
	2MB MODULE	H33475A	\$ 155.00
	3MB MODULE	N/A	\$ 215.00
	4MB MODULE	N/A	\$ 259.00

Part #	PRICE	Part # EQ	PRICE
8087-3	\$ 80.00	2C87-8	\$ 175.00
8087-2	\$ 117.00	2C87-10	\$ 185.00
8087-1	\$ 155.00	2C87-12	\$ 215.00
80287-8	Call	2C87-20	\$ 255.00
80287-9	Call	3C87-16	Call
80287-10	Call	3C87SX-16	Call
80287XL (12.5 MHz)	\$ 229.00	3C87-20	\$ 325.00
80287XLT (12.5 MHz)	Call	3C87-25	\$ 385.00
80387-16	\$ 305.00	3C87-33	\$ 485.00
80387SX-16	\$ 290.00		
80387SX-20	\$ 315.00		
80387-20	\$ 350.00		
80387-25	\$ 450.00		
80387-33	\$ 550.00		

We also carry memory upgrades for  
**ACER • AT&T • DELL • DTK • EPSON • ZENITH**  
**• EVEREX • HP Vectra • SAMSUNG • SUN • Canon Printer**  
**• SILICON GRAPHICS • WYSE • and other AT & XT clones**

1228 Village Way, Unit D • Santa Ana, CA 92714 • (714) 542-8292 • FAX (714) 542-8648 • Hours 8:00 AM-5:00 PM PST

DEALER'S INQUIRIES WELCOME

Prices are subject to change

Circle 566 on Reader Service Card (RESELLERS: 567)



# Microcom Computers

A HRW Technologies Company



## Custom Configuration Computer Systems

**Standard System Features:**

- \* Teac 5.25" 1.2 MB or 3.5" 1.44 MB Diskette Drive
- \* 1:1 Interleaved Hard/Floppy Drive Controller
- \* Enhanced 101-key Keyboard w/Tactile Click Feedback
- \* 2 Serial, 1 Parallel & 1 Game Port
- \* High Capacity 200 Watt System Power Supply
- \* Real Time Clock/Calendar with Battery
- \* Small Footprint Case (14.875" W x 16.25" D x 6.75" H) (Optional Cases Available)

### 286/12 Standard System \$499

**Standard System Features plus:**

- \* 80286 Processor running at 12 MHz
- \* 512 KB RAM Standard (Expandable to 4 MB RAM)
- \* 0 Wait State Performance for 16 MHz Effective Throughput
- \* Landmark = 16.0 MHz - Norton SI = 15.4x
- \* AMI BIOS with MS-DOS, Novell & Windows Support

\* For 1 MB RAM - Add \$50

### 386SX/16 Standard System \$699

**Standard System Features plus:**

- \* Intel 80386SX Processor running at 16 MHz
- \* 1 MB RAM Standard (Expandable to 8 MB RAM)
- \* 0 Wait State Performance for 21 MHz Effective Throughput
- \* Landmark = 21.0 MHz - Norton SI = 18.4x
- \* AMI BIOS with MS-DOS, OS/2, XENIX, UNIX, Novell, Windows & 386-Specific Software Support

### 386/25 Standard System \$1,099

**Standard System Features plus:**

- \* Intel 80386DX Processor running at 25 MHz
- \* 1 MB RAM Standard (Expandable to 8 MB RAM)
- \* 0 Wait State Performance for 34 MHz Effective Throughput
- \* Landmark = 34.5 MHz - Norton SI = 29.7x
- \* AMI BIOS with MS-DOS, OS/2, XENIX, UNIX, Novell, Windows & 386-Specific Software Support

### 386/33C Standard System \$1,599

**Standard System Features plus:**

- \* Intel 80386DX Processor running at 33 MHz
- \* 1 MB RAM Standard (Expandable to 8 MB RAM)
- \* 64 KB Static RAM Cache for Increased Performance
- \* 7 Million Instructions Per Second (MIPS) Operation
- \* Landmark = 56.0 MHz - Norton SI = 45.9x
- \* AMI BIOS with MS-DOS, OS/2, XENIX, UNIX, Novell, Windows & 386-Specific Software Support

### 486/25C Standard System \$4,299

**Standard System Features plus:**

- \* Intel 80486 Processor running at 25 MHz
- \* 4 MB RAM Standard (Expandable to 8 MB RAM)
- \* 64 KB Static RAM Cache for Increased Performance
- \* Over 11 Million Instructions Per Second (MIPS) Operation
- \* Landmark = 117.0 MHz
- \* AMI BIOS with MS-DOS, OS/2, XENIX, UNIX, Novell, Windows & 386-Specific Software Support

**Options/Upgrades:**

- Mini-size Desktop Tower Case Add \$50
- Full-size Tower Case Add \$150
- 2 MB RAM (Upgrade from 1 MB) Add \$125
- 4 MB RAM (Upgrade from 1 MB) Add \$350
- Second 5.25" 1.2 MB or 3.5" 1.44 MB Diskette Drive \$85
- Microsoft Mouse with Windows 3.0 \$189
- Internal 2400 Baud Modem \$99
- DOS 3.30 or 4.01 \$69

### MICROCOM 286/12

286/12 System Features, Hard Drive, Monitor & Video Card

Hard Drives:	IDE	IDE	IDE	ESDI	IDE
MB/Ms	42/28	80/18	105/18	150/18	205/18
No Video	\$799	\$1,099	\$1,199	\$1,599	\$1,599
Mono	\$924	\$1,224	\$1,324	\$1,724	\$1,724
VGA-Mono	\$1,049	\$1,349	\$1,449	\$1,849	\$1,849
SVGA	\$1,349	\$1,649	\$1,749	\$2,149	\$2,149
Hires	\$1,399	\$1,699	\$1,799	\$2,199	\$2,199

### MICROCOM 386SX/16

386SX/16 System Features, Hard Drive, Monitor & Video Card

Hard Drives:	IDE	IDE	IDE	ESDI	IDE
MB/Ms	42/28	80/18	105/18	150/18	205/18
No Video	\$999	\$1,299	\$1,399	\$1,799	\$1,799
Mono	\$1,124	\$1,424	\$1,524	\$1,924	\$1,924
VGA-Mono	\$1,249	\$1,549	\$1,649	\$2,049	\$2,049
SVGA	\$1,549	\$1,849	\$1,949	\$2,349	\$2,349
Hires	\$1,599	\$1,899	\$1,999	\$2,399	\$2,399

### MICROCOM 386/25

for 64 KB Cache, add \$300

386/25 System Features, Hard Drive, Monitor & Video Card

Hard Drives:	IDE	IDE	IDE	IDE	ESDI
MB/Ms	42/28	80/18	105/18	205/18	340/18
No Video	\$1,399	\$1,699	\$1,799	\$2,199	\$2,699
Mono	\$1,524	\$1,824	\$1,924	\$2,324	\$2,824
VGA-Mono	\$1,649	\$1,949	\$2,049	\$2,449	\$2,949
SVGA	\$1,949	\$2,249	\$2,349	\$2,749	\$3,249
Hires	\$1,999	\$2,299	\$2,399	\$2,799	\$3,299

### MICROCOM 386/33C

386/33C System Features, Hard Drive, Monitor & Video Card

Hard Drives:	IDE	IDE	IDE	IDE	ESDI
MB/Ms	42/28	80/18	105/18	205/18	340/18
No Video	\$1,899	\$2,199	\$2,299	\$2,699	\$3,199
Mono	\$2,024	\$2,324	\$2,424	\$2,824	\$3,324
VGA-Mono	\$2,149	\$2,449	\$2,549	\$2,949	\$3,449
SVGA	\$2,449	\$2,749	\$2,849	\$3,249	\$3,749
Hires	\$2,499	\$2,799	\$2,899	\$3,299	\$3,799

### MICROCOM 486/25C

486/25C, System Features, Hard Drive, Monitor & Video Card

Hard Drives:	IDE	IDE	IDE	ESDI	ESDI
MB/Ms	80/18	105/18	205/18	340/18	650/18
No Video	\$4,899	\$4,999	\$5,399	\$5,899	\$7,099
Mono	\$5,024	\$5,124	\$5,524	\$6,024	\$7,224
VGA-Mono	\$5,149	\$5,249	\$5,649	\$6,149	\$7,349
SVGA	\$5,449	\$5,549	\$5,949	\$6,449	\$7,649
Hires	\$5,499	\$5,599	\$5,999	\$6,499	\$7,699

## Pre-Configured Computer Systems

### Our Commitment to Service

- \* Free 4 Month On-Site Servicing Nationwide
- \* 1 Year Warranty on Parts & Labor
- \* Toll-free Technical Service & Support
- \* No Surcharge on Credit Card Purchases
- \* Comprehensive 72 Hour Burn-in Testing on All Systems
- \* All Systems Made with pride in the USA
- \* Guaranteed 100% IBM Compatible
- \* Best Quality at an Affordable Price

### 286/12 Super VGA System \$1,399

- \* 286/12 Standard System with 1 MB RAM
- \* 42 MB Hard Disk w/Quick 28 ms Access Time
- \* High Performance 16-bit VGA Graphics Card
- \* 14" Color Super VGA Monitor with 800 x 600 Resolution and 0.31 dot pitch
- \* DOS 3.30 or 4.01 Included

### 386SX/16 Super VGA System \$1,599

- \* 386SX/16 Standard System
- \* 42 MB Hard Disk w/Quick 28 ms Access Time
- \* High Performance 16-bit VGA Graphics Card
- \* 14" Color Super VGA Monitor with 800 x 600 Resolution and 0.31 dot pitch
- \* DOS 3.30 or 4.01 Included

### 386/25 Super VGA System \$1,999

- \* 386/25 Standard System
- \* 42 MB Hard Disk w/Quick 28 ms Access Time
- \* High Performance 16-bit VGA Graphics Card
- \* 14" Color Super VGA Monitor with 800 x 600 Resolution and 0.31 dot pitch
- \* DOS 3.30 or 4.01 Included

### 386/33C Hires System \$2,799

- \* 386/33C Standard System
- \* 105 MB Hard Disk w/Quick 18 ms Access Time
- \* High Performance 16-bit 512K VGA Graphics Card w/1024 x 768 Capability
- \* 14" Color Hi-Res VGA Monitor with 1024 x 768 Resolution and 0.28 dot pitch
- \* DOS 3.30 or 4.01 Included

### 486/25C Hires System \$5,999

- \* 486/25C Standard System
- \* 205 MB Hard Disk w/Quick 18 ms Access Time
- \* High Performance 16-bit 512K VGA Graphics Card w/1024 x 768 Capability
- \* 14" Color Hi-Res VGA Monitor with 1024 x 768 Resolution and 0.28 dot pitch
- \* DOS 3.30 or 4.01 Included

## Microcom Computers' Customers Include:

Xerox, GTE, Motorola, Raychem, General Electric, Eastman Kodak, SEGA of America, Toshiba, Genetech, Holiday Inn, U.S. Court of Appeals, U.S. Food & Drug Administration, NASA, U.S. Dept. of Energy, U.S. Dept. of Agriculture, Lawrence Livermore National Laboratory, U.C. Berkeley, U.C. San Francisco, Stanford University, Princeton University and many, many more

# To Order - Call Toll Free 1-800-248-3398

Open from 9:00 A.M. to 6:00 P.M. PST, Monday-Friday

## Microcom Computers

48890 Milmont Drive, Fremont, CA 94537 - Tel: (415)623-3628 - Fax: (415)623-3620

3650-18th Street, San Francisco, CA 94110 - Tel: (415)255-2288 - Fax: (415) 255-8873



Prices are subject to change without notice. Not responsible for typographical errors. CA residents please add 7.25% sales tax. No surcharge on credit card purchases. Personal and company checks require 2 weeks clearance. All trademarks acknowledged. Tower is a registered trademark of NCR Corporation. Microcom Computers reserves the right to substitute any and all items with equivalent or better parts. All benchmarks and specifications are for your information only and may vary from system to system. Prices do not include shipping and handling.



## The University of the Arts & SCAN

announce

*The Tenth Annual Symposium  
for Small Computers in the Arts*

**November 8-10, 1990**

at The University of the Arts  
Philadelphia, Pennsylvania

*The symposium explores how computers have radically created a paradigm shift,  
and as a result changed the concepts and the techniques employed by designers, artists,  
performers, and arts educators.*

*Topics include:*

Computer Animation  
Computer Graphics & Music Education  
Electronic Musical Instruments  
Electronic Painting  
Meta-media  
MIDI Implementation  
Performance  
Sculptural Applications for Computers  
Videography

*Guest Speakers include:*

Tim Binkley  
Peer Bode  
Joel Chadabe  
Connie Coleman  
Tim Druckery  
Rob Fisher  
Jon Fordyce  
Isaac Kerlow  
Don Slepian  
Kenneth Snelson  
Walter Wright

*In addition, there will be pre-conference activities, performances, special events,  
and an open trade show with exhibits by inventors, artists, musicians, publishing  
companies, and computer companies.*

For more information, call (215) 875-2221,  
or write:

**SCAN Symposium**

Office of Continuing Education  
The University of the Arts  
Philadelphia College of Art and Design  
Broad and Pine Streets  
Philadelphia, Pennsylvania 19102

Conference proceedings  
will be available for a small fee.

To order, contact:

**SCAN**

Box 1954  
Philadelphia, Pennsylvania 19105

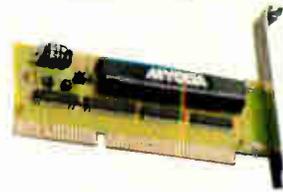
# Built for Speed, Priced for Comparison!



## MYODA VG-303

# \$159

- Protection from any type of virus
- power on password function
- Hardware designed, it can not be destroyed by virus
- Better protection than software alone
- Softswitch keyboard lock function
- No effect on RAM or speed
- For IBM-PC/XT, AT, 386 486 & compatibles
- Supports networks
- Easy installation



## No Virus Allowed!

## MYODA LT5200 SERIES

Flexibility of a Laptop with the true power and expandability of a high-performance Desktop computer. MYODA has designed and built these machines with the needs of today's demanding users in mind. Just look at our features and then compare them with other machines costing twice as much and you will see why we are the clear choice for professional users. We offer true expandability with 2 FULL SIXTEEN BIT SLOTS, MEMORY IS EXPANDABLE TO 8MB, VGA SCREEN, EXTERNAL VGA MONITOR PORT, EXTERNAL FLOPPY DRIVE PORT. There's even a true 386-25 running at 0 WAIT STATE available with 32KB CACHE MEMORY. And they all come with a CONNER, 40 MB HARD DRIVE & a 3.5/1.44MB FLOPPY DRIVE, AMI, or Award BIOS

**FREE DOS 4.01 or 3.3** with every LT5200 order

Model	cpu	Internal Slots	Screen	FD	HD	EXT FD Port	Max Memory	Price
5200CD	386-25	2x16 Bit	VGA GAS plasma	3.5/1.44	40MB IDE	YES	8MB	\$3599
5200SX	386-16	2x16 Bit	VGA GAS plasma	3.5/1.44	40MB IDE	YES	8MB	\$2999
5200NV	286-16	2x16 Bit	VGA GAS plasma	3.5/1.44	40MB IDE	YES	8MB	\$2399

Larger Hard Drives Also Available. Call for Details

Get up to  
**\$300**  
in rebates



**LIMITED  
TIME**



## MYODA LT-3500

# \$1499

Here is your chance to pick up on the biggest bargain in Laptops anywhere. The LT-3500 is packed with features. The 80286-12 MHz CPU runs at 0 wait state, ready to blaze through those tough applications. There is also a 40MB fast hard drive and an internal 3.5/1.44MB diskette drive

- Intel 80286 CPU 0 wait state
- 3.5/1.44MB floppy drive
- 6/12 MHz clock speed
- 40MB(28ms) hard drive
- EGA GAS plasma display
- 2 serial/1 parallel/CRT port
- 1MB installed 4MB max
- Free carrying case

### Laptop Accessories

- External 5.25/1.2MB floppy drive
- External battery pack with 12V inverter
- Expansion chase 2x8 bit, 2x16 bit (For LT-3500 only)
- Numeric keypad

Prices and Availability subject to change without notice

## MYODA MD7240

# \$1499

With 64KB Cache Memory

- Intel 80386-25 microprocessor
- 0 wait state, 25MHz clock speed
- 4MB memory installed
- 64KB cache memory(optional)
- One 5.25/1.2MB floppy drive
- IDE dual floppy/hard drive controller card
- 2 serial and 1 parallel port
- 101 enhanced keyboard
- Tower Case Optional



Circle 579 on Reader Service Card (RESELLERS: 580)

we will configure each system to your exact requirement. Call us today with your specifications

## MYODA MD3410

# \$529

- Intel 80286-12 microprocessor
- 0 wait state, 12 MHz clock speed
- 1MB memory installed
- One 5.25/1.2MB floppy drive
- IDE dual floppy/hard drive controller card
- 2 serial 1 parallel port
- 101 enhanced keyboard



## MYODA MD5030

CALL FOR OUR LOW PRICE

- Intel 80386SX-16 Microprocessor
- Same configuration as above

See us at Booth 1492

**COMDEX/Fall '90**  
November 12-16, 1990  
Las Vegas, Nevada

We carry a full line of computer components. Call us for details!

HOURS:

Mon-Fri: 8:30-5:00 Sat: 8:30-1:30  
(Central time)

# MYODA<sup>®</sup> Inc.

1053 Shore Rd, Naperville IL 60563 Tel: (708) 369-5199 Fax: (708) 369-6068

Call Toll Free: **1-800-562-1071**

World Radio History

OEM Inquire: Alex Chen Taipei Office 3F No. 191 Sec. 3 Roosevelt Road  
Taipei, Taiwan TEL: 886-2-3628445 FAX: 886-2-3626283

Dealers/Vars Inquires: 1053 Shore Road Naperville Illinois 60563  
TEL: (708) 369-5199 FAX: (708) 369-6068

The 7th Annual

# C O M P U T E R G R A P H I C S S H O W • 1 9 9 1

Javits Center  
New York City  
January 15-17, 1991



Illustration by Audrey Fleisher  
Computer Graphics Specialist  
Saatchi & Saatchi Advertising

## Where Computer Graphics and Business Merge

Sponsored by:

- Corporate Video Decisions
- HOW Magazine • PC Today
- Personal Publishing Magazine
- Pixel - The Computer Animation News People
- The New York MAC Users' Group
- A Mijo, Inc. Production

**DISCOVER** the premier exhibition of electronic business presentation products.

**JOIN** other publishing & pre-press managers, information systems directors, ad agency creatives, art directors, post production managers, video facilities managers, marketing communications directors, animators, AV department heads, desktop publishing managers, commercial slide producers and corporate trainers.

**ATTEND** application oriented conference tracks covering: Art & Design Graphics; Business/Presentation Graphics; Computer Animation; Corporate Video; Electronic Publishing/Pre-Press; and Multimedia Applications.

113

**7th Annual  
Computer Graphics Show**

817 Silver Spring Ave., #409  
Silver Spring, MD 20910  
301-587-4545 • FAX: 301-587-6527

I am interested in attending. Please send Registration Brochure.

I am interested in exhibiting and require a \_\_\_ x \_\_\_ foot booth.

**PLEASE PRINT...**

Name \_\_\_\_\_

Title \_\_\_\_\_

Company ATTACH BUSINESS CARD

Address \_\_\_\_\_

City, State, Zip \_\_\_\_\_

Phone \_\_\_\_\_

# Software: The Next Step for Taiwan's Information Industry

By David Hoffman, industry analyst and consultant for the Market Intelligence Center division of the Institute for Information Industry.

For a country whose entrepreneurs have long since mastered the art of PC hardware development and production, software development and integration is the next logical step.

## The ROC's Pressing Need for a Software Industry

Taiwan-long judged by American software companies to be an island teeming with incorrigible software pirates-has, over the past 18 months, implemented an unprecedented campaign to protect intellectual property rights. The dozens of computer shops down at Chung Hwa Road in downtown Taipei, a favorite shopping place for students and computer hobbyists alike, still resemble a swap-meet, with cluttered, cavernous stalls selling mishmashes of components, cases, motherboards, and monitors all at bargain prices; but now, the pirated software, once indiscriminately displayed on storefront turn-racks, is nowhere to be "seen". Albeit, to some extent, what is "seen" and "not seen" represents the island's new-found discretion. Undoubtedly, some software is still illegally copied. Nevertheless, "that PC retailers at Chung Hwa Road see fit to exercise discretion when selling pirated software attests to the fact that the ROC's software protection campaign is taking effect," comments Howard Brooke, and expatriate contract lawyer practicing in Taipei.

Interestingly, Taiwan's aggressive software protection campaign has less to do with outside pressure from American trade negotiators than it has to do with an internal pressure from the island's own industrialists, software developers, and information industry planners. Indeed, the software protection campaign is simply the ROC's first logical step in an ambitious plan to rapidly develop its own software industry.

"In a broad sense, Taiwan's profiteering software pirates hurt Taiwan much more than they ever hurt companies like Ashton-Tate. Because of software piracy in the past, Taiwan is now stuck with a seriously stunted software industry," claims Bishop Chen, Deputy Director of the Market Intelligence Center, a division of the ROC's Institute for Information Industry (III). Of the \$5.2 billion dollars Taiwan's information

industry turned over in 1989, less than 8% came from software sales. "No Taiwanese is going to invest money in developing software here is his product's going to be copied as soon as it's released."

The ROC's Industrial Development Bureau (IDB) has targeted the software industry as a priority for development in the 90s. Taiwan's IT infrastructure needs a software industry in order to give its flagship hardware industry long-term viability. At present, the island's hardware manufacturers are finding it increasingly difficult to differentiate their "boxes" from one another. Software-be it housed in ASIC firmware or on floppy diskettes-represents one of the few technological means of adding value to any given PC or PC peripheral. Taiwan's hardware vendors are realizing none too soon the importance software plays in increasing hardware functionality-the key to maintaining margins. "Without software, a PC is but an empty shell," observes an industry analyst, "anyone can make one."

A more subtle and important reason for the ROC government's recent promotion of the software industry is that advanced, customized software is urgently needed by Taiwan's core industries: textiles, plastics, electronics, and chemicals. "Taiwanese people always measure success in terms of 'export dollars brought in'," comments Dr. Rhett Tsao, a Ph.D from Harvard, and Director of International Integrated Systems (IISI). "This point of view is a real limitation." IISI, a joint venture between Taiwan's III and IBM, develops advanced software for IBM on a sub-contract basis. Founded in 1988, IISI, Taiwan's first major strategic alliance in the software, is designed to set an example for the island's debutante software developers on how a world-class software company should be run. "Software isn't like hardware. Success shouldn't be measured by raw export dollars alone. The ROC needs a strong software industry, first and foremost, in order to increase the productivity and competitiveness of its core export industries. Japan's software industry is very strong; but you don't see packages like Lotus 123 and dBase being exported from Japan. The dozens of incredibly competitive Japanese industrial companies, companies like: Honda,

Mitsubishi, and Sony, are the result of Japan's software efforts." Tsao continues, "that Taiwan now ranks sixth on the list of information technology producing countries is deceptive. In terms of software penetration, the ROC is way behind Singapore, Korea, and even Hong Kong. This condition has got to change-and fast-if we're to maintain our competitive edge, not only in the computer hardware industry, but in other industries as well."

## Meeting Future Needs: The Taiwan Software Park

Image 40 hectares of landscaped campus with clusters of neo-modern glass buildings-each building a work/home to hundreds of engineers researching specific software disciplines: firmware scientists in this building, CIM engineers in that, personal productivity software designers in the next, and so forth. Each building will be connected in satellite fashion to a administrative core, a degree-offering software research institute, a market intelligence center, a CASE-tools center, a hardware-platforms center, a software standards library, and a multi-purpose training center. There will be a "small business incubator" to support cash-low software start-ups with great ideas; eligible entrants must produce results in a given period of time-graduate out of the incubator, if you will-or be forced to leave. Sound impressive? "It will be," comments Richard Kamman, Dataquest Taiwan. "The Taiwan Software Park will be the first real software park if it's kind in the world. I have no doubt that the park will be as successful in software as the Hsin Chu Science-based Industrial Park outside Taipei has been in hardware and semi-conductors."

Taiwan's software park will be operational by 1992. The ROC's IDB has donated the land (recall that Taipei's land is the second most expensive in the world, next to Tokyo), and allocated some \$40 million dollars to develop the park's first phase. Dataquest has been commissioned by IDB to do a planning study for the park. Dataquest's plan for the park's first phase has already been completed and accepted by the IDB. "It's really exciting," exclaims Kamman. "This is the best project I've seen here in 21 years in terms of government and private industry working together. There's phenomenal interest in participation from the private sector. It's going to be a first-class development."

In short, the IDB wants Taiwan's

# There are some deliveries you can count on.



Don't you wish you had an OEM supplier that was as reliable? Now you do. Sampo Technology, part of the Sampo Group, has been a leader in designing and manufacturing high-quality laptops, monitors, terminals and other computer products for years.

With service centers and branch offices in the United States, West Germany, and the U.K. Sampo Technology has the facilities to back up its expertise.

You can count on it — Sampo delivers.



## SAMPO

Today's new product:

### *LapStar* SX

- \* 16MHz 80386SX CPU
- \* VGA display, 16 shades of gray
- \* 40MB HDD, 3.5" 1.44MB FDD
- \* 1MB, up to 5MB DRAM on board
- \* Built-in 2400 bps modem (optional)
- \* Detachable keyboard
- \* Power management

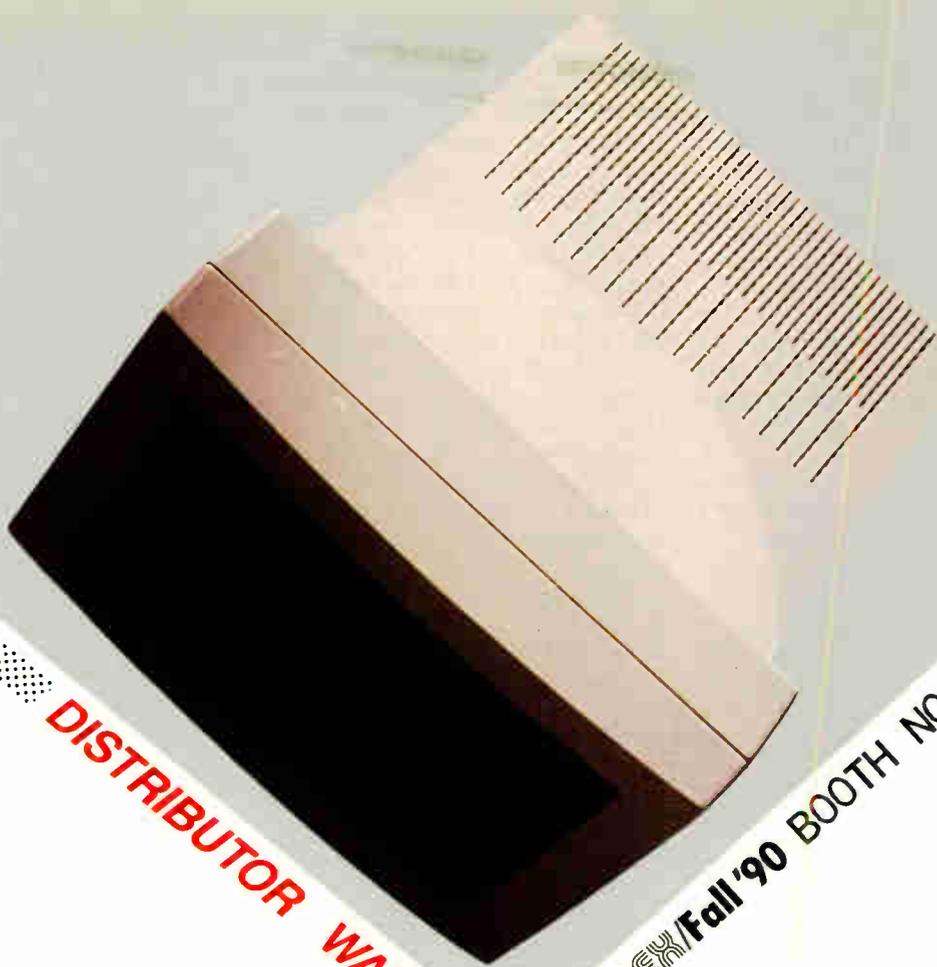
Circle 582 on Reader Service Card

#### SAMPO TECHNOLOGY CORPORATION

TAIPEI OFFICE: 9F, NO. 629, MIN-SHENG E. RD., TAIPEI, TAIWAN, R.O.C. TEL: 886-2-7191101 FAX: 886-2-7196623

FACTORY: 26-2, TING-HU, TA-KANG TSUN, KUEI-SHAN HSIANG, TAO-YUAN HSIEN 33334, TAIWAN, R.O.C.

TEL: 886-3-3285001-10 FAX: 886-3-3285020 TELEX: 34640 SEMCO.



**DISTRIBUTOR WANTED**

**COMDEX/Fall '90 BOOTH NO. N2244**

## Today's users ask for more

Your customers require nothing less than crisp-clear displays. For their DTP, CAD/CAM, etc. they need monitors that are up to video standards such as VGA, 8514A, or MACII.

If you require a reliable, reasonably priced supply of high-class 100% compatible monitors, we should talk...



### DM-1431

### DM-1435

CRT Type	0.28/0.29mm	
Resolution (Pixels) Max	640*480	800*600 (for non-interlaced). 1024*768 (for interlaced).
Display Type	Non-interlace	Non-interlace, interlace.
Video Standards Supported	IBM VGA	VGA, 8514A, Apple MACII.
Sync Signal	TTL level	TTL level or Composite sync. On green. Video 0.7Vp-p Positive. Sync. 0.3Vp-p Negative.
Vert. Scan Range	50-70 Hz Auto Sync.	50-90 Hz
Hor. Scan Range	31.5KHz	31.5KHz/35.5KHz Auto switch.
Bandwidth	35MKz	45MKz
Display Area (mm)	240*180	240*180



**Chun Yun Electronics Co., Ltd.**  
351 Szu Yuan Rd., Hsin Chuang, Taipei, Taiwan, R.O.C.

TEL: 886-2-9926363·9918480

FAX: 886-2-9918483

Circle 559 on Reader Service Card

software industry to be a \$6 billion dollar industry by the year 2000. By all accounts, this target will require a force of at least 100,000 highly skilled, software engineers. At present, however, the ROC only has about 10,000 software engineers of which only a small percentage could be considered highly skilled. Therefore, the intellectual infrastructure of the park, by encouraging the free interchange of ideas through the concentration of expertise, is designed to accelerate the cultivation of engineering talent.

Several factors are likely to contribute to increasing the ROC's software engineering manpower. As with Taiwan's existing hardware-focused park in Hsin Chu outside Taipei, foreign firms, the likes of Ashton-Tate and Microsoft, are certain to open affiliate R&D centers in the park. Not only will they be able to develop their software less expensively; but, they can utilize the expertise of local engineers in 2-bit code technology to localize their software into versions appropriate for use in countries with character-based languages: China, Japan, and Korea in particular. It is just as certain that seasoned, American-educated Chinese engineers will return to develop software in the park. (Indeed, it is estimated that some 30 to 40% of the 11,000 engineers working in the Hsin Chu Science Park are overseas Chinese scientists who have returned to Taiwan from experienced career abroad.)

"These factors will help the Taiwanese develop their skills in the 'R' of 'R&D'. Today, we're great at 'D', D-evelopment; where we're weak is in 'R', R-esearch. Research demands ideas: marketing, strategic vision, business-sense. Overseas' alliances and returning Chinese with international experience will help a lot in this regard," claims Ke C. Shih, General Manager Cadence Taiwan. Mr. Shih should know. A graduate from MIT's computer science program, Shih just returned to Taiwan from a highly successful 27 year career in the US working for companies like DEC and National Semi Conductor. Mr. Shih's Cadence is a world leader in advanced IC design tools and CAD software. "My mission is drive Taiwan's IC design industry. Taiwan currently has the most advanced IC production facilities in the world. These resources are terribly underutilized. What we

lack is the design expertise to translate the demands of local system companies into an IC specifications. Cadence will be the catalyst to change all of this—we have the right tools. We will train. We will consult. We will set an example. And, we will be the first company to set-up operations in the Software Park."

Another problem the software park hopes to overcome is the fact that out of Taiwan's 250 to 350 software companies, only ten have over 100 employees. "The software companies in this country are incredibly small and fragmented," claims IISI's Dr. Tsao. "Before a potential customer will consider your software they must have complete confidence that you can 1). solve their problem, 2). continue to support them. The ten-employee software houses typically found in Taiwan today can't even begin to inspire this kind of confidence in potential clients. The real strength of the park will be that Taiwan's small software companies can band together in an unified front to really compete effectively on an international scale. The ROC government needs to encourage this kind of cooperation."

### What Software Will You See From Taiwan in the Future

Will you see a replacement for Lotus 123 come out of Taiwan in the next 2 to 3 years? "Definitely not," asserts L.Y. Lee, General Manager of Marketing at Systex Corporation. Mr. Lee should know. In 1986, Systex, a partner in a US joint-venture company called : Daybreak Technologies, introduced a revolutionary 3 dimensional spreadsheet program called: Silk. Silk represented an investment of some 40 man years worth of engineering-in dollar terms, just shy of \$1 million US. "Except for their mouse support and partial recalculation function, even Lotus' newest 123 v.3 is not as advanced as Silk was in '86," claims Mr. Lee. Beautifully packaged by an American PR firm, Silk's macro-maker, on-line help, and reverse calculation functions won it "PC Magazine's" Editor's Choice in 1986. Priced at \$149, how could it fail? Yet, five months after it's introduction, Silk had sold only 10,000 copies. "The best product doesn't necessarily win in today's market. We simply lacked sufficient marketing capital and expertise to go head to head with a

veteran like Lotus."

As a testament to the flexibility of Taiwan's software houses, Systex's 250 software engineers have long since scrapped Silk and are now focussing on value-added network services. They've developed an extremely successful real-time securities-analysis package for the local stock market that can be easily adapted to other Asian bourses. Furthermore, they've just introduced a micro-to-mainframe communications utility program called Tast-to-Task (TTT). TTT is a tool that generates applications designed to increase PC utilization and MIS efficiency within the micro-to-mainframe environment of on-line transaction processing. "This is the niche for us," claims Lee.

What you're most likely to see from Taiwan in the future is software like Systex's TTT-tools, utilities, and other software enhancements that are incorporated into well know application environments. For example, III's Technology Research Division has written a host of tools and utilities for Windows version 2.x, including a form tool, an image processor, and a Chinese language screen and printer device driver. One such program called EyeStar-plus, helped Taiwan's Microtek International take the lead in desktop scanners away from HP and Sharp. "Bill Gates was shocked when he visited us in June to find 50 engineers here doing all this work using only the generic Window's Binary Adaption Kit. When he saw the complexity of the work we had done he thought that we must have had access to Windows' source code or something. I assured him that we hadn't; in fact, we've had no support from Microsoft," confides Alex Chiu Sun, Division Director. Mr. Sun's division is focusing on desktop publishing tools and utilities." All of the programs we've done are now being ported to Windows 3. In general, we're concentrating our software efforts on bringing improvements to the Windows' environment. Hopefully, companies like Microsoft, Aldus and others will want to integrate our work into their commercial products." Another example is Datex System's highly successful LANsmart product. LANsmart, a network operating system completely compatible with Novell's Netware, brings peer-to-peer functionality and ease-of-use to Novell's somewhat rigid system. "LANsmart makes resource sharing a 'piece of cake' in the Novel environment," claims one reseller in the UK. "It's a really simple and interesting product that adds

# Introducing a Revolutionary Concept



## HEALTHY COMPUTING

- *Flicker free... less eyestrain and stress.*
- *Flat screen... less fatigue and headaches.*
- *Low electromagnetic radiation... healthier work environment.*

## Low Radiation Monitors

### The Difference Is What You Can't See.

Do you experience eyestrain, headaches, fatigue and stress? Scientific studies show that many of these symptoms are caused by computer monitor radiation — even with occasional use.

See us at

**COMDEX/Fall '90**

12-16 November, 1990  
Las Vegas, Nevada, USA

Booth No: H7642

### We Care About Your Computing Safety.

Our customers demand quality, and expect long life from monitors. We expect the same from our customers. As a concerned manufacturer, ADI announces a new line of low radiation monitors to innovate a next to radiation-free computing environment.

### ADI Is More Than a Monitor Manufacturer.

We also offer personal computers ranging from desktop and diskless PCs to workstations, and the complete spectrum of IBM plug-compatible and ASCII/ANSI terminals.

---

For more information, please contact:

HEADQUARTERS  
ADI Corporation  
14/F, 1, Nan-King E. Road,  
Sec. 4, Taipei, Taiwan,  
R.O.C.  
Tel: 886-2-713-3337  
Fax: 886-2-713-6555  
Tlx: 21790 ADICORP

U.S.A. HEAD OFFICE  
ADI Systems, Inc.  
2121 Ringwood Avenue  
San Jose, CA 95131  
Tel: (408) 944-0100  
Fax: (408) 944-0300  
CA: (800) 232-8282  
US: (800) 228-0530

U.S.A. EAST COAST  
ADI Systems, Inc.  
1259 Rt. 46E., Bldg #4  
Parsippany, NJ 07054  
Tel: (201) 334-0019  
Fax: (201) 334-0076

The logo for ADI Corp. features the letters 'ADI' in a large, stylized, red font. The 'A' and 'D' are connected, and the 'I' is a simple vertical bar. To the right of 'ADI' is the word 'CORP.' in a smaller, red, sans-serif font.

台 北

# TAIPEI



## COMPUTEX'91

June 4-10, 1991

Instant access to the world of computers.

### Featuring

Computers

Peripherals

Software

Office automation systems

Data communications

Applications

Mass storage

Components

### Organizers:



CHINA EXTERNAL TRADE  
DEVELOPMENT COUNCIL



TAIPEI COMPUTER  
ASSOCIATION

### Sponsor:



TAIPEI WORLD  
TRADE CENTER

Venues: TWTC EXHIBITION HALL  
CETRA EXHIBITION HALL

Contact: TWTC EXHIBITION HALL  
5 Hsinyi Road, Section 5, Taipei, Taiwan  
Republic of China  
Tel: (02)725-1111 Fax: 886-2-725-1314  
Telex: 28094 TPEWTC

TAIPEI COMPUTER ASSOCIATION  
3Fl., No. 2 Pa Teh Rd., Sec. 3, Taipei, Taiwan  
Tel: (02)7764249 Fax: (02)7764410

### Branch Offices:

• New York-CETDC, Inc.  
Tel: (212)532-7055 Fax: (212)213-4189  
• San Francisco-Far East Trade Service, Inc.  
Tel: (415)788-4304 Fax: (415)788-0468  
• Chicago-Far East Trade Service, Inc.  
Tel: (312)819-7373 Fax: (312)819-7377

Taipei  
Trade  
Shows

# Put The Power Of A Desktop Right In Your Hands

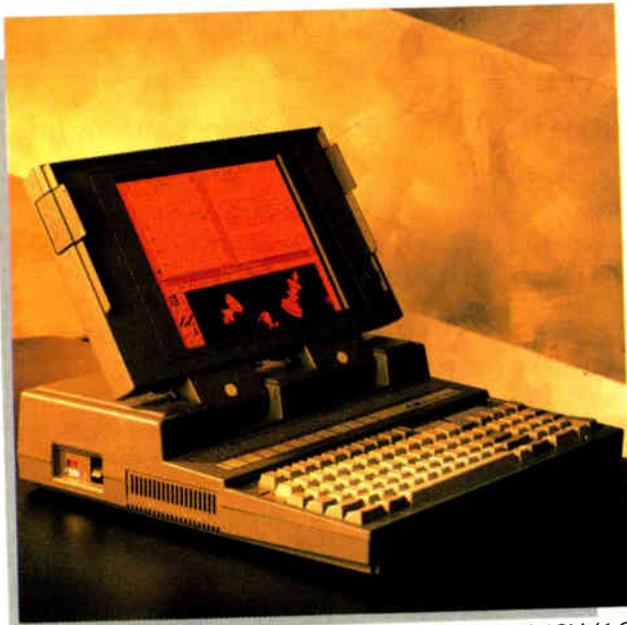
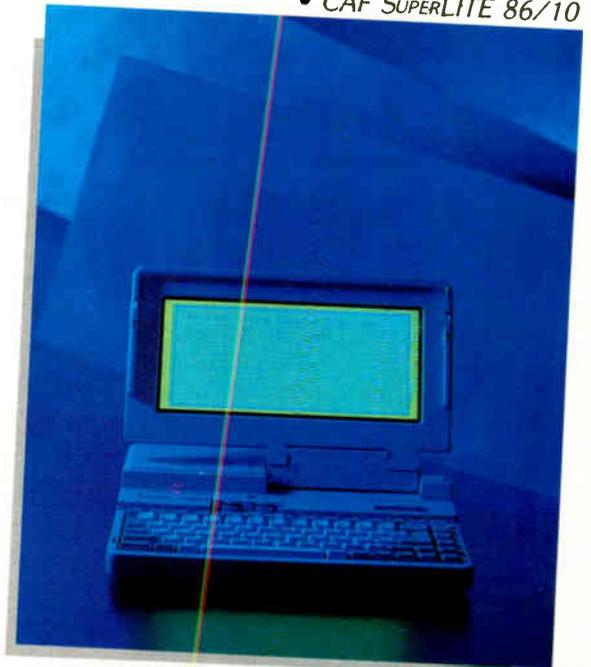
CAF makes a system to suit just about every PC computing need. With more than 7 years experience in the manufacture of desktop systems, CAF's award winning R&D team, turned its talent on the development of laptop and notebook systems. The result has been phenomenal.

The CAF ProLITE 286 Laptop was such a tremendous success, we decided to follow it up with a 386SX version, the CAF ProLITE 386SX Laptop.

We also wanted a series that would cover the entire range of 86, 286 and 386SX computing in a Notebook size. The CAF SUPERLITE line, does just that. Combining small size and light weight with power to burn, the CAF SUPERLITE line has all the advanced features you expect in a state-of-the-art system.

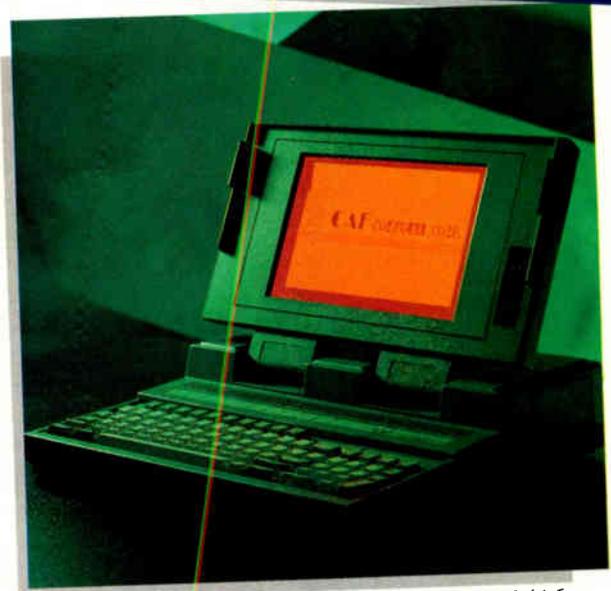
Put the power of CAF to work for you.  
You'll be glad you did.

• CAF SUPERLITE 86/10



• CAF ProLITE 386SX/16

\* SEE US AT COMDEX®/Fall '90  
SANDS EXPO AND CONVENTION  
CENTER. #N866.



• CAF ProLITE 286/16

 **CAF**® **COMPUTER CORP.**

12th Fl., No. 51, Chung Ching S. Rd., Sec. 2, Taipei, Taiwan, R.O.C. Tel: (02) 396-1166 (50 Lines) Telex: 14058 STXFTX Fax: (02) 392-5212, 395-3562  
**CAF TECHNOLOGY, INC., U.S.A.** TEL: 818-289-8299 FAX: 818-289-8752 **CAF Computertechnik GmbH, W.G.** Telefon: 0 23 06/2 50 17 Telefax: 0 23 06/2 50 10

Circle 557 on Reader Service Card

NOVEMBER 1990 • B Y T E 72NE-31

real value to a Novell LAN. My clients love it."

"I think you'll see a lot more than just tools and utilities," claims Dataquest's Kamman. "Software's going to play a huge role in the advancement of ASIC technology in this country. This will result in more functional, more integrated, less expensive computer hardware." Also, Taiwan's strong background in manufacturing industries coupled with their strength in computer hardware is sure to result in software geared toward Computer Aided Manufacturing and Computer Integrated Manufacturing (CAM/CIM). In fact, most of Taiwan's 300 software companies today develop CAM/CIM applications. One such company, Gain Associates, has been successfully developing dying-process control software and hardware combinations for nearly 10 years. Gain's products are sold worldwide by the UK's ICS-Texicon-Europe's leader in textile production equipment. "More than half of our engineers are from the textile industry itself. Therefore, we understand the textile production processes and specifically, the problems in the processes, implicitly. This enables us to develop solutions. That's all the

business is about really. Even IBM has approached us for help recently," comments David Ting, Vice President of Gain Associates.

Although ASIC and CAM/CIM only indirectly affect everyday PC users, both stand to have profound effects on the computer industry as a whole.

This month's article is the last in a series. The following advertisers made the series possible:

#### ADI Corporation

Founded in 1979, ADI is one of Taiwan's premier producers of PC monitors. ADI did \$132 million dollars of business last year-posting a remarkable fivefold increase in revenues over the last five years.

#### Diamond Flower Electric Instrument Co.

Established in 1981, DFI is one of Taiwan's leading makers of PC enhancement products. DFI's introduction of the innovative Handy Scanner in 1987 led to the birth of the now booming hand scanner product category.

#### Sampo Corporation

Founded in 1964, \$500 million dollar Sampo is one of Taiwan's largest industrial corporations. Having primarily served Fortune 500 OEM's to date, last year saw the spin-off of Sampo Technologies, a \$135 million dollar division devoted exclusively to

the marketing and development of Sampo-brand computer products.

#### CAF Computer Corporation

CAF is part of Taiwan's \$2 billion dollar Yuen Foong Yu Group. Together the group has over 10,000 employees and is Taiwan's 10th largest industrial company. Since joining the group in 1984, CAF has expanded its surface mount equipped factory space fivefold to 172,000 square feet.

#### Intra Electronics Co.

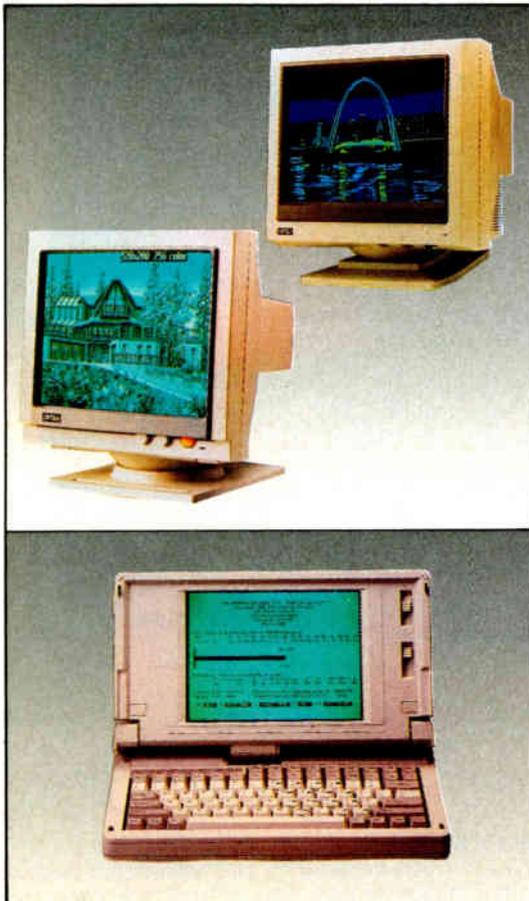
Established in 1976, \$35 million dollar Intra Corporation has branch offices in Hamburg, Germany, and San Jose, California.

#### Chun Yun Electronics Co.

With an estimated market share of 80%, Chun Yun has long been a leader in Taiwan's domestic public-display and television markets. Chun Yun is now seeking to expand into the international PC monitor market.

#### China External Trade Development Council (CETRA)

Established in 1970, CETRA is the only non-profit trade promotion organization in Taiwan. Funded by the Taiwan business community, CETRA receives full backing from the ROC government. CETRA's mission is to aid the trade process for importers and exporters. With over 600 employees, and 27 branch offices around the world, CETRA offers a wide range of services to local and foreign businesses.



### We put the vision and quality into your hands.

The LT-386SX laptop from INTRA features an extremely compact design of remarkable 4.9Kg weight and 6cm height, that is similar to a letter-size notebook PC. Yet it is as powerful as a 386 desktop computer, allowing access to a wide selection of 386-AT compatible software packages. The rechargeable battery assures 3 hours of continuous use, offering true flexibility. The high resolution, 0.27mm dot pitch LCD display screen can be folded down to a flat position for convenient view of an external VGA color monitor.

That leads us to INTRA's complete range of color and monochrome monitors, that deliver brilliant performance with sharp images, crisp texts, and vivid colors. For applications ranging from word processing to graphic design, quality is the ultimate message that shines out clearly from every screen.

INTRA's products are designed and manufactured to the highest quality standards, and are backed by years of reliable performance. Contact us now for more attractive information.



OEM IS WELCOMED!  
Original manufacturer of laptop & monitor.

#### Intra Electronics Co., Ltd.

HEAD OFFICE  
3F, 57-1 CHUNG SHAN N. RD.,  
SEC. 2, TAIPEI, TAIWAN, R.O.C.  
TEL: 886-2-623-7027  
TLX: 19925 INTRA  
FAX: 886-2-541-8513

U.S.A. SALES AGENT  
VIDEO TECHNOLOGY INC.  
847 WEST MAUDE AVE  
SUNNYVALE, CA 94086 U.S.A.  
TEL: (408) 739-8782  
FAX: (408) 739-8549

#### We put quality into your hands.

CANADA SALES AGENT  
TRANSORIENT CAPITAL  
MANAGEMENT CORP.  
SUITE 918, BARRARD BUILDING  
1030 WEST GEORGIA STREET,  
VANCOUVER, B.C. V8E 2Y3  
TEL: (604) 682-7840  
FAX: (604) 682-1061

EUROPE LIAISON OFFICE  
3RD FL., NEUER WALL 50,  
2000 HAMBURG 36,  
WEST GERMANY  
TEL: (040) 380017-0  
FAX: (040) 367937



# MULTIMEDIA VIDEO

When Jerry combines computers, video cameras, and VCRs, seeing is believing

All of us in the computer business get used to two kinds of video. On the one hand, there is the full-motion video you see on your TV. This is known as NTSC, for reasons that don't matter. What does matter is that it is quite low-resolution compared to what you see on your computer screen. It has to be, because if it were high-resolution, the full motion would be a great deal more complicated. Full motion, after all, requires on the order of 30 frames a second if it's not to look jerky (some older newsreels, as well as some of the first pictures taken in space during the Mercury/Gemini days, use a lower frame rate, which is why they *do* look jerky).

A VGA screen has a higher resolution, but that's also why it's tough to do full-motion video out of a PC: the amount of information that would have to flow at that resolution at 30 frames per second would swamp the system.

## Genlock, Anyone?

On the other hand, a PC-compatible is perfectly capable of displaying NTSC output, if there is some way to get TV video into the system: which is where genlock boards come in. These boards accept video input, mix it with what comes out of computer programs, and display the mixture on-screen. They will also pipe that mixed signal out to a VCR so that you can record it. (You can't record that live-action video on your hard disk because it wouldn't hold more than a minute or so; live-action video recordings use a *lot* of megabytes. And yes, there are some tricks involving video

compression, but that's not important here.)

This is important to us because Mrs. Pournelle's Reading Program needs some good promotional materials. We figured the best way to do that was to make videotapes; alas, the problem was, how do you videotape the output of a computer? You sure can't just use a video camera on the screen, as Roberta found; at least, you can't just use *our* video camera. The results are awful.

We thought of using an Amiga, which knows how to put out NTSC output, but I wrote the program in Microsoft QuickBASIC, and it is not easily ported to the Amiga.

Then I discovered the USVideo TVGA Video Board at a BYTE Editorial Expo. It looked to be the answer to our prayers: this is a PC board that accepts video camera or other TV input, mixes that with what's on the screen, and puts the combination out for recording by a VCR. Not only that: you can also mix in the output of Autodesk Animator, which is a program that, if you have artistic talent or can hire someone who does, will produce results best described as amazing.

Want fairies to dance on your screen? Perhaps a screen background of program output, with fairies to illustrate your point? Birds in full color? Really weird titles? You can get it all from Animator. In a word, the USVideo board and Animator seemed the perfect combination for presenting Roberta's program.

About that time, we discovered Willow Peripherals. Willow also makes a Genlock Video Board. Moreover, our copy came with Entropy Engineering's Video Titler, which will make all sorts and conditions of high-resolution titles and screen effects that can be mixed in with other PC output and stored on videotape. Now we really had everything we needed.

Thus, when Larry Aldridge of Sterling Microsystems brought over the Cheetah Gold 486, we tried to install one

of the genlock boards. There was only one problem: we didn't have a monitor of poor-enough quality.

That is, the monitors that we had available at the time included my Zenith Flat Technology Monitor, which I use every day and which is about the best text-work monitor I know of; the 19-inch Electrohome monitor, which I have had nearly forever and which everyone loves; and a very high-resolution 19-inch Hitachi monitor primarily used for CAD. None would work properly: they just don't go down low enough in frequency to display NTSC output. Sigh.

I have, somewhere around here, a converter for the Electrohome monitor that will let it eat NTSC output, but it would have been a great deal of trouble to get it out and connect it up, and besides, we were anxious to get the Cheetah 486 running with a Sota VGA board and look at some really high-resolution CAD and Animator work, which looks terrific on the Hitachi monitor. Thus, I put both genlock boards away for another time.

A few weeks later, Alex and his roommate tried to get things running on a Gateway 2000 system, but they had the same problem: both genlock boards want a multifrequency monitor, and we didn't have one. Meanwhile, at Spring Comdex Roberta had been mightily impressed by the USVideo demonstration and was now anxious to get started.

Of course, it never rains but it pours. Two days later there arrived two multifrequency, auto-sync monitors. One was from Princeton Graphic Systems: I'd met Princeton's president Tom Anderson at Spring Comdex and told him my story, and he'd arranged for an Ultra-14 to be sent. I knew those worked, because that is what came with the Northgate system I reviewed last year. The other monitor was a Panasonic PanaSync C1391, which was recommended by Willow as a good one for use with their board.

After that, things were simple: using the Gateway 2000 (a good, solid, reliable

machine) as the basic engine, we installed both the Willow and the USVideo boards, connecting them to the VCR/TV I keep in the back room up here. Both boards work with both monitors. The images on both monitors are rock solid. Alex and I set up the Willow board with Video Titler and turned things over to Roberta—and the adventures began.

Both Willow and USVideo advertise their products as if reasonably knowledgeable people who aren't computer experts can use them. We make no doubt at all that this is true, but it's not simple. It's going to take time. As Roberta says, before you can genlock, you have to understand what genlocking is all about; and you only think you know that.

First came the Willow manual: she reports that in 12 pages of text, there was not *one single sentence* that she understood. Part of it is the terminology, but some of it is the English: she's not at all sure some of the sentences actually say what Willow thinks they say. The USVideo manual wasn't a lot better.

On the other hand, both companies have very good telephone technical support. "They both put up with my stupid

**W**ith both genlock boards, you cannot easily mix monochrome and color.

questions," is the way Roberta put it. My guess is that they have no choice, since these products are going to find their way to art departments and account executives, creative people with little computer experience, who will desperately need the output—genlock stuff can be *spectacular*—and they will have less experience than Roberta, who has, after all, lived in Chaos Manor during the entire computer revolution.

Technically, both boards work, except that you cannot easily mix monochrome and color: Roberta describes that as similar to what happens when you watch oil and water mix, and it seems to be the same with both boards. Neither one is

easier or harder to use: they're both simple enough to set up once you have the right monitor, and both are equally confounding when it comes to making the software do what you want it to.

I wish I were more of an expert on this subject, because it's important; maybe I can trigger BYTE's expert test crew to do a complete evaluation, because I'm really not competent to tell you which is the best product in this line. I can tell you why it's important, and that we have two systems that are state of the art.

And there, alas, matters stand. Roberta has done the beginnings of some work. I've seen it, and it's already pretty good. Not spectacular, but she's only getting started. I'm sure I'll have more to say on this next month.

### Rogers Specialist

When it came time to hook up a monitor to the Willow board, we needed a gizmo to convert a 9-pin video into a 15-pin video. We put on our safari outfits and made an expedition into the cable room, and there among the monsters we found the cable we needed, but there was a gender problem, so we searched some more.

# Frequent Flyers.



See us at COMDEX/Fall, Booth #N4438

If a portable computer has improved the way you do business away from the office, think what a portable modem can do for you. With it, you'll be able to send and receive data, and even faxes, anytime you want. In or out of the office.

The WorldPort family gives you a choice of four portable modems, including an MNP® error-correcting modem and an electronic fax/data modem.

Each is no more than 8 ounces and can fit in a shirt pocket. They're small but tough

and capable, built for the rigors of business on the road.

They connect to practically any telephone, public or private, via standard RJ-11 jacks or an optional acoustic coupler. They adhere to Bell and CCITT standards world-wide so you can connect to other modems (or fax machines) almost anywhere. They're powered by a single 9-volt battery or through an AC outlet, whichever is more convenient. And, they're easily shared as external peripherals among co-workers.

The WorldPort family of modems. They're built for travel, whether it's to extreme environments, to exotic locations or just down the hall.

Call us today for the dealer nearest you:

**800-541-0345.**

(In New York, 516-261-0423.)



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

# Everything You Ever Wanted In UNIX. And Less. \$99.95\*

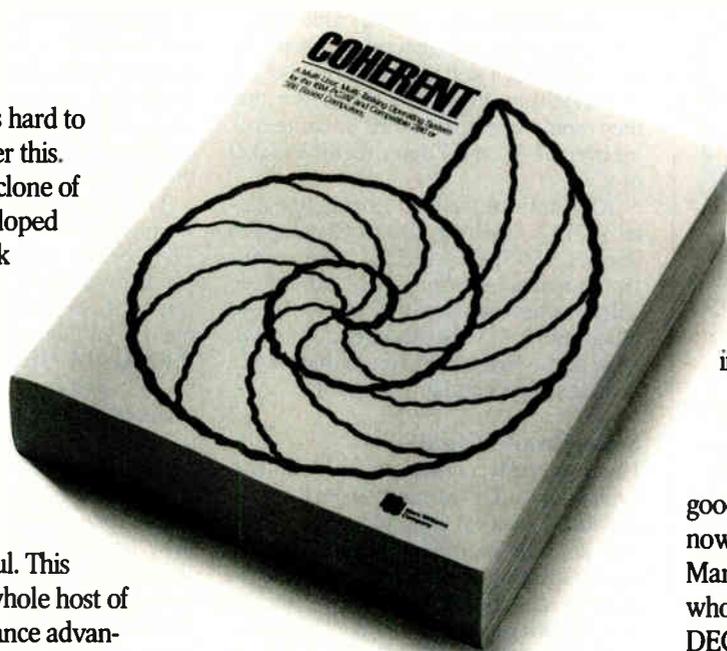
OK. We know it's hard to believe. So just consider this. Coherent™ is a virtual clone of UNIX. But it was developed independently by Mark Williams Company. Which means we don't pay hundreds of dollars per copy in licensing fees.

What's more, Coherent embodies the original tenet of UNIX: small is beautiful. This simple fact leads to a whole host of both cost and performance advantages for Coherent. So read on, because there's a lot more to Coherent than its price.

## SMALLER, FASTER... BETTER.

Everybody appreciates a good deal. But what is it that makes small so great?

For one thing, Coherent gives you UNIX capabilities on a machine you can actually afford. 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. You can also have it running faster, learn it faster and get faster overall performance. All because Coherent is small. Sounds beautiful, doesn't it?

But small wouldn't be so great if it didn't do the job it was meant to do.

## EVERYTHING UNIX WAS MEANT TO DO.

Like the original UNIX, Coherent is a powerful multi-user, multi-tasking development system. With a complete UNIX-compatible kernel which makes a vast world of UNIX software available including over a gigabyte of public domain software.

Coherent also comes with Lex and Yacc, a complete C compiler and a full set of nearly 200 UNIX commands including text processing, program development, administrative and maintenance commands.

And with UUCP, the UNIX to

UNIX Communication Program that connects you to a world-wide network of free software, news and millions of users. All for the cost of a phone call.

We could go on, but stop we must to get in a few more very important points.

## EXPERIENCE, SUPPORT AND GUARANTEES.

Wondering how something as good as Coherent could come from nowhere? Well it didn't. It came from Mark Williams Company, people who've developed C compilers for DEC, Intel, Wang and thousands of professional programmers.

We make all this experience available to users through complete technical support via telephone. And from the original system developers, too!

Yes, we know \$99.95 may still be hard to believe. But we've made it fool-proof to find out for yourself. With a 60-day money-back no-hassles guarantee.

You have to be more than just a little curious about Coherent by now. So why not just do it? Pick up that phone and order today.

You'll be on your way to having everything you ever wanted in UNIX. And for a lot less than you ever expected.

**1-800-MARK WMS**  
(1-800-627-5967 or 1-708-291-6700)  
**60-DAY MONEY BACK GUARANTEE!**



**Mark Williams  
Company**  
60 Revere Drive  
Northbrook, IL 60062

\*Plus shipping and handling. Coherent is a trademark of Mark Williams Company. UNIX is a trademark of AT&T. XENIX is a trademark of Microsoft.

<b>LESS IS MORE!</b>	Coherent For the IBM-PC/AT and compatible 286 or 386 based machines.	Santa Cruz Operation's XENIX 286, Version 2.3.2
No. of Manuals	1	8
No. of Disks	4	21
Kernel Size	64K	198K
Install Time	20-30 min.	3-4 hours
Suggested Disk Space	10 meg	30 meg
Min. Memory Required	640K	1-2 meg
Performance*	38.7 sec	100.3 sec
Price	\$99.95	\$1495.00

\*Byte Exec'd benchmark, 1000 iterations on 20 MHz 386. Hardware requirements: 1.2 meg 5¼" or 1.4 meg 3½" floppy, and hard disk. SCSI device driver available soon. Does not run on Microchannel machines.

Finally, a fast, powerful text editor that integrates your favorite

**VEDIT PLUS** programming tools and uses no memory!



- Mouse support
- Pull-down menus
- Columnar blocks
- 1000 Level Undo
- Regular Expressions
- Small 70K, super fast
- DOS, UNIX/XENIX, FlexOS
- Also VEDIT \$69, VEDIT Jr. \$29



## FREE Evaluation Copy Call 1-800-45-VEDIT

The new VEDIT PLUS is the productivity breakthrough programmers have been looking for. Run not only popular compilers, but all of your favorite tools from within the editor. When shelling to DOS, VEDIT swaps itself and any desired TSRs out of memory to give you more memory than when you entered VEDIT.

Only VEDIT gives you the advantages of a powerful and flexible editor without giving up the convenience of an integrated environment.

VEDIT offers stunning performance, versatility and ease of use. Completely written in assembly language, it's small and lightning fast. Edit text and binary files of any size, even 100+ megabytes. Installation is trivial; VEDIT.EXE and an optional help file are all you need - no overlays, no configuration files.

Other features include multiple file editing, windows, unlimited keystroke macros, "hot keys", context sensitive help, word processing, automatic indenting and total configurability. VEDIT has been the choice of 100,000 programmers, writers and engineers since 1980.

VEDIT PLUS adds a powerful "off the cuff" macro programming language, complete with source level debugging.

VEDIT PLUS - \$185 for DOS, \$285 for UNIX/XENIX. Call for a free demo today.

## Greenview

P.O. Box 1586, Ann Arbor, MI 48106  
(313) 996-1299 \* Fax (313) 996-1308

"Aha," Alex said. "The very thing."

He hauled out a large bag of cable adapters, gender changers, 9-pin to 25-pin converters, and other such stuff. It took me a moment to remember where I'd got it: just as we were leaving the last West Coast Computer Faire, I'd stopped at a booth that sells cables, cable adapters, data switches, general small parts, and other such stuff, and grabbed some of everything in sight on the theory that they would come in handy. It came to a bit over \$100, and I don't regret a nickel of it.

Alex noticed the bill: Rogers Specialist (27712 Pinehills, Santa Clarita, CA 91351, (805) 251-2520). "We order from them all the time," he said. "They deliver what they promise, no nonsense. Good outfit." This exhausts my knowledge of the firm, but I figure that when I can identify a good guy, I ought to.

### Stony Brook Modula-2

I was an early enthusiast of Modula-2, even back in CP/M days; indeed, when Modula-2 first came out, I was confident that it would be the language of the future, replacing Pascal, C, and BASIC—truly a language for the rest of us. Of course, things didn't work out that way.

In my defense, one reason I was so pleased with Modula-2 was that I had an early Lilith, a machine that uses Modula-2 as its assembly language. Modula-2 in the Lilith environment was a programmer's dream: the machine kept track of versions, and libraries, and what had to be recompiled, and all the other details that make programming tedious. With Lilith, programming was *fun*, especially compared with the other machines available then. Alas, the Lilith didn't survive.

There have been many problems with Modula-2. Probably the biggest is that there haven't been any good, standard run-time libraries of I/O routines for PCompatibles and other machines. Although Logitech developed a really neat debugger, the Logitech compiler, while quite adequate, is only that. And the Logitech programming environment has never been described as fun. Other compilers had some good features, some bad. The Taylor compiler produces small and speedy code, but it's not easy to use.

Worse, Modula-2 has design flaws. Not just the traditional I/O problems that any Niklaus Wirth language seems to have, but some odd quirks, such as rigid enforcement of case sensitivity and odd variable-name syntax (InOut is not only legal, but mandatory, but `big_screen` would not be a legal variable name). All these difficulties can be overcome, but

they're obstacles to learning and enjoying a language for which there never were any really good tutorial manuals.

I am happy to say that many of those problems are no longer relevant.

The Stony Brook compiler comes with a programming environment that takes some getting used to, but once learned, it can actually be *fun*. The editor is more than adequate, and the environment does a good job of keeping track of libraries, versions, recompilations needed, and suchlike. It's not a Lilith, but it's easily the next best thing I've seen.

The Stony Brook documents include an introduction with lots of examples. They begin, as they should, by telling you in exact detail how to set up the environment, begin your library management, and then write, compile, and run PROGRAM HELLO. Then they move on systematically through the different features of the system.

Moreover, with the Professional package (will anyone *ever* admit that something might be good for amateurs?), you get not one compiler but two: one that is *fast*, perhaps as fast as Borland Turbo Pascal, and which produces darned good code; and an optimizing compiler that produces *really* good code—small, fast, tight, and generally neat. Code from this second compiler is Microsoft object code-compatible, meaning that you can link it up to compiled BASIC, C, Microsoft Pascal, or FORTRAN code. There are good instructions on how to do this.

The Stony Brook compiler can produce code you can debug with Code-View; Stony Brook also provides a good debugger of its own, along with a tutorial on how to use it in the environment.

The Stony Brook package comes with advertisements and coupons for other Modula-2 products, all compatible, including sorts, B-tree, and a decent I/O library. I'd like to see more of that sort of thing: what Modula-2 needs is a body of compatible libraries of programs and toolboxes easily available for all flavors of PCs, and particularly all keyboards and video boards. This is a good start.

Realistically, I suppose, Modula-2 has lost out in the language wars, and the likelihood that it will surge ahead to capture the place held by Pascal or C is low. I think that's a pity: in my judgment, Modula-2 is more powerful than Pascal (even Turbo Pascal) and incomparably easier to use than C. Modula-2 really shines when you have a large project to be worked on by a number of programmers: with Modula-2, you really can have the programmers get together to write Definition modules and then work



# You always find something in the last place you look. Unfortunately, the average hard disk has about 20,000 places.

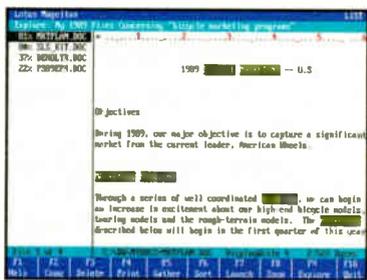
Of course, you might get lucky. And find the file you want in the 19,992nd place.

Or, you can find it almost immediately with new Lotus® Magellan® 2.0.

When you can't remember a file name, just type in a word, phrase, or concept related to it. Magellan will search your entire hard disk and come back with a list of relevant files in seconds.

Scroll down the list and you'll see each one as it actually appears in its application. Even if it's a graphics file. When you find the file you want, a single

keystroke launches the application and loads the file.



*Magellan lets you find a file in seconds, even when you can't remember its name.*

Magellan simplifies all of the other utility functions you use most, too. Copy, Delete, Move, Sort, Back-up or Rename files, groups of files, or entire directory branches in the Tree mode, with one keystroke. And Undelete erased files just as easily. Even view a deleted file before you decide to restore it.

Magellan also lets you save disk space by compressing data files

up to 50%, with the built-in PKzip™ file compressor. And view compressed files without expanding them.

And since Magellan is customizable, you can turn any of its functions on and off, or even build custom menus.

All of which is why *PC Magazine* said, "Magellan could very well be the finest utility ever written for the PC." And why every major computing magazine has given it practically every award they have.

**Call 1-800-TRADE-UP, extension 878, for a free auto demo disk.**

You'll see. It's exactly what you've been looking for.



## New Magellan 2.0 from Lotus

If you own the original Magellan, upgrade to new Magellan 2.0 for only \$39. Call 1-800-TRADE-UP, extension 877, and ask for the upgrade information kit. PKzip is a registered trademark of PKWARE, Inc. © 1990 Lotus Development Corporation. All rights reserved. Lotus and Magellan are registered trademarks of Lotus Development Corporation.

**World Radio History**

# POWER DEBUGGING

## BOUNDS-CHECKER

*Finds out-of-bounds memory accesses —  
AUTOMATICALLY.*

Flush out those Nasty pointer problems and other out-of-bounds memory accesses — AUTOMATICALLY.

Each time you make a change to a program, run BOUNDS-CHECKER while testing the new code. If you accidentally access out-of-bounds memory, BOUNDS-CHECKER will pop up displaying the offending SOURCE LINE. And your program runs at full speed.

### Ship Bug-Free Products

You can run BOUNDS-CHECKER while testing your program. There are no additional steps to your testing cycle, but you can feel secure when the program has passed through BOUNDS-CHECKER with no reported problems.

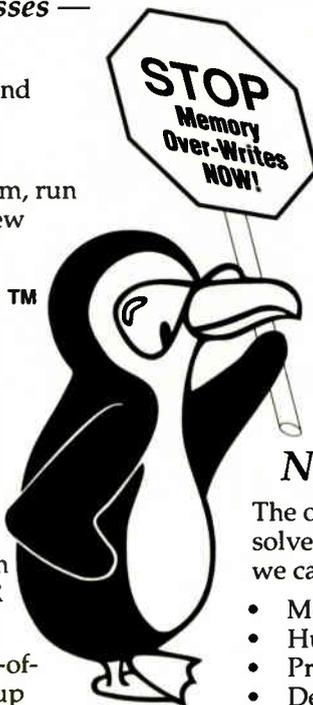
Many over-write problems and other out-of-bounds memory accesses do NOT show up during normal testing. An out-of-bounds memory location may be modified, but that particular location doesn't happen to be important at the time. Once the program is in the field and a certain network is loaded or a certain T&SR or device driver is loaded, that memory location suddenly becomes very important... AND THE SYSTEM CRASHES.

You can prevent these problems by making BOUNDS-CHECKER a standard part of your testing procedure.

*Gives you the protection of a protected operating system under MS-DOS.*

BOUNDS-CHECKER uses the 80386 virtual machine technology to provide real-time memory protection. In addition BOUNDS-CHECKER uses the symbolic information output by your compiler to differentiate CODE and DATA. When your program is running, BOUNDS-CHECKER protects the program's CODE and all memory outside your program.

Requires 80386 PC.  
MS-DOS is a trademark of  
Microsoft Corporation.



*"BOUNDS-CHECKER and Soft-ICE make sophisticated use of the most powerful versions of Intel's processor family to track down some of DOS programming's most insidious bugs. If you're developing programs for DOS, these are essential tools."*

PC Magazine  
July, 1990 pg. 48

### Soft-ICE 2.5 New Version, New Features

The only debugger specifically designed to solve those problems unique to MS-DOS that we call the DOS Nasties.

- Memory over-writes
- Hung programs
- Program too big to debug
- Debugging T&SRs and Loadable Drivers
- Multiple Symbol Tables
- Supports Microsoft C 6.0 & Turbo C++

### MagicCV 3.0 (with LOAD-BIG)

A set of tools designed to ease the memory crunch with Microsoft C 6.0.

- Run CodeView in *Less than 8k*
- Run CodeView with EMM & VCPI
- Increase heap space when compiling
- Increase memory with make
- Load high T&SR's and device drivers
- VCPI support

BOUNDS-CHECKER .....	\$249
Soft-ICE 2.5 .....	\$386
MagicCV 3.0 .....	\$199

### Special Offer...

Buy BC & S-ICE .....	Save \$100
Buy S-ICE & MCV .....	Save \$86
Buy all three .....	Save \$186

30 Day Money-Back Guarantee



CALL TODAY (603) 888-2386 or FAX (603) 888-2465  
P.O. BOX 7780 ■ NASHUA, NH ■ 03060-7780 ■ U.S.A.

apart on their implementation, yet have some hope that when they get back together, the code will run with no side effects. Of the other languages, only Ada can make that claim with any honesty.

This isn't meant to knock Turbo Pascal, which is a realistic choice for many programs. Borland provides excellent support for Turbo Pascal and continues to improve it and add features.

Then, too, I still like BASIC, and modern compiled BASICs have incorporated a number of advanced features derived from ALGOL, Pascal, and Modula-2. Given the on-again, off-again nature of the programming I do, I'll probably stay with QuickBASIC and the various Crescent tool libraries for most of my work; however, if I ever went more nearly full-time as a programmer, I do believe I'd adopt the Stony Brook Modula-2 environment, which has hooks to Windows and OS/2 (you'll still need the Windows and OS/2 development kits, understand).

If Stony Brook Modula-2 had existed in the early days, I think it would have the place that Turbo Pascal has now, and more. If you've ever wondered about

**I**f Stony Brook Modula-2 had existed in the early days, I think it would have the place that Turbo Pascal has now.

Modula-2, or if you tried it and sort of liked it but gave it up, or if you're looking for a language, look at Stony Brook Modula-2. Recommended.

[Editor's note: See "Modula-3" on page 385.]

#### Zero Surge

One of the participants in the sciences conference on BIX told a story of a meeting of meditation people at a European

village near a lake. The guru in charge told the group to concentrate on the weather, which they duly changed to something wildly improbable; the next day, supposedly, they did it again, this time changing the weather a dozen times in the course of an afternoon and playing merry hob with the local tourists. As in all such stories, the guru isn't named, the group isn't named, the lake isn't named, and the date and year aren't specified. Moreover, the person telling the story wasn't there himself, but heard it from someone who was.

"Great," said I. "Tell you what. Get that guru to make it rain in Los Angeles on the afternoon of August 7, 1990. Specifically, rain in the Hollywood Hills."

I thought no more about it until on August 5 came a freak lightning storm and rain. Then more on the 6th, with a really spectacular show of lightning and thunder. Some of the lightning came quite close to Chaos Manor, with thunder less than a second after the flash. Alas, it didn't rain on the 7th, although there were showers on the 8th....

However, the lightning got me thinking about surge and spike suppressors.

**SAVE 30 MINUTES EVERY TIME YOU HAVE A PC PROBLEM!**

**NEW VERSION 3.0 Now Available!**

By using Check✓It<sup>®</sup> to find out if the problem is Hardware or Software

The second you suspect a problem with your PC, you should reach for Check✓It, the world's most popular PC diagnostic software. Running Check✓It should be the first thing you do -- because confirming or eliminating your PC's hardware as the source of the problem can save you time, money, and unnecessary repair calls.

Check✓It will test your PC's main system board, memory, hard disk drive and floppy disk drives, video subsystem, communication ports, printer, keyboard, mouse, or joystick. Check✓It will also display key software and setup data, including your PC's exact equipment configuration, current IRQ assignments, memory allocation, device drivers, and CMOS table.

Take a minute to run Check✓It the next time you have a PC problem. Then you'll know the answer to these key questions: Should you back it up, pack it up, and send it out for repair? Should you fix a hardware problem yourself? Or, should you concentrate on the software and configuration problems that you can correct?

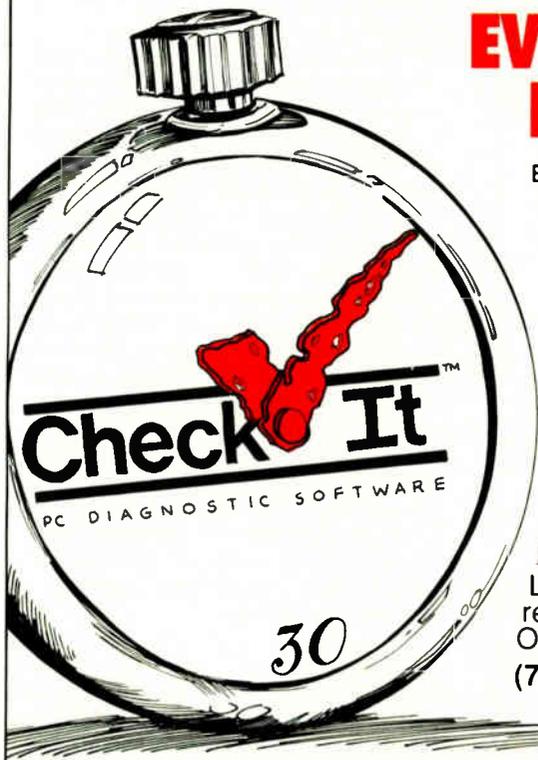
The moment you suspect a PC problem, run Check✓It. It's about time!

Look for Check✓It at leading retail stores everywhere, Or call TouchStone TODAY!  
(714) 969-7746 or (800) 531-0450

**TouchStone**  
Software Corporation

2130 Main Street, Suite 250, Huntington Beach, CA 92648

Check✓It is a registered trademark of TouchStone Software Corporation. Copyright ©1990 TouchStone Software Corporation. ALL RIGHTS RESERVED.



**NEW "Basic PC Maintenance" Hands-On Video Ask for it TODAY!**

Regular readers may remember The Great Power Spike that hit Chaos Manor last year: light bulbs literally exploded, and the Priam MacDisk on the Mac II suffered a hit to the power supply, as did the Mac II itself, although both were plugged into a commercial surge suppressor. We also lost a Tandon computer, a TV and VCR, and some other electronic gear, none plugged into a suppressor; and we did not lose Roberta's machine, although its surge suppressor

literally died in its defense.

Since then I have learned that a lot of surge suppressors do not work very well. The passive metal-oxide varistors (MOVs) may over time lose their capability, especially if subjected to power spikes. In addition, since most surge suppressors divert the power surge to ground, and most LAN and modem systems have one side of the signal system grounded, there can be power surges in the resulting "ground loop."

Note that I say "may" and "can be"; none of this is inevitable. Unfortunately, many people out there seem determined to convince you that it is: that if you use ordinary surge suppressors, you are playing Russian roulette, and you'll probably *lose your expensive computer equipment*, so you had better *replace those now*. Even an uninterruptible power supply (UPS) isn't going to save you, because, as one article I have here says, "their inputs are 'protected' by the very same fifteen-cent MOVs as the average surge suppressor!" There is, according to this, only one exception to this, Abacus Controls, which licenses their technology from Zero Surge.

And this leaves me with a dilemma. It's certainly true that the Zero Surge protection systems are excellent, better than the stuff you buy at Radio Shack or at swap meets; it's true that shunting power spikes to ground *can* blow up a modem. It's true that UPS systems often rely on MOVs. It's true that MOVs can die and you won't know it, because doing a nondestructive test on an MOV requires extremely sophisticated (and expensive) test gear.

It's also true that in The Great Power Spike at Chaos Manor when, due to an automobile accident, 16,000 volts AC was shunted into our house wiring, not only was there no damage to the computers connected to our Clary UPS, but there was absolutely no damage to the UPS—we had it tested. Moreover, of the equipment connected to the off-the-shelf surge suppressors we use, the only thing killed was the Mac stuff, which had been connected to a different—premium!—brand. Everything else was fine.

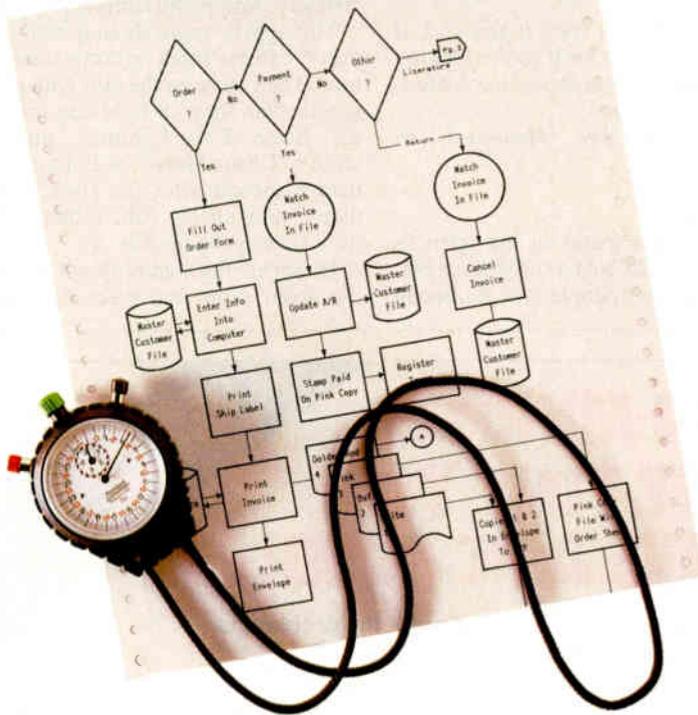
So: yes, the Zero Surge suppressors are qualitatively different, and better, than the usual device. They don't shunt power spikes to ground, they work faster, and they don't deteriorate. You will certainly be safer with Zero Surge than with a random MOV device. I sincerely doubt that you'll be safer with Zero Surge than with a Clary UPS, or let me put it another way, I sure don't want to *have* to be protected from anything worse than our Great Power Spike. However, if you have LANs and modems and generally interconnected devices not all connected to UPS systems, you probably do want to look into Zero Surge.

**It's Binary**

I love gadgets. I don't usually have a chance to write about them, but this is November and Christmas is coming up. Perfect time.

The neatest gizmo I've got all year is *continued*

**BY HAND. OR BY NOON.**

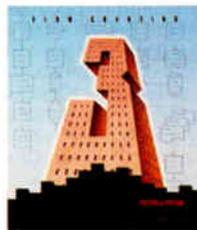


**Announcing Flow Charting™ 3**

Now, even complex flowcharts that once took days to perfect can be presentation-perfect—in no time!

Quick to master and a snap to use, Patton & Patton's flowcharting software is the standard of both large and small businesses around the world—and is available through all major software dealers.

See your dealer today! Or, for a "live," interactive demo disk, call: **800-525-0082, ext. BY44.** International: 408-778-6557, ext. BY44.



**PATTON & PATTON**  
Software Corporation

*Excellence in charting the flow of ideas!*

Works on IBM & 100% compatible PC's, supports CGA/EGA/VGA and over 150 dot matrix and laser printers, with multiple print densities and 10 font sizes. **Creates multi-page charts, portrait or landscape, on most standard paper sizes.** Mouse or keyboard controlled.

IBM is a registered trademark of International Business Machines Corporation.

See Us At  
**COMDEX**  
Booth #151

# MINUTEMAN<sup>®</sup>

## UNINTERRUPTIBLE POWER SUPPLIES

### TOTAL POWER PROTECTION

- ★ BLACKOUTS
- ★ BROWNOUTS
- ★ OVERVOLTAGE
- ★ UNDERVOLTAGE
- ★ SURGES
- ★ SPIKES
- ★ EMI/RFI

### STANDBY UPS MODELS

- 250 VA To 2300 VA
- Sinewave output - 1 millisecond transfer time
- Communications interface and external battery packs available for extended run times

### ON-LINE UPS MODELS

- 500 VA To 5,000 VA
- Static By-pass Standard
- True On-Line - Sinewave outputs
- Communications Interface and external battery packs available for extended run time



### NETWORK MANAGER

- Shutdown software for unattended operation
- Only software to communicate with LANs and WANs
- Novell 286 VAP and 386 NLM
- SCO Xenix

### SLIMLINE & UPRIGHT MODELS



### COMMUNICATIONS INTERFACE

For Unattended System Shutdown

### COMPATIBLE WITH:

- Novell
- LAN Manager
- ALTOS
- BANYAN
- VINES
- System V UNIX
- Custom Configuration Any System

**NOVELL**  
Monitor Boards Available



1455 LeMay Drive  
Carrollton, TX 75007

Telephone:  
(214) 446-7363

FAX: (214) 446-9011 TELEX: 140275 OMEGA

**1-800-238-7272**

FOR L.A.N.  
NOVELL LABS  
TESTED AND  
APPROVED  
NetWare Compatible

"Distributed in over eighty countries"

Circle 277 on Reader Service Card

World Radio History

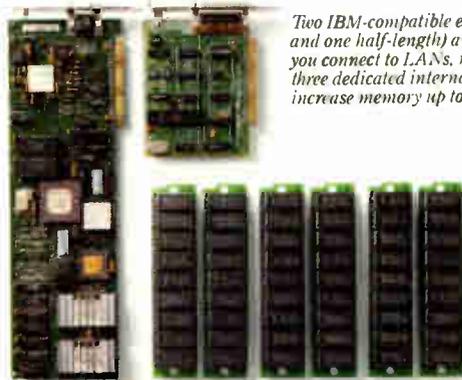
# Buy a portable and



*T3200SX: 170 pounds, 16MHz 386SX with 80387SX-16 coprocessor socket, 5 built-in ports, 40MB hard disk with 25msec access, 1MB RAM expandable to 13MB, gas plasma VGA display with 16 gray scales, 1.4MB 3½" diskette drive. IBM is a registered trademark of International Business Machines Corp. 386 is a trademark of Intel Corporation.*

*For more information call 1-800-457-7777.*

NOW AVAILABLE IN  
**120MB**  
HARD DISK MODEL



*Two IBM-compatible expansion slots (one full-length and one half-length) and an internal modem slot let you connect to LANs, mainframes and more. Plus, three dedicated internal expansion slots let you increase memory up to 13MB.*

# get a desktop free.



At first glance what you see is a sleek, 170-pound portable.

But looks can be deceiving. Because with a powerful 386™ SX microprocessor, 6 internal expansion slots and 5 built-in ports, our new T3200SX easily replaces desktop computers.

Which means it does every-

thing a bulky desktop computer can do. Like networking, computer aided design, data bases or even complex spreadsheet analysis — anywhere you can plug into an AC outlet.

It has a built-in VGA gas plasma display system that lets you connect an external color

monitor. And it can even accommodate an optional 101-key enhanced keyboard.

So you can take advantage of today's and tomorrow's most powerful new 386 applications, wherever you think best.

The new Toshiba T3200SX. Take it. See how far you can go.

In Touch with Tomorrow  
**TOSHIBA**

Toshiba America Information Systems Inc., Computer Systems Division

Circle 348 on Reader Service Card (RESELLERS: 349)

World Radio History

**PS/2<sup>®</sup> MEMORY**

Introducing **OS/RAM8™**

- ✓ 8 Mbytes of memory + 2 serial ports.
- ✓ Extended and expanded memory. LIM 4.0.
- ✓ Works with all of your programs.
- ✓ Run DOS or OS/2 effortlessly.
- ✓ Fast and simple switchless installation.
- ✓ Auto-configuration for all operating systems.
- ✓ Works in all Micro Channel™ computers.
- ✓ Expanded memory 10 times faster than Intel.
- ✓ Risk free guarantee. Two year warranty.
- ✓ IBM approved ID. Best price. Fast delivery.

Call today 1-800-234-4232 or 617-273-1818

**cec** Capital Equipment Corp.  
Burlington, MA. 01803

PS/2 and Micro Channel are trademarks of IBM

Nemesis Igo Dojo plays by both Chinese and Japanese rules. In Chinese rules, the handicap stones may be placed anywhere; the stronger player passes until the weaker has placed handicap stones where he wants them. In Japanese rules, the handicap stones go on fixed points. In addition to handicaps, there are levels of play, although the book doesn't recommend that you use the weaker ones; as Wilcox says, you won't become a strong player by watching weak play. Use the handicap system if the machine continues to beat you.

The only real defect, so far as I can tell, is the size: at 9 by 5 by 1½ inches, it is considerably larger than a Sharp Wizard, larger even than the Atari Portfolio. You won't carry this in your pocket, or even in a gentleman's shoulder bag; you'll want a briefcase or small backpack.

What more can I say? The Nemesis Igo Dojo works, works well, and is just the thing for a go fanatic or someone who wants to become one. It's made in the U.S., and many are exported to Japan. And, of course, if you just want a strong go opponent for your computer, there are PC and Mac versions of the program itself. Recommended.

### Scene Generator

This doesn't quite qualify as a gadget, but there are similarities.

Graphics capabilities on the PC have pretty well caught up with the Mac and Amiga, although you'll spend a bit doing it. Even so, every now and then there's a program unique to the Amiga. This is one of them: if there's anything like it for the Mac or PC, I haven't seen it.

Nature loves fractals, curves of infinite complexity that have the property of being similar no matter what level of detail you go down to. Case in point: coastlines, seen from orbit, are irregular. Get closer, and they still are. Get down to resolution in feet, and they still are; and even down to grains of sand, there are still these irregularities, similar although not identical to what you saw from orbit.

Scene Generator uses this property of nature to generate scenery. Some years ago, the designers of the game Starflight used a similar technique to generate the scenery for the thousands of planetary areas you could explore, but the scenes they generated weren't nearly as realistic as the ones Scene Generator comes up with; indeed, some of Scene Generator's fractally generated random scenes are nearly indistinguishable from scanned-in photographs taken in the High Sierra,

the Amazon Binary Clock, which is not cheap, but nothing in the house attracts more attention. It looks like a golden-mean dimensioned rectangular block of black plastic about 8 inches tall. There are three columns of six lights: left column for hours, middle for minutes, and right for seconds. They give the time in binary, which is to say: the bottom row is 1, row two is 2, row three is 4, up to row six for 32; to get a number, add all lights that are on. Thus, if 1, 3, and 4 in a column are on, the number would be 13. All 18 lights flash once per second and then settle into the current time.

Time can be displayed in a 12- or 24-hour format. Depending on which setting you choose, the top one or two rows of hour lights are superfluous. It will take either 50- or 60-cycle current; it comes set to 50-cycle, which gives the wrong time over here, but it's easy to change.

The instructions are complete and foolproof, and actually, after a few weeks, you learn to read it fairly well, or at least I did. This isn't something anyone needs, but if you're into unusual things for your mantle or coffee table, this will do it. I have it on a living room display table with my collection of archaeology artifacts: somehow, it seemed in good company with an ancient Roman (obscene) oil lamp. And it keeps good time, too.

### Go!

I don't keep track of computer go tournaments, so I don't recall whether COSMO or Bruce Wilcox's Nemesis-Go master version from Toyogo is the current champion, but one of them is, much to the vexation of the Japanese go programmers. Go is the Japanese national game; it's played on a board of 19 by 19 lines, the rules are extremely simple, and the strategy is much more complex than chess.

I long ago became fond of Nemesis-Go for the Mac and PC, so much so that I have the PC version on my Zenith Z-386 laptop portable, in case I get stuck in an airport lounge with nothing to do. (Fat chance; there's *always* a deadline, so I end up writing. Oh, well.) Now, though, there's another way to have go with you wherever you are: Toyogo has a dedicated go-playing hand-held machine that is called Nemesis Igo Dojo.

It plays excellent go—unless I give myself a handicap, it will usually beat me—and it's well designed, with a good user interface. The screen is easy to see, and the controls are easy to use. There are bays to plug in additional modules (not yet available). I had some trouble figuring out what the controls do—some of it isn't obvious—but straightening that out only took reading the manual, maybe 10 minutes of work, after which it's quite intuitive.

## CHAOS MANOR

and others would convince you they were from the moon.

There are six resolutions. The program gives you a great deal of control over what you generate—how much water, snow, greenery, clouds, and such-like. I can't think of much practical use for this program except to generate eye candy, although you might use it when building a game; but it's fun to play about with. If you have an Amiga, this is likely to be interesting.

### Disney Animation

As long as we are talking about the Amiga, Walt Disney Software presents a paint and animation program, The Animation Studio, in which Mickey Mouse and Donald Duck teach you how to do animated drawings; for my money, it's the easiest such program I've seen. I was about to push the Amiga into another room, but now I have second thoughts: this thing might even make *me* an artist, and that would take some doing.

I was recently back at Douglas Trumbull's Berkshire Studios, where we had a meeting about Klaus Heiss's Mars Cup, to be awarded for racing a solar sail vehicle from Earth to Mars; there's some hope actually to get that started as part of the 500th anniversary of the first voyage of Columbus. One of Klaus's demonstrations was a videotape of some solar sail models and their deployment; this was done by some Georgetown University students using an Amiga and Degas Paint. It would have been even easier to do with The Animation Studio.

Every time I think the Amiga is about finished, someone comes up with new and unique products for it. As long as Amiga has friends like Disney's programmers, you can't count it out. This program is good—and it's *fun*.

### Multi-Media Birds

CMC Research continues to refine their DiscPassage CD-ROM retrieval software. Now there are help files, and the video imaging works with just about every major video card, including those from Tseng Laboratories, Video Seven, and Tecmar. The help routines aren't always as helpful as they think, and there's a harshness to some of the retrieval interface that wasn't there on their first Sherlock Holmes disk; on the other hand, it does the job, and once you're used to the interface, it works on a whole raft of CD-ROM disks.

CMC's lineup includes a number of medical books and journals, and I'd advise any physician to look into them: you may find that what you want is on a CD-

**PS/2® MEMORY**

Introducing OS/RAM32™

- ✓ 8 Mbytes of fast 32 bit memory.
- ✓ Works in all Micro Channel™ computers.
- ✓ Fast LIM 4.0 driver included.
- ✓ Provides extended and expanded memory.
- ✓ Easy switchless installation.
- ✓ Automatic configuration for DOS, OS/2 or UNIX.
- ✓ Risk free guarantee. Two year warranty.
- ✓ IBM approved ID. Fast delivery.
- ✓ From \$299 to \$1249 with 8 Megabytes.
- ✓ PC Magazine "Hot Prospect" 1/16/90.

Call today 617-273-1818 or 1-800-234-4CEC

**cec** Capital Equipment Corp.  
Burlington, MA. 01803

PS/2 and Micro Channel are trademarks of IBM

ROM, meaning that it is nicely organized, with search and retrieval capabilities superior to the best paper indexes.

Their latest CD-ROM is Multi-Media Birds of America, which consists of the complete John James Audubon *Birds of America* lithographs. There are also recordings of bird calls and the Audubon text.

The bird calls, which are pretty nice, are what justify calling this "multimedia." There's no animation, the text itself is pretty dry, and, worse, it was all written a long time ago and could use some modern commentary.

Example: there are families of red-tailed hawks in the hills above our house, and we go up to visit them quite often; so naturally I looked up red-tailed hawk in the search pattern, to find that this bird is not known as a red-tailed hawk, but Harlan's buzzard. There's no entry at all for the peregrine falcon. Now, I'm no expert, and it may well be that the real experts call a California red-tailed hawk "Harlan's buzzard" and have some esoteric name for peregrine falcons making them impossible to find; but Peterson's *Field Guide to Hawks* sees it quite differently, as do all the other bird books we have.

I had similar problems looking up the goatsucker: from this CD-ROM, you may or may not be able to find out that

the whippoorwill and the common night-hawk are members of the goatsucker family, but I didn't.

In other words, this is J. J. Audubon's book and nothing else; for the practical bird watcher it's no substitute for the Peterson guides, which, alas, have yet to be put onto a CD-ROM. On the other hand, the 500 Audubon paintings are magnificent, they show up beautifully on a VGA screen, the bird calls are interesting, and the retrieval software works fine: if the information is on the disk, DiscPassage will find it. You don't buy this for the text, though.

### Grolier Again

It is my practice to send the text of my column to the company or people affected, with a notation that I'll correct errors of fact, I'll listen to arguments concerning errors of judgment, and I reserve the right to determine which is which. I did that with the Grolier text last month; alas, they took a very long time to respond, so that by the time they did, the column was set in galley. When an author rewrites in galley, it is very tough on the composition and layout crew; and after some thought, I corrected the things easily done and let the rest stand.

Herewith, then, not quite a retraction.

First, Grolier is reconsidering their license policy, in part due to my nagging

ITEMS DISCUSSED

**Amazon Binary Clock**.....\$150  
Eugene Amazon  
13, Rue de la Madeleine  
1204 Geneva, Switzerland  
022-21-18-96  
**Inquiry 1146.**

**Autodesk Animator**.....\$395  
Autodesk, Inc.  
2320 Marinship Way  
Sausalito, CA 94965  
(800) 525-2763  
(415) 332-2344  
**Inquiry 1147.**

**Genlock Video Board**  
with 512K bytes of RAM and  
Video Titler program.....\$895  
Willow Peripherals, Inc.  
190 Willow Ave.  
Bronx, NY 10454  
(800) 444-1585  
(212) 402-0010  
**Inquiry 1148.**

**Grolier Encyclopedia**  
**Americana**.....\$399  
Grolier Electronic Publishing, Inc.  
Sherman Tpk.  
Danbury, CT 06816  
(203) 797-3500  
**Inquiry 1149.**

**Modula-2 Professional**  
**for DOS and OS/2**.....\$295  
Stony Brook Software  
187 East Wilbur Rd., Suite 9  
Thousand Oaks, CA 91360  
(800) 624-7487  
(805) 496-5837  
**Inquiry 1150.**

**Multi-Media Birds of America**.... \$99  
CMC Research, Inc.  
7150 Southwest Hampton St.,  
Suite C120  
Portland, OR 97223  
(800) 262-7668  
(503) 639-3395  
**Inquiry 1151.**

**Nemesis-Go**.....\$79  
**Nemesis Igo Dojo**.....\$695  
Toyogo, Inc.  
P.O. Box F, Dept. Y  
Kaneohe, HI 96744  
(800) 869-6469  
(808) 254-1166  
**Inquiry 1152.**

**PanaSync C1391**.....\$899  
Panasonic Communications &  
Systems Co.  
Office Automation Group  
2 Panasonic Way  
Seacaucus, NJ 07094  
(800) 742-8086  
(201) 348-7000  
**Inquiry 1153.**

**Scene Generator**.....\$49.95  
Natural Graphics  
P.O. Box 1963  
Rocklin, CA 95677  
(916) 624-1436  
**Inquiry 1154.**

**Surge Eliminators**.....\$149 and \$199  
Zero Surge, Inc.  
103 Claremont Rd.  
Bernardsville, NJ 07924  
(201) 766-4220  
**Inquiry 1155.**

**The Animation Studio**.....\$179.95  
Walt Disney Software  
500 South Buena Vista St.  
Burbank, CA 91521  
(818) 567-5340  
**Inquiry 1156.**

**TVGA Video Board**.....\$799  
**Genlock Overlay Module**.....\$399  
USVideo  
62 Southfield Ave.  
One Stamford Landing  
Stamford, CT 06902  
(203) 964-9000  
**Inquiry 1157.**

**Ultra-14**.....\$899  
Princeton Graphic Systems  
1100 Northmeadow Pkwy., Suite 150  
P.O. Box 100040  
Roswell, GA 30076  
(800) 221-1490  
(404) 664-1010  
**Inquiry 1158.**

**Video Titler EGA and VGA**.....\$495  
Entropy Engineering  
12317 Village Square Terrace,  
Suite 202  
Rockville, MD 20852  
(301) 770-6886  
**Inquiry 1159.**

them. They were concerned that if they routinely released the "network version" of their CD-ROM retrieval software, they would have dozens of people using one CD-ROM. I asked how many establishments there are in the U.S. where that's likely. Or even possible. Could there be more than 20?

And of course there are not, meaning that they're inconveniencing thousands of users in order to prevent the possibility (hardly a certainty) of being ripped off by a couple of dozen customers at most. That's assuming that Grolier is being ripped off if several people on a network access a single CD-ROM in rapid succession. They can't, after all, access it simultaneously, because the laser can't be in more than one place at once—and in any event, how is it worse than when sev-

eral people use different volumes of the printed encyclopedia?

So: as I said, Grolier is reconsidering that policy. At the moment, though, what I said is true: if you have a network card in your machine, even if it is not enabled, you'll have to get the network version of the Grolier retrieval software. They say they are willing to send the network version free to anyone willing to sign a statement that it won't be used by more than one person at a time.

Second, if you have multiple CD-ROM drives, you must invoke the Grolier retrieval software as EE -d0 or EE -d1, depending on which one of your drives you have the CD-ROM in. Don't bother looking for that in the manual: it's not there. There are apparently further undocumented features in the software. In addi-

tion, if you use the Install program on the distribution floppy disk, it does not copy over all the files, and thus you will be unable to reconfigure unless you have the original disk; however, you can manually do a COPY \*.\* , which will bring over all the files; the disk isn't really copy-protected. That, too, is not in the manual.

Someone in the Grolier hierarchy decided that explaining all this stuff would confuse the user. I am told that this policy has now been abandoned and there will be a new appendix to the manual explaining the switches and other undocumented features, to which I can only say, hurrah.

I am becoming increasingly fond of the Grolier Encyclopedia Americana itself, and once you get used to it, the

# 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 321 on Reader Service Card

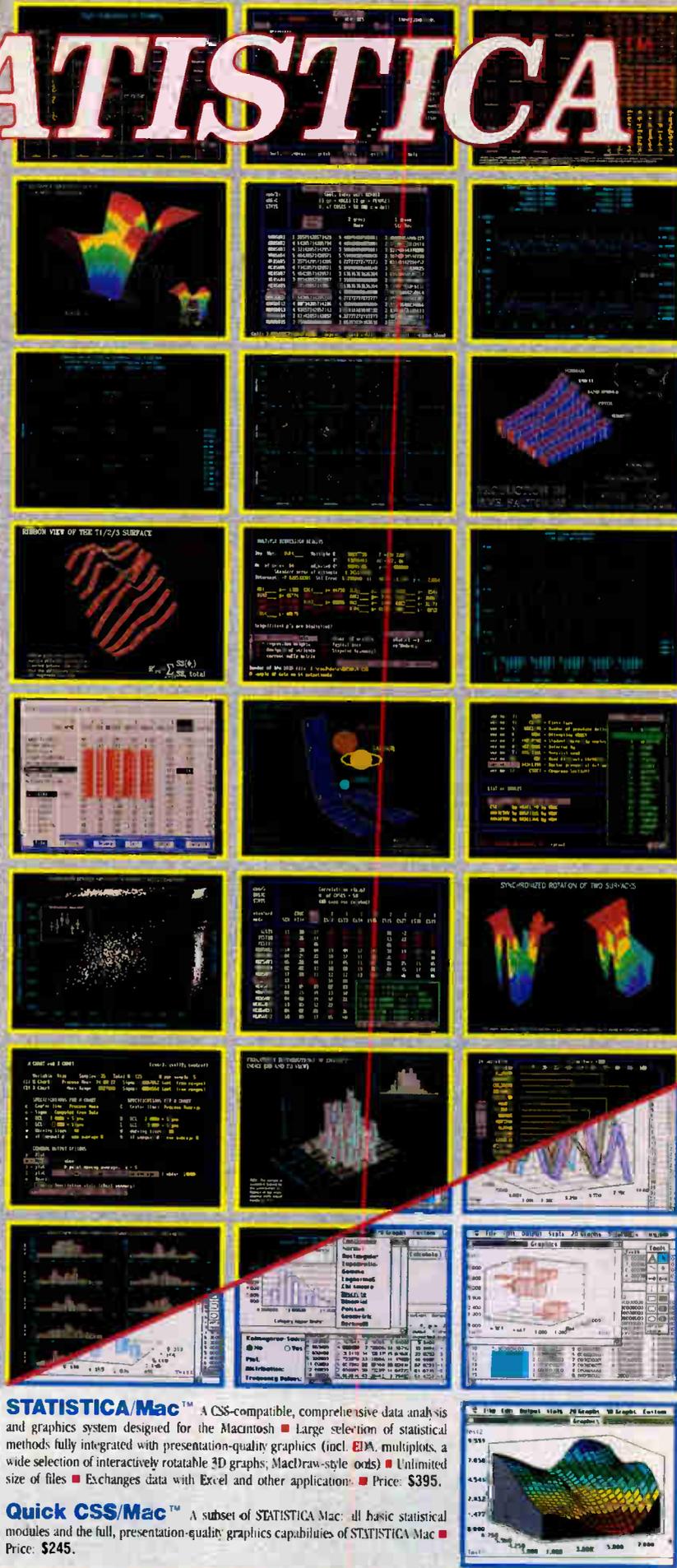


**StatSoft™**

2325 E. 13th St. • Tulsa, OK 74104 • (918) 583-4149  
Fax: (918) 583-4376

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: 613-497-4755, fax: 613-499-7410, StatSoft Canada-CCO (Ontario), ph: 416-849-0737, fax: 416-849-0918 Available From: CORPORATE SOFTWARE and other Authorized Representatives Worldwide: Holland: Lemax BV 02968-94210; France: Conceptel (1) 45669700; Sweden: AkademiData 018-240035; Spain: ADLINK, SRL: ph: 34-3-459-0722

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.



**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 oods) ■ Unlimited size of files ■ Exchanges data with Excel and other applications ■ Price: \$395.

**Quick CSS/Mac™** A subset of STATISTICA Mac: all basic statistical modules and the full, presentation-quality graphics capabilities of STATISTICA Mac ■ Price: \$245.

retrieval software is easy both to remember and to use. I'm pleased to see that the company is reevaluating its licensing policies to make life easier for their customers. I wish more companies would.

### Winding Down

Again, my desk is piled high with stuff I won't get to. The Sola Publishing Group (Via Nerino, 8-20123 Milan, Italy) sent me a CD-ROM labeled "An unabashed history of photographic erotica" that isn't precisely what the title says: most of the pictures would be better described as "raunchy" than erotic. About half the text is in Italian.

There are two Mannesmann Tally printers. One is their MT 906 laser printer, which uses the Microsoft/Bauer interpreter and Bitstream fonts to print PostScript files. It also emulates the Hewlett-Packard LaserJet II and comes with the Z print cartridge, my favorite for my old LaserJet I, the Printer That Will Not Die. We are in the middle of torture-testing the MT 906 with some complex PostScript files that I got from Dave Moore and Trevor Marshall; if it prints those files properly, it should print any-

thing. It's sure fast.

I also have the MT 81, a really neat dot-matrix printer that's small enough to become the "throw it in the Bronco" printer for field use. It came in a sturdy box that I have reinforced and practically waterproofed with duct tape.

The bribe of the month is a wonderful Victorian inkwell, from Underware, in celebration of the company being bought out. The game of the month is still Railroad Tycoon, although the Strategic Studies Group does have some nifty new scenarios for their World War II simulation system—and the first decent Austro-Prussian war game I know of. The latter is a scenario for their Decisive Battles of the Civil War.

The books of the month are Jacques Barzun's *The Culture We Deserve* (Wesleyan University Press, 1989), typical Barzun, delicious and informative; and *In Pursuit of Truth: Essays on the Philosophy of Karl Popper on the Occasion of His 80th Birthday*, edited by Paul Levinson (Humanities Press, 1982). I became a convert to Karl Popper's theory of "falsification" as the only route to truth many years ago, and I'm ashamed of hav-

ing missed this book on its publication. It contains a good introduction to and appreciation of Karl Popper's work, although anyone seriously interested in the philosophy of science would do well to read Sir Karl Popper himself: his *Open Society and Its Enemies* (Princeton University Press, 1966) is thoroughly readable, and his other works aren't really obscure.

I have the production copy of DR DOS 5.0, and next week I am going to a seminar on the new Desqview; next month I'll cover those, and, with luck, much, 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 "jerrypp."*

## Assembly Language TOOLBOX

### Assembly Language Toolbox

Incorporate sophisticated and efficient assembly language functions and procedures into your own programs quickly and easily! The Assembly-Language Toolkit includes over 100 routines designed to speed up program development for both professional and hobbyist programmers alike. The toolbox allows the use of menus and windows with full mouse support, popup context-sensitive help, full printer support as well as allowing access to the innermost secrets of the PC. The Assembly-Language Toolbox comes complete with sample programs and a comprehensive reference manual.

### Toolbox - Professional Edition

Coming complete with all the features of the Assembly Language Toolbox, the Professional Edition includes fully documented source code of all the functions and procedures that make up the toolbox. Written by

£99

£299

## PROGRAMMERS

### Powerful Programming Tools for PC Applications

a team led by one of the UK's leading PC authorities, Christy Gemmell, author of the Waite Groups 'QuickBASIC Bible' which is published by Microsoft Press, the Professional Edition is a unique programming tool which gives you maximum control over your hardware and software.

### Toolbox - Utility Pack

Designed to complement the toolbox, the utility pack comprises programs allowing complex screen designs to be built easily, mouse pointers to be created and incorporated into your own programs, custom printer support and a help screen generator.

### Toolbox - On Line Documentation

Comprises on-line documentation for the toolbox and its utilities and is supplied in forms suitable for the Norton Guide engine, the Microsoft Advisor and Microsoft Programmers Workbench.

### Toolbox for Novell -

### Call for further Information

All Packages are available for the Microsoft BASIC 6.0 / QuickBASIC 4.x, Microsoft BASIC 7.1/ QBX and Microsoft C 6.0. All text modes of the Hercules, CGA, EGA, VGA and MCGA adapters are supported including 30, 43 and 50 line modes together with support for the enhanced (101/102 key) keyboard. Trademarks are the property of their respective holders.

ArdensoftWare 115-117 Barkby Road  
Leicester, LE4 7LG. England

Tel: 010 1 44 (533) 460000 Fax: 010 1 44 (533) 740249



# CompuAdd's NEW DX Success Kit \$1995

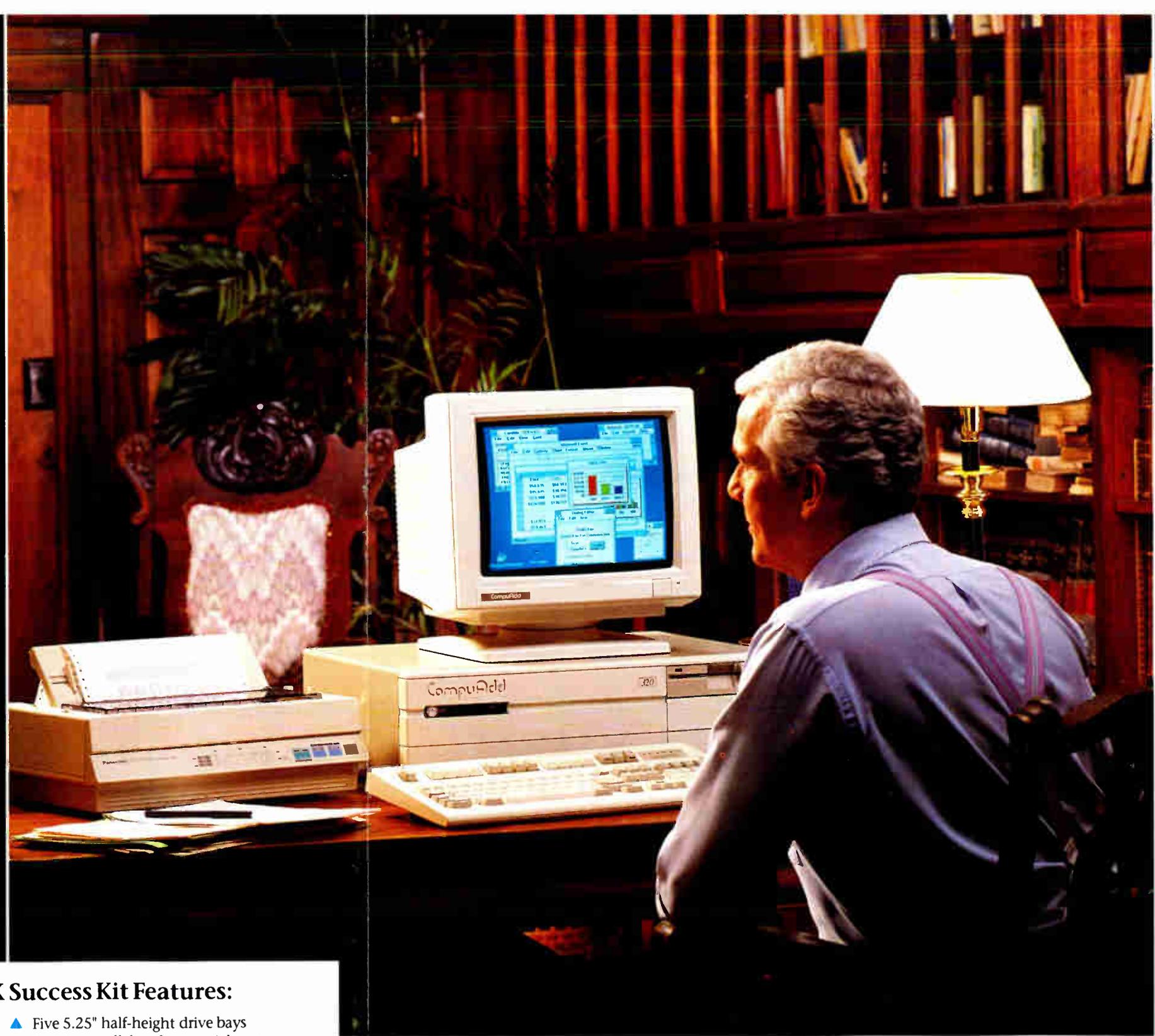
**320 System Alone Was \$2259.  
Save \$263 and Get the Printer and  
CompuAdd Windows 3.0 FREE!**

CompuAdd answers your demands for affordable 386-powered systems — and goes one better with the NEW CompuAdd DX Success Kit.

The 320 system *alone* was \$2259. Now you *save* \$263 and get a FREE Panasonic KX-P1180 printer — a \$179 value! Add to that, a FREE CompuAdd mouse *plus* FREE software worth over \$230, and you have a deal that appeals to the shrewdest executive.

The NEW DX Success Kit gives you the power of our 20MHz 386 system with the convenience of our popular "plug-and-go" kits. FREE CompuAdd Windows 3.0 and FREE CompuAdd MS-DOS 4.01 come preloaded on your hard drive, so your system is ready to go right out of the box!

With the 320 at the heart of your kit, you have power for the most demanding tasks — detailed spreadsheets, complex databases, desktop publishing and even CAD/CAM. Compatible with OS/2 and Novell operating systems as well as MS-DOS and SCO XENIX, the 320 also makes an excellent network file server or powerful workstation.



## CompuAdd's NEW DX Success Kit Features:

- ▲ 80386 microprocessor running at 20MHz
- ▲ 1 MB DRAM expandable to 16MB
- ▲ 0 wait-state cache memory
- ▲ 40MB (28ms) hard drive
- ▲ 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- ▲ Dual diskette controller
- ▲ Dual IDE hard drive interface
- ▲ Six 16-bit and two 8-bit expansion slots
- ▲ Five 5.25" half-height drive bays
- ▲ Built in parallel and two serial ports
- ▲ High performance monitor and graphics adapter
- ▲ **FREE** Panasonic KX-P1180 printer
- ▲ **FREE** CompuAdd mouse
- ▲ **FREE** CompuAdd Windows 3.0 preloaded
- ▲ **FREE** CompuAdd MS-DOS 4.01 preloaded

Part Number 66674

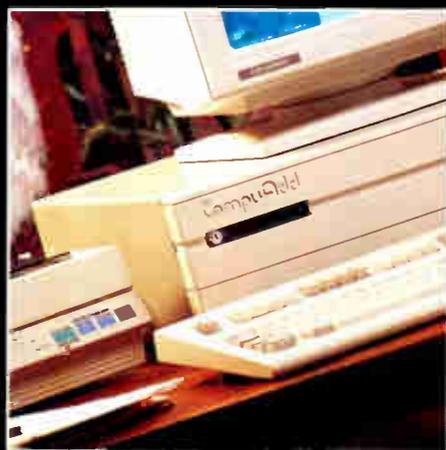
The Panasonic KX-P1180 printer that comes with your NEW DX Success Kit is a 9-pin Near-Letter-Quality printer. Chosen *PC Magazine* Editor's Choice in November 1989, the Panasonic printer is a \$179 value — yours FREE when you buy CompuAdd's NEW DX Success Kit!

*Get 386 Power, Kit  
Convenience and CompuAdd Value!*

**Call 800-999-7103**

**CompuAdd**<sup>®</sup>  
Customer driven. by design.<sup>™</sup>

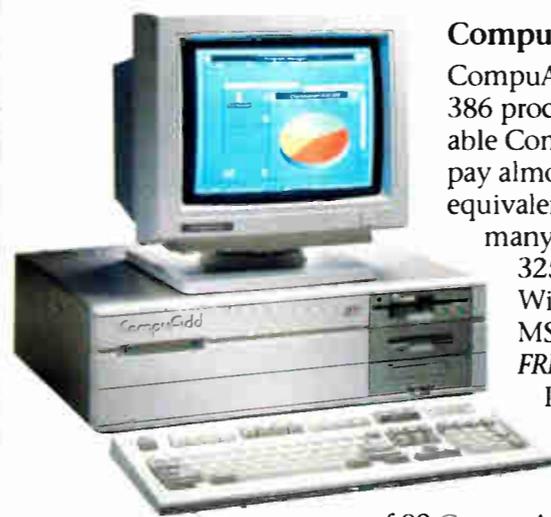
Their 20MHz 386 System Alone: \$6,354.  
 CompuAdd's NEW DX Success Kit: \$1995.  
 And The Deal Gets Better...



- CompuAdd 320 system and monitor
- 40MB hard drive
- **FREE** Panasonic printer
- **FREE** mouse
- **FREE** CompuAdd Windows 3.0
- **FREE** CompuAdd MS-DOS 4.01

We Give You A FREE Printer And More!

# CompuAdd's Top-of-the-Line Technology at Bottom-Line Prices



## CompuAdd 325

CompuAdd's 325 gives you 25MHz 386 processing power at an unbeatable CompuAdd value price. Why pay almost \$2000 more for Compaq's equivalent system, when you get so many extras with the CompuAdd 325? Extras like **FREE** CompuAdd Windows 3.0, **FREE** CompuAdd MS-DOS 4.01, a **FREE** mouse and **FREE** onsite service for one year.

Plus you get CompuAdd-designed reliability, backed by toll-free telephone support and the convenience

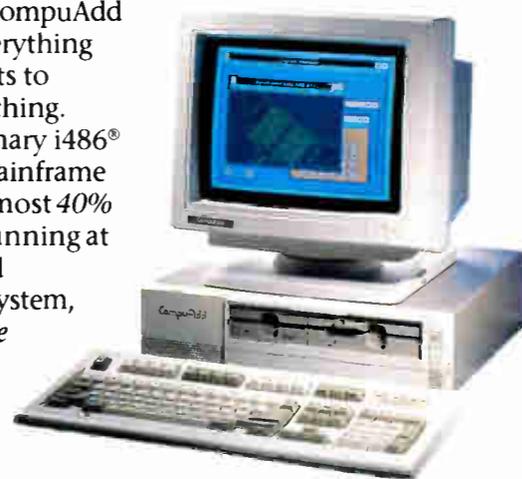
of 89 CompuAdd Superstores across the country. With the CompuAdd 325, you'll master RAM-intensive applications such as accounting, database management, desktop publishing and CAD. Pick from a variety of hard drive and monitor options to get exactly what your work requires.

## CompuAdd 425

Running at 25MHz, the CompuAdd 425 delivers power for everything from complex spreadsheets to heavy-duty number crunching.

Based on Intel's revolutionary i486<sup>®</sup> microprocessor — the "mainframe on a chip" — the 425 is almost 40% faster than a 386 system running at the same clock speed! And because it's a low profile system, you save 30% desktop space over comparable 486 systems. It's compatible with MS-DOS<sup>®</sup>, OS/2<sup>®</sup>, SCO XENIX<sup>®</sup> and Novell

environments, so you can easily run all your favorite 286 and 386 applications. Plus, you get it all (including **FREE** CompuAdd Windows 3.0, MS-DOS 4.01 and mouse!) for a low \$4995 — less than half of what you'd pay for IBM's or Compaq's 386\* technology! (\*Based on the IBM<sup>®</sup> PS/2 Model 70-186 and Compaq<sup>®</sup> Model 84-186.)



## CompuAdd 325 Features:

- 80386 microprocessor rated at 25MHz (8MHz, and 25MHz)
- 1MB DRAM expandable to 16MB
- 0 wait-state cache memory
- Dual diskette drive controller
- Dual IDE hard drive interface
- Six 16-bit and two 8-bit expansion slots
- Parallel port and two serial ports
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Real-time clock/calendar
- **FREE** CompuAdd serial mouse
- **FREE** CompuAdd Windows 3.0
- **FREE** CompuAdd MS-DOS 4.01
- **FREE** one-year onsite service
- Base System Price: \$1695 (64834)

## CompuAdd 425 Features:

- 80486 microprocessor rated at 25MHz with internal 8KB cache and floating point processor
- 4MB DRAM expandable to 8MB using SIMMs (supports 1, 2, 4, 5 and 8MB on motherboard, full 16MB on system bus)
- 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- 80MB hard drive
- Three 16-bit and two 8-bit expansion slots
- One 5.25" and two 3.5" half-height drive bays
- 16-bit video graphics adapter
- CVGA monitor
- **FREE** CompuAdd serial mouse
- **FREE** CompuAdd Windows 3.0
- **FREE** CompuAdd MS-DOS 4.01
- **FREE** one-year onsite service
- Base System Price: \$4995 (66652)

**CompuAdd**<sup>®</sup>  
 Customer driven. by design.™

12303 Technology, Austin, Texas 78727

Telex: 763543 COMPUADD AUS  
 Fax: 512-335-6236  
 Technical Support: 800-999-9901  
 Outside US: 512-258-5575  
 Canada: 800-387-3266  
 Mexico: 95-800-010-0401  
 United Kingdom: 0800-373535  
 Germany: 0130-6009

Think Technology, Think CompuAdd

CALL TODAY! or visit a CompuAdd Superstore for these savings.

800-999-7103

Hours: Monday - Friday 7:00am to 9:00pm CST; Saturday 9:00am to 5:00pm CST

We accept MasterCard, VISA, money orders, certified checks and personal checks (please allow ten days for processing). COIs (\$50 minimum order), company and institutional purchase orders (minimum initial purchase \$500, thereafter \$50) and wire transfers. Please add 2% to all purchases for shipping and handling (minimum \$3, shipping outside the continental United States will increase cost). Add \$10 for shipping and handling to APO/FPO addresses (minimum \$10). AZ, CO, CT, DC, FL, GA, HI, IL, IN, KS, LA, MA, MD, MI, MN, MO, NC, NE, NJ, NM, NY, OH, OK, PA, RI, SC, TN, UT, VA and WI residents, please add appropriate local sales tax. Thirty-day money-back guarantee does not include return freight or shipping and handling. Opened software, videotapes, other consumables and shipping costs are nonrefundable. All return items must be accompanied by a return merchandise authorization (RMA) number. Prices and product descriptions are subject to change without notice. CompuAdd is not liable for damage due to omissions or typographical errors. Call 800-666-1872 for a copy of CompuAdd's complete warranty.



# THE GROWTH OF GROUPWARE

Don't buy more—  
or less—groupware  
functionality than  
you need

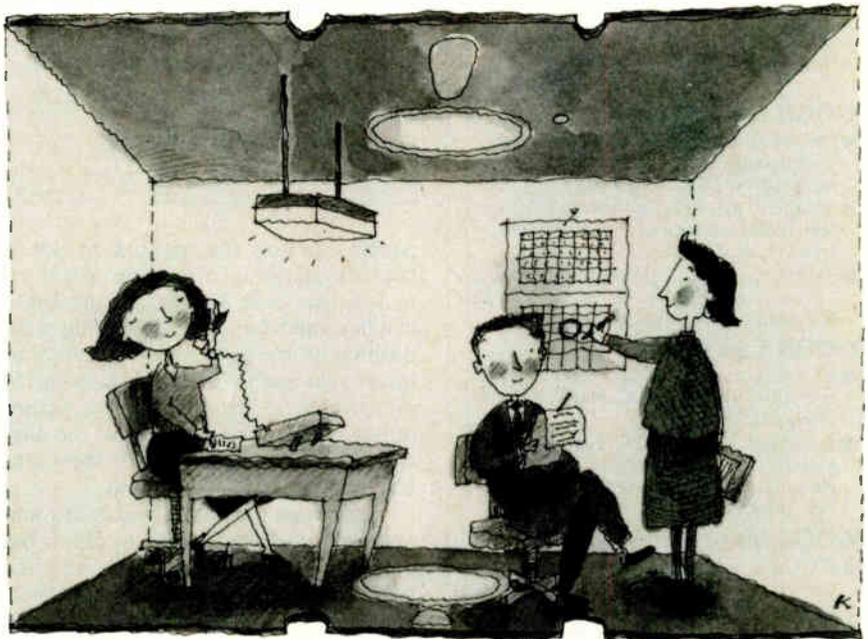
As LANs become more popular in business, the demand that they do something to support groups of people who work together becomes more important. The reason for this requirement is clear. In most organizations, people work in groups assigned to accomplish a task. These may be called project teams or departments, but either way, they are groups of people who work together.

Stand-alone software packages enhance a group's work only to the extent that they make an individual's work more productive. So, group productivity software, or *groupware*, was developed.

Last year I discussed two early groupware packages, WordPerfect Office and Higgins (see "Groping for Groupware," April 1989 BYTE). Since that time, groupware has become much more popular, there is a lot more of it, and there is a lot of variety in what it does to help a group be more productive.

The wider selection of groupware functions means that you have to look at what your organization needs in group productivity software before the company buys it. This variety is important, because, unlike with stand-alone applications, everyone must use groupware, so it must support everyone's needs.

On the other hand, there are reasons why vendors should not include unnecessary functions in a groupware package. For example, extra functions mean added complexity and more difficulty in learning how to use the package. Also because of this sophistication, it takes more to motivate people to use groupware once they have it available.



## What Functions Do You Need?

Every groupware package includes E-mail, and nearly all of them include electronic appointment books and group scheduling. Beyond these features, the field is wide open. You will find packages that include everything from word processors and databases to calculators.

The key to determining which functions you really need is to look at how your workgroups work. Is communications their primary need? Do they have to schedule a lot of meetings? Are they working on creating reports and documents that have to get passed around a lot? Are group members confident computer users, or do they need to work from some kind of menu shell? Is the network limited to IBM PCs and clones, or are there Macs and VAXes in the mix? Before you start looking at groupware, you need to have answers to these questions, and you need to know a lot about how your LAN is used and how it's set up.

## What's Available?

Of course, before you know whether or not you need any software, you should know what features and functions it offers. For example, you need to know that, with some packages, it is possible to schedule resources such as meeting rooms and slide projectors, along with the people who need to use them. You also might find that your organization is paying for features that it doesn't need and won't use, and that make the rest of the package harder to use.

As I mentioned, all these packages let you send E-mail messages across the network to other users. To use E-mail or be notified of new messages, users must log onto the file server containing the groupware package.

Likewise, most groupware packages contain some form of appointment calendar that can interface with a group scheduling package. You can keep your appointments on the computer, and other

## Good Labor ain't cheap!



**Optical Character Recognition Software for your scanner that is fast, accurate and easy to use. Why type when you can just scan?**

## SX-OCR



### SX-OCR Reads Text

- SX-OCR will automatically "re-type" your documents, producing text files that work with your word processor
- SX-OCR handles English and foreign text, footnotes and headlines, typeset and typewritten material
- SX-OCR will automate the typing process - from simple business letters to illustrated product catalogs

### SX-OCR Can Learn

- SX-OCR can be taught to read nearly everything through its trainable recognition process
- In addition, SX-OCR automatically avoids dirt, boxes, lines, logos and graphics while converting text images to ASCII files

### SX-OCR Manages Graphics

- SX-OCR uniquely separates graphics from text in one scan... and remembers both
- SX-OCR can import and export popular image formats such as PCX and TIFF

### Compatibility

- PC-AT with 640K RAM and 2mb available on hard disk - EMS memory can be used in place of the hard disk space to speed up the OCR process
- SX-OCR works directly with the following scanners: Cannon, HP, Microtek, Panasonic, Ricoh, Umax, Chinon, Zsoft, Princeton, Abaton, AST, Mitsubishi and others; also will work with any scanner that will make a .PCX file or a bilevel .TIF file

*The heart of OCR is the quality of the software engine, the algorithm that converts the graphic image into the actual text character. SX-OCR is better and faster than any OCR package on the market today*

**Suggested Retail Price \$395.00**

Call for special, discount prices on SX-OCR and handheld, sheetfeed and flatbed scanners:

**1-800-759-4001**

**Desktop Technology Corporation**

**dtc**

986 mangrove, suite b  
sunnyvale, ca 94086  
(408) 738-4001  
fax (408)-739-3109

## DOWN TO BUSINESS

### ITEMS DISCUSSED

**cc:Mail** .....\$695-\$1290  
(25 to 125 users)  
**cc:Mail, Inc.**  
2141 Landings Dr., Building T  
Mountain View, CA 94043  
(415) 961-8800  
**Inquiry 1221.**

**INTO** .....\$1499-\$3899  
(five to 25 users)  
**Benchmark Associates, Inc.**  
7400 West Detroit St.  
Chandler, AZ 85226  
(602) 961-7519  
**Inquiry 1222.**

**Network Scheduler** .....\$495-\$995  
(eight to 50 users)  
**cc:Mail Link** .....\$695-\$1195  
(eight to 50 users)  
**3 + Mail Link** .....\$695-\$1195  
(eight to 50 users)  
**PowerCore, Inc.**  
P.O. Box 756  
Manteno, IL 60950  
(815) 468-3737  
**Inquiry 1223.**

**Office Works LAN** ....\$195-\$1995  
(one to unlimited users)  
**Data Access Corp.**  
14000 Southwest 119th Ave.  
Miami, FL 33186  
(305) 238-0012  
**Inquiry 1224.**

people can use the network to see if you're available for a meeting and, if so, include you in it. Each of the packages handles calendars and scheduling a bit differently. But most give you a place to insert your appointments, usually in 15-minute blocks. You can also get a picture of how your calendar looks for the day, week, and month. Some will show six- and nine-month blocks of time.

If you want more than scheduling and mail features, you'll need to check out groupware packages with more sophisticated capabilities. Office Works LAN from Data Access, for example, includes the ability to send E-mail to other systems using telex and fax. Its mail system also supports specialized phone messages—electronic versions of the little pink messages that build up on your desk—and it can dial the phone for you while you're looking at the message.

Office Works includes the ability to track people and documents as well as mail. You can store names and addresses and use the information to print everything from mailing labels to Rolodex cards. This package also contains a control function that lets you track the location and contents of a document. If the document isn't in electronic form, the process is very difficult. If it is, the process is easy. Office Works LAN will start up the word processor that created the document and then load in the document for you to read.

### You Want More?

Some managers want a complete groupware solution so that everyone will be using the same software for everything they do. To meet this requirement, they

must have either a standard suite of network applications along with their groupware, or a groupware package that supports just about all the features that they are likely to want. There are packages that provide this type of functionality.

One such package is INTO (Intuitive Network Total Office) from Benchmark Associates. It attempts to support all the common office functions. In addition to E-mail and scheduling, you also get a phone book, a data manager, phone messaging, and a note taker (a kind of text editor with a search capability). And there's more.

At the point where other packages run out of features, INTO begins. Along with all the typical groupware capabilities, INTO includes a full-featured word processor, a spreadsheet, business graphics, and a calculator. Overall, you may find that this combination of features saves you money and helps to integrate your groupware and applications more tightly.

### Do-It-Yourself Groupware

While the massive integration of large groupware packages might fit the needs of some organizations, many others find that their requirements don't extend beyond E-mail and time management. Either their corporate practices don't lend themselves to the rigid format demanded by more structured systems, or the projects involved are too specialized for most generalized applications. What doesn't change is people's need to communicate, either by mail or in meetings. A groupware package that fills this need is all that many organizations require.

If you have modest needs, it makes sense to purchase in a modest fashion.

# Zenith Data Systems Presents Everything You Love About The PC ...Plus The Benefits Of Graphical Computing.

## ZENITH DATA SYSTEMS INNOVATES AGAIN™

Zenith Data Systems was the first to offer Microsoft® Windows™ version 3.0 and Asymetrix® ToolBook® pre-installed on every hard drive 386-based desktop PC. And that's just part of *The Seamless Solution* we've created for today's graphical computing environment.

With Microsoft Windows version 3.0 and the fingertip simplicity of the Microsoft Mouse, your Zenith Data Systems PC lets you glide graphically, *seamlessly* between applications. While Asymetrix ToolBook lets you design your own applications under Windows version 3.0. So your productivity will soar. With the greatest of ease.

A \$643 value,\* Microsoft Windows version 3.0, Asymetrix ToolBook and the Microsoft Mouse are all yours with every Intel386™, 386 EISA or 386SX desktop PC.

Add our award-winning 14" VGA Flat Technology Monitor, and you've got *The Seamless Solution*. So your Windows version 3.0 and ToolBook applications will come to life with breakthrough clarity.

Zenith Data Systems. Transforming the PC into a powerful graphic environment. For more information and the name of your nearest Zenith Data Systems Medallion Reseller, call:  
**1-800-523-9393**



### *The Zenith Data Systems Sphere*

*The universal symbol of simplicity, the sphere perfectly represents The Seamless Solution™ from Zenith Data Systems.*

**ZENITH**  
data systems



Groupe Bull

Microsoft and Windows version 3.0 are trademarks of Microsoft Corporation. Asymetrix and ToolBook are registered trademarks of Asymetrix Corporation. Intel386 is a trademark of Intel Corporation.  
\*Based on suggested retail price if purchased separately. © 1990 Zenith Data Systems Corporation

World Radio History

Circle 376 on Reader Service Card

Likewise, if your needs for word processing are already met by another application, such as the LAN version of WordPerfect or WordStar, why pay for word processing in a groupware package? In fact, why buy a package at all? Why not assemble the parts you need yourself?

A modular approach to groupware is still in its infancy, but the initial parts exist now. Many organizations are finding that with a combination of the highly regarded cc:Mail and Network Scheduler, you can take advantage of the best of two excellent products. The fact that Network Scheduler will integrate itself with cc:Mail makes the system even more attractive.

Both of these packages were designed to perform a single specific task. For that reason, cc:Mail is very well designed, runs on a variety of platforms, including the Mac and the VAX, and is very rich in functionality. Likewise, Network Scheduler is designed simply to schedule time and does not go overboard providing needless frills like calculators and address lists. You get a complete scheduling package that's flexible and easy to use.

With a do-it-yourself approach, you

don't have to buy anything until you need it. You can get started with E-mail by buying cc:Mail and then add Network Scheduler later as you need it. Both packages are inexpensive (\$695 for a 25-user LAN), making them cost-effective as well as performance favorites. While you may not think price is your highest priority, consider how much you'd have to pay for a really large LAN and the fee many vendors charge for each user.

#### Groping for Groupware

As you can see, if you want to use groupware, you have a lot of options. They range from a solution you can assemble yourself to one that attempts to combine all the software your workgroup is ever likely to need.

Each of the packages will do what it's supposed to do, and each works on most popular LANs. The critical factor when choosing any groupware package is the requirements that you need to meet. Buying groupware that greatly exceeds your needs is probably a waste of money. Buying groupware that doesn't meet your needs is wasteful and shortsighted.

How do you find out what your re-

quirements for groupware really are? You talk to the group of people whose productivity you're trying to enhance. You analyze what they actually need to accomplish by asking them what they do now and what they would do if it were possible. Then you turn those needs into documented requirements and match the requirements against the functions that each groupware package supports. By this process, you can obtain software that actually increases your productivity.

Next month, more on this subject as I look at how the heavy hitters can help your group be more productive. ■

*Wayne Rash Jr. is a contributing editor for BYTE and technical director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as "waynerash," or in the to.wayne conference.*

*Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

# ABC Flowcharter for Windows

*"Simply the easiest way to document procedures."*



ABC Flowcharter™ makes drawing and editing flowcharts easier than ever. It's loaded with features that help you make and edit charts in a fraction of the time needed with other flowcharting or drawing programs.

ABC Flowcharter's advanced link feature lets you break complicated procedures into smaller, more manageable steps. Just click on a shape to display a sub-chart or procedure. It's that easy.

Ask your dealer for a demonstration or call 1-800-227-0847 for more information. See for yourself why ABC Flowcharter is quickly becoming the standard flowcharting tool for the Fortune 1000. Retail price \$295.

## Roykore™

2215 Filbert St.  
San Francisco, CA 94123  
415-563-9175

# There Are Many Ways to Take Control.



Only one puts you in control of your personal computer.

**Control Room™**—The ultimate utility from Ashton-Tate.

Imagine having a built-in computer consultant that can analyze your system's capabilities. Configure it for optimal comfort and performance. Automate dozens of chores. Check your system daily for viruses. Perform hardware and software inventories of entire networks. And make your internal support easier.

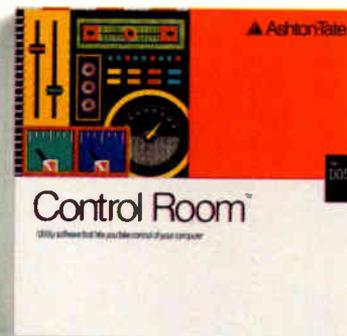
Control Room does all this and more in seconds. And in plain English.

You can customize your keyboard to work the way *you* want it to work. Save time with an outstanding disk cache. Change system files in a flash. Undelete files and directories without access to tools that can be damaging when used by novices. Have the answers you need to simplify technical support calls. And get instant response to hundreds of questions. In fact, Control Room replaces up to 25

different utilities. Even if you don't yet own a computer, just pop it into any IBM® or 100%-compatible

for an in-depth summary that helps you choose the system that's right for you.

For more information on the ultimate software utility—one that puts control of your computer at your fingertips—call 1-800-437-4329, ext. 3713.



 Ashton-Tate®

# THE BEST USE IN TOWN. NOW SCREEN N



© 1990 Sun Microsystems, Inc. \*Sun Microsystems and the Sun logo are registered trademarks of Sun Microsystems, Inc. OPEN LOOK is a trademark of AT&T. All other products or services

# R INTERFACE PLAYING AT A EAR YOU.

The OPEN LOOK™ user interface.

It's a real hit with independent software vendors, in-house developers and end users. In fact, over 300 applications are in development today. By people like Lotus®, INFORMIX®, Island Graphics®, Interleaf®, and Frame®. And it's the most popular front end to UNIX®. For a number of reasons.

First of all, it makes UNIX easy to use. Because there are no complicated UNIX commands. It also looks better than any other interface. From its icons to its 3D elements. And makes users more efficient. For example, our drag and drop feature gives them a simple, intuitive way to move files around the desktop. Our push-pin icon makes it even easier to use. And OPEN LOOK gives users the same interface across multiple platforms, so they learn it once. And enjoy access to a huge range of network resources.

As a developer, you'll see it's also the easiest to work with. Because it's part of OpenWindows™, a complete development environment. With the tools you need to create applications faster than

ever. And ready-made features, like our DeskSet™ graphical productivity tools, that you can give users right away.

Of course, the business reasons to choose OPEN LOOK are just as strong. OPEN LOOK is the standard interface of AT&T's UNIX System V.4, so it's included at no charge. And it will run on over 20 platforms, including DEC®, HP®, and IBM®. Since it's portable across multiple platforms, you only write your application once. Which saves thousands of man-hours. Finally, with OPEN LOOK, you have the full support of a company that leads the workstation industry in worldwide shipments\*.

We've put together a videotape that shows you exactly what OPEN LOOK is all about. Just call us at 1-800-624-8999 (ext. 2068), and we'll send you a free copy.

Then find a nice comfortable seat close to your screen. Because the closer you look, the better we get.



mentioned are identified by the trademarks or registered trademarks of their respective companies or organizations. \*Source, International Data Corporation, 1990. 36.3% market share.

Circle 329 on Reader Service Card

# 3780 RJE Emulation for:

## Operating Systems

- MS-DOS
- Concurrent DOS
- UNIX SystemV/386
- XENIX 286/386
- AIX
- 386/ix
- HP-UX
- Sequent Dynex
- NCR UNIX
- VMS
- Macintosh

## Applications

- EDI
- Point-of-Sale
- Mainframe RJE
- Medical Claims Filing
- Check Clearing and Deposits
- Electronic Funds Transfer
- Credit Card Verification
- U.S. Customs Automated Broker Interface
- Electronic Tax Filing

# ...and More!

CLEO's 3780Plus® is the preferred 3780/2780 bisynchronous communications solution for applications requiring fast, efficient data transfer. It's been proven in over 50,000 worldwide installations.

With 3780Plus, you get full IBM 3780/2780 RJE emulation for IBM PCs, PS/2s, and

*Scripting Command Language*

compatibles. It also works with RS/6000, DEC VAX, HP9000, NCR Tower, Prime, Pyramid, Sequent, Altos, and Apple Macintosh systems.

Features include forms control, auto dial/auto answer, and a communications line monitor. Our powerful Scripting Command Language and Application Program Interface make unattended operation easy.

We offer 3780Plus on

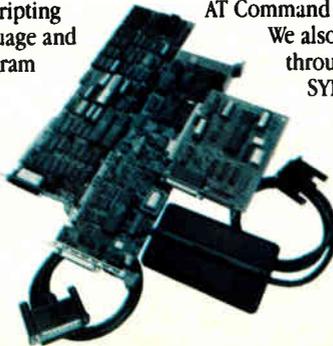
high-speed modem boards, high-performance co-processor boards, and economical synchronous interface boards. Internal modems supported include 201/212, 208, 208/2400, V22 bis, V32, and others. External modem auto-dialing capabilities include UDS BSC, SADL, AT Command Set, and V.25 bis.

We also offer 3780Plus through our intelligent SYNCable, which allows synchronous communications activity through asynchronous ports.

*Application Program Interface*

To learn more, call us today at 1-800-233-2536. Or write to us at 3796 Plaza Drive, Ann Arbor, Michigan 48108. FAX: 313/662-1965

**CLEO**   
CLEO Communications  
A Division of Interface Systems, Inc.



AVAILABLE WORLDWIDE!

In Europe, call Sintec Peripherals Ltd. in Slough, England, at 0753-811888 (FAX: 0753-811666).

World Radio History



# HARD CHOICES FOR NETWORK MANAGERS

Most people can't afford to wait for tomorrow's solutions

**N**etworks are practically unmanageable, and the situation is only getting worse. Unless vendors rally around a single network management standard, we'll all pay with more network downtime and more network problems in general.

The problem isn't that network management products don't exist. Quite the opposite is true; such products abound. The problem is that no single product addresses all the problems facing the managers of today's large, heterogeneous networks. Users need a single product with which to manage an entire network; what they have are different management products for every component.

It doesn't have to be that way. We recently got a tantalizing glimpse of what the future of network management could be. An administrator at a large institution was managing a network of over a thousand devices from a single Sun workstation. On the Sun's screen was a map of the network—little white boxes linked by glowing green lines. Each of the boxes represented a device, such as a workstation, bridge, router, or gateway. The lines indicated connections between the devices. Some of the connections were network media, such as Ethernet or fiber-optic cables, while others were T1 and microwave transmissions. When a device or connection encountered a problem, its on-screen counterpart turned yellow; when the device went down, its box or line glowed red.

You could even zoom in for a closer look. We double-clicked the mouse on a bridge, for example, and up popped statistics on the number of packets that bridge had received and transmitted, the



number of errors, and so on.

We instantly knew what else the program could do. Clicking on a server's box would produce statistics on its file and printer usage. Clicking on an Ethernet cable would give us a closer look at the PCs hooked to that cable. Everything was in one place, accessible from this one program.

We were wrong. The program could not do what we wanted because the devices on the network didn't all support the same network management standard.

## Back to the Future

Many of those devices, however, did support the Simple Network Management Protocol, and that support made possible the features we saw. The SNMP specification comes from the Internet Engineering Task Force, the folks who brought us TCP/IP, the Unix networking standard. At its core, SNMP just defines how a network *manager* can communicate with

network *agents*. The manager is a program that can accept, manipulate, and, generally, display information about the state of the network—such as the program we saw running on the Sun workstation. An agent is a device on the network, and theoretically it can be anything from a workstation to a bridge, router, gateway, or server. The only requirement an agent must meet is that it must be able to run some SNMP software; thus, it needs its own processor and memory.

SNMP is only a protocol, a specification for how the manager and the agents can communicate. It does not specify the contents of all possible exchanges—just how to make those exchanges. Even the way in which the manager and the agents communicate is fairly simple. The manager and the agents do not need to stay in touch constantly; instead, the manager merely “yells” to the agents periodically. Nor do the agents have to remember

# 24-bit Color is Just One of Our Strengths.



The Hercules Graphics Station Card gives you the real picture and power to spare. Power to run Windows 3.0 and beyond.

With 1024K of VRAM for 16- and 24-bit color, up to 16.7 million colors are within your grasp. Pictures will appear more lifelike than ever. And with its TI 34010 processor, the Hercules Graphics Station Card frees your CPU from time-consuming graphics functions. You can run programs like PageMaker, Excel and Corel Draw up to five times faster than the fastest super VGA card, even at 1024 x 768 resolution.

Only the Hercules Graphics Station Card combines VGA for today's applications, the TI 34010 for more power and future applications, and 16- and 24-bit color high quality photo realism. All at a surprisingly low price. Call 800 532-0600, ext. 722.

for more information. After all, 24-bit color is just one of our strengths.

## Hercules



Come  
See Us At  
COMDEX  
Booth #N456

© Copyright 1994 Hercules Computer Technology, Inc., 921 Parker Street, Berkeley, CA 94710. Hercules and Hercules Graphics Station Card are trademarks of Hercules Computer Technology, Inc. All other product names are trademarks of their respective owners, who are not affiliated with Hercules.

## NETWORKS

these conversations; only the manager needs such records, and then only as a management tool.

SNMP is well on its way to becoming a standard. More than 100 vendors have signed up for it so far, with more coming all the time. Some of the vendors are even major workstation players, such as IBM and Sun. Most, however, are makers of network connection devices—the vendors behind the bridges, routers, and gateways that worked so well with the software we saw.

### Roadblocks

With all this momentum behind it, you might think that SNMP was unstoppable, maybe even on its way to fulfilling our earlier visions. But that's not the case.

For one thing, SNMP doesn't cover enough ground to meet all our needs. The base specification details only how the manager and the agents communicate. To make our universal-management dream come true, we also need standards for what every possible kind of agent—including workstations and servers—can say to the manager. Some such SNMP-based standards exist, but mostly for bridges, routers, and gateways—hence the wider adoption of SNMP by vendors of those products than by any other types of vendors. Server vendors, for example, have largely ignored SNMP, so SNMP console products typically offer no information about server activity. SNMP also has so far been associated primarily with Ethernet, although work is ongoing to bring it to Token Ring, Fiber Distributed Data Interface, and other types of network connections.

### Back to the Future, Part II

The newest and perhaps greatest obstacle to SNMP, however, is a second—and, in many ways, better—proposed network management standard: Common Management Information Protocol.

CMIP comes from the International Standards Organization (ISO), the group behind both the Open Systems Interconnection model and the networking software of the same name. CMIP defines standard types of communication for practically every kind of information you might want about a network—physical faults, security breaches, file operations, configuration data, performance, accounting, and on and on. It's obviously a much larger and more comprehensive standard than SNMP. A companion specification, the Common Management Information Service standard, defines a large set of functions that a manager must provide. You don't have to look long

← Circle 160 on Reader Service Card

# You can't be too rich, too thin or too smart



## RICH

*in features like a replace battery indicator, internal control language, site diagnostics, and full-time surge and noise suppression*

## THIN

*to fit easily under the monitors of desktop servers and workstations*

## SMART

*with an intelligent interface to allow automatic shutdown of network operating systems such as Novell, Lan Manager, Lan Server, SCO Unix, Banyan and more*



Some people also say you can't be too powerful. But to a computer too much or too little power can be disastrous. Protect your desk space and your data with APC's new Smart-UPS™ 400, designed

specifically for servers or workstations such as the IBM PS-2/80 and the Compaq DeskPro 386. With PowerDoctor™ software, you can even monitor your site's power quality and export the data directly to popular spreadsheets. So even if

you're finding it hard to get rich or thin, protecting your data with an APC UPS will always make you look smart. **Call 800-541-8896, Dept. A2 to receive your free Power Protection Handbook.** Resellers ask about our extensive support programs.

See us at BOOTH 236  
 **COMDEX/Fall '90**  
November 12-16, 1990  
Las Vegas, Nevada

*The industry's leading UPS systems*



"All Around  
Reliable  
Choice"  
PCWEEK



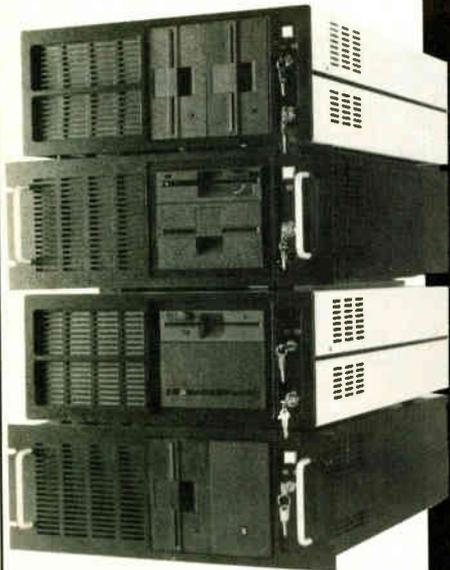
  
**American Power Conversion**  
**Lan's Best Friend™**

© 1990, APC, 132 Fairgrounds Rd., West Kingston, RI 02892 USA. Int'l headquarters at 2 bis rue P.H. Spaak, Esplanade Parc d'Enterprises, Saint Thibault des Vignes, 77462 Lagny sur Marne, Cedex, France, 011-33-1-64-021158. Products carry a two year warranty. Lan's Best Friend, Smart-UPS, PowerDoctor are trademarks of APC. All other trademarks are the property of their owners.

Circle 23 on Reader Service Card (RESELLERS: 24)

# Rack & Desk PC/AT Chassis

Integrand's new Chassis/System is not another IBM mechanical and electrical clone. An entirely fresh packaging design approach has been taken using modular construction. At present, over 40 optional stock modules allow you to customize our standard chassis to nearly any requirement. Integrand offers high quality, advanced design hardware along with applications and technical support *all at prices competitive with imports*. Why settle for less?



## Rack & Desk Models

Accepts PC, XT, AT Motherboards  
and Passive Backplanes

Doesn't Look Like IBM

Rugged, Modular Construction

Excellent Air Flow & Cooling

Optional Card Cage Fan

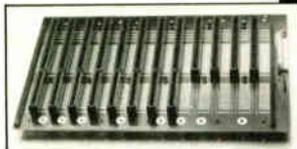
Designed to meet FCC

204 Watt Supply, UL Recognized

145W & 85W also available

Reasonably Priced

**Now  
Available**  
Passive  
Backplanes



# INTEGRAND

RESEARCH CORP.

Call or write for descriptive brochure and prices:  
8620 Roosevelt Ave. • Visalia, CA 93291

**209/651-1203**

TELEX 5106012830 (INTEGRAND UD)

FAX 209/651-1353

We accept Bank Americard/VISA and MasterCard

IBM, PC, XT, AT trademarks of International Business Machines.  
Drives and computer boards not included.

## NETWORKS

at the CMIP and CMIS specs to believe that they cover the vast majority—if not all—of the network management options that you're likely to want.

Of course, you pay for all this size. For one thing, CMIP, unlike SNMP, requires a permanent connection between the manager and each agent. Worse, to work fully with a CMIS manager, each agent needs to implement every layer of the CMIP spec, so each agent needs a lot

# S

NMP

*is well on its way to  
becoming a standard.*

*More than 100  
vendors have signed up  
for it so far.*

of memory to run the CMIP software. CMIP and CMIS are new enough that we have no hard data on the amount of memory that a full commercial implementation would require, but some estimates run as high as 1 megabyte, with the most optimistic projections in the hundreds of kilobytes. This memory requirement is a problem for network devices like bridges and routers, and it's not likely to sit too well with most MS-DOS PC users.

IBM and 3Com have teamed up to propose a solution to this memory problem: the Heterogeneous LAN Management standard. A subset of CMIP, HLM includes only the lower few layers of the larger standard. HLM can work with both Token Ring and Ethernet networks and should cost only 20K bytes to 30K bytes per PC, so it has the potential to bring network management options right to your desktop. Both IBM and 3Com plan to include HLM in their PC networking software, and they're encouraging other vendors to do so as well. HLM does not, however, include any monitoring software or specifications, just an application programming interface on which vendors can build their own management monitors—as both IBM and 3Com plan to do.

### Picking a Future

Aside from its memory requirement, CMIP sounds great. HLM isn't as good,

but at least it fits on a PC. At first glance, the two seem to offer a great one-two punch: Do HLM now, and then do CMIP as PC operating environments, such as Windows that can handle large software products become more commonly available. Together, CMIP and HLM seem like the death of SNMP.

The thing is, CMIP is the future, and there are network management problems today that can't wait for it to reach the market. The CMIP ISO standards are only in draft form, awaiting ratification. IBM and 3Com say that HLM won't be ready until sometime in 1991. When both are done, users will still face a long wait while all the networking vendors implement these standards and bring their products to market.

Meanwhile, SNMP is out in the real world doing useful work today. That's the bottom line. Network management problems are too important to wait, so everyone should adopt SNMP as quickly as possible. Every network vendor, including the LAN server companies—Novell, Microsoft, and the rest—should embrace this standard. Every server, workstation, and other network device should be able to talk SNMP.

Does this mean we're giving thumbs down to CMIP? No. In fact, we also think that every network vendor should jump on the CMIP bandwagon as soon as possible, so that in four or five years CMIP products will be everywhere.

"But wait," we hear the budget-conscious folks crying, "does this mean that we'll end up using SNMP for a few years and then moving to CMIP? Does it mean we'll end up paying twice for many network management components? Does it mean we're opting for a relatively short-term, imperfect solution, while an almost ideal one is only years away?"

Yes, yes, and yes.

Those questions are good ones, but they beg the most important question of all: Do you really have any other choice? Our answer is no; network management is too vital to today's businesses to wait for a standard that's years away. That's not an ideal answer, admittedly, but right now it's the best one we've got. ■

*Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.*

*Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*



# Our Printer Sharing Unit Does Networking!

## **An Integrated Solution**

Take our **Master Switch™**, a sophisticated sharing device, combine it with **MasterNet™** networking software for PCs, and you've got an integrated solution for printer and plotter sharing, file transfer, electronic mail, and a lot more. Of course you can also share modems, minis, and mainframes or access the network remotely. Installation and operation is very simple.

## **Versatile**

Or you can use the Master Switch to link any computer or peripheral with a serial or parallel interface. The switch accepts over 20 commands for controlling the flow of data. It may be operated automatically, by command, or with interactive menus. Its buffer is expandable to one megabyte and holds up to 64 simultaneous jobs. The

**MasterLink™** utility diskette for PCs comes with every unit and unleashes the power of the switch with its memory-resident access to the commands and menus.

## **Other Products**

We have a full line of connectivity solutions. If you just want printer sharing, we've got

it. We also have automatic switches, code-activated switches, buffers, converters, cables, protocol converters, multiplexers, line drivers, and other products.

## **Commitment to Excellence**

At Rose Electronics, we're not satisfied until you're satisfied. That's why we have thousands of customers around the world including large, medium, and small businesses, factories, stores, educational institutions, and Federal, state, and local governments. We back our products with full technical support, a one-year warranty, and a thirty-day money-back guarantee.



**ROSE  
ELECTRONICS**

**Call now for literature or  
more information.  
(800) 333-9343**

*Give a Rose to your computer*

P.O. Box 742571 • Houston, Texas 77274 • Tel (713) 933-7673 • FAX (713) 933-0044 • Telex 4948886

Circle 303 on Reader Service Card  
World Radio History

Can you stomach spending an extra \$10,000 for a PC network or UNIX® workgroup server with dubious service?

We can't. Workgroups are too critical to leave in the hands of amateurs.

So Dell has gone overboard in servicing servers. In fact, we just won a *PC Week* Poll for Corporate Satisfaction for servers, where our reliability and service were rated far above our competitors.

Which brings us back to our question:

Would you spend an extra \$10,000 for iffy service?

We think it's a no-brainer.

**We have two new 486™ EISA servers.** Dell

TO ORDER, CALL  
**800-444-1470**  
 HOURS: 6 AM-9 PM CT M-F 8 AM-4 PM CT ON SAT.  
 FOR NETWORKING/UNIX INFO,  
**800-678-UNIX**  
 IN CANADA, CALL 800-387-5752

gives you a choice of the 25 MHz Dell™ 425TE and the 33 MHz Dell 433TE.

The 25 MHz Dell System® 425TE has up to 64 MB of RAM capacity, 11 storage bays, and a whisper-quiet 300 watt power supply. We've also built in features such as password protection, a software controlled reset switch, and an efficient cooling system to protect component life.

What's more, both the 433TE and the 425TE have the Dell designed SmartVu™ diagnostic display built in. This ingenious innovation helps identify problems even if the monitor goes down.

For even more performance, the 33 MHz Dell System 433TE is everything our 425TE is, with 32% more speed. The Dell exclusive memory design with a 128 KB external cache gives it maximum throughput.

# UNBELIEVABLE PRICES.



**\$11,799**  
 Dell System 433TE  
 Lease: \$423/mo.\*

**\$9,599**  
 Dell System 425TE  
 Lease: \$359/mo.\*

## THE NEW DELL SYSTEM 433TE 33 MHz EISA i486™ AND THE NEW DELL SYSTEM 425TE 25 MHz EISA i486.

- Intel® 80486 microprocessor running at 33 MHz (433TE) or 25 MHz (425TE) with 8 KB internal cache
- 128 KB external cache (433TE)
- Standard 4 MB of RAM\* expandable to 64 MB (eight internal SIMM sockets, each accepting a 1 MB, 2 MB, 4 MB, or 8 MB SIMM, or installable in matched pairs)
- Socket for WEITEK 4167 math coprocessor
- 11 internal half-height drive bays
- Eight 12-bit EISA expansion slots (six EISA master slots and two EISA slave slots)
- High-performance IDE (80 MB, 100 MB, 190 MB) and EsDI (330 MB, 650 MB) hard disk drives

650 MB VGA Color Plus System	433TE	425TE
Using 2 MB SIMMs	\$11,799	\$9,599
Using 4 MB SIMMs	\$ 2,199	\$9,999
Prices listed include 8 MB of RAM		

AD CODE 11E33



# UNBELIEVABLE.

course, they're completely compatible with all major network operating systems, including Novell, 3COM and Banyan.

In a UNIX environment, the 425TE and 433TE are perfect for workgroups supporting either traditional multiuser or

high-speed client/server environments. You can buy Dell servers preloaded with UNIX System V, making them literally plug and play. Even more impressive is the fact that UNIX system administration can be done by Dell, remotely.

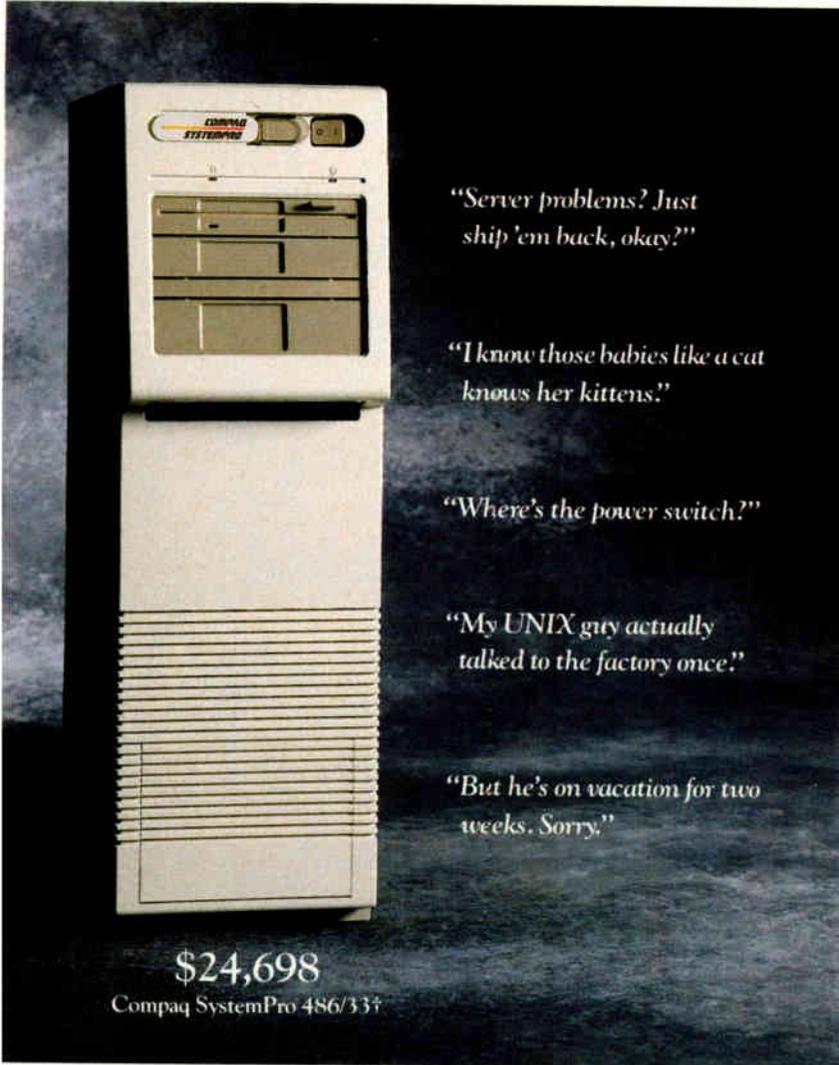
**Servicing servers is beyond most Compaq dealers.** If a server happens to go down, your whole company can go down with it.

Would you trust some unknown technician to bring it back up?

We wouldn't.

That's why we have a special advanced systems hotline so you can call us direct. Dell is an AT&T UNIX source code licensee and an authorized Novell Network Reseller.

On those rare occasions we can't fix it over the phone, Xerox technicians will come to your office with the solution or part in hand.<sup>△</sup>



\$24,698

Compaq SystemPro 486/333

■ **From this foundation, create a powerful PC network or UNIX workgroup.** Dell's new systems have more than enough performance to function as a LAN Server and WAN or internetworking gateway. So they're capable of supporting the most demanding server use—a multi-function network. Of

The Dell System 433TE and 425TE are Class A devices sold for use in commercial environments only. Performance enhancements within the first megabyte of memory. 384 KB is reserved for use by the system to enhance performance. All systems are photographed with optional extras. All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typography or photography. \*Payment based on 36-month, open-end lease. Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices may vary. DELL SYSTEM is a registered trademark. Dell and ServerPro are trademarks of Dell Computer Corporation. Dell UNIX System V 3.2 is based on INTERACTIVE Systems Corporation's 386™. Intel is a registered trademark and 486 and 486 are trademarks of Intel Corporation. †From Compaq July 23, 1990 press release. UNIX is a registered trademark of AT&T in the United States and other countries. Other trademarks and trade names are used to identify the products of other companies. On-site service may not be available in certain remote locations. Shipping, handling and applicable sales tax not included in the price. For information on and a copy of Dell's 30-day Total Satisfaction Guarantee, limited warranty, and Xerox's Service Contract, please write to Dell Computer Corporation, 9505 Arboretum Boulevard, Austin, Texas 78759-7299, ATTN: Warranty. ©1990 Dell Computer Corporation. All rights reserved.

**There's a lot more to know before you buy a server.**

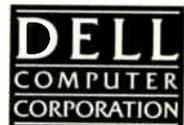
When you call Dell, our experts will give you the help you need to buy an advanced PC or UNIX server.

Then we'll send it off with a 30-day no questions asked money back guarantee, and a one year limited warranty.

Call us.

We'd like to make believers out of you.

**Above and beyond the call.**



Circle 104 on Reader Service Card

# THE LAP OF LUXURY.

Talk about good things falling into your lap.

Dell's first laptop—the 16 MHz 386™ SX—was *PC Magazine's* Editor's Choice, and won *PC Week's* Corporate Satisfaction Poll for 386SX laptop computers.

Now we've made a faster 20 MHz model, with a new higher contrast display.

And it's only \$3,899.

Which is a hefty \$2,900 less than

Compaq's SLT 386s/20.†

In fact, it even costs less than most slower 16 MHz laptops.

How those other guys can charge so much is insane.

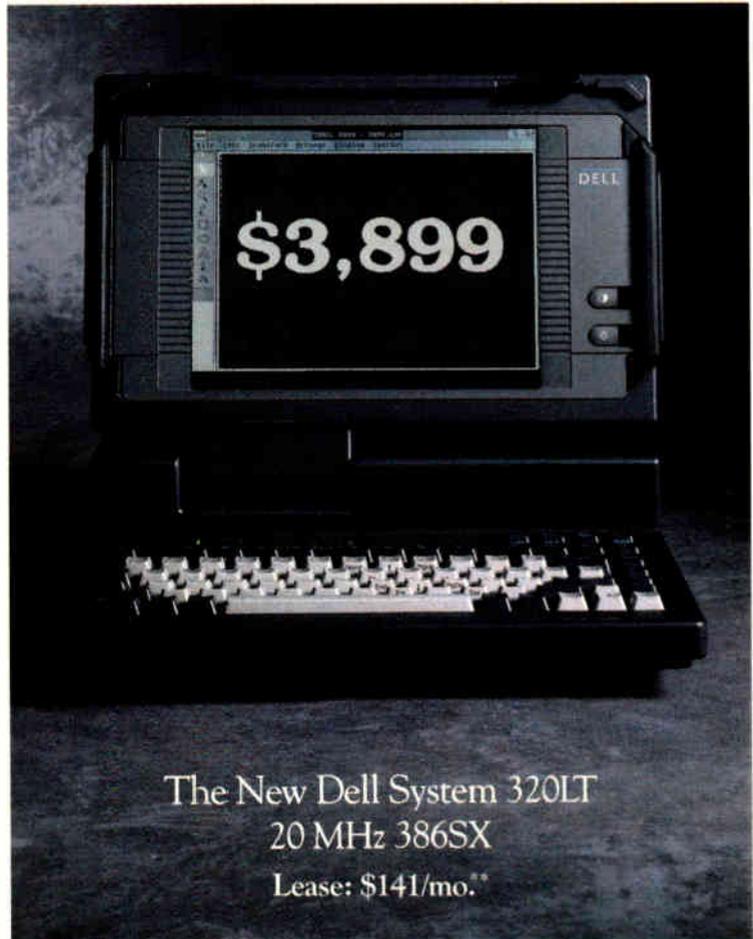
(Here's another good one: We're also cutting the price of our original 16 MHz laptop to \$2,999. That should drive our competitors up the padded wall.)

***It's a desktop PC trapped in the body of a laptop.***

This lightweight laptop acts suspiciously like a desktop system.

With the Intel® 20 MHz 386SX microprocessor, it's as powerful as most desktops.

It's nearly as expandable, too. You get up to 8 MB



TO ORDER, CALL  
**800-444-1470**  
 HOURS: 6 AM-9 PM CT M-F 8 AM-4 PM CT SAT  
 IN CANADA, CALL 800-387-5752

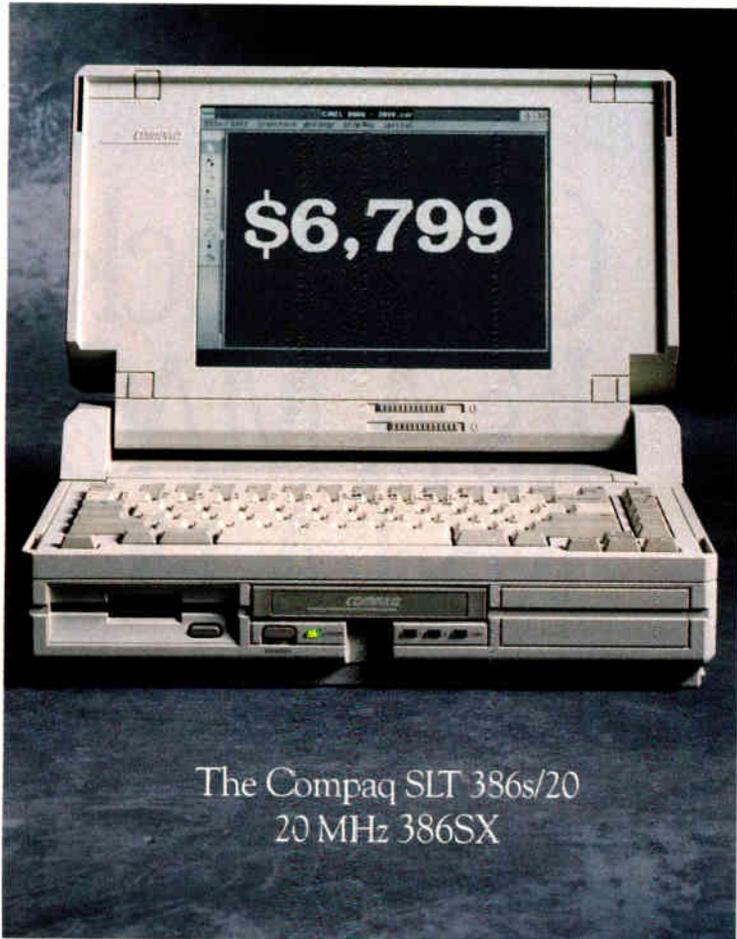
## THE NEW DELL SYSTEM® 320LT 20 MHz 386SX AND THE DELL SYSTEM 316LT 16 MHz 386SX

- Intel 80386SX microprocessor running at 20 MHz (320LT) or 16 MHz (316LT).
  - Standard 1 MB of RAM,\* optional 2 MB of RAM expandable to 8 MB (on the system board using 1 MB SIMMS).
  - LIM 4.0 support for memory over 1 MB.
  - 640 x 480 VGA Liquid Crystal Display.
  - One industry standard half-size 8-bit expansion slot.
  - Dedicated Data/Fax modem slot.
  - Socket for Intel 80387SX math coprocessor.
  - 3.5" 1.44 MB diskette drive.
  - 83-key keyboard with embedded numeric keypad.
  - 1 parallel, 1 serial, and external VGA monitor port.
  - Connector for 101-key keyboard or numeric keypad.
  - Connector for external 5.25" 1.2 MB diskette drive.
  - Two removable and rechargeable NiCad battery packs utilizing Dell's "Continuous Power Battery System" (patent pending).
- 316LT: 20 MB, 1 MB RAM \$2,999  
 320LT: 40 MB, 2 MB RAM \$3,899

AD CODE 11E32

\*Performance Enhancements: Within the first megabyte of memory, 128KB is reserved for use by the system to enhance performance. DELL'SITE is a registered trademark and Dell is a trademark of Dell Computer Corporation. Intel is a registered trademark and 386 is a trademark of Intel Corporation. †Source: Dataquest Inc. (SpecCheck Spring 1990). \*\*Payment based on 36-month, open-end lease. Leasing arranged by Leasing Group, Inc. In Canada, configurations and price may vary. Dell cannot be responsible for errors in typography or photography. Shipping, handling and applicable sales tax are not included. Other trademarks and trade names are used to identify the entities, claiming the marks and names of their products. Dell Computer Corporation disclaims any proprietary interest in trademarks and trade names other than its own. On-site services may not be available in certain remote locations. ©1990 Dell Computer Corporation. All rights reserved. For information on and a copy of Dell's 30-Day Total Satisfaction Guarantee, limited warranty, and Xerox's Service Contract, please write to Dell Computer Corporation, 9505 Arboretum Boulevard, Austin, Texas 78759-7299, ATTN: Warranty.

# THE LAP OF LUNACY.



The Compaq SLT 386s/20  
20 MHz 386SX

of RAM, a 3.5" 1.44 MB diskette drive and a 20 or 40 MB hard drive. It also has a dedicated slot for a Dell™ Data Fax modem, and a separate slot for a standard half-length expansion card. (On a Compaq, that expansion slot would cost you an extra \$1,000). When it's time to stay put, you can connect our laptop to an external VGA monitor and keyboard, a 5.25" external floppy disk drive, and even to your network or mainframe.

**If you can work 24 hours a day, our laptop can work 24 hours a day.** Dell's special Continuous Power Battery System lets you change batteries without losing your data, or your train of thought. The system includes two lightweight rechargeable battery packs.

**The service goes where you go.** If you have a question, our toll-free technical hotline solves 90% of all problems over the phone. If we can't solve it over the phone, a trained technician from Xerox will be sent to your lapside the next business day—nearly anywhere in the contiguous U.S.△

**For sale, for lease, for less.** When you call us, you talk with a computer expert whose sole mission is to give you exactly what you

want. At a great price. We'll custom configure your laptop, give you a 30-day no questions asked money back guarantee, and a choice of leasing plans.◇

Then we'll do a configured system test, and ship it wherever you want.

Call now for either our 16 MHz or new 20 MHz 386SX laptops.

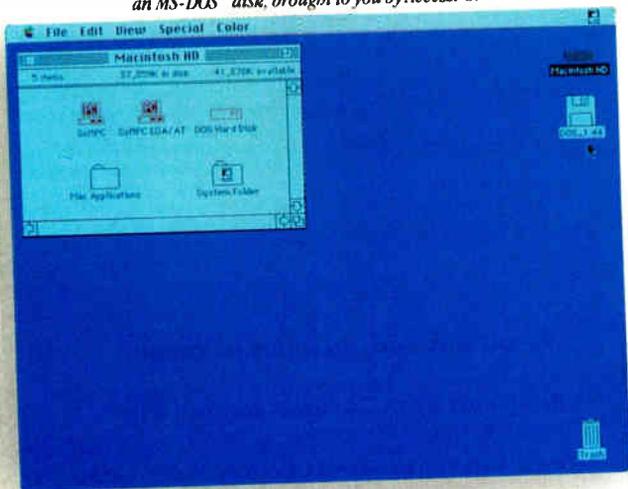
It'd be lunacy not to.

**Above and beyond the call.**

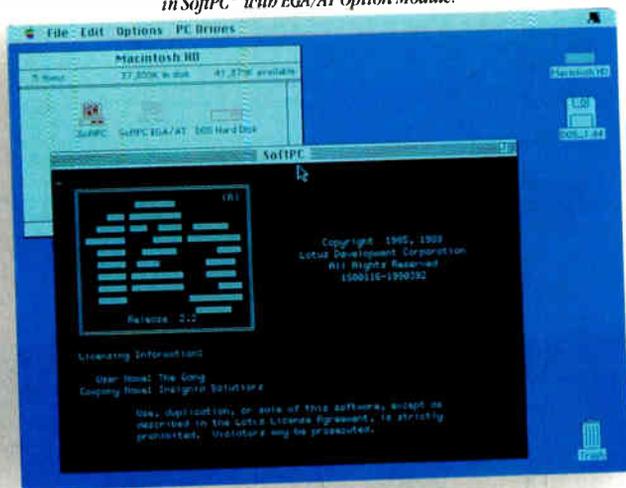


Circle 105 on Reader Service Card

The floppy disk icon "DOS-1.44M" is actually an MS-DOS® disk, brought to you by AccessPC™.



Shown: Lotus® 1-2-3® release 2.2, running in SoftPC™ with EGA/AT Option Module™



# Click, It's A MAC.

# Click Click, It's A MAC And A PC.

Load SoftPC, click twice, and you've got a window wide open to the entire MS-DOS world. Everything a Mac can do plus everything a PC can do, in one machine.

Whether you're a Macintosh user who needs access to PC software and data, or a PC user who wants to go Macintosh without losing PC compatibility, you can have it all with Insignia's best-selling software solutions.

SoftPC is a software emulation precise enough to run the toughest PC applications—Norton Utilities, Lotus 1-2-3, Harvard Graphics, AutoCad, even custom development programs. You get *complete* XT or AT compatibility for the SE/30, Macintosh II family and the Macintosh Portable.

Add an EGA/AT Option Module, and get vibrant EGA color compatibility, LIM expanded memory and math coprocessor support.

New AccessPC lets you use PC and PS/2 disks just like Mac disks. Now you can move and view PC file and disk icons—even in locked or full disks!—format DOS disks, launch Mac applications and much more.

For more information and the name of a SoftPC dealer near you, call Insignia at 800-848-7677 (U.S. only) or 408-522-7600 (outside U.S.).

**Insignia**™

Insignia Solutions, Inc. 254 San Geronimo Way, Sunnyvale, CA 94086. Fax: 408-733-9541. We give a SoftPC (retail \$399) or AccessPC program (retail \$129) daily to a caller selected at random. SoftPC is a registered trademark and AccessPC is a trademark of Insignia Solutions, Inc. Other product names are trademarks or registered trademarks of their respective owners.

Circle 173 on Reader Service Card



# WORKING WITH WINDOWS 3.0 AND A MAC

Overall, the Windows 3.0/386 combo is an 85 percent Mac

**A**s I have written here before, using Windows 3.0 on a good-quality 386 PC is surprisingly similar to using a Mac IIcx. It's nowhere near an exact match, but it's close enough to force the obvious comparisons. Overall, I call the Windows 3.0/386 combo an 85 percent Mac.

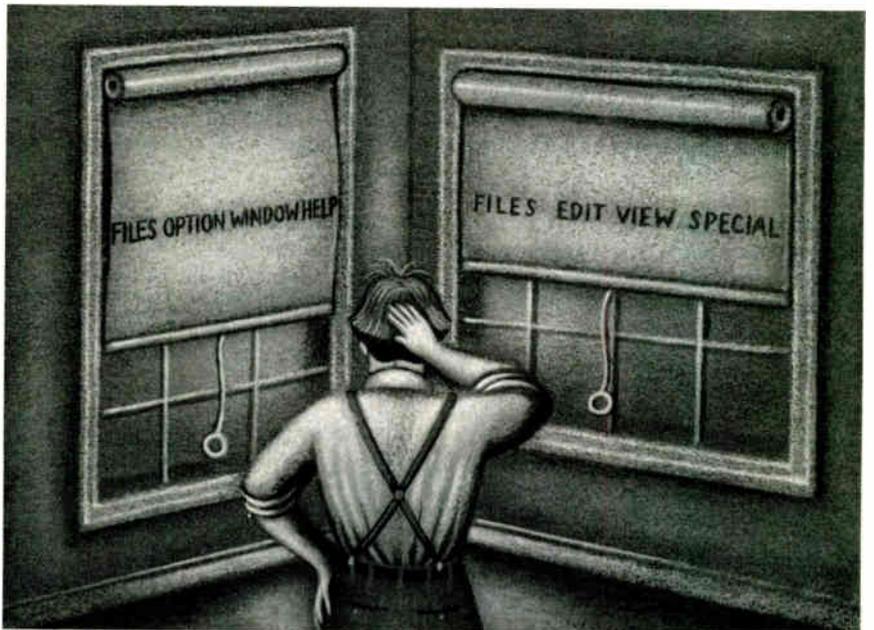
The reality of microcomputing life is that lots of different graphical user interfaces (GUIs), stuck on lots of different operating systems, are going to be the norm for the nineties. Mac and Windows users must learn to get along, because interoperability will be the defining technology. I have had my share of Mac OS/Windows 3.0 attempts at détente, and here are some early tips based on my experience.

## Networking

I do a lot of work over computer networks, both at home and at the office. I use both LocalTalk and Ethernet to interconnect Macs, PCs, Sun SPARCstations, and NeXT Computers. For Windows 3.0 to be a viable GUI for me means that I have to make it work with these existing networks.

Right now, that's a big problem. I use both AppleShare and TOPS on the PCs and Macs, while Network File System handles the file sharing over the Unix boxes. Thus, I want to run AppleShare PC or TOPS on my Windows-equipped PCs, or even NFS. But that's not yet possible. None of these file-server technologies are Windows 3.0-compatible.

I've tried loading AppleShare PC and TOPS first and then loading Windows 3.0 on the PCs, but there's not enough memory left in the 640K-byte start-up



segment for Windows to fly. I've also tried Windows in real mode (where you lose all the multitasking and extended memory magic) to shoehorn in the networking stuff, but that's been a wash.

Novell's NetWare or 3Com's 3+Share might be an answer for my cross-platform file sharing, since Windows 3.0 has hooks that can support these networked operating systems. But the cheapest version of NetWare that supports all my Macs and PCs as clients would cost me \$4600. I don't see that as much of a solution. Plus, I'd need to establish a PC as a dedicated NetWare server, to say nothing of the hassle of Novell network administration.

NFS isn't an answer either, since there is no PC version of it that works with Windows. The best I can do is run my PCs under DOS 4.01 and do my file sharing over the networks under that operating system. Then, I can kill the networks and reboot under Windows to run

my applications. Not exactly transparent networking, is it? Let's hope that Apple and Sitka (formerly TOPS) can fix things at their end, and that Microsoft's promised easy adaptability of Windows 3.0 to different networks becomes a reality.

## File Exchange

When I've used a Toshiba T3100SX laptop on the road and want to move its files over to my Mac, I have always used Traveling Software's LapLink Mac III. It works well and simply. Luckily, LapLink Mac III works fine as a non-Windows application, so I can continue to use it that way. Since I'm using Microsoft Word for Windows on the T3100SX, I also don't have to worry about invoking file-conversion software or file filters.

I've tried other file-exchange solutions on the T3100SX and on both an Outbound Systems portable Mac and Apple's Mac Portable connected to a Toshiba T5200 running Windows 3.0. I

used a direct serial connection on both Macs to the T5200 and ran Procomm as a non-Windows application on the T5200, while running VersaTerm-Pro on the Macs.

A similar serial connection between the T3100SX and a Mac IIci also worked fine for file exchanges as long as I made sure to use the correct file translators or filters first. For the most part, I use the Apple File Exchange with the Claris, DataViz (MacLink Plus), and Systems Compatibility (Software Bridge) translators for this. I've had no trouble getting PageMaker 4.0, Excel 2.2, PowerPoint 2.0, and other files over to Windows from the Mac.

As more DOS and Mac vendors produce Windows 3.0-compatible software, the transparent exchange of files between these two operating systems should become much easier.

**On-Line Service and BBS Access**

Over the past two years, I've become addicted to the ease of use offered by Connect's MacNet, CompuServe's Navigator, AppleLink, and America Online. Unfortunately, there is no Windows 3.0

version of AppleLink, and the same is true for America Online, a service dedicated to Mac users with a spiffy GUI.

Thankfully, though, there is a PC version of Connect (PCNet), and I've gotten by with it in the past. Unfortunately, it's not expected to appear in a Windows-compatible version anytime soon, and I can't make it work quite right as a non-Windows application. Although there's no Windows version of Navigator, CompuServe does have a new PC package for making access easier, called the CompuServe Information Manager. But it's not Windows 3.0-compatible either, and it's pretty mediocre compared to all the auto-scripting capabilities of Navigator.

For Windows 3.0 to gain the same reputation as a high-quality interface for on-line services as the Mac, we need Windows-based on-line software written for it.

**Similarities and Differences Can Aggravate**

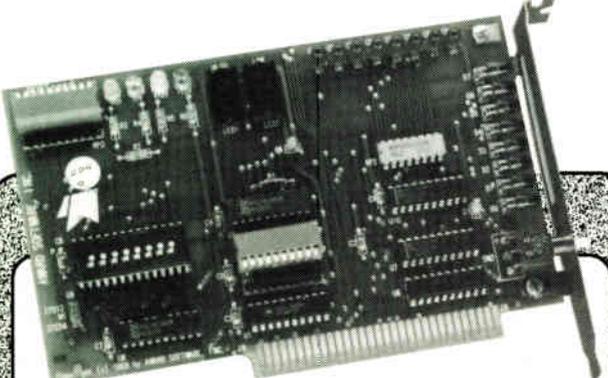
If you spend more than 5 minutes using Windows 3.0, you realize that it *looks* more like the Mac Finder/MultiFinder than it *works* like it. While Windows 3.0

includes resizable windows, scroll bars, menus, icons, proportional screen fonts, and color, the way they work isn't usually the same as their Mac equivalents.

If you're a Mac person, a number of annoying omissions (e.g., the lack of a Trashcan and different functional menu bars for each Desktop window) can confuse you. If you're used to the clean screen fonts on the Mac, you'll hate the lousy screen fonts under Windows, although Adobe's Type Manager for Windows should help. You'll also find that many of the Windows icons look a tad mediocre.

There are quite a few Windows capabilities that Mac users would love to have: icons that represent parent and daughter windows (which keeps the Desktop tidy), standard interapplication communication in the form of Dynamic Data Exchange that MacFolk have to wait for System 7.0 to savor, true preemptive multitasking with dynamic memory allocation (System 7.0 won't have dynamic memory), and seriously enhanced printer control.

Mac users with anything more than a passing familiarity with that machine



**AWARD POSTCARD™**  
**DIAGNOSTIC CARD**

- DOS not required for diagnostic functions
- POST (Power On Self Test) routine monitoring
- Supports XT/286/386 based microcomputers
- Works with most BIOS versions including AWARD, AMI, PHOENIX, QUADTEL
- Built in comprehensive diagnostic functions in ROM
- Fits into any 8/16 BIT slot
- Optional digital diagnostic diskettes for floppy disk alignment
- Serial and parallel loop back connectors included

• **New Low Price \$249.00**

**Order Now**  
**1-800-800-2467**

**UNICORE SOFTWARE**  
599 Canal Street Lawrence, MA 01840 (508) 686-6468

**"Highly Recommended" —PC Magazine**



**The AC outlet for your car!**

**PowerTrip®** gives you AC power from your car's cigarette lighter! Safely runs:

- Computers
- FAX machines
- only \$199.95!
- Any 100 watt AC electronics
- 220 volt version available (US \$299.95)
- Runs for hours with no significant battery drain

**Zirco**  
Enhancing the Mobile Office

10900 W. 44th Ave. Wheat Ridge, CO 80033 USA  
Tel (303) 421-2013 FAX (303) 423-8346

# THE OPTICAL ZONE

**Y**ou're traveling through another dimension — a dimension of increasing storage demands and rewritable optical technology.

**S**ubmitted for your approval, storage solutions from the #1 source of optical storage systems in the world. Systems designed for Macintosh, SUN, DEC, HP, IBM and compatibles. Support for advanced applications running Unix, Xenix, A/UX, Novell, and more.

**P**innacle Micro, the leader in this new storage revolution, provides expanded storage for multimedia, digital video, pre-press, desktop publishing, CAD/CAM, and other data-intensive applications.



**I**n the Optical Zone, these storage requirements are met with the latest optical technology available. From the world's first 3.5 inch optical drive to the largest selling 5.25 inch optical drives and disk changers. On line, network, backup and archiving storage solutions from 128 Megabytes to 36 Gigabytes.

**W**ith optical storage, your data's life is prolonged and protected. Expansion is as easy as inserting another optical disc. With Pinnacle's

ASCENT™ program, systems can be upgraded from 650 Megabytes to 1 Terabyte.

*See the future ... Store the future ... Recall the future ... The future is Optical.  
For further reference, check under "S" for storage, from Pinnacle in ... The Optical Zone.*

© (800) 553-7070

Trademark Owners: Pinnacle Micro of Pinnacle Micro, Inc. Sun of Sun Microsystems, DEC of Digital Equipment Corp. IBM of International Business Machines Corporation. Macintosh of Apple Computer, Inc.

**PINNACLE MICRO**

THE OPTICAL STORAGE COMPANY™

15265 Alton Parkway • Irvine, CA 92718 • In CA (714) 727-3300 • FAX (714) 727-1913

Circle 284 on Reader Service Card

World Radio History

will peg Windows 3.0 as being different. After a bit more exploration, you'll likely find that it's annoyingly different, despite some of its obvious pluses. After a few months, you'll find yourself asking when Windows 4.0 is coming out to fix all the interface mistakes Microsoft still managed to build into version 3.0.

On the other hand, Windows 3.0 users should be able to switch over to a Mac (or switch back and forth between the two environments) with considerably less

trouble, since Windows 3.0 is a vast improvement over version 2.03. And it does look a lot like a Mac. Sometimes looking good is all that matters, I guess.

#### Tip of the Month: Subscribe to a Newsletter

This past summer proved to be another tough time for computer magazines. An industry that was already condensed has compacted further with the failures of VNU's *Personal Computing*, IDG's *PC*

*Resource*, and CMP's *Macintosh News*.

Surprisingly, though, as some mainstream computer magazines have failed, computer newsletters have gotten stronger. Old standbys like Stewart Alsop's *PC Letter* have gotten bigger and better, while McGraw-Hill's BYTEWEEK has established itself as a reliable weekly for up-to-the-minute computing news and analysis for both PC and Mac users.

Two of my most pleasant surprises, however, come from industry experts relatively new to the newsletter game. Denise Caruso, the gifted columnist of the *San Francisco Examiner* and several on-line venues, has just started a newsletter for working multimedia users.

Called *Media Letter*, this newsletter is exactly what real multimedia people need. If you're using your Mac for multimedia work, or if you expect to in the future, you should subscribe to *Media Letter* (P.O. Box 142075, Coral Gables, FL 33114, (305) 441-1282). It costs from \$195 to \$395 a year, depending on your institutional affiliation.

My favorite Mac newsletter will soon be celebrating its first anniversary. The *Weigand Report* (P.O. Box 647, Gales Ferry, CT 06335, (203) 464-6188) is written and published by former *MACazine* and *Personal Publishing* editor Chuck Weigand. This newsletter practically begs to be read, since it's jammed with useful and specific tips for Mac novices and Mac experts.

Since much of Chuck's expertise is in desktop publishing, that's the focus, but the newsletter also includes coverage germane to small-business Mac owners. A recent issue had articles on high-resolution plain paper printers, font-transformation software, SCSI-bus screwups caused by multiple SCSI devices, and the compression of TIFF images.

Chuck gives you plenty of theoretical and engineering (he is, after all, a retired Navy lieutenant commander and nuclear submariner) information about the topics he covers, but he also includes plenty of practical tips for solving the problems he reveals. A yearly subscription to the *Weigand Report* (20 issues) costs \$128. It's easily worth thrice the price. ■

*Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."*

*Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

# 1000 DPI!

## From Your HP LaserJet Series II or III

It's true! We can turn your existing Series II or III printer into a 1000 x 1000 TurboRes™ Plain-Paper Typesetter! National TeleVAR™ (Raster Devices Direct) introduces the 1000 Enhancer Kit™ for your HP Series II or III printer.

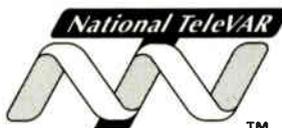


Windows (such as PageMaker, CorelDRAW!, Micrografx Designer, Word for Windows, etc.), GEM (such as Xerox Ventura Publisher, GEM Artline, etc.) and Word Perfect.

By using a new imaging technology called TurboRes™ on our PC-based controller, we can transform your 300 dpi printer into a state-of-the-art Plain-Paper Typesetter that gives you print quality previously undreamed of, even on devices costing over \$20,000.

Send us your HP Series II or III laser printer and we will do the rest. We factory install a video board and connector in your Series II or III, and supply a PC/XT/AT or MCA 6Mb printer controller, 135 scaleable fonts, direct driver software for

CALL NOW! 1-800-468-1732, Source Code #106 (In MN: 612-941-4919) and ask about the 1000 Enhancer Kit for your Series II or III printer. The 300 dpi barrier will fall by the way-side as you experience 1000x1000 TurboRes. Note that all your existing PCL functionality remains unchanged, so your printer can live in both worlds —PCL and 1000x1000 TurboRes!



PrePress Systems Specialists

Formerly Raster Devices Direct, Inc.

©1990. Raster Devices Direct, Inc., National TeleVAR and 1000 Enhancer Kit are trademarks of Raster Devices Corporation. TurboRes is a licensed technology and a trademark of LaserMaster Corporation. All other product and brand names are trademarks and registered trademarks of their respective companies. All prices and specifications are subject to change without notice. Please call for current pricing and warranty details.

VISA, MASTERCARD AND AMERICAN EXPRESS ACCEPTED

# Database Users Respond To Queries

*Users vote ORACLE number one in five important user polls.*

In a series of recent polls, Oracle's products were ranked number one by five magazines representing over four hundred thousand readers. Leading to only one conclusion: Oracle's database and networking products are the best solutions for the widest variety of PC and Mac users.

The readers of both DATA BASED ADVISOR and DBMS Magazine named Professional ORACLE Tools and Database the best SQL-based database. The readers of VARBUSINESS,

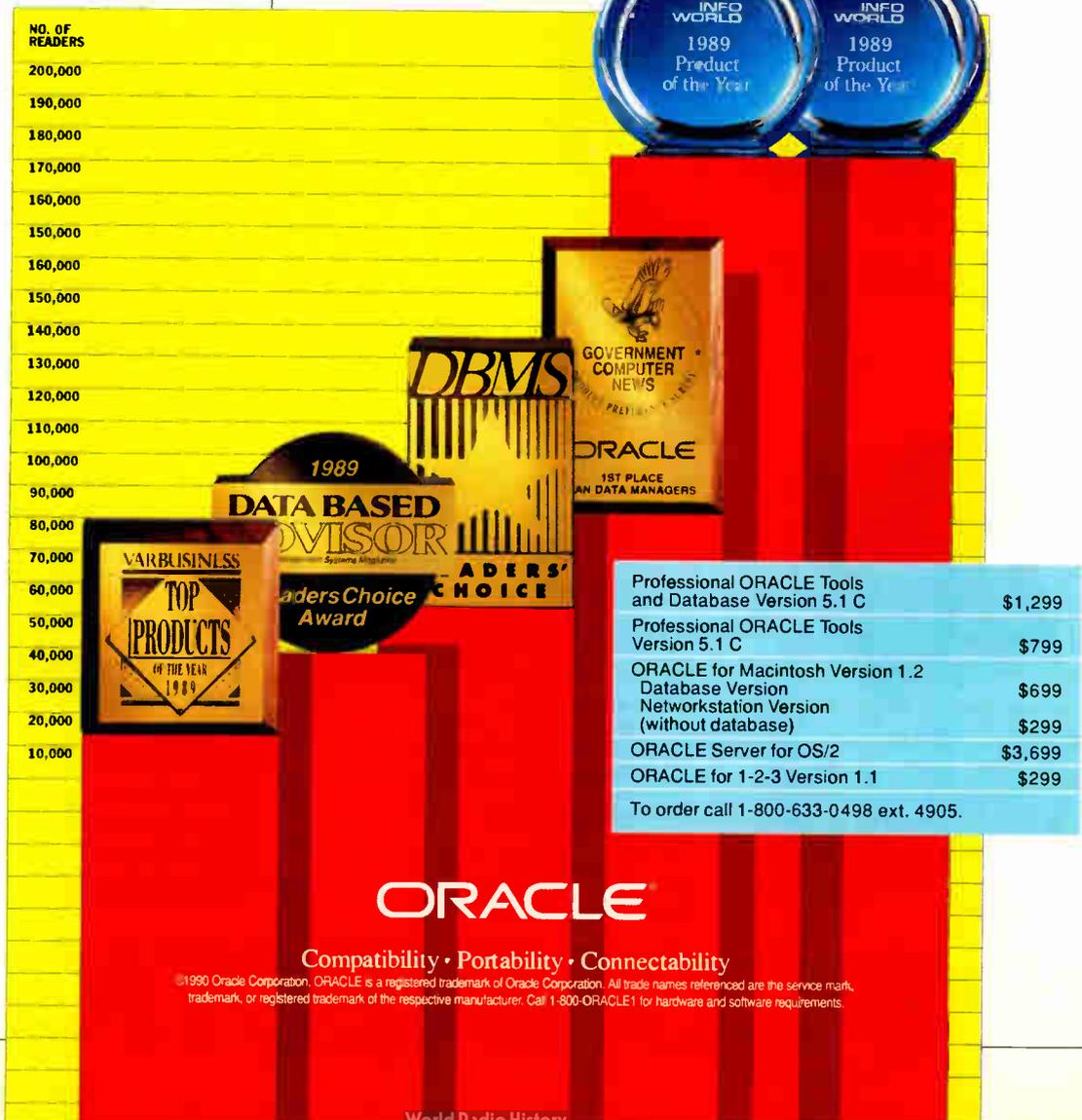
who should know something about developing applications, named it the best applications software. And Government Computer News cited reliability, compatibility and speed as some of the reasons they awarded Professional ORACLE Tools and Database the number one data manager for local area networks.

ORACLE for Macintosh received its share of acclaim from Info World readers, who named it Macintosh Product of the Year.

Info World readers also

named Oracle's newest desktop product, ORACLE Server for OS/2, product of the year. As did subscribers of DBMS Magazine, who rated ORACLE Server for OS/2 the best database server.

Call 1-800-633-0498 Ext. 4905 to order or sign up for the free Oracle Client-Server Forum in your area. And see what kind of software generates this kind of hardware.



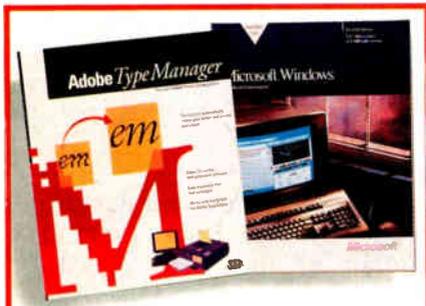
Professional ORACLE Tools and Database Version 5.1 C	\$1,299
Professional ORACLE Tools Version 5.1 C	\$799
ORACLE for Macintosh Version 1.2 Database Version	\$699
Networkstation Version (without database)	\$299
ORACLE Server for OS/2	\$3,699
ORACLE for 1-2-3 Version 1.1	\$299
To order call 1-800-633-0498 ext. 4905.	

**ORACLE**

Compatibility • Portability • Connectivity

©1990 Oracle Corporation. ORACLE is a registered trademark of Oracle Corporation. All trade names referenced are the service mark, trademark, or registered trademark of the respective manufacturer. Call 1-800-ORACLE1 for hardware and software requirements.

# Have you heard our



**Adobe Systems ... NCP**  
 7902  Adobe Type Manager for Windows and Microsoft Windows 3.0—Clean up that jagged type with Adobe Type Manager and Windows 3.0. Two hot programs for one great price. Specify media size ..... \$149.

- 3 1/2" format available from us. Specify when ordering.
  - package includes both 5 1/4" and 3 1/2" disks.
  - 3 1/2" format available from manufacturer by request. Call us for details.
- CP—copy-protected; NCP—not copy-protected.

The four-digit number next to each product is the product's ITEM NUMBER. Please refer to this number when ordering. Thank you.

## SOFTWARE

We only carry the latest versions of products. Version numbers in our ads are current at press time.

Products listed here in red are Microsoft Windows Applications.



**Corel Systems ... NCP**  
 5506  CorelDRAW! 1.2—The world's leading PC illustration software now comes with even more value: CorelTRACE, over 100 typefaces, over 300 clip-art images, a Pantone license—all bundled in for free ..... \$329.

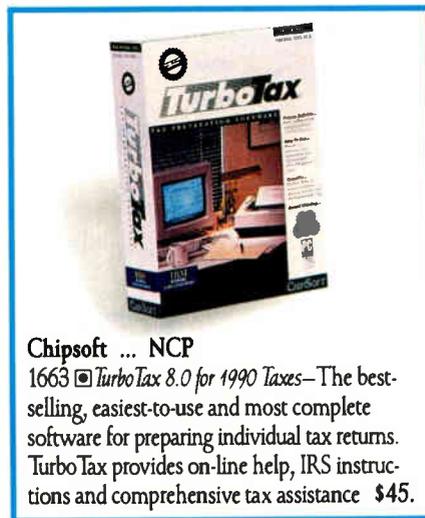
- Adobe Systems ... NCP**  
 6591  Illustrator Windows 1.0 ..... \$279.  
 7547  Adobe Type Manager for Windows 59.  
 7902  Adobe Type Manager for Windows and Microsoft Windows 3.0 ..... 149.  
 6590  Streamline Windows 1.0 ..... 229.  
 7392  Adobe PostScript Cartridge ..... 249.  
 (Entire Adobe Type Library, from 1 to 133 is available. Call for more information.)  
**Aldus ... NCP**  
 1332  PageMaker 3.01 ..... 499.  
**Alpha Software ... NCP**  
 5104  Alpha Four 1.1 ..... 319.  
**Application Techniques ... NCP**  
 1214  Pizazz Plus 2.0 ..... 69.  
**ASD Software ... NCP**  
 7847  Planisoft 1.0 ..... 145.  
**Ashton-Tate ... NCP**  
 4450  dBASE IV 1.1 ..... 499.  
**Asymetrix ... NCP**  
 7384  Toolbook 1.0 for Windows ..... 309.



**ASD Software ... NCP**  
 7847  Planisoft 1.0—Coordinate agendas, find available time-slots for appointments, keep track of deadlines & priorities, distribute tasks, optimize resources, share information between PCs & Macs over any LAN. \$145.

- Avery ... NCP**  
 6006  Label Pro 1.0 ..... 49.  
 7336  Label Pro 1.0 for Dot Matrix ..... 49.  
**Bitstream ... NCP**  
 7568  FaceLift 1.0 ..... 59.  
 Collections: Newsletters, Flyers, Books & Manuals, Reports and Proposals, Presentations or Spreadsheets each 129.  
 Fontware ..... each 89.  
**Borland International ... NCP**  
 7357  Turbo C++ 1.0 Professional ..... 159.  
 7356  Turbo Pascal Professional 2nd Ed. 179.  
 6242  Quattro Pro 1.0 ..... 325.  
 1514  Paradox 3.0 ..... 469.  
**Broderbund ... NCP**  
 1434  New Print Shop (NCP) ..... 39.  
**ButtonWare ... NCP**  
 6419  PC-File 5.0 ..... 89.  
**Caere ... NCP**  
 6004  Omnipage 386 2.1 ..... 599.  
**Central Point ... NCP**  
 5039  PC Tools Deluxe 6.0 ..... 89.  
 5038  Copy II PC 5.0 ..... 27.

- Checkfree**  
 6360 CheckFree (electronic checking sv.) \$25.  
**Chipsoft ... NCP**  
 1663  TurboTax 8.0 for 1990 Taxes ..... 45.  
**CompuServe**  
 7546 DOS Membership Kit ..... 23.  
**Concentric Data Systems ... NCP**  
 6575  R & R Relational Report Writer 3B 109.  
**Corel Systems ... NCP**  
 5506  CorelDRAW! 1.2 ..... 329.  
**Custom Applications ... NCP**  
 7474  Freedom of Press 2.2 ..... 255.  
**Data Storm ... NCP**  
 4798  PROCOMM PLUS 1.1 ..... 65.  
**DCA ... NCP**  
 2908  Crosstalk XVI 3.71 ..... 119.  
 5611  Crosstalk for Windows 1.1 ..... 129.  
**Delrina Technology ... NCP**  
 7351  PerFORMPRO 1.0 for Windows. 299.  
**Fifth Generation Systems ... NCP**  
 7725  Direct Access 5.0 ..... 59.  
 2762  Mace Utilities 1990 ..... 99.  
 7795  Disklock 1.0 ..... 109.  
 3950  Fastback Plus 2.1 ..... 119.  
**FNN Data Broadcasting**  
 7005  NewsReal 1.0 ..... 99.  
**FormWorx ... NCP**  
 5810  FormWorx with Fill & File 2.5 ..... 85.  
 7311  Form Publisher for Windows 1.2. 145.  
**Fox Software ... NCP**  
 6188  FoxPro 1.02 ..... 489.  
**Franklin Software ... NCP**  
 7071  Language Master 2.0 ..... 59.  
 7416  Language Master 3.0 for Windows 59.  
**Funk Software ... NCP**  
 2228  Sideways 3.3 ..... 52.  
 7380  P.D. Queue 1.0 (print spooler) ... 55.  
**Generic Software ... NCP**  
 2265  Generic CADD Level 3 1.1.3 ... 225.  
**Great American Software ... NCP**  
 4880  One Write Plus Acct. Sys. 2.06 ... 179.  
 5825  Money Matters 1.0 ..... 55.  
**Harvard Associates ... NCP**  
 2324  PC Logo 3.0 ..... 59.



**Chipsoft ... NCP**  
 1663  TurboTax 8.0 for 1990 Taxes—The best-selling, easiest-to-use and most complete software for preparing individual tax returns. TurboTax provides on-line help, IRS instructions and comprehensive tax assistance \$45.

# latest breakthrough

- hDC Computer Corp. ... NCP**  
 7389  Windows Express 3.0 ..... \$55.  
 7383  First Apps 1.0 ..... 55.  
**Hilgraeve ... NCP**  
 2323  HyperACCESS/5 1.1 (DOS & OS/2) 115.  
**IBM ... NCP**  
 6599  Current 1.1 ..... 239.  
**Individual Software ... NCP**  
 6222  Resume Maker 1.1 ..... 29.  
**Inset Systems ... NCP**  
 7298  Hijaak 2.0 ..... 99.  
 7300  Inset Plus Hijaak ..... 125.  
**Intuit ... NCP**  
 2426  Quicken 3.0 ..... 39.  
**Isogon ... NCP**  
 7478  FontSpace 2.0 ..... 59.  
**Laser Go ... NCP**  
 7635  Go Script Plus 3.0 ..... 189.  
**LaserTools ... NCP**  
 6882  PrintCache 2.3 ..... 99.  
**Lord Publishing ... NCP**  
 5191  Ronstadt's Financials 1.02 ..... 75.  
**Lotus ... NCP**  
 5417  1-2-3 3.1 ..... call  
 5653  1-2-3 2.2 ..... 349.  
 5134  Magellan 2.0 ..... 119.  
**MECA ... NCP**  
 4603  Andrew Tobias' Tax Cut-1990 Taxes 49.  
 7002  Home Lawyer 1.0 ..... 69.  
 2798  Managing Your Money 6.0 ..... 135.  
**Microcom ... NCP**  
 7649  Virex 1.1 ..... 79.  
 6234  CarbonCopy Plus 5.2 ..... 119.  
**Micrografx ... NCP**  
 7683  Charisma 1.0 ..... 349.  
**Micro Logic ... NCP**  
 6787  Info Select 1.1 ..... 55.  
**Microlytics ... NCP**  
 2731  GOfier 2.0 ..... 45.  
**Microsoft ... NCP**  
 7882  Productivity Pack for Windows ... 45.  
 7010  Windows 3.0 ..... 99.  
 7388  Project for Windows 1.0 ..... 469.  
 7387  PowerPoint for Windows 1.0 ..... 329.

- 2904  Works 2.0 ..... \$99.  
 2901  Word 5.0 ..... 209.  
 6195  Word for Windows 1.1 ..... 329.  
 2856  Excel 2.1 ..... 329.  
 2894  QuickBASIC 4.5 ..... 69.  
 2853  C Compiler 6.0 ..... 339.  
**Multisoft ... NCP**  
 4925  PC-Kwik Power Pak 1.5 ..... 79.  
**Nolo Press ... NCP**  
 2982  WillMaker 4.0 ..... 39.  
**Norton-Lambert ... NCP**  
 4928  Close-Up Customer/Terminal 3.0 135.  
 4929  Close-Up Support/ACS 3.0 ..... 165.  
**PC Globe ... NCP**  
 5902  PC Globe 4.0 ..... 39.  
 5900  PC USA 2.0 ..... 39.  
**Personics ... NCP**  
 4384  Ultravision 2.0 ..... 79.  
 7048  Monarch 1.0 (Data Mgmt. Tool) . 319.  
**PowerUp ... NCP**  
 7860  Calendar Creator Plus ..... 45.  
 7858  Express Publisher 2.0 ..... 89.

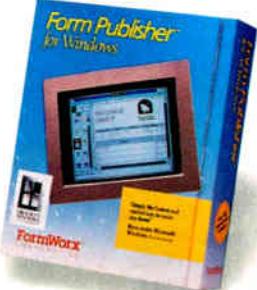


**Bitstream ... NCP**  
 7568  FaceLift 1.0—Fast & easy-to-use, scales screen & printer fonts to any size. 13 type-faces to give you professional documents instantly. Superb laser output & near laser-quality output for dot matrix printers . \$59.



**Funk Software ... NCP**  
 2228  Sideways 3.3—Rotates your spreadsheets 90° as they print ..... \$52.  
 7380  P.D. Queue 1.0—Lotus add-in that saves time by spooling Sideways & Always output to hard disk & printing in the background 55.

- Revolution Software ... NCP**  
 4480  VGA Dimmer 2.01 (screen saver) . 29.  
**RightSoft ... NCP**  
 4155  RightWriter 4.0 ..... 55.  
**Samna ... NCP**  
 5799  Ami Professional 1.2 ..... 309.  
**Softlogic Solutions ... NCP**  
 3542  Software Carousel 4.0 ..... 55.  
**Software Publishing ... NCP**  
 3499  PFS:First Publisher 3.0 ..... 99.  
 3478  PFS:First Choice 3.02 ..... 105.  
 3496  Professional Write 2.2 ..... 179.  
 3482  Harvard Graphics 2.3 ..... 359.  
**Spinnaker ... NCP**  
 7604  Plus for Windows 1.0 ..... 289.  
**Symantec ... NCP**  
 3152  Norton Commander 3.0 ..... 105.  
 6397  The Norton Backup 1.1 ..... 105.  
 3146  The Norton Utilities 5.0 ..... 125.  
 3425  Q&A 3.0 ..... 229.  
 3431  Timeline 4.0 ..... 469.

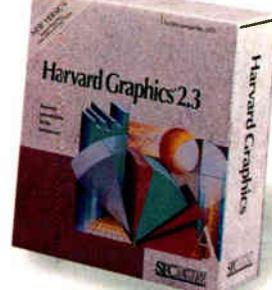


**FormWorx ... NCP**  
 7311  Form Publisher for Windows 4.2—Desktop publishing designed especially for creating professional-quality forms. Use unique object-oriented design techniques & import graphics. Over 600 forms included! . . \$145.

- Precision Software ... NCP**  
 6600  Superbase 4 for Windows 1.2 . . 469.  
**Qualitas ... NCP**  
 7539  386MAX 5.0 ..... 75.  
**Quarterdeck ... NCP**  
 6422  QRAM 1.0 ..... 49.  
 3221  Expanded Memory Mgr. 386 5.1 . 59.  
 3220  DESQView 2.3 ..... 79.  
 4586  DESQView 386 5.1 ..... 129.  
**Realty Technologies ... NCP**  
 6572  WealthBuilder 1.1 ..... 145.  
**Reference Software ... NCP**  
 4396  Grammatik IV 1.0 ..... 52.  
 7483  Grammatik for Windows 1.0 ..... 52.

1-800/776-7777

**MMC** **PC Connection** **780B**  
 6 Mill Street  
 Marlow, NH 03456  
 SALES 603/446-7721 FAX 603/446-7791



**Software Publishing ... NCP**  
 3482  Harvard Graphics 2.3—New version! Built-in drawing tools and other new features make this superior graphics and charting program a top performer. Graphically the best choice ..... \$359.



ALL ITEMS SUBJECT TO AVAILABILITY. PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

# Makes unpacking



## Microsoft ... NCP

7882  **Productivity Pack for Windows**—Includes: Learning Windows—a comprehensive tutorial, Working Smarter—on-line productivity tips, and Quick Troubleshooter—helps solve common Windows problems ..... \$45.

## Systems Compatibility ... NCP

- 6564  Software Bridge 4.1 ..... 79.
- TIMESLIPS ... NCP**
- 2987  Timeslips III 4.0 ..... 195.
- 6994  PercentEdge 1.0 ..... 69.
- Timeworks ... NCP**
- 6253  Publish-It! 1.1 ..... 115.
- TOPS ... NCP**
- 6675  TOPS Network Bundle 3.0 ..... 159.
- 3720 Flashcard 2.1 (AppleTalk network card; 1 year warranty) ..... 155.
- Touchstone Software ... NCP**
- 7420  Check It 3.0 ..... 89.
- Traveling Software ... NCP**
- 5179  LapLink III 3.0 ..... 95.
- True BASIC ... NCP**
- 3561  True BASIC 2.1 ..... 52.
- Vericomp ... NCP**
- 6771  Memory Master 1.1 ..... 45.
- Volkswriter ... NCP**
- 6246  Volkswriter 4 1.02 ..... 109.



## Touchstone Software ... NCP

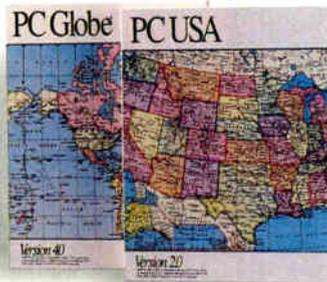
7420  **Check It 3.0**—Diagnostic software will help find and get rid of system problems. Run over 160 tests on all major system components. Results can be logged to disk or printer with suggestions on fixing simple troubles .. \$89.

- West Lake Data Corp. ... NCP**
- 7577  PC-FullBak+ 1.12 ..... \$52.
- 7574  PathMinder+ 1.0 ..... 79.
- 7575  ValuePak (includes 4 programs) .. 69.
- WordPerfect Corp. ... NCP**
- 7781  LetterPerfect 1.0 ..... 135.
- 3804  WordPerfect 5.1 ..... 265.
- 6685  DrawPerfect 1.1 ..... 279.
- WordStar International ... NCP**
- 6791  WordStar Prof. 6.0 ..... 279.
- Xerox ... NCP**
- 7796  Ventura Publisher for Windows 3.0 569.
- XTREE ... NCP**
- 6161  XTreePro Gold 1.4 ..... 75.
- ZSoft ... NCP**
- 7016  PC Paintbrush IV Plus 1.0 ..... 119.
- 7014  PC Paintbrush Plus for Windows 1.12 89.

## RECREATIONAL/EDUCATIONAL

### Broderbund ... CP

- 5701  Where/Time Carmen Sandiego? . 32.
- 5851  SimCity ..... 33.

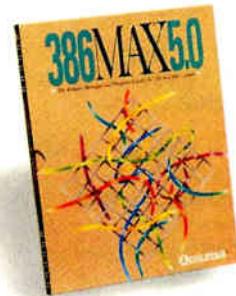


## PC Globe ... NCP

5902  **PC USA 2.0**—Instant profiles on all 50 states and Puerto Rico, including maps, graphics, and data ..... \$39.  
 5900  **PC Globe 4.0**—Provides profiles of 177 countries. Exports to many programs .. 39.

### Electronic Arts ... NCP

- 5804  Deluxe Paint II (Enhanced) ..... 89.
- HyperGlott ... NCP**
- 7849  Word Torture - French ..... 29.
- 7853  Word Torture - Spanish ..... 29.
- Microsoft ... NCP**
- 2858  Flight Simulator 4.0 ..... 39.
- Penton Overseas ... NCP**
- VocabuLearn/ce Levels I & II (French, Italian, German, Spanish, Russian, Hebrew and Japanese) ..... each 39.
- Sierra On-Line ... CP**
- 6023  Leisure Suit Larry III ..... 39.
- 6796  Codename: Iceman ..... 39.
- 6972  Conquests of Camelot ..... 39.
- Software Toolworks ... NCP**
- 6436  Hunt for Red October ..... 20.
- 4659  Chessmaster 2100 (CP) ..... 35.
- Stone & Assoc. ... NCP**
- 7564  Young Math (ages 5 to 8) ..... 22.
- 3439  2nd Math (ages 7 to 16) ..... 27.



## Qualitas ... NCP

7539  **386MAX 5.0**—Powerful new MAXIMIZE feature finds and uses all the memory you paid for. Automatic install makes this industry-standard memory manager indispensable for all level of 386 users . \$75.

### Toyogo ... NCP

- 7676  Go Master Deluxe ..... 89.
- True BASIC, Inc. ... NCP**
- Kemeny/Kurtz Math Series. each 45.

## HARDWARE

**Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.**

### American Power ... 2 years

- 7108 APC Smart-UPS 400 ..... 339.
- 6811 360SX (stand-by power source) ... 219.
- 7107 450AT (stand-by power source) ... 279.
- 7106 520ES (stand-by power source) ... 329.

### AST Research ... 2 years

- 1299 SixPakPlus 384k C/S/IP ..... 179.
- 6795 SixPak 286 512k ..... 179.
- 4107 RAMpage Plus 286 512k ..... 419.

### Boca Research ... 5 years

- 7001 BOCARAM/IAT PLUS (0-8 Meg) (LIM 4.0 extended) ..... 125.
- 7061 BOCARAM/XT OK (0-2 Meg, LIM 4.0) 99.
- 7135 TophAT (16-bit backfill 512K to 640K) 99.

- 6998 I/O Board for AT ..... 59.
- 6999 I/O Board for Microchannel S/S/IP . 109.
- 6995 SuperVGA (800 x 600, 16/8 bit) ... 115.
- 7026 1024 VGA (16 bit non-interlaced) .. 149.

### Bravo Communications

- 7400 2 Pos. Laser Compatible Switch Box 109.

### Brother International ... 1 year

- 5787 HL-8e Laser Printer (HP2 comp.) . 1399.

### Canon ... 1 year

- 7894 BJ-10e BubbleJet Printer (4.6 lb.) . 349.
- 7896 Sheet feeder for BJ-10e ..... 75.

### CH Products ... 1 year

- 7341 Gamecard III Plus (for Microchannel PS/2s) ..... 49.
- 7340 Flight Stick (includes Falcon F-16) .. 49.
- 7345 RollerMouse (Trackball) serial 85. bus 99.

### CompuCase ... 2 years

- 1604 2-Position switch box ..... 25.

# more pleasant to do?

# Newsprint is in.



**Intel ... 5 years**  
Above Boards—FREE Quarterdeck QRAM and Manifest with any Above Board or piggyback, now through December 31, 1990! ... see Intel listing for prices.

- Curtis ... lifetime**  
708 Ruby-Plus SPF-2 Plus ... 65.  
358 Command Center ... 93.  
Glass Filter Plus (specify size) ... ea. 65.  
**Datadesk ... 3 years**  
901 Switchboard ... 175.  
**Epson ... 1 year**  
We are an authorized Epson Service Center.  
906 FX-850 (80 col., 264 cps, 9 pin) ... call  
904 FX-1050 (136 col., 264 cps, 9 pin) ... call  
183 LQ-510 (80 col., 180 cps, 24 pin) ... call  
930 LQ-850 (80 col., 264 cps, 24 pin) ... call  
917 LQ-1050 (136 col., 264 cps, 24 pin) call  
184 LX-810 (80 col., 180 cps, 9 pin) ... call  
052 Printer-to-IBM cable (6 feet) ... 15.  
775 Equity LT-286e Laptop ... 1995.  
774 Equity LT-386SX Laptop ... 3069.  
Removable Hard Drives for Epson Laptops  
776 20 Meg ... 499. 7777 40 Meg ... 699.  
**5th Generation ... 1 year**  
157 Logical Connection Plus 512k ... 599.  
**Hayes ... 2 years**  
307 Smartmodem 2400 ... 349.  
391 Ultra 9600 Modem ... 899.  
**Hewlett-Packard ... 1 year**  
754 LaserJet III (w/toner) ... 1699.  
582 LaserJet IIP (w/toner) ... 1069.  
**Intel ... 5 years**  
421 2400B MNP Internal Modem ... 199.  
352 2400B Internal Modem 2 (for PS/2) 249.  
119 2400 Baud External Modem ... 179.  
420 2400EX MNP Modem ... 229.  
880 9600EX Modem ... 549.  
346 Inboard 386/PC w/1 Meg (w/Free Ami) 519.  
266 Above Board Plus 512k ... 369.  
267 Above Board Plus I/O 512k ... 399.  
336 Above Board Plus 8 2 Meg ... 599.  
342 Above Board Plus 8 I/O 2 Meg ... 629.  
272 Above Board 2 Plus 512k ... 469.  
396 Above Board MC 32 0k ... 359.  
782 SatisFAXtion ... 399.  
552 NetPort ... 489.  
**MATH COPROCESSORS**  
385 80287XL (16 MHz 80286 CPU's) ... 199.

- 4750 80387SX (16 MHz 80386SX CPU's) \$309.  
2371 80387 (16 MHz 80386 CPU's) ... 349.  
2372 80387-20 (20 MHz 80386 CPU's) 399.  
**Kensington Microware ... 1 year**  
7899 Expert Mouse serial ... 119. bus ... 129.  
**Keytronic ... 3 years**  
4518 101 Plus Keyboard ... 99.  
**Kraft ... 5 years**  
5800 3 button Thunder Joystick ... 29.  
5802 Trackball ... 59.  
**Logitech ... limited lifetime**  
5464 C9 Mouse for PS/2's ... 69.  
7768 C9 Mouse with Windows ... 149.  
5151 HiREZ Mouse (C9) ... 85.  
6029 Trackman (Trackball) serial 85. bus 89.  
4297 ScanMan Plus (hand scanner) ... 185.  
**Micron Technology ... 2 years**  
7595 Intensity 2 Meg Expansion for HP LaserJet IIP or III ... 175.  
7012 Beyond Memory Board for PS/2 Model 70 (2 Meg) ... 265.



**Intel ... 5 years**  
80287XL & 80287XLT Math CoProcessors—Runs up to 50% faster than other 80287 math chips. The 80287XL works in virtually every 80286-based PC, and the 80287XLT is made especially for Compaq LTE/286.. each \$199.

- Microsoft ... lifetime**  
7597 Microsoft Mouse ... 89.  
2897 Mouse with Paintbrush ... 109.  
2898 Mouse with Windows 3.0 ... 149.  
**MicroSpeed ... 1 year**  
6007 PC-TRAC Trackball (includes a free copy of Welltris) serial ... 75. bus ... 85.  
**Mouse Systems ... lifetime**  
5997 Trackball (1 yr. wrnty.) serial 75. bus 85.  
7878 PC Mouse III ... 99.  
**NEC ... 2 years**  
4799 Multisync 2A (VGA Monitor) ... 499.  
5085 Multisync 3D Monitor ... 689.  
**Orchid Technologies ... 4 years**  
7512 ProDesigner VGA II (1024 x 768) ... 299.

**1-800/776-7777**

**MMC PC Connection 780B**  
6 Mill Street  
Marlow, NH 03456  
SALES 603/446-7721 FAX 603/446-7791



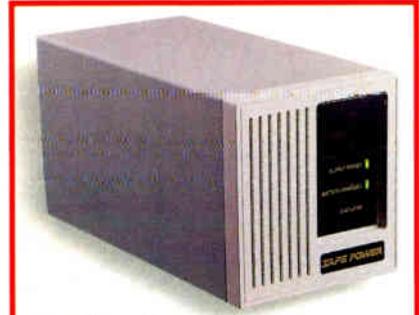
**Intel ... 5 years**  
7880 9600EX Modem—Provides ultra-fast data communications without sacrificing compatibility. Supports V.32 & V.42 9600 bps operation, as well as MNP Level/5 and Hayes compatible 2400/1200/300 bps modes ... \$549.

- PC Power & Cooling ... 1 year**  
**REPLACEMENT POWER SUPPLIES**  
3202 Turbo Cool 150 (25° - 40° cooler) ... 129.  
3200 Silencer 150 (84% noise reduction) 115.  
**Pacific Data Products ... 1 year**  
6779 25 Cartridges in One! (for LJ II, IIP, IID) 275.  
7072 25 Cartridges in One! (for LJ III) ... 349.  
Memory upgrade for LaserJet IIP/III  
7054 1 Meg ... 149. 7055 2 Meg ... 199.  
7758 3 Meg ... 279. 7759 4 Meg ... 339.  
Memory upgrade for LaserJet II  
6839 1 Meg ... 179. 6838 2 Meg ... 249.  
7158 Pacific Page (PostScript Cartridge for LaserJet IIP/III) ... 379.  
6834 Pacific Page with free 2 Meg Memory Board (for LaserJet II) ... 379.  
7632 Outlines I. 209. 7631 Outlines II. 209.  
**Practical Peripherals ... 5 years**  
3101 1200 Baud Internal Modem ... 65.  
3100 1200 Baud External Modem (mini) ... 77.  
3103 2400 Baud Internal Modem ... 135.



**Intel ... 5 years**  
2346 Inboard 386/PC with Free Samna Ami—Gives you 80386 processing power, 1 Mb RAM, and Samna's powerful Windows-based word processor (regularly at \$129). 30 Day Money Back Guarantee. ... \$519.

- 3102 2400 Baud External Modem ... \$179.  
5286 2400 Baud Int. MNP Modem (Lev. 5) 175.  
5285 2400 Baud Ext. MNP Modem (Lev. 5) 209.  
4542 2400 Baud Internal Modem for PS/2 ... 229.  
**Reflection Technology ... 1 year**  
7127 Private Eye (virtual display) ... 499.  
**SAFE Power Systems ... 2 years**  
7913 Safe 650W ... 459.  
7914 Safe 800W ... 599.  
4560 Safe 1200W ... 739.  
**Targus ... lifetime**  
4899 Nylon Laptop carrying case ... 55.  
6037 Premier leather carrying case ... 199.  
**TheComplete PC ... 2 years**  
5140 TheComplete Page Scanner ... 549.  
5828 TheComplete Communicator ... 449.  
**Tripp Lite ... 2 years**  
6199 Isobar 4-6 (4 outlets, 6 ft. cord) ... 49.  
6200 Isobar 6-6 (6 outlets, 6 ft. cord) ... 59.  
**Video 7 ... 7 years**  
5883 1024i VGA (includes 512k) ... 219.  
4931 VRAM VGA 512k ... 379.



**SAFE Power Systems ... 2 years**  
7913 Safe 650W—All new space-saving design provides easy storage of your battery backup. LED status lights, audible alarm, transient protection, and more. ... \$459. (See SAFE Power listing for more models)

## DRIVES

- IOMEGA ... 1 year**  
5116 Bernoulli II Single 44 Meg Internal 995.  
5113 44 Meg Cartridge Tripak (5 1/4") ... 249.  
2500 PC2B Controller ... 229.  
7551 Bernoulli II Transportable 44 Meg ... 997.  
**Mountain Computer ... 1 year**  
2917 40-60 Meg Internal Tape Drive ... 299.  
5502 83-152M Ext. Tape Drive ... 799.  
5190 DC2000 Pre-formatted Cartridges ea. 35.  
**Pacific Rim ... 1 year**  
5009 1.2 Meg External ... 209.  
5010 1.2 Meg External (for PS/2's) ... 215.  
6602 1.44 External (for PC/XT/AT) ... 239.  
**Plus Development ... 2 years**  
6425 Hardcard II 40 Meg (19 ms) ... 399.  
6424 Hardcard II 80 Meg (19 ms) ... 699.  
**Seagate ... 1 year**  
2285 20 Meg Int. Hard Drive ST225 (w/controller and cables, 65 ms) ... 255.

- 2286 30 Meg Int. Hard Drive ST238R (w/controller and cables, 65 ms) ... \$269.  
4554 40 Meg Int. HD ST251-1 (28 ms) ... 329.  
**TEAC ... 1 year**  
4951 720k Drive (specify XT or AT, 3 1/2") ... 75.  
4670 1.44 Meg Drive for PC/XT (3 1/2") ... 89.  
4326 1.44 Meg Drive for AT ... 109.



**Intel ... 5 years**  
7782 SatisFAXtion—Send and receive faxes from within most applications using the print command. Built-in 2400 bps MNP modem standard. Includes coupons for free PC Tools and Fax-It software ... \$399.



**Canon ... 1 year**  
7894 BJ-10e BubbleJet Printer—Light weight, excellent print quality and a great price make this 4.6 lb. printer a winner. Choice of black or white. Optional sheet feeder ... \$349.

## DISKS

- Maxell ... lifetime**  
2789 5 1/4" MD2-D 360k Disks (Qty. 10) ... 12.  
2790 5 1/4" MD2-HD 1.2Mb Disks (Qty. 10) ... 19.  
2792 3 1/2" DS/DD 720k Diskettes (Qty. 10) ... 14.  
2793 3 1/2" DS/HD 1.44Mb Diskettes (Qty. 10) 27.  
**Sony ... lifetime**  
3291 5 1/4" DS/DD 360k Disks (Qty. 10) ... 10.  
3292 5 1/4" DS/HD 1.2Mb Disks (Qty. 10) ... 19.  
3297 3 1/2" DS/DD 720k Diskettes (Qty. 10) ... 13.  
3298 3 1/2" DS/HD 1.44Mb Diskettes (Qty. 10) 22.  
6659 QD 2000 Tape Cartridge ... 19.

- MEMORY**  
6556 256k DRAMs (100 nanosecond) ... call  
5510 1 Meg x 9 SIMMs (80 nanosecond) call  
5746 1 Meg Chips (80 nanosecond) ... call

## OUR POLICY

- We accept VISA and MASTERCARD only.
- No surcharge added for credit card orders.
- Your card is not charged until we ship.
- If we must ship a partial order, we never charge freight on the shipment(s) that complete the order (in the U.S.).
- No sales tax.
- All U.S. shipments insured; no additional charge.
- APO/FPO orders shipped 1st Class Mail.
- International orders U.S. \$250 minimum.
- Upon receipt and approval, personal and company checks clear the same day for immediate shipment of your order.
- COD max. \$1000. Cash, cashier's check, or money order.
- 120 day limited warranty on all products.\*
- To order, call us Monday through Friday 8:00 AM to 1:00 AM, or Saturday 9:00 AM to 5:30 PM. You can call our business offices at 603/446-3383 Monday through Friday 9:00 AM to 5:30 PM.



**MECA ... NCP**  
4603 Andrew Tobias' Tax Cut—New power for handling your 1990 taxes. Import data from Quicken and/or TurboTax, read last year's Tax Cut data, and print your return—all with new versatility ... \$49.

## SHIPPING

- Note:** Accounts on net terms pay actual shipping.  
**Continental US:**  
• For heavy hardware items such as printers, monitors, Bernoulli Boxes, etc. pay actual charges. Call for UPS 2nd-Day & Next-Day-Air.  
• For all other items, add \$3 per order to cover UPS Shipping. For such items, we automatically use Airborne Express at no extra charge if you are more than 2 days from us by UPS ground.  
**Hawaii:**  
• For monitors, printers, Bernoulli Boxes, computers, hard drives, and power backups, actual UPS Blue charge will be added. For all other items, add \$3 per order.  
**Alaska and outside Continental US:**  
• Call 603/446-7721 for information.



\*DEFECTIVE SOFTWARE REPLACED IMMEDIATELY. DEFECTIVE HARDWARE REPLACED OR REPAIRED AT OUR DISCRETION.

© COPYRIGHT PC CONNECTION, INC., 1990. PC CONNECTION, PCTV AND THE RACCOON CHARACTER(S) ARE REGISTERED TRADEMARKS OF PC CONNECTION, INC., MARLOW, NH. ALL OTHER TRADEMARKS REMAIN THE PROPERTY OF THEIR RESPECTIVE COMPANIES.



# PC Clout.

**Diamonds in the rough.  
(Or, why you're always safe with us.)**

An early fall afternoon. The sky is bluer than the IBM logo and there's enough electricity in the air to light up Yankee Stadium. You could be at Candlestick, Wrigley, or Fenway, munching a frank, and yelling, "It's outta here!" But the players are suspiciously furry and there's a level of play you rarely see anymore, even in the big leagues. Welcome to the silicon sandlot of Marlow, NH (pop. 563). Where the only game that's played is hardball. And where we don't take American Express. (Just VISA, MC, and Corporate P.O.s.)

Students of the game know that when it comes to PC mail order we

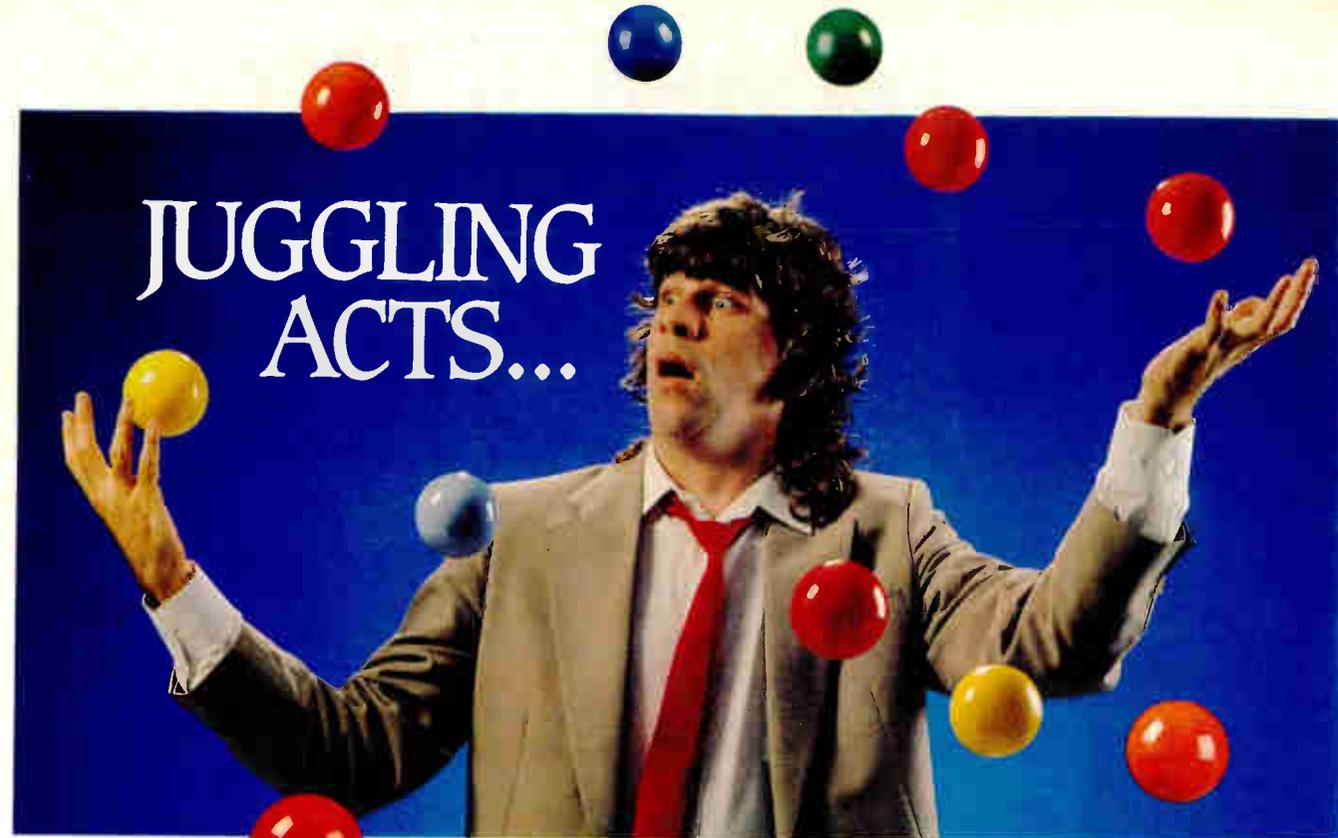
wrote the book: toll-free tech support, latest versions only, and price lists complete with up-to-date stats on warranties, disk size, and copy protection. Give us a call next time you need to know the score on any PC product. We'll never leave you out in left field.

**Get into the swing of things.**

We have a reputation for always going to bat for our customers. Well now you can go to bat for yourself anytime you like with your very own 32" "R.G. Johnson" bat, custom-made and hand-crafted in New England from solid ash by R.G.'s grandson Bob. This cracker-jack offer is free to everyone who places an order of \$1000 or more between now and November 30.



Go for the fences with the PC Connection Bat featuring our own heavy-hitting mascots. Offer not available to accounts on net terms. One per customer.



## ...ARE FOR CLOWNS

● **Juggling files, documentation, people and time is no way to manage a software project. You need to know who is working on what, which files are being changed and why. And your team should be moving ahead on development, not stuck in costly collisions.**

### MKS RCS – Your Project Manager

MKS RCS (Revision Control System) helps keep your project from becoming a juggling act by maintaining a complete history of changes to a file and giving you access to any of the changes. MKS RCS also automatically saves crucial descriptive information about each revision.

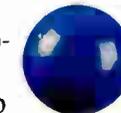
An advanced user interface and excellent documentation make MKS RCS extremely easy to use. Or if you prefer, you can operate from the command line. MKS RCS can automate every aspect of your project, handle both binary and text files with ease, provide unlimited branching and merging capabilities and compress log files to save valuable disk space.

### The Bigger the Better

The more complex your project, the more you need MKS RCS. In a multi-user environment, eliminate access conflicts

with locking options. Manage and track development to deliver your project on time, on spec and on budget.

For individual projects, MKS RCS handles the headaches of recording and retrieving files. Whether you are on a LAN or an individual PC, MKS RCS will make you more productive.



### Price and Performance Leader

MKS RCS has all the features you will ever need in a revision control system at a price that will fit your budget.

MKS RCS for DOS is just \$249; for OS/2, SCO or 386 Unix \$349. A 5-CPU LAN license for DOS is \$995; for OS/2, SCO or 386 Unix \$1,395.

Call MKS for LAN pricing for more than 5 CPUs.

### MKS Software Management Team

Reduce the juggling act even more with the MKS Software Management Team (MKS RCS and MKS Make). You set up the rules stating which files must be changed when other files are altered, and MKS Make automatically keeps those files in synch.

TO ORDER, CALL:

1-800-265-2797 (continental U.S. only)	Australia 03-419-0300	France 01 47 95 01 07
1-519-884-2251 (outside continental U.S.)	03-555-4544	Netherlands 020 14 24 63
1-519-884-8861 (FAX)	England 0763 244114	Sweden 0762 704 60
	0364 53499	West Germany 0551-704800
	071 833 1022	0721 886 664
Full 30 day money back guarantee.	Finland 08-5054536	06126/595-0

MKS, MKS RCS and MKS Make are trademarks of Morise Kem Systems Inc. UNIX is a trademark of AT&T



**MKS** 35 King Street North  
Waterloo, Ontario  
Canada. N2J 2W9

Circle 234 on Reader Service Card



# NOT QUITE UNIX

## Tribulations and treats of using a \$100 Unix clone

Last month I mentioned that I had received a copy of Coherent, an operating system for 286- and 386-based machines that was designed to be very much like Unix. (The Mark Williams Company sells it for \$99.95.) I had hoped to report that it would make a good base for an inexpensive UUCP (Unix-to-Unix copy) connection, as well as a Unix learning base for people with DOS machines. Alas, that doesn't seem to be the case yet, at least for me.

### Building My System

Installing Coherent was pretty straightforward. There are only four high-density floppy disks to work with, and if you have a free partition of at least 10 megabytes on your hard disk, you're ready to go. I didn't have one, so I had to do some long-overdue partition rearranging on my 286 clone. Between some DOS repartitioning software I had around and the tools supplied with Coherent, it wasn't too bad, even though I'm strictly a novice when it comes to DOS. I hooked up a spare terminal and can report that Coherent is indeed multiuser and multitasking, with quite decent response.

Coherent comes with some truly remarkable features, considering it's a Unix look-alike. Apart from the usual 200 or so basic file-manipulation and system-maintenance commands, it also has a driver program for Epson printers, troff (with output to the Hewlett-Packard LaserJet), and software development programs such as lex, yacc, make, sed, and awk.

I was very excited that Coherent came with a set of UUCP programs. (OK, it's a



bit of a misnomer, but if they called it Coherent-to-Coherent copy program, or CCCP, it would sound like a Soviet space vehicle!) UUCP is the means by which all Unix machines can communicate with each other via phone lines. A functioning UUCP package, together with the mail program also included in Coherent, would give you access to the worldwide UUCP network.

So, my scheme was to first hook up Coherent via a direct-wired UUCP connection (far faster and easier, generally, than attempting to hook up a modem) to my regular Unix machine and then download programs to Coherent and attempt to recompile them.

Unfortunately, I was unable to get Coherent to talk to Unix. It wouldn't dial out at all, whether the port was enabled or not. The dial-in attempts from the Unix machine showed that Coherent was indeed answering with the expected prompts. However, once past the pass-

word check, Coherent would respond with an error message and return a LOG-IN FAILED status message to the Unix connection.

I called the Mark Williams Company's technical-support line and talked to someone who went through a number of likely reasons for the failure. He also came up with a few suggestions that didn't seem to bear on this situation at all (for instance, removing a UUCP reference in the `/etc/domains` file). Together, we eventually concluded that there was no reason why it shouldn't be working; it just wasn't.

### Hard Aport

I then tried porting the xcomm package to Coherent, in response to a query from a reader about a method of dialing out that was simpler than using the Kermit utility provided in Coherent. This revealed that some signals in Unix System V that are needed for compiling xcomm

## ITEMS DISCUSSED

**Coherent**.....\$99.95  
 Mark Williams Company  
 60 Revere Dr.  
 Northbrook, IL 60062  
 (800) 627-5967  
 (708) 291-6700  
 Inquiry 1015.

(which is the only communications program I have that's small enough to fit into Coherent's 64K-byte space) are not implemented in Coherent.

Just for testing purposes, I commented out all references to these signals. Unfortunately, Coherent was unable to put the object modules together. The error message said that the loader couldn't relocate modules compiled for separate I/D (instruction and data) space, yet I hadn't compiled or tried to load with that option (nor could I find it in the manual). Using the `f11e` command showed that all the object modules had properly compiled as relocatable code. Very strange.

So how did I get the `xcomm` source files onto Coherent? Coherent has an all-

purpose utility called `dos`, which does everything from formatting DOS disks to file transfer between Coherent and DOS. In fact, my only complaint with that command is that there are too many options, making it too easy to delete files or format a disk when you don't intend to.

I did have a little problem figuring out how to address the DOS floppy disk drive, since none of the references listed under the `dos` command gives the information. After searching likely places, I finally discovered that the information is under the entry "fd" in the manual, where I discovered by trial and error that a low-density disk is called `/dev/f9a0` and a high-density disk is called `/dev/fna0`. The default is to access the DOS partition on the hard disk.

**Think Small**

A word about the 64K-byte limit is also in order. This was a familiar problem back in the early days of Unix, when Unix was almost always implemented on one of Digital's PDP-11 computers. All programs had to fit into just 64K bytes of memory, even when there was 256K bytes on the machine. The improved

PDP-11/70 model, a large minicomputer, allowed programs to have 64K bytes of executable instruction code and 64K bytes of static and dynamic data space, which allowed you to write larger programs.

Coherent's compiler, written to work on both the 386 and the smaller 286, is limited to "small model" compilation, and therefore also bound by the 64K-byte limit for programs. Having studied much of the 1000-plus-page Coherent manual and all the promotional literature, I could find only a single sentence that acknowledged this, and that was buried in a note under the heading "Data Formats," rather than in any information about the compiler or even the loader. Unless, of course, you take the company's "small is beautiful" motto literally.

Because BYTE has published its Unix benchmarks with the intention of making them portable, I then decided to try them. I was rewarded to see that many of the programs compiled cleanly (some were missing references to time constants, though).

Unfortunately, the benchmarks did not run as delivered, because the shell

The DGIS™ SDK and a TI 34010-based High-Performance Graphics Board for one amazing price.

High performance, high resolution graphics are the wave of the future. With the DGIS Software Developer's Kit™ (SDK), qualified software developers can write for the future today.

The DGIS Developer's Kit provides everything needed to develop applications and drivers for DGIS-compatible 34010 graphics boards—boards from companies such as Compaq, Dell, Hewlett-Packard, NCR, NEC, TI and more than 30 others worldwide. Software developed with this kit can access the full power of the 34010, supporting the greatest number of high resolution graphics boards at the highest levels of performance, resolution and color.

DGIS, the premier and most widely-shipped interface for the TI 340X0 family of graphics coproces-

## THE POWER OF HIGH RESOLUTION GRAPHICS PROGRAMMING CAN BE REACHED WITH ONE EASY NUMBER:



sors, provides an outstanding feature-rich programming model with 100+ graphics functions. The DGIS SDK includes documentation and language bindings for the DGIS interface, device drivers for Windows 3.0, utilities, and the GSS AT1050™ 1024x768 34010 graphics board (which normally sells for \$1295 alone).

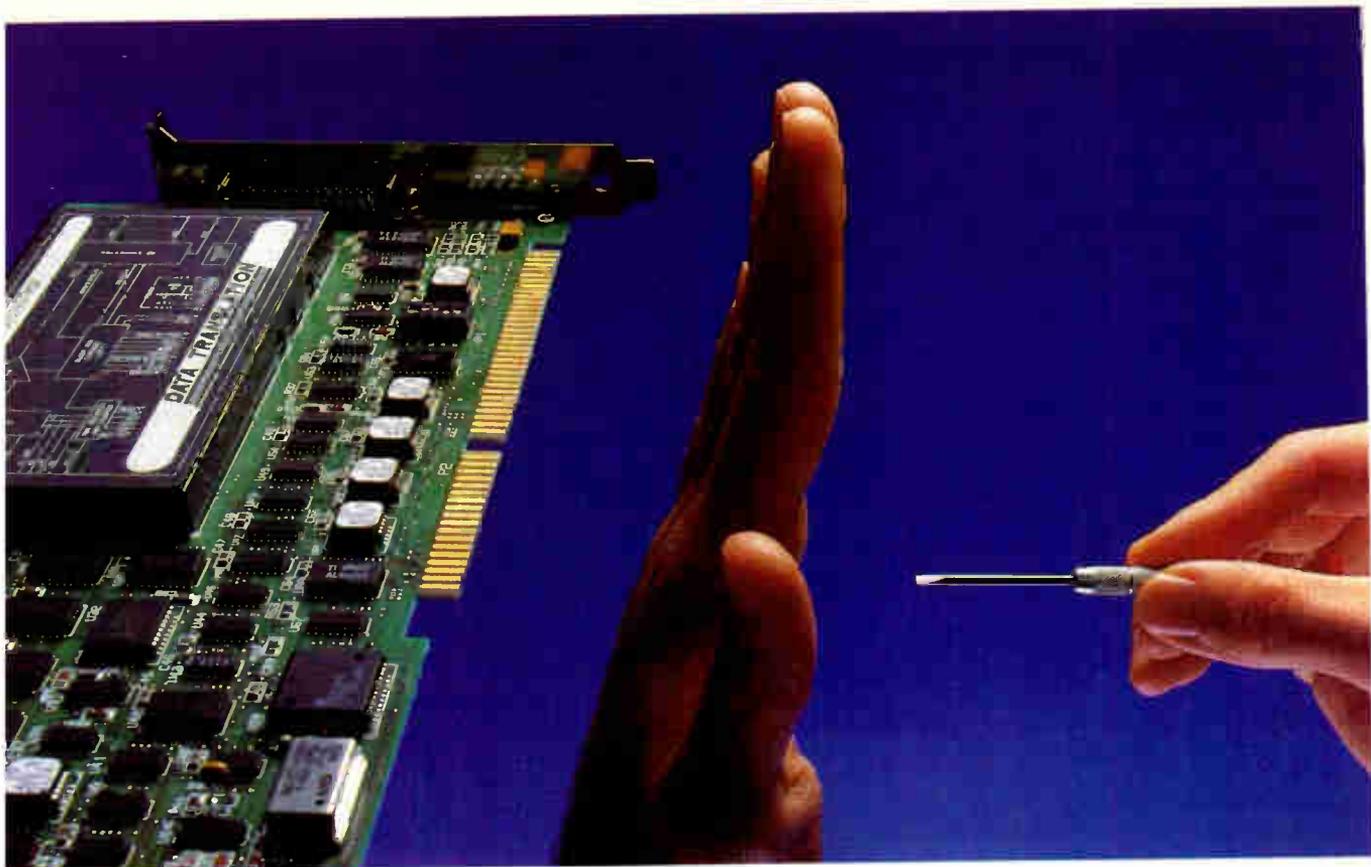
The DGIS SDK is compatible with most C compilers and supports the XMS standard as well as DOS Extenders from Rational and PharLap.

Stepping up to the big screen has never been easier or more attractive. Call today.



Call (503) 641-2455.  
 Ask for Dept. DGIS-1.  
 See us at COMDEX  
 Booth #3126 LVCC.

All prices subject to change without notice.  
 GSS, DGIS, The DGIS Software Developer's Kit, GSS AT1050 are trademarks of Graphics Software Systems Inc. All other trademarks belong to their respective owners.



**“Stop! Hands Off!**

**We’ve got an easier, more accurate way to calibrate and configure data acquisition boards.”**

—Fred Molinari, President

**GLOBAL LAB™ Data Acquisition software with “Hands-Off” control for the DT2831 Series.**

Put down that screwdriver! GLOBAL LAB™ Data Acquisition software fully supports the DT2831 Series “Hands-Off” design, so setup, installation, calibration, and maintenance are 100% mouse/menu-driven.

Once you’ve installed your DT2831 Series board, you can forget it. With GLOBAL LAB™, all DT2831 operating parameters are controlled via software menus. No manual adjustments—no jumpers, no pots, no hassles! You get greater reliability, improved productivity.

In addition to supporting “Hands-Off” control, GLOBAL LAB™ provides numerous data acquisition, signal processing, and display functions. For advanced signal processing, ask us about GLOBAL LAB™’s add-on STATPACK™ Signal Processing Module.

Call today for a GLOBAL LAB™ demo package. Use it with a DT2831 Series board, and we think you’ll agree nothing comes close to “Hands-Off” data acquisition.

**Call (508) 481-3700**

In Canada (800) 268-0427



Also available—New GRAPHPACK™ Printing Module provides customized laser quality output.

**DATA TRANSLATION®**

World Headquarters: Data Translation, Inc., 100 Lockwood Drive, Marlboro, MA 01752-1192 USA, (508) 481-3700, Fax (508) 481-8620, Tlx 951646  
 United Kingdom Headquarters: Data Translation Ltd., The Mulberry Business Park, Wokingham, Berkshire RG11 2QJ, U.K., (734) 793838, Fax (734) 776670, Tlx 94011914  
 West Germany Headquarters: Data Translation GmbH, Stuttgart-Strasse 56, 7120 Bietigheim-Bissingen, West Germany 7142-4025, Fax 7142-64042  
 International Sales Offices: Australia: (2) 699-8300; Belgium: (2) 466-8199; Brazil: (1) 240-0598; Canada: (416) 525-1907; China: (1) 868-721-x4017; Denmark: 42 274511; Finland: (0) 3511800; France: (M) 69077802; Greece: (1) 361-4300; Hong Kong: (5) 448-963; India: (2) 23-1040; Israel: 52-545655; Italy: (2) 82470.1; Japan: (3) 502-5550; (3) 5379 1971; (3) 355-1111; Korea: (2) 718-9521; Netherlands: (70) 395-6360; New Zealand: (2) 53 12 50; Poland: (22) 580701; Portugal: (1) 545313; South Africa: (12) 803-7580; Spain: (1) 555-8112; Sweden: (8) 261 78 20; Switzerland: (0) 723-1410; Taiwan: (2) 3039836  
 GLOBAL LAB, STATPACK and GRAPHPACK are trademarks and Data Translation is a registered trademark of Data Translation, Inc. All other trademarks and registered trademarks are the property of their respective holder.

Circle 98 on Reader Service Card

driver program makes heavy use of the Bourne shell's keyword parameters, which apparently are not implemented in Coherent. In that sense, it's a bit misleading of the Mark Williams Company to refer to its shell as a "Bourne shell," since that implies that its shell is either compatible with, or a derivative of, the standard Unix shell (written by Steve Bourne).

By looking around the Mark Williams conference on BIX (mwc/coherent), I've found that I'm having a bit more trouble than some other folks. Several people have gotten their UUCP running and are all ready to set up a Usenet node. Others are working on ways of compiling *esh*, *vi*, and similar popular Unix programs. Clearly, just because I've run into a snag or two doesn't mean it can't be done.

I also learned from BIX that the Mark Williams Company is planning a virtual-memory capability for the 286 version of Coherent, plus a full-featured 386 version, for next year. Both would presumably get rid of the 64K-byte limit imposed by the small-model compiler.

At this point, I'm at a bit of a standstill. If your intention in buying Coherent

is to use it for creating a UUCP or Usenet node and downloading public domain programs for compilation and use, or for developing programs to be used on true Unix or Xenix systems, then Coherent's current compiler limitations, slightly nonstandard features, and the other problems I've experienced might give you pause.

On the other hand, if you want a Unix-like development and learning system for less than \$100 that supports multiple users, can be coresident with a DOS installation, and can transfer text files to and from DOS floppy disks and hard disk partitions, I don't see how you can go wrong with Coherent.

#### A Personal Note

My offer to send out the list of public-access Unix systems (see "Free Software!" in the June BYTE) was, to put it mildly, very well received. I had no idea that so many Unix-literate people read BYTE, let alone my column. I have my wife Susan to thank for most of the envelope stuffing and sealing.

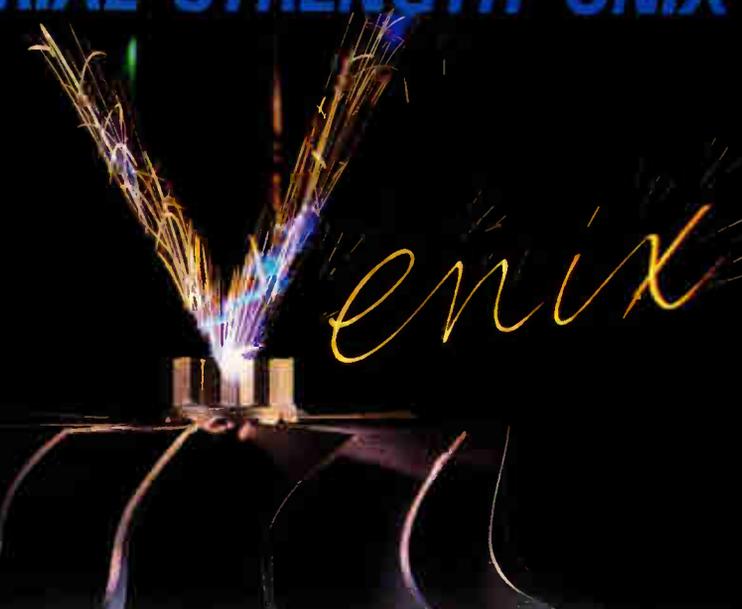
Enough of you wrote with interest about my new publication, *Unix Video*

*Quarterly*, that this is a good time to talk briefly about it here. I started *Unix Video Quarterly* as an alternative to traditional industry newsletters, partly because of my experience in video and film production. Certainly, the move toward Unix graphics software and user interfaces was a factor; imagine trying to describe how OSF/Motif differs from Open Look by using text alone! I also realized that sometimes you have to experience things to totally understand them, and video technology is the closest thing to actually being on the scene. If you want to know more about *Unix Video Quarterly*, contact me at P.O. Box 220, Rescue, CA 95672, (800) 843-8649, or on BIX as "fiedler." ■

*David Fiedler is executive producer of Unix Video Quarterly and coauthor of the book Unix System Administration. He has helped start several Unix-related publications. You can reach him on BIX as "fiedler."*

*Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

## INDUSTRIAL STRENGTH UNIX



enix

VENIX offers the real time UNIX\* needed enough for your demanding acquisition and control applications. VENIX is a true AT&T UNIX, optimized for even the harshest industrial environments.

In addition to the functionality of a nonproprietary operating system, VENIX offers multiple hardware plat-

form and real-time shell programs, plus the flexibility to develop and maintain your own programs. All this plus durability and real time. And you can design seamless dedicated applications with new Embedded VENIX.

VenturCom has been at the forefront of UNIX technology for over ten years. We

offer the most advanced software for embedded UNIX and real time UNIX operating on AT bus microcomputers.

Call (617) 661-1230 today to test the best. VENIX, the industrial strength UNIX.

 **VenturCom**

215 First Street Cambridge, MA 02142  
UNIX is a registered trademark of AT&T.

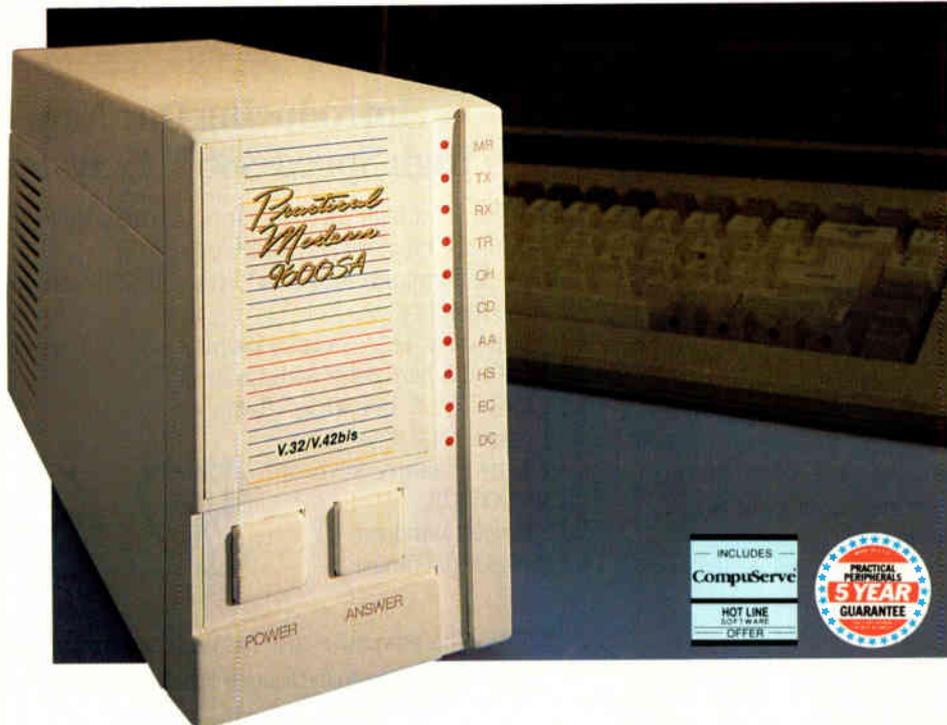
Circle 365 on Reader Service Card (RESELLERS: 366)

World Radio History

# THE 9600 BPS V.32/V.42bis

*very Practical*

## \$699 BREAKTHROUGH



**Believe it. A true full duplex 9600 bps, CCITT V.32, V.42, V.42bis error correcting, data compressing modem for just \$699!**

The PM9600SA™ V.32/V.42bis supports high speed full duplex data transmission at 9600 bps data over common phone lines. Combined with V.42 and MNP/4 error detection and correction, V.42bis and MNP/5 data compression protocols deliver more effective throughput. In fact, automatic speed buffering allows data to flow from computer-to-modem at throughput rates up to 38,400 bps. And the PM9600SA V.32/V.42bis is compatible with the Hayes Ultra Smartmodem 9600.™ At just \$699, the PM9600SA just may be the most Practical buy in the industry...and it's backed by the Practical Peripherals 5 year guarantee: the PM9600SA performs for 5 years or we'll repair or replace it. FREE! It's that simple. That Practical.

See us at Merisel Booth #1916  
**COMDEX/Fall '90**  
November 12-16, 1990

**PRACTICAL PERIPHERALS®**

31245 La Baya Drive, Westlake Village, CA 91362. Sales Office: 1-800-442-4774  
Corporate Headquarters: 1-818-706-0333, Technical Support: 1-818-991-8200, FAX: 1-818-706-2474

All products and names trademarked are properties of their respective manufacturers.

© 1990 Practical Peripherals, Inc. All rights reserved.

Circle 398 on Reader Service Card

World Radio History

# If You Want In A 386 System, Do

Selecting a new computer system can be a real challenge. That's where we come in. We have the knowledge and experience to make your job easy. So, just do the Standard thing. Pick up the phone and check us out. Test us. Talk to us about our quality. Our service. And especially our prices. You'll like what you hear.

## Introducing Features, Flexibility and Fantastic Color.

Then ask us about our new 386/25 and 386/33 systems. The list of standard features includes the latest that high technology has to offer. Features like a 64 KB memory cache for the 386/25, and 128 KB for the 386/33, both expandable to 256 KB, providing the fastest possible memory access. Then there's the integrated VGA controller supporting 1024 x 768 resolution, with 256 vibrant colors and a 50% performance increase all made possible by 1 MB of 32-bit video memory. Plus support for interlaced and non-interlaced monitors. When it comes to features, we set the standard.

No one can beat our flexibility either. An integrated floppy controller and hard disk interface that support up to three floppy drives and two hard drives. Up to 16 MB of RAM on board using the new industry standard 32-bit memory modules leave all six expansion slots available. Our small footprint chassis includes both 5.25" and 3.5" floppy drives and 1 parallel and 2 serial ports. And consider this feature, our new 386/25 and 386/33 systems come standard with 5 drive bays to hold up to one

## Introducing Our New High Speed 386/25 System.

- 4MB of 32-bit high speed memory (Expandable to 16MB on board)
- 64K Cache memory (Expandable to 256K)
- High performance 1024 x 768 VGA with 256 colors including 1MB of video memory
- Super Hi-Res 14" VGA color monitor with tilt/swivel base
- 100MB IDE hard drive with Cache buffer
- 1.2MB 5.25" & 144MB 3.5" floppy drives
- 1 parallel & 2 serial ports
- 101-key enhanced keyboard
- MS DOS 4.01
- Microsoft Windows 3.0
- Hi-Res serial mouse

# \$2,695.00

386/33 This powerful system has Cache memory upgraded to 128K in addition to the features listed above for only \$2995.00.

Visit us at Comdex booth # N2193.

additional floppy drive or tape backup and 2 hard drives. So, we can help you add on and update to your heart's content.

Our research and development center is always striving for excellence. Since 1984 we've been designing our own products, and all of our system boards are manufactured right here in the U.S. When building our computers we utilize the latest surface mount and VLSI technology for the ultimate in product reliability and space saving design. Our performance and quality are simply the standard for our competitors to beat.

We are committed to providing you with a complete system that is ready to use the minute you open the carton. Everything is loaded, tested, burned in, and ready to go. And, in order to help you easily handle the new multi-tasking

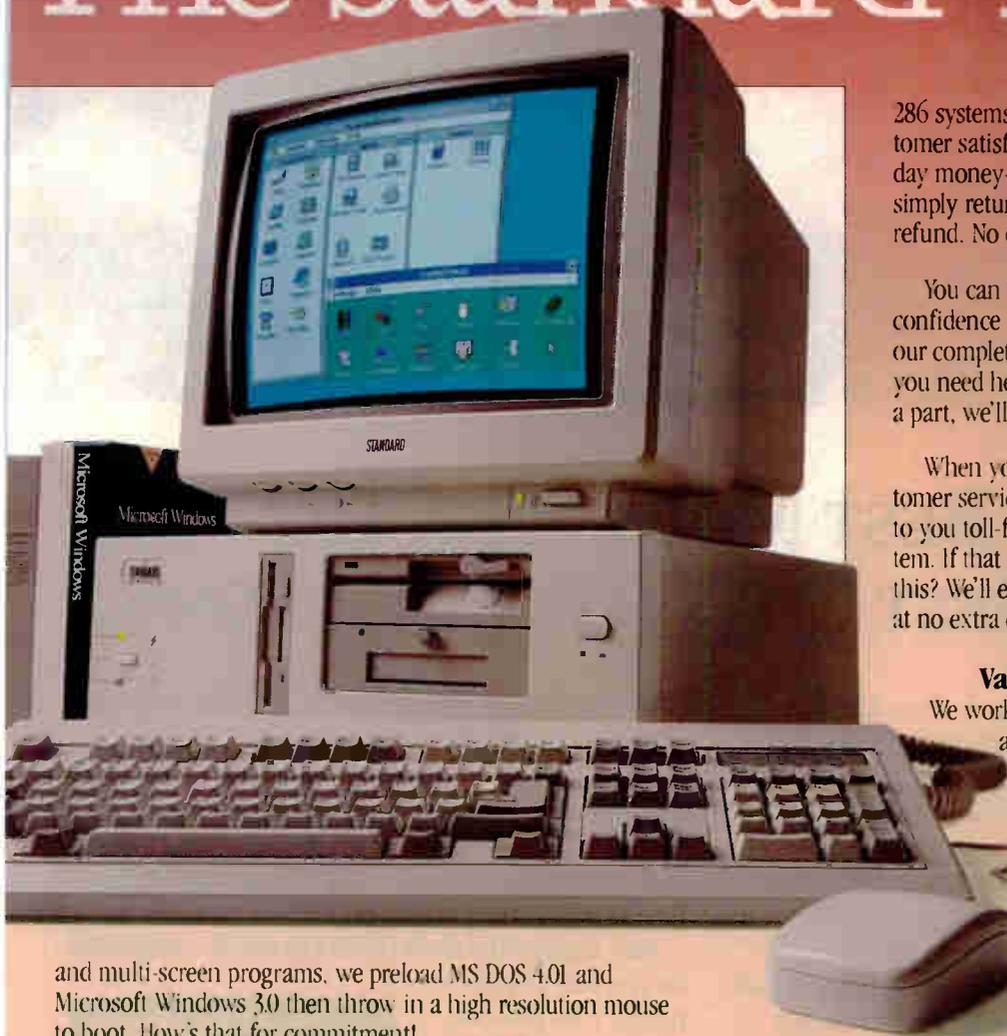
## Look At Our Other Value-Packed Systems

All of these fully-loaded systems include:

- 2MB RAM (Expandable to 8MB on board)
- High performance 1024 x 768 VGA with 256 colors including 1MB of video memory
- Super Hi-Res 14" VGA color monitor with tilt/swivel base
- 1:1 interleave Floppy/Hard Disk Controller
- 40MB 28ms Hard Disk Drive
- 1.2MB 5.25" & 144MB 3.5" floppy drives
- 1 parallel, 2 serial and 1 game port
- 101 key enhanced keyboard
- MS DOS 4.01
- 386SX includes Windows 3.0 and mouse

**386/SX at \$1895.00   286/16 at \$1595.00   286/20 at \$1695.00**

# The Best Value The Standard Thing.



and multi-screen programs, we preload MS DOS 4.01 and Microsoft Windows 3.0 then throw in a high resolution mouse to boot. How's that for commitment!

# 800/662-6111



We're also a Novell Gold Authorized Dealer, so you have total compatibility with all levels of the Novell operating system.

### **We Stand Behind Our Systems and Our Customers.**

At Standard Computer, we manufacture everything from high performance 486 and 386 systems to low cost 386SX and

286 systems. And we back them with our total customer satisfaction program beginning with a 30 day money-back guarantee. If you are dissatisfied, simply return your system within 30 days for a full refund. No questions asked.

You can buy from Standard Computer with total confidence because all systems are also covered by our complete one-year parts and labor warranty. If you need help, we'll see that you get it. If you need a part, we'll express ship it to you.

When you have a question, just call our customer service hotline. Our technicians are available to you toll-free for as long as you own your system. If that isn't enough protection, how about this? We'll even include one year of on site service at no extra charge.

### **Value That's Easy to Afford.**

We work hard to make it easy for you to own and use our products. That also includes offering many convenient ways to purchase or lease a Standard system. Our corporate leasing programs are designed to fit your business needs.

Qualified company purchase orders, personal checks and most major credit cards are also accepted.

So, go ahead. Pick up the phone and call us. Right now. Find out why we take so much pride in the exceptional products and services that we provide. Why our repeat customer rate is one of the highest in our industry. And why our product reliability is so famous. For us, it's just the Standard thing.

Standard Computer Corporation, 12803 Schabarum Avenue, Irwindale, CA 91706, phone 818/337-7711, FAX 818/337-2626.

**STANDARD**  
C O M P U T E R

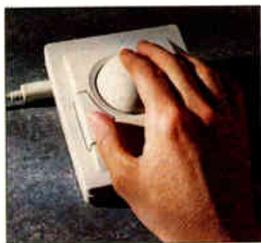
Circle 320 on Reader Service Card



# WHY THE BEST MOUSE FOR THE MAC IS YOUR BEST CHOICE FOR WINDOWS.®

In the graphical environment of the Macintosh® our Turbo Mouse® is number 1 in both sales and awards. That's why your choice for the graphical environment of Windows should be our PC version: Expert Mouse™.

What makes Expert Mouse outshine the rest? Superior optical hardware and unique software are the difference.



One button lets you pull down a menu or open a window. The other button can be set to "click-lock" for extended selections like automatic scrolling.

Press both buttons together and you activate our special "chording" feature. Chording gives you advanced features, like three-button emulation, without the inconvenience of lifting your hand off the ball.

What's more, our Custom Control Panel lets you adjust both acceleration and double-click speed to match the way you work. It even lets you decide which button performs what function.

Best of all is the way Expert Mouse feels — solid and comfortable, with an easy ball movement that means no jumping or sticking.

And Expert Mouse is 100% Microsoft compatible. So you will be able to run all your favorite Windows applications.

Windows can make your computer a lot easier to use. Now, the Kensington Expert Mouse will make it even easier.



For a free brochure and the dealer nearest you, call 800-535-4242. Outside the U.S. 212-475-5200.

**KENSINGTON.**

Expert Mouse is a trademark and Kensington and Turbo Mouse are registered trademarks of Kensington Microware Limited. Microsoft and Windows are registered trademarks of Microsoft Corporation. Macintosh is a registered trademark of Apple Computer Inc. © 1990 Kensington Microware Limited.

# TALES FROM THE TRENCHES

## An OS/2 device-driver specialist talks shop

**I**n January of 1989, I was giving a presentation on OS/2 to representatives of a prospective client. They had a DOS-based system for data acquisition that lacked the ability to simultaneously gather and process data. They had done their homework and concluded that OS/2 could do the job, but they weren't convinced that Unix could not do the job as well.

It was a perfect application for OS/2. The system had to monitor serial-bus transactions and voltage levels in real time, and it had to act on certain conditions immediately. This quickly ruled out Unix, which lacks a preemptive, time-critical kernel.

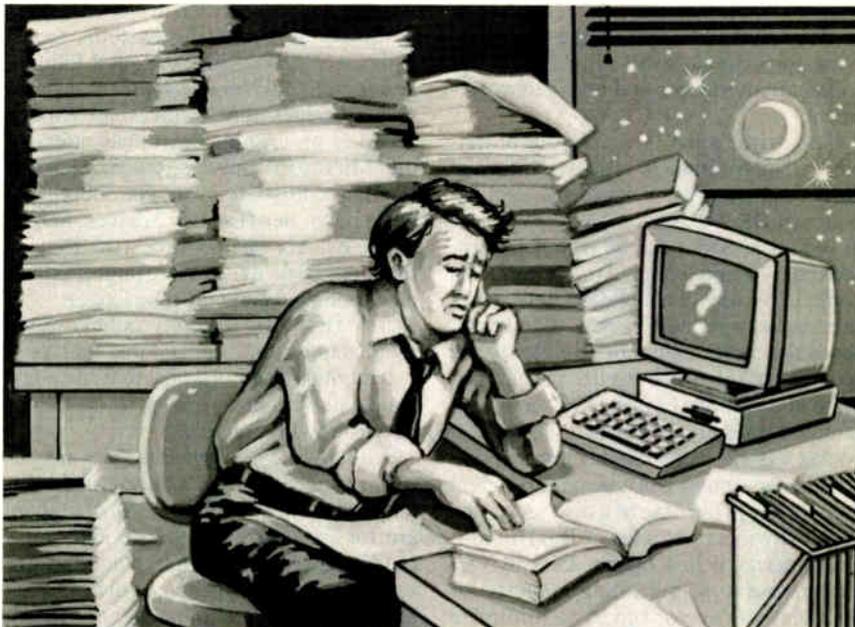
I gave an upbeat presentation, and everything was going well until one of the senior engineers asked an obvious question: "Of course, we can get device drivers for our special hardware, right?" I did some hand-waving and went on to other topics, promising I'd get back to them regarding the drivers.

When I called the various hardware vendors, I got the same answer every time. "Sorry, we only have DOS drivers. We'd like to support OS/2, but we don't have anyone who knows how to write them. We understand they are extremely hard to write, and only a few customers have asked for them anyway." I decided to find out why. Why should writing a device driver for OS/2 be so difficult?

I packed my bags and headed out to Microsoft University for the OS/2 Driver Writing course. The class ran for one week, and it was one of the most intense I have ever attended.

### Device-Driver Basics

When an OS/2 application needs to perform I/O, it makes an I/O request call to



the kernel. The kernel verifies the request, translates it into a driver request packet, and calls the device driver for service. The driver handles all the hardware details: I/O addressing, timing, register setup, interrupt handling, and error checking. When the device responds, the driver massages the data into a format recognizable by the application, sends back the data (or a status message), and notifies the kernel that the request is complete.

If it can't handle the request right away, the driver may either block the requesting thread or return a "request not done" to the kernel. Either way, the driver relinquishes the CPU and lets other threads run. If there's an error, the driver relays it to the kernel along with a "request complete" status.

What makes OS/2 drivers unique is the need to operate in both real mode and protected mode. Addresses computed in real mode are not valid if the system

switches to protected mode, and vice versa. The driver has to handle such mode switches on the fly. Understanding this bimodal operation is the key to writing OS/2 1.x drivers. Several Device Helper (DevHlp) routines support bimodal operation, but learning how to organize them properly can be harrowing.

### Jumping into the Deep End

When I got back from Microsoft University, I was anxious to plunge into my first driver. I ordered the device-driver development kit (DDK) from Microsoft, which comes with the all-important kernel debugger. KDB is a replacement kernel that, among other things, has knowledge of driver structures. For instance, to display a request packet, you can use the command `.d req es:bx`. KDB formats the data and displays it in request packet form. Don't even think about writing an OS/2 driver without this tool!

I began with a simple, do-nothing

driver based on examples given in the course. It worked perfectly. Next, I tackled the real project. My client needed a driver for an eight-channel A/D board. The board used an intelligent interrupt-driven controller and could do DMA transfers. I fumbled furiously through my student documentation for examples of how to implement such a driver and broke out in a cold sweat. There were no examples of interrupt handlers, no examples of DMA operation, and no examples of user-defined I/O control functions.

Microsoft, when I called for help, referred me to Compaq (I'm using its version of OS/2). Compaq referred me back to Microsoft. I searched the computer bookstores to no avail. Finally, I just rolled up my sleeves and began to experiment.

The driver's job is simple—in principle. It has to manage requests from the kernel and return results to the application. An OS/2 driver receives two kinds of requests: Some can be completed immediately, and some can't. Requests come in by way of a standard data structure called a request packet. The kernel sends the driver a bimodal pointer to the request packet. Since the driver must operate in real mode or protected mode, the bimodal pointer ensures that the request packet will be accessible in either mode.

When a request can't be handled right away (e.g., in the case of a disk seek), the driver (by means of a set of DevHlp routines) places it in a queue. Disk drivers can choose to sort pending requests for disk seeks in sector order, to minimize seek time.

OS/2's threaded architecture assigns one extra responsibility to the device driver. When a driver can't handle a request right away, it blocks the requesting thread; when it completes the request, it unblocks the thread.

### Tools for Driver Development

The DDK comes with a three-ring binder containing driver structures, descriptions of the DevHlp routines, and instructions for using the KDB. I found only the first 40 or so pages useful. The book does describe the DevHlp routines in detail, but it contains no examples of working drivers.

I write all my device drivers, including interrupt handlers, in Microsoft C 6.0 with maximum optimization. Don't waste your time writing your driver in assembly. Writing a device driver in C takes about half the time it would take to write the same driver in assembly, and the driver will work just as well.

Another useful tool is DDC.LIB,

which is a C-callable device-driver library from PentaSoft (17541 Stone Ave. N, Seattle, WA 98133, (206) 546-0470). Probably the most important function in DDC.LIB is Transfer, which transfers data between the driver and applications and accounts for mode switching during the transfer. It handles transfer of data from virtual memory to physical memory, physical to virtual, virtual to virtual, and physical to physical. If you're serious about OS/2 driver development, this library is a must.

### Light at the End of the Tunnel?

Anyone who has written drivers for other multitasking operating systems (e.g., Unix or VMS) will have a good foundation for OS/2 driver development. Microsoft estimates that it takes an experienced C programmer who has attended the Microsoft University OS/2 Driver Writing course four to six months to write his or her first OS/2 driver. Subsequent drivers should take two to four months. Disk drivers are significantly more complex and may take longer.

My first driver took roughly three months to write. The next one took only two months, and I was able to write a few simple drivers in a week or so, so it does get easier with practice.

Although OS/2 device drivers are becoming more common nowadays, the situation remains fairly grim. Most of them are for specialized hardware and aren't readily available. What's needed are standard, general-purpose drivers that can be adapted to more generic hardware. For instance, I would like to see an OS/2 driver for a CD-ROM drive, fax card, or tape drive, yet none are available. Why not? There are certainly more customers now who need OS/2 drivers. Without them, the operating system of choice may not be OS/2.

OS/2 2.0 won't make the task of writing device drivers any easier. True, version 2.0 will run DOS applications in protected mode, so the driver won't have to concern itself with bimodal operation. But the driver architecture for DOS programs will change radically. DOS programs will now call a Virtual Device Driver instead of accessing the device hardware directly. The VDD will massage the request and send it to a Physical Device Driver. The PDD will perform the low-level hardware communication with the device and send the data back to the VDD.

The VDD interface is new, while the PDD is nothing more than an OS/2 1.x bimodal driver with the real-mode sections removed. The VDD will emulate

the BIOS and other interrupt functions, letting a DOS application assume it is talking directly with the device when it is actually communicating with the VDD. Protected-mode applications will continue to call OS/2 drivers, as in version 1.x, but can use 0:32 ("flat model") addressing.

In June, Microsoft announced a new device-driver architecture for mass storage devices called the layered device-driver architecture (LADDR). Microsoft claims that LADDR can reduce by 90 percent the time to develop an OS/2 mass storage device driver. I hope this is true, but based on what I've seen so far, I wouldn't bet the farm on it.

A new DDK will come with standard driver code, so the developer need only add the code specific to the device itself to implement a fully functional driver. I haven't seen the new DDK yet, so I can't verify Microsoft's claims. At the time of this writing, Microsoft still had no firm release date for the LADDR kit. Non-mass storage drivers will continue to be written using conventional methods.

Neither IBM nor Microsoft has done enough to help the people trying to produce the drivers that OS/2 so desperately needs. The DDK upgrade from version 1.1 to 1.2 is way behind schedule, and the NDDK, used to develop network card drivers for the Extended Edition, is also late. The version 1.1 DDK does not work with PS/2 machines, so drivers must be developed on Industry Standard Architecture bus systems.

Information is still sketchy and incomplete. Although more books have appeared, none show examples of device drivers written in C. Most of the available documentation describes the DevHlp routines and their calling sequences, but not how to organize them into an actual driver.

What is needed is a driver writer's guide to take the mystery out of OS/2 driver writing. The guide should contain examples of actual drivers written in C, not scattered code fragments in assembly. It should also contain a list of helpful functions to aid in driver coding and debugging. Until such information becomes available, device drivers will remain the Achilles' heel of OS/2. ■

*Steve Mastrianni is an independent consultant in South Windsor, Connecticut, who specializes in OS/2 device drivers. He can be reached on BIX c/o "editors."*

*Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

After everything  
you've heard  
about Windows  
Computing,  
there are only  
two things you  
should believe.

# Windows™

## *Free Working Model*

# Your

See for yourself. With Windows™ Computing, using your PC becomes easier, faster, and more productive than you ever imagined possible. But you don't



*Windows Computing is the Windows version 3.0 environment combined with any of the hundreds of Windows applications already available.*

have to take our word for it. Because, right now, we're making fully functional Working Models of Microsoft® Windows version 3.0, Microsoft Excel, Project, Word and PowerPoint® presentation graphics program as easy to get a hold of as they are to use.

Just pick up the phone and call (800) 323-3577, Dept. N61, and we'll

\*The first Working Model you select is free during our Windows Computing Promotion, September 15 through December 31, 1990. One free Working Model per person. Each additional Working Model is \$9.95, applicable sales tax not included. Offer good while supplies last.

# Computing

---

**Microsoft®**

eyes.

send you a free copy of the Working Model\* you're most interested in.

Or, if you would prefer, just ask for the date, time and location of a Windows Computing seminar being held near you. Either way, the experience is sure to impress you.



The truth is, we believe there could be only one reason why people might not see just how much Windows Computing means to the future of the personal computer.

They haven't looked.

**Microsoft®**  
Making it all make sense™

Applies last and only in the 50 United States. © 1990 Microsoft Corporation. All rights reserved. Microsoft, PowerPoint and the Microsoft logo are registered trademarks and Making it all make sense and Windows are trademarks of Microsoft Corporation.

# SHORT TAKES

BYTE editors' hands-on views of new and developing products

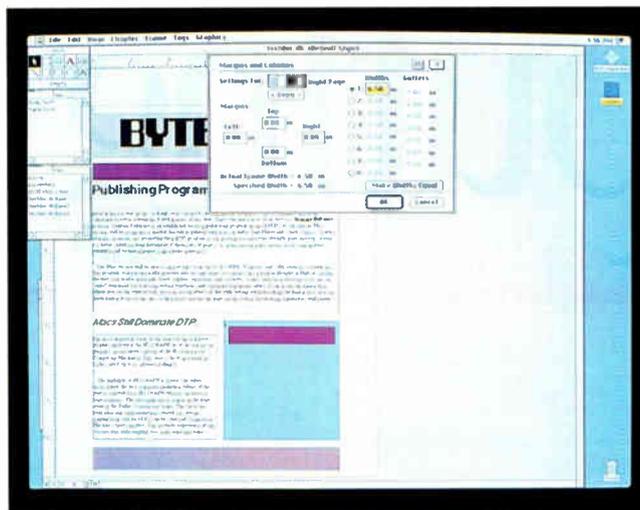
Ventura Publisher,  
Macintosh Edition 1.0

ScanMan 256

NewWave 3.0

WinSleuth

WordPerfect Rhymer



## Ventura Meets the Mac

If you work in a mixed-machine environment in which some people are using Ventura Publisher on their PCs, the arrival of **Ventura Publisher, Macintosh Edition 1.0**, is good news.

Ventura Mac is a straightforward port of the version running under Windows, which makes jumping between systems easy; if you've learned one, you've basically learned the other, and that's what platform hopping is all about. I was able to take a diverse bunch of Ventura files that the BYTE Lab staff had generated on DOS machines, move them to the Mac (using the BYTE LAN and LapLink), and open them up, with their styles and formats intact. This was painless. The fact that you can easily swap Ventura-published documents between PCs and Macs is one of the greatest advantages of this program. Only Aldus PageMaker 3.0 currently provides this capability.

Working in a diverse environment is a Ventura forte. Besides letting you swap between Macs and PCs, this program will pull in text from most word processors you're likely to run across and graph-

ics from most drawing or painting programs.

Ventura is also good at working with long documents. You can line up a string of text files, and the program will run them from page to page, almost automatically, setting up the extra pages as needed. Ventura is built for this kind of work. With its cross-referencing and indexing capabilities, it's essentially a book-oriented page composer.

For doing a long but straightforward publication—no fancy layouts, few graphics—Ventura is a good choice. But for documents with a snazzier look, a more complex page structure, and heavy on the graphics, Ventura is—and here we walk into the shadowy land of subjectivity—hard to work with. Maybe I've been using PageMaker too long, but

I find it far more flexible for page design. Its approach, descended from the cut-and-paste world of the composing room, feels right. Ventura is more geometrical. Like some other popular programs, Ventura uses frames. Everything you do has to be within a frame (a rectangular area). You can expand and shrink these frames, and you can move them around on the page easily enough, but we're still talking rectangles. I find this confining.

While PageMaker is an excellent tool for designing layouts, letting you freely move things around and change widths, lengths, and shapes of columns, Ventura is more of a layout fulfillment program. I'd recommend sketching your page design on paper first.

Ventura does beat the pants off PageMaker in a couple of things, particularly working with tabular material. Setting up a table with PageMaker almost hurts. Ventura has a wonderful dialog box in which you specify how many rows and columns you want; you hit a button, and there it is—a nice grid that you can jump around in, from cell to cell, using pointer or cursor keys. The program also excels at setting up equations, which can be a typesetter's nightmare.

Another of Ventura Mac's strengths is in stylizing the text on the page. The program will let you assign a style (e.g., type of font or character size) to every paragraph. You can keep these different styles in a catalog of sorts. This collection of style sheets can also include specifications for the page itself.

There's not room here to cover all the capabilities of Ventura. For a better look at this and other desktop publishing packages, see "Is the Typesetter Obsolete?" in the October BYTE. And before you buy, take them all for a test drive.

Page-layout software, like any other program that combines functionality and aesthetics, is a highly subjective matter. What one person finds excellent is execrable to someone else. What one user finds intuitive is arcane to another. I know totally reasonable people who swear by Quark XPress, and professional graphics designers who concoct fine-looking materials with Ventura. Although I wouldn't want to switch from PageMaker to Ventura, I can't say it's not right for you. This is a good program that does what it's designed to do. The question is: Does it do what you want to do?

—D. Barker

### THE FACTS

**Ventura Publisher,  
Macintosh Edition 1.0**  
\$795

**Requirements:**  
Mac with 2 MB of RAM,  
System 6.0.2, Finder

6.0.2, and a hard disk drive.

Ventura Software  
15175 Innovation Dr.  
San Diego, CA 92128  
(619) 673-7524  
**Inquiry 1160.**

## Logitech Puts Photo-Realism in Windows

The **ScanMan 256** is a 256-gray-level scanner that can scan at up to 400 dots per inch. It is similar in appearance to previous Logitech scanners but has a number of functional improvements. The scanner itself is in a head a little over 5 inches wide. Below this is the body of the scanner, which you hold to move it. The body has a number of switches that you use to set the various scanner modes. The ScanMan 256 also has an indicator light that shows if a scan is being made at the right speed.

The ScanMan 256 is designed to be used in a Windows 3.0 environment. It comes with a gray-scale scanning and editing package called Ansel, which controls the scanner directly from within Windows 3.0 and provides some easy-to-use tools for editing. Logitech has provided a simple DOS Scan utility that lets you scan, view, and save images without entering Windows 3.0 or using Ansel. However, it isn't as flexible or as easy to use as Ansel, and it doesn't include editing tools.

Installing the scanner and



### THE FACTS

**ScanMan 256**  
\$499

*Requirements:*  
IBM PC or compatible  
running Windows 3.0.

Logitech, Inc.  
6505 Kaiser Dr.  
Fremont, CA 94555  
(415) 795-8500  
**Inquiry 1161.**

software is easy. Logitech has set the defaults to match the most likely free configurations. All I had to do was plug the scanner board in my system, plug in the scanner, install the software using the supplied

Install program, and start scanning. Setting up the scanner in any of its different modes is done simply by setting the switches. The controlling software reads these automatically and adjusts accordingly.

Choosing the right setting for a scan is not a simple matter. With the range of options available, it becomes important to make a careful choice. The problem lies in the size of the image files created at high resolutions with large numbers of gray scales. A simple 2- by 2-inch image takes up almost 2 megabytes at 300 dpi with 256 gray scales. This taxes the memory of the system considerably. Logitech has devised its own system for paging image data to and from disk to counteract this, but the bottom line is that if you want to scan images at 300 or 400 dpi with 256 gray scales, you'll need a lot of memory. What setting you choose also depends on whether you want to use line art, perform optical character recognition, or have true gray-scale images.

I scanned a range of actual photographs and some from magazines, and the quality of the results was extremely good at all levels. Overall, I found the ScanMan 256 an extremely powerful and flexible scanner. It is useful for scanning small documents and all kinds of images. But I would recommend that you make sure that your system can deal with the kind of large files that a scanner this powerful can create.

—Owen Linderholm

## Hewlett-Packard's Newest Wave for Windows

One of the most interesting—and potentially most important—applications to appear for Microsoft Windows 3.0 is an updated version of Hewlett-Packard's **NewWave** environment. There are two ways of looking at this program: as a set of reasonably priced utilities for Windows, or as a glimpse of what most graphical user interfaces

(GUIs) will be like in the future.

This latest version of NewWave introduces an Agent capability, which is essentially a powerful keyboard macro facility. To perform a given task, all you need to do is select that task's icon and drop it on the Agent icon, which looks remarkably like Patrick McGoohan in the

"Secret Agent" TV show. One of the nice things about this macro facility is its ability to do tasks on a routine basis (e.g., every hour, day, or week).

Another important feature of this new version is network support, which lets users share NewWave features.

Perhaps the most important feature of NewWave—and the

hardest to describe adequately in a simple features list—is its support of objects.

NewWave has no data files as such. There are only objects, which are data files that have been linked to a NewWave application. One important type of object is a folder, which functions much like a Macintosh folder. It can contain other objects, and you

organize your desktop, or Office, as NewWave refers to it.

There are also no applications as such. What look like applications are really tools—specialized folders that store, print, or delete the objects dropped onto them.

Creating a new data file in NewWave involves an unusual process. For example, in Windows, you start a new spreadsheet data file by first clicking on the Excel icon and opening a new file. In NewWave, you instead select the menu command Create a New Object. A dialog box then asks you what type of object you want to create. You could then select a Lotus 1-2-3 object and give it a name. An icon for a Lotus object would then be displayed on the NewWave Office workspace. When you click on this application, NewWave will automatically load 1-2-3 and launch you into the data file you selected.

The most important capability of NewWave's objects is their ability to incorporate other objects. Unfortunately, only those objects that are linked with a small number of true NewWave applications have this capability. For example, NewWave Write, the



#### THE FACTS

**NewWave 3.0**  
\$195

*Requirements:*  
IBM AT or compatible  
with a hard disk drive, a  
mouse, and Windows 3.0.

Hewlett-Packard  
Santa Clara Information  
Systems Division  
3410 Central Expy.  
Santa Clara, CA 95051  
(408) 749-9500  
**Inquiry 1162.**

NewWave version of the simple Windows Write word processor, can incorporate 1-2-3 objects, but 1-2-3 objects cannot incorporate other objects.

Since NewWave Write has the capability to incorporate

other objects, it is actually a fairly impressive word processor. In a NewWave Write document, you can insert tables from 1-2-3, graphics from HP's optional DOS-based graphics programs, and simple annotations. And as

more object types appear (made possible by new NewWave applications), NewWave Write will continue to acquire new capabilities.

Unfortunately, there's a dark side to NewWave. For one thing, the program is huge. It takes up about 7 megabytes of disk space and requires quite a long time to install.

NewWave also suffers from a lack of applications. Only a handful of programs now work well with it. Some sorely needed applications that HP would do well to add are NewWave versions of Windows Paintbrush or Terminal.

In some cases, the program could be markedly improved by simple additions. For example, you can incorporate 1-2-3 tables into NewWave Write documents, but you cannot change the font that the tables appear in. If you could change the font, NewWave could function as a nice complementary program for 1-2-3.

NewWave is a very interesting program, and it's available at an affordable price. It is probably true that someday all GUIs will be like it. But it needs a few more applications before it becomes a required day-to-day business tool.

—Rich Malloy

## Peeking Through Windows

The original System Sleuth for DOS was a diagnostics package that snooped around your PC and told you all sorts of goodies about its configuration, including the microprocessor type, how much and what kind of memory was available, and the results of power-on self tests (POSTs). It also fished out a lot of esoteric but important data about I/O cards, hard disk drive partitions, device drivers, and TSR programs.

Moving the package to the Windows 3.0 environment, Dariana Technology Group confronted an interesting dilemma: When a PC runs in protected mode instead of real

mode, a lot of nuts-and-bolts information about the computer becomes invisible or irrelevant. So what's left to diagnose?

Plenty, as it turns out. Dariana's new **WinSleuth** still delivers pages of data that can help you summarize your system's configuration, resolve board conflicts, or identify nagging software incompatibilities. Even without its diagnostic capabilities, the package might be indispensable for system administrators, who could print out and file a complete report about every system in their facility.

Gone from WinSleuth—when it is running in Windows

standard or 386 enhanced modes—is the low-level data about memory allocation, disk drive partitions, and device drivers, since these are handled by Windows. If the package is run in Windows' real mode, however, more low-level information is provided, although some of it isn't relevant to the behavior of the system in protected mode.

What is gained in WinSleuth—aside from an attractive and very simple graphical user interface—is specific information about the Windows environment, including how it has allocated available memory, which drivers it is using to talk to your peripherals, and

how it is managing tasks. The new release also adds a file viewer for peering into your hard disk and a new module for analyzing network connections.

The rest of the package is organized similarly to the DOS version, as a series of modules addressing different subsystems: microprocessor, POSTs, hard disk drive, video/display, RAM, I/O cards, printer, and DOS.

For example, the General Information section tells you what CPU you are using (although not the clock speed), if you have a math coprocessor, and how many and what kind of I/O ports and storage

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

**SOFTWARE  
PROTECTION**

**Windows 3.0  
Support Available**

## We'll Never Tell...

... the world how we protect your hard work. But then, why should we? It's not that we're hard to get along with. On the contrary. We'll show you how our unworried approach to software protection can actually work better for you. We'll deliver the best balance of guaranteed copy control and cost-effective installation.

Unlike other manufacturers, our hardware is *uniquely custom-wired for each developer* and supplied with a specific *encrypted interrogation routine* for maximum security.

The precise routines assume responsibility for all hardware, software and timing issues so your time and money isn't wasted engineering protection schemes.

The Products That Protect Your Revenues

- ▶ **PROTECH KEY**  
Identically reproduced packages.
- ▶ **MEMORY KEY**  
**MACINTOSH MEMORY KEY**  
**NEC MEMORY KEY**  
Active protection, modular packages, customized packages, serialization, demo control, access control.
- ▶ **MEMORY-ONE KEY**  
Customized packages, modular packages
- ▶ **MICROPROCESSOR KEY**  
Non-operating system specific protection based on RS232C communications for minicomputers, workstations, etc.



**In EUROPE:**  
MICROPHAR, 122 Ave. Ch. De Gaulle 92200,  
Neuilly Sur-Seine FRANCE Tel: 33-1-47-38-21-21 Fax: 33-1-46-24-76-91

**For distributors in:**

- BELGIUM/NETHERLANDS. E2S (091 21 11 17) • SPAIN, (343 237 31 05)
- IRELAND, TMC (021 87 37 11) • GERMANY, Microphar Deutschland (06223 737 30)
- PORTUGAL, HCR (1 56 18 65) • UNITED KINGDOM, Clearsoft (091-3789393)
- SWITZERLAND, SAFE (024 21 53 86) • ITALY, Siosistemi (030 24 21 074)



**PROTECH**  
MARKETING, INC.

**1-800-843-0413**

**In the U.S., the AMERICAS & the PACIFIC:**  
PROTECH, 9600-J Southern Pine Blvd.,  
Charlotte, NC 28217 *Se Habla Español*  
Tel: 704-523-9500 Fax: 704-523-7651  
Hours: Mon-Thurs: 8:30-7:00 ET, Fri: 8:30-5:30 ET

FOR A DEMONSTRATION PACKAGE OR ADDITIONAL  
INFORMATION, PLEASE WRITE OR CALL.

\*Macintosh is a registered trademark of Apple Computer, Inc.  
\*NEC is a registered trademark of NEC Information Systems, Inc.

For Europe, circle 291 on Reader Service Card

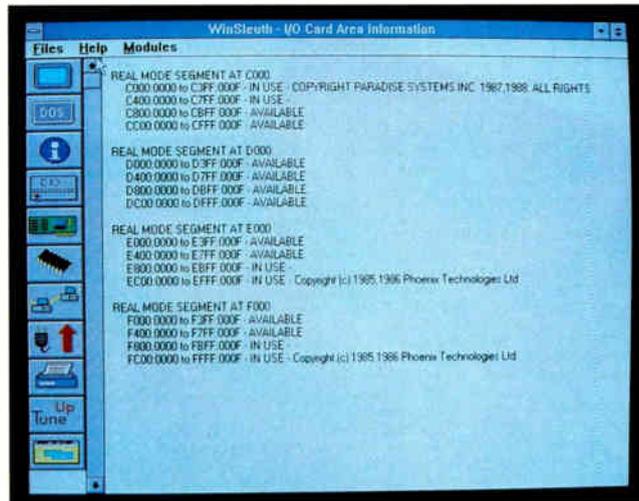
World Radio History

For Americas & Pacific, circle 292 on Reader Service Card

peripherals are installed.

The modules affected by the difference between Windows modes include hard disk drive, DOS, and RAM. The hard disk drive module always tells you how many sectors and file allocation tables you have, but in real mode you can also see partition information. In real mode, the DOS module shows you device drivers and TSR programs. The RAM module, in 386 enhanced mode, gives you extensive information on memory allocation by the DOS Protected Mode Interface memory manager.

Perhaps the most useful features of WinSleuth are its help system and Windows Tune-Up module. The on-line help is like a short course on the inner workings of PCs and



Windows; I recommend working your way through each topic. And if you need advice on getting the best perfor-

mance out of your system under Windows, run the Tune-Up for suggestions that range from adding more RAM, to

**THE FACTS**

**WinSleuth**  
\$149; \$60 upgrade for System Sleuth owners

**Requirements:**  
IBM PC or compatible with Windows 3.0.

Dariana Technology Group, Inc.  
6945 Hermosa Cir.  
Buena Park, CA 90620  
(714) 994-7400  
**Inquiry 1163.**

optimizing your hard disk drive, to removing conflicting extended memory managers.  
—Andy Reinhardt

## Could WordPerfect Rhymmer Be Finer?

**W**ordPerfect Corp. has come up with a truly unique writer's helper in **WordPerfect Rhymmer**, a 93,000-word American English rhyming dictionary.

Rhymmer is a tool for the student of the *sound* of language. A TSR program requiring 34K bytes of RAM, Rhymmer searches for a variety of rhymes and phonetic patterns. It works with any DOS word processor.

Being a sucker for a good rhyme, I loaded Rhymmer onto my hard disk. The program took up a mere half-megabyte of storage space, which was good news. The program worked fine with my word processor and my other TSR dictionary, neither of which carries the WordPerfect label.

To see whether Rhymmer could determine which words have multiple pronunciations, I requested a triple rhyme for the word *interested*. The results were positive. Rhymmer asked me to select between the pronunciations "in-tu-rus-ted" and "in-trus-tud" before beginning its rhyme search.

Although Rhymmer isn't designed for regional U.S.

dialects, it does include a phonetic finder to help you tailor your rhyme search to suit your speech patterns. This feature includes a phonetic chart—

similar to a pronunciation key in the front of a dictionary—that lists a variety of sounds, including vowels, stops, fricatives, affricates, liquids, and

glides. If your pronunciation of the word *car* sounds more like "cah," for example, you can instruct Rhymmer to search for words with the <aw> vowel sound. And you can control the scope of your rhyme hunt by limiting the number of syllables and letters you want the program to search for.

I had just one major complaint about Rhymmer: The program displays only 24 rhymes at once. Once you hit Enter to see additional rhymes, you can't go back to review the previous list. Since many words have dozens of rhymes, it would be helpful to be able to page through an entire list—much as you page through a word processing document. You can configure Rhymmer to save all rhymes in a DOS text file, however, but you must first exit the program to view the list.

No doubt someone will eventually include a rhyming utility with a spelling/grammar checker program, or perhaps with an on-line dictionary, but until then, Rhymmer is good enough for the rhyming fool in all of us. ■

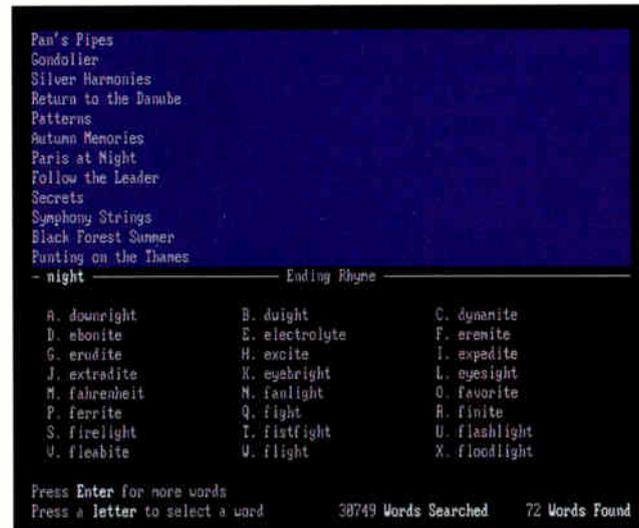
—Jeff Bertolucci

**THE FACTS**

**WordPerfect Rhymmer**  
\$79

**Requirements:**  
IBM PC or compatible.

WordPerfect Corp.  
1555 North Technology Way  
Orem, UT 84057  
(801) 225-5000  
**Inquiry 1164.**





**The Brick**  
3" x 8" x 11", Only 8.3 lbs.

# The Cure For The Common Clone.

## Introducing The BRICK™:

**386SX™ power, a 44-212 MB HD, 1-8 MB RAM, 1024 x 768, with a 2,400bps modem... and it fits in half a briefcase!**

Now you don't have to choose between the power of a desktop and the portability of a laptop. The Brick™ starts a whole new era of flexibility and convenience.

For some, the Brick is the perfect desktop PC. It has enough power, storage and graphics capabilities to run the most demanding applications. It's the

first desktop PC that's quiet enough, small enough, elegant enough not to be banished instantly to the floor.

For others, the Brick is an office computer and a home computer. The core module is no bigger than a collegiate dictionary, and weighs



only 8.3 pounds. Simply keep a full-sized keyboard and monitor at your home and office and carry only the

Brick in between. You can have one machine, with all your files, wherever you need it.

Complete systems start at just \$2,695.

### FREE CATALOG

You'll find complete information on all Brick systems, plus a full complement of enhancement products in our free 32-page catalog. All products come with a 30-day satisfaction guarantee, a one-year warranty, and unlimited 800-line support. Call **1-800-633-1925** today!



**Order Direct!**

**Call 1-800-633-1925 today**

Ergo Computing, One Intercontinental Way, Peabody, MA 01960 (508) 535-7510 FAX (508) 535-7512

Circle 127 on Reader Service Card

# If you think the HP LaserJet III is great,

ASTRONOMY IS **LOOKING UP**

THE MARCH REPORT OF THE SKIES VOL. 8, NO. 4, FALL 1990

---

**STAR SHORTS**

*Reported by The Star*

Every day billions of dust particles enter in to Earth's atmosphere. Now scientists are working to make them more useful communication a practical and economical alternative to the use of tele-

*You Can't See the Great Wall from the Moon!*

Everyone has heard that you can see the Great Wall of China from the Moon. Or from Earth orbit. Or even from Mars. Certainly you cannot see the Great Wall from the Moon. According to

an astronaut, it's difficult even seeing continents. You may be able to see the Great Wall from orbit, but, in general, it's difficult even to see familiar objects, the planet's swift motion.

*More on planetary explorations inside*

---

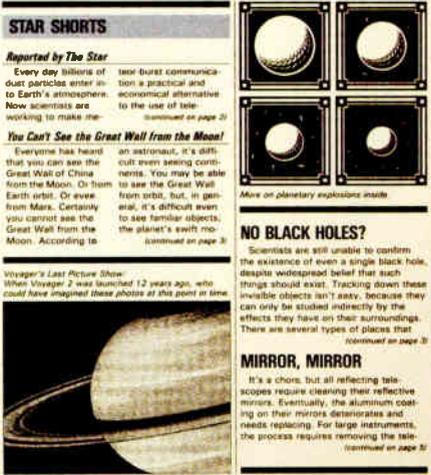
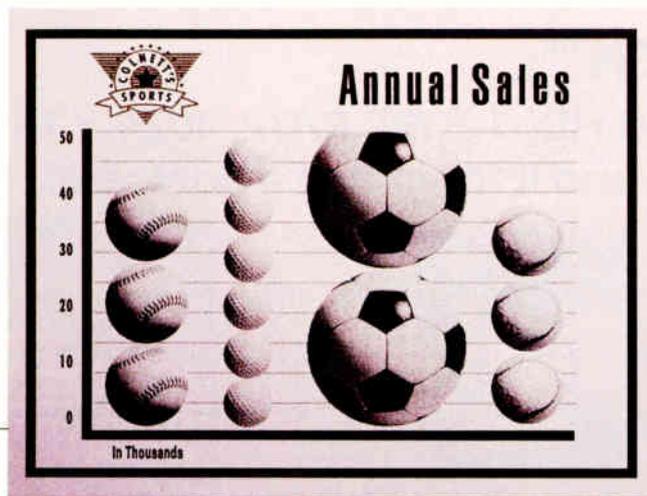
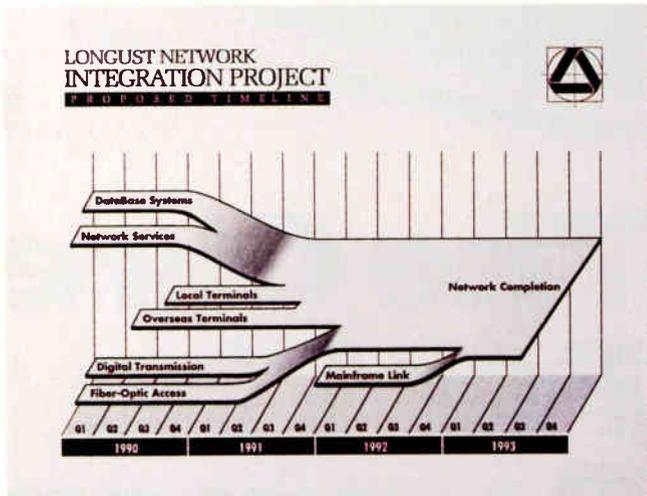
**NO BLACK HOLES?**

Scientists are still unable to confirm the existence of even a single black hole, despite widespread belief that such things should exist. Tracking down these invisible objects isn't easy, because they can only be studied indirectly by the effects they have on their surroundings. There are several types of places that

---

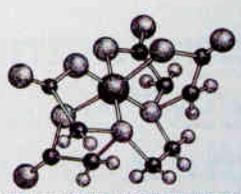
**MIRROR, MIRROR**

It's a chore, but all reflecting telescopes require cleaning their reflective mirrors. Eventually, the aluminum coating on their mirrors deteriorates and needs replacing. For large instruments, the process requires removing the tele-

**CHAIN REACTION**  
EAST'S CHEMICAL LETTER

JUNE 8, 1990  
VOLUME FIVE  
ISSUE THREE



- New Leaps in Metal-Organic Chemistry
- What's New in Superconductivity?
- Antimatter Bottled
- Fifty Years Ago

**Metal-organic chemistry bridges the gap between organic and inorganic chemistry. It can lead to important new products (for example, poison antidotes). A chelate, such as EDTA (which contains carbon, hydrogen, oxygen and nitrogen atoms) can surround ions of metals and remove them from unwanted places.** (continued next page)

**It was almost exactly three years ago that a ceramic material that superconducts above liquid nitrogen temperature was discovered. Within days of the discovery, electronics, power transmission, and transportation were being redefined in everyone's imagination. Yet superconductivity was not a new phenomenon. The effect was first observed in mercury in 1911, and, since then, more than 6000 elements, alloys, and compounds have been found to superconduct.** (continued next page)

**A device tested may give investigators a glimpse of what an antineutrino world might look like. The device cools antimatter to a temperature a few degrees above absolute zero and stores it for several days at a time.** (continued next page)

**Humor has it that before WWII, our chemists were experimenting with a distilling process to lower the caloric of ordinary beer. Abandoning the research at the onset of world war, researchers then pursued the development of a shell stable C ration. Don't believe all rumors.**

Introducing the new HP LaserJet IIID printer. The LaserJet that combines all of the advanced capabilities of the exciting LaserJet III with all of the paper-handling features required by today's busy office.

There's a lot to like. Like two paper trays for different types and sizes of paper. 200-sheet

capacity in each of those trays for less reloading. And two-sided printing that lets you easily condense your output. Even an optional automatic envelope feeder that eliminates manual feeding.

Equally impressive is HP's Resolution Enhancement technology.

Pioneered in the LaserJet III, this technology actually varies the sizes of dots. So curves really curve. Lines are never jagged. And you get resolution never before seen in a 300 dpi printer. Output has never looked so good.

Documents can be made even more elaborate thanks to our en-

\*Suggested U.S. list price. Adobe and PostScript are registered trademarks of Adobe Systems Inc. in the U.S. and in other countries.

# you'll automatically like the new HP LaserJet IIID.

Two-sided printing means better paper usage and more professional-looking documents.

Resolution Enhancement technology actually shrinks dots to handle the finest curves.

The optional envelope feeder allows for up to fifty envelopes.

Enhancements to our HP-GL/2 language allow you to reverse, scale, and shade output.

Two paper trays allow for regular or legal correspondence while also increasing paper capacity.



hanced PCL5 printer language, which includes HP-GL/2 graphics language. You can print regular or reverse type. Shaded text. Even portrait and landscape on the same page.

Beyond this, all types of options are available for all types of users. Which means you can customize with Adobe® PostScript® software. Add memory. Or better express yourself with our MasterType

library of fonts and typefaces. You can even connect a Macintosh.

The best part is that the \$2,395\* LaserJet III and \$3,595\* LaserJet IIID are both easily within any budget. So call 1-800-752-0900, Ext. 1586. We'll tell you where to find your nearest authorized HP dealer.



# Compaq Notebook Ups the Ante

The LTE 386s/20  
is the first notebook-class  
PC that has a 20-MHz  
386SX CPU and converts  
to a desktop system



Michael Nadeau

**T**ake a Compaq Deskpro 386/20, give it a faster hard disk drive, and squeeze it into a 7½-pound notebook-size format, and you have the Compaq LTE 386s/20. Worried about expandability? No problem; Compaq will sell you a Desktop Expansion Base that provides AT-compatible slots and mass storage expansion options and allows the LTE 386s/20 to double as your desktop system.

The LTE 386s/20 is unique on two counts: It is the first notebook PC to use the 20-MHz 386SX CPU, and it is the only notebook PC that is convertible to desktop use. (At this writing, only a handful of other vendors have announced

16-MHz 386SX notebook PCs; none are shipping at this time.) In fact, it is the only notebook PC powerful enough to compete with the typical desktop systems that businesses are buying today (see photo 1). There is a catch, and that is the LTE 386s/20's price tag: \$6499 for the base system; the Desktop Expansion Base is another \$1499—not including a full-size keyboard or external monitor. (All prices mentioned are not final, but Compaq says prices will not exceed those listed here.)

The base system, the Model 30, comes standard with 2 megabytes of RAM, a 4K-byte RAM cache, a 3½-inch 1.44-MB floppy disk drive, a 2½-inch 30-MB

Conner Peripherals hard disk drive, a 640- by 480-pixel VGA display, and system utilities. This version also comes with a full complement of I/O ports: one serial, one parallel, and one mouse port; ports for an external monitor, keyboard, and keypad; and an "external options interface."

The Model 60 comes with a 60-MB hard disk drive and lists at \$6999. It will be the first system to use the 2½-inch drives of that capacity. Compaq called the unit that I saw an early prototype, although it appeared to be of production quality and seemed fully functional. The LTE 386s/20 should be out by late October.



**Photo 1:** *The Compaq LTE 386s/20 is arguably the world's most powerful 7-pound PC.*

**LTE-Like in Looks Only**

At first glance, the LTE 386s/20 is identical to the original LTE except for color; it is beige instead of gray. On closer inspection, you can see differences in drive location, thickness, port arrangement, screen size, and some cosmetic aspects.

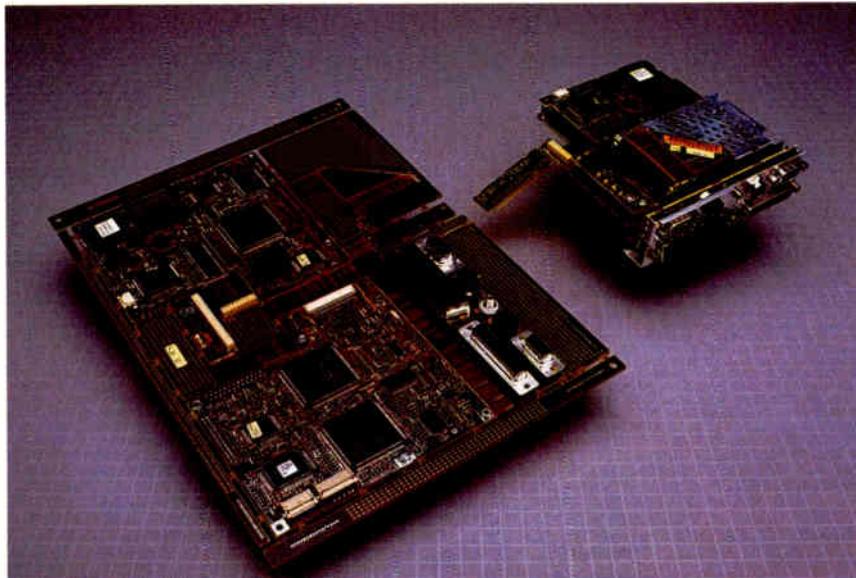
Compaq has a totally new design for the electronics, which determined the placement of the drives. For the motherboard, the LTE 386s/20 uses a manufacturing technique developed for the aerospace industry. If you look inside the computer, you'll see what appears to be a three-piece motherboard—two boards, one on top of the other, and a third board mounted vertically at the rear and

**PRELIMINARY BYTE BENCHMARK INDEXES: LTE 386S/20**

*The LTE 386s/20 is the fastest notebook-class PC that BYTE has benchmarked to date. It seems that Compaq simply shrank its Deskpro 386/20 and gave it a faster hard disk drive. The Dell 320LX is a 20-MHz 386SX desktop system included for comparison.*

	CPU	Disk	Video
Compaq LTE 386s/20	2.58	2.32	8.00
Compaq Deskpro 386/20	2.58	1.72	8.21
Dell 320LX	2.19	1.86	7.10

Benchmark results are indexed to show relative performance; higher numbers indicate better performance. For all indexes, an 8-MHz IBM AT running MS-DOS 3.3 = 1.



**Photo 2:** On the left is the LTE 386s/20 motherboard before it is punched out from its silicon casing. On the right is the motherboard as it is installed in the computer.

holding all the ports. These three components are manufactured as one sheet, connected by the cabling and thin silicon tabs. A machine "punches out" the motherboard along these tabs, and then, after the components are in place, it is folded by hand into its proper configuration (see photo 2). The procedure speeds assembly and helps conserve space inside the unit.

A major weakness of the original LTE was its CGA display with its less-than-perfect aspect ratio. Compaq saw the light and gave the LTE 386s/20 a full VGA display, although this added a smidgen to the unit's thickness. The screen is edge-lit and has good contrast and even light distribution.

All the ports congregate behind a sliding door (a nice touch) to accommodate the Desktop Expansion Base with its own I/O ports, which are extensions of those on the notebook. Unlike with the NEC

ProSpeed SX/20 (see "The NEC ProSpeed SX/20: Take It and Leave It," September BYTE), you must maintain separate CONFIG.SYS and AUTOEXEC.BAT files for the portable and desktop configurations of the LTE 386s/20 (this is especially important if the desktop version is on a LAN), and you must remember to use the correct combina-

tion. Unfortunately, no prototype of the Desktop Expansion Base was available for me to see. Its features include two full-size 16-bit expansion slots, monitor and keyboard ports, and two 5¼- or 3½-inch drive bays.

What has not changed on the LTE 386s/20 is the keyboard. It is the same 80-key IBM Enhanced-compatible layout. Key travel is somewhat less than what you find on desktop units, but the tactile feedback is adequate. I prefer the familiar inverted *T* arrangement for the cursor movement keys, rather than Compaq's cumbersome reclined *L* configuration.

Memory expansion makes use of the increasingly popular RAM cards. The LTE 386s/20 has two slots into which the credit-card-size RAM cards slide. Prices for the RAM cards, which come in 1-MB and 4-MB configurations, are \$549 and \$2599, respectively.

Compaq claims a battery life of about 3 hours. I didn't have the opportunity to verify that; it is about an hour less than

the rated time for the original LTE. The LTE 386s/20 has a fast-charge feature built into the system that brings the battery back to full capacity in 1½ hours.

#### Early Assessment

The preliminary BYTE Lab low-level benchmark indexes place the LTE 386s/20 on a par with the Compaq Deskpro 386/20 in the CPU and video categories, but the notebook's speedier hard disk drive bests the Deskpro's index of 1.72, with a score of 2.32 (see the table). No other notebook-class PC even comes close to this performance. The LTE 386s/20 will run any software that you are likely to use, and at an acceptable pace.

The price will scare away casual users and many cash-conscious businesses, but the LTE 386s/20 seems to have what computing-dependent businesses need: power and flexibility. Compaq's reputation for high quality and compatibility further enhances the product. (Some of the original LTEs did have a problem with cracking cases; Compaq insists that it has solved that problem by going with a stronger plastic for the case.) But price aside, Compaq has produced the high-performance notebook PC against which all others will be compared. ■

*Michael Nadeau is the managing editor of the BYTE Lab. You can reach him on BIX as "miken."*

#### THE FACTS

**Compaq LTE 386s/20 Model 30**  
No more than \$6499

Compaq Computer Corp.  
P.O. Box 692000  
Houston, TX 77269  
(713) 370-0670  
Inquiry 1079.

# They Left out Features.... We Left out the **COMMA!!**

## The only thing missing...

is the comma in the price. If you look at the chart on the right you will see prices charged by our competition. All but one contain a comma. **DesignCAD 3D** sells for \$399.00. Period. No Comma!

In order to draw the complex pictures shown below it is desirable to have the following 3D features:

- Interactive design with 3D cursor
- Blending of surfaces
- Boolean operations such as add, subtract, and intersection
- Complex extrusions
- Cross sectioning
- Block scaling
- On screen shading
- Shaded output to printers and plotters

All of these competitors left out one or more of these desirable features in their standard package. They didn't forget the most horrible feature - the comma.

**DesignCAD 3D** offers **ALL** the listed features plus many more!

If **DesignCAD 3D** has the power to create the 3D objects shown below, imagine how it could help with your design project!

**DesignCAD 3D** sells for \$399. We left out the comma. We didn't think you would mind!

### PC MAGAZINE SAYS...

*DesignCAD 3D, the latest feature-packed, low-cost CADD package from American Small Business Computers, delivers more bang per buck than any of its low-cost competitors and threatens programs costing ten times as much. For a low-cost, self-contained 3D package... DesignCAD's range of features steals the show.*

# \$399

AutoCAD rel. 10	\$3,000.00	AutoCAD AEC \$1,000.00 AutoShade \$500.00
CADKEY 3.12	\$3,195.00	Solids \$995.00 IGES translator \$1,995.00
DataCAD with DC Modeler	\$3,990.00	DataCAD Velocity \$2,000.00
<b>DesignCAD 3D ver. 2.0</b>	<b>\$399.00</b>	<b>NO expensive options! IGES Free, Shading Free</b>
MaxiCAD 1.02	\$1,895.00	N/A
Mega Model	\$995.00	MegaDraw \$195, List \$295, MegaShade \$395
MicroStation PC 3.0	\$3,300.00	Customer Support Libraries \$1,000.00
ModelMate Plus 2.8	\$1,495.00	N/A
VersaCAD Design 5.4	\$2,995.00	N/A

Source: Byte Magazine

### BYTE MAGAZINE SAYS...

*"At \$399, DesignCAD 3D was the least expensive package we saw, yet it was one of the more powerful. ..Don't be fooled by the remarkably low price, this program can really perform."*

May 1989, page 178

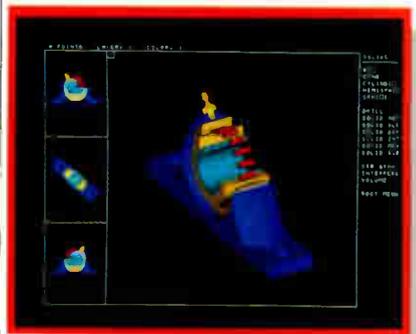
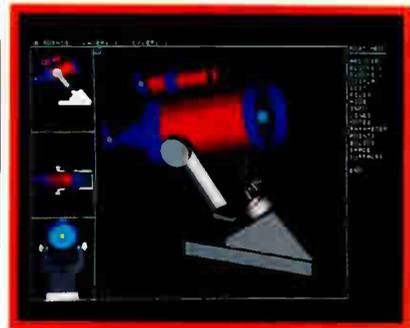
Complete 3-Dimensional design features make it easy for you to construct realistic 3-D models. With full solid-object modeling capabilities you can analyze your drawing to determine the volume, surface area or even center of gravity! **DesignCAD 3-D** even permits you to check for interference between objects! Aeronautical Engineers can now find the center of gravity for a new airplane design with a couple of keystrokes. The Architect can determine the surface area of a roof for decking in a matter of minutes. The Civil Engineer can calculate the volume of a lake or dam in seconds. The Mechanical Engineer will know for sure if certain parts fit together without interference. The uses for **DesignCAD 3-D** are only limited by YOUR imagination!

### HOW DO I GET ONE?

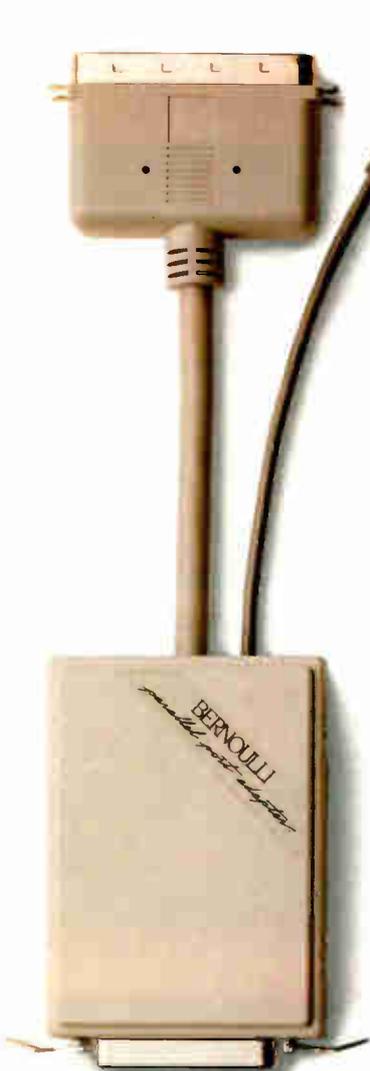
**DesignCAD 3-D** and **DesignCAD 2D** are available from most retail computer stores, or you may order directly from us. If you have questions about which program to purchase please give us a call. All you need to run **DesignCAD 3-D** is an IBM PC or compatible computer with 640 K RAM memory and a hard disk. Both products support most graphics cards, printers, plotters and digitizers. Free Information and a demo disk are available by faxing (918) 825-6359 or telephoning:

## 1-(918) 825-4844

American Small Business Computers • 327 South Mill Street • Pryor, OK 74361 U.S.A.



# THE NEW B ANY SYSTEM. ANY



The computing world is a changing place. That's why we're introducing a totally new family of universal removable storage products that can be easily attached to today's newest systems. Our Parallel Port Interface even lets you attach a Bernoulli to computers without an expansion slot or SCSI port. Now that's versatility.



Bernoulli® brought worry-free storage to everyone—now you can take it everywhere. Our new Transportable picks all the power and data security of our 44MB removable

**BERNOULLI AT A GLANCE**

**Disk Configuration -**  
- 5.25" half-height 44MB

**Drive Configurations -**  
- single or dual (internal or external)  
- battery-powered portable.

**Effective Access Time -**  
- 22 msec

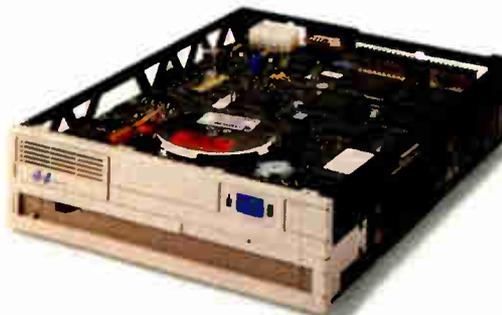
**Disk Shock -**  
- 1,000 Gs

**Mean Time Between Failure -**  
- 60,000 hrs.

**Compatibility -**  
- DOS, PC, PS/2®  
- Macintosh®, OS/2®  
- Windows®, NetWare®

**Installed Base -**  
- 625,000 drives  
- 3,750,000 disks

InfoWorld Product of the Year 1989

When space allows, the Bernoulli Insider fits neatly into leading PC and PS/2 computers. As a total storage solution, it's much better than a hard disk plus tape because you get the benefits of both, along with the unlimited data growth and security of removable storage.

Bernoulli's removable disks are the most rugged available. And we back that up with an unheard-of 5-year Gold Standard Limited Warranty.

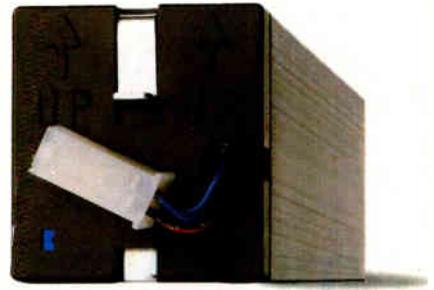


For the truly power hungry, the Bernoulli Dual is your premium choice. It's optimized to bring you up to 89MB of removable on-line storage with a 22msec effective access time. And it makes disk-to-disk copies in under three minutes. That's performance for the real world.

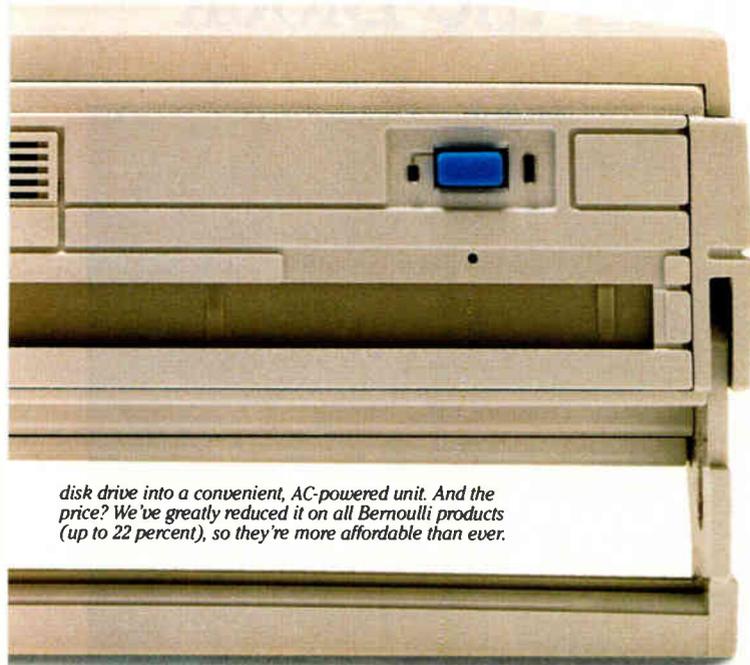


©1990 The Omega logo and Bernoulli are registered trademarks, and Bernoulli Means Security For Your Data is a trademark of Omega Corporation. All other company names and products are trademarks of their respective companies.

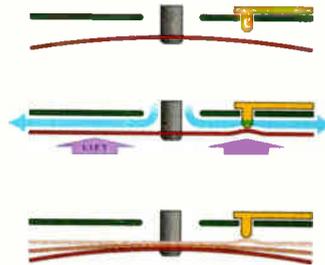
# ERNOULLI. TIME. ANY PLACE.



What if you're caught someplace with a lot of work to do and no outlets to be found? No problem. Each removable battery in the Bernoulli Portable provides approximately two hours of operation. And you can run it off the AC adapter while the battery is charging.

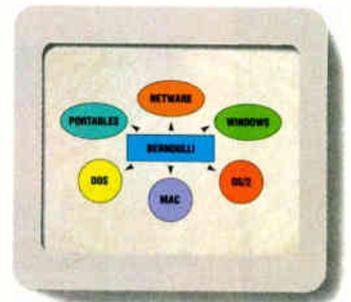


disk drive into a convenient, AC-powered unit. And the price? We've greatly reduced it on all Bernoulli products (up to 22 percent), so they're more affordable than ever.



You don't want to entrust your data to anything you have to pamper. That's the beauty of Bernoulli. Its patented design spins a flexible disk at high speed, drawing it toward the head. Should your system encounter a bump, air impurity, or power-loss, the flexible disk simply falls away from the head. The result? Hard-disk performance without the risks.

With all the computing choices out there, the last thing you need is a storage device that limits your options. Our new universality is a unique innovation which lets you easily attach the same Bernoulli to most any system, giving your data (and budget) protection for tomorrow.



Who says you can't take it with you? The new Transportable and Portable were specifically designed for a shrinking world on the move. But just because they're lightweight doesn't mean they're light on performance. Bernoulli implements the latest drive enhancements to help you keep pace with your busy schedule.



## ANY QUESTIONS?

The rest of the Bernoulli story is just a phone call away. Dial 1-800-777-6616. We'll rush you a free copy of this limited-edition, 18-page brochure. It's packed with everything you need to know about removable data storage. Any way you like it.



# BERNOULLI

STORAGE SOLUTIONS BY **MEGA**



Owen Linderholm  
and Jeff Bertolucci

# The New Macs on the Block



---

## Apple's new systems feature lower prices and a new modular design

---

**A**lthough Apple has long been fond of calling the Macintosh "the computer for the rest of us," many potential Mac users have found the machines too expensive for their pocketbooks. Apple has long been criticized for being too expensive and for not being competitively priced against IBM PC-compatible computers. This criticism seems especially apt when you consider that, except for a brief trial period last year, no Mac has ever had a list price below \$1000. Since Apple has no direct competition in its Macintosh

product line, competitive pricing has never been its foremost concern.

Apple is hoping to change that image with its introduction of three new Macs. First is the long-awaited "Cheap Mac"—the new Mac Classic, which retails for \$999 in its simplest configuration. For users who need color but can't afford a Mac II, Apple will be offering the new Mac LC for approximately \$3000, including monitor. Finally, there's a new member of the Mac II family, the Mac IIxi, priced at \$4870 including monitor.

Apple is trying to make a point with

these systems. A Mac always comes with enough features to let you get to work immediately and productively with a range of applications. Features that are options on IBM PC-compatible systems are built in on the Mac (e.g., networking, digitized sound, and a graphical user environment). Apple has also tried wherever possible to make these systems ready for the future—ready, specifically, for the forthcoming System 7.0 software. The only exception to this is the basic Classic configuration, which will require additional memory.

---

### The Mac Classic

The Mac Classic represents a complete overhaul of the lowest end of Apple's current product line. Essentially, it is the hardware soul of the Mac SE at less than the price of a Mac Plus. The Classic comes in two configurations: a low-end model that includes 1 megabyte of 120-nanosecond RAM and a SuperDrive floppy disk drive for \$999; and a \$1499 model with 2 MB of RAM and a fast (21-ms average access time) 40-MB hard disk drive. The street price of the low-end Classic might go below \$700, while the high-end model's might dip to \$1000.

Externally, the Classic closely resembles the SE. There are some minor cosmetic differences, but the familiar upright chassis with the built-in black-and-white 9-inch monitor remains the same. The system also remains relatively easy to carry around, for a desktop system. The high-end model weighs in at 17 pounds, only 1 pound more than a Mac Portable.

The Classic uses a single Apple Desktop Bus (ADB) port and two mini-DIN-8 connectors for the serial ports. In contrast, the Mac Plus used a unique keyboard and keyboard connector, and DB-9 connectors for the serial ports. Unlike



with previous Macintosh systems, the keyboard is included in the price of the Classic.

Other I/O ports include a DB-25 SCSI port, an external speaker port, and the external floppy disk drive port for 800K-byte or 1.4-MB disks. The Classic's internal hard disk drive is considerably faster than the hard disk drives currently available from Apple for the SE.

The Classic's system board has been

completely redesigned with lower cost in mind. It is only 60 percent of the size of the SE's system board. Apple put a great deal of effort into integrating as many functions as possible into custom application-specific ICs and into laying the board out optimally. One example of the improvements achieved in this way is a smaller and lighter power supply that powers both the Classic's main system and its monitor. In contrast, the SE uses

## New Mac Lineup

By January 1991, when the Mac LC becomes available, Apple's Macintosh lineup will contain the following systems:

### PORTABLE FAMILY

Mac Portable

### COMPACT FAMILY

Mac Classic  
Mac SE/30

### "LC" FAMILY

Mac LC

### MODULAR FAMILY

Mac IIsi  
Mac IIx  
Mac IIfx  
Mac IIfx

## New Prices for Existing Macs

**Mac IIfx**  
with 4 MB of RAM and  
a floppy disk drive:  
**\$5969**

**Mac IIfx**  
with 4 MB of RAM and  
an 80-MB hard disk drive:  
**\$6669**

**Mac SE/30**  
with 1 MB of RAM and  
a 40-MB hard disk drive:  
**\$3369**

**Mac SE/30**  
with 4 MB of RAM and  
an 80-MB hard disk drive:  
**\$4569**

two separate supplies: one to power the digital board, and another to power the analog circuits that drive the monitor. The Classic's fan mounts at the bottom of the unit for cooling efficiency and is extremely quiet.

Like the SE, the Classic uses an 8-MHz 68000. Memory is expandable to a maximum of 4 MB by adding 120-ns single in-line memory modules. You add this memory by inserting a small card that has 1 MB of RAM on it and two SIMM sockets.

Like those of its predecessors, the Classic's video buffer is in main RAM. While this simplifies the Classic's design (as it did the Mac Plus and SE's), there's a 25 percent performance penalty for bus bandwidth when RAM used for video is accessed to refresh the screen. The Classic should be as fast as an SE and 25 percent faster than a Plus.

The Classic has 512K bytes of ROM, twice the size of the SE's ROM. This ROM incorporates the Hierarchical File System and drivers for SCSI, ADB, AppleTalk, the Toolbox, and QuickDraw.

Where the Classic more closely resembles the Mac Plus than the SE is in its lack of an internal expansion slot. This was a cost/design trade-off. Leaving out the slot was a way to save money on the Clas-

sic's design, and Apple's research indicated that 90 percent of users wouldn't be interested in expansion capabilities. You could expand the system by way of its SCSI bus, but it will be hard to add accelerators or large external monitors.

The Classic will ship with the newest revision of System software, version 6.0.6, although it will work with version 6.0.5. The Classic was, however, designed with System 7.0 in mind. The high-end model is System 7.0-ready, while the low-end model only requires an additional megabyte of RAM. Although the Classic cannot make use of it, System 6.0.6 includes the new Sound Manager with its sound input capabilities.

Apple is going to discontinue both the Mac Plus and the SE, since it believes that the Classic is a good replacement for both. Those in the market for either a Plus or an SE will be better off with a Classic instead. (This includes university students or anybody who wants a "transportable Mac" for an occasional journey.) According to Apple, retaining the small, all-in-one footprint of the original Mac is important for the low-end market.

The preliminary BYTE benchmark results (see the table) indicate that the Classic is—no surprise here—on a par with the SE in performance.

### MAC CLASSIC BENCHMARK RESULTS

*Preliminary BYTE benchmark results (in seconds) for the new Mac Classic suggest that it performs at about the same speed as the older Mac SE. The Classic turned in an appreciably slower time on two of the tests, but this could be due to problems with the early prototype we used. The prototype system we tested had 2 MB of RAM and a 40-MB hard disk drive.*

Test	Mac Classic	Mac SE
<b>CPU</b>		
Matrix	77.22*	67.10
String move		
Byte-wide	374.73	374.50
Word-wide	187.38	186.70
Doubledword-wide	121.73*	92.40
Sort	154.53	154.20
Sieve	170.83	170.20
<b>Disk I/O</b>		
1-megabyte write	6.63	14.80
1-megabyte read	4.38	8.10
<b>Video Text</b>		
Text		
TextEdit	16.35	15.10
DrawString	3.85	3.80
Graphics		
Slow test	88.28	84.40
QuickDraw	1.22	1.10

\* Possible benchmark error.

For a full description of the Mac benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.

## Mac LC:

### Low-Cost Color in a New Box

The Mac LC is Apple's "lowest-cost color-capable computer"—hence the name. This system is intended to fill the void between the SE/30 and the IIx line. The LC will be offered for a complete system price of \$3000, including keyboard (the same compact keyboard that comes with the Classic), hard disk drive, and color monitor.

The LC also represents a new design shape for Apple. It is similar to Sun's "pizza box" workstation, but in a different, smaller size. The case is a flat box shape, measuring 12½ inches wide by 15 inches deep by 3 inches high. It weighs 8½ pounds. The front of the case, which is similar in style to the Mac II line, has a SuperDrive floppy disk drive on the right. On the back are seven ports: a video port, a printer port, a modem port, a SCSI connector, an ADB connector, a sound-out port, and a sound-in port. The last two provide the LC with built-in complete sound-processing capabilities.

With only 24 chips, the LC's logic board represents a high level of integration that helps reduce costs (see photo 1). The LC uses a 16-MHz 68020 CPU and has built-in video logic like the Mac IIci. The system comes standard with 2 MB of 100-ns fast paged-mode soldered RAM, expandable to 10 MB in two SIMM sockets. There is no FPU, and no socket for one. The 512K-byte ROM includes 32-Bit Color QuickDraw. The system uses a 40-MB internal SCSI hard disk drive.

The LC's built-in video supports three monitors. One is Apple's existing 13-inch 640- by 480-pixel color monitor. Another is a 12-inch 640- by 480-pixel monochrome monitor, a basic redesign of the existing 12-inch monochrome monitor that makes it cheaper to produce while improving the picture quality.

Finally, a new color monitor, the Macintosh 12-inch RGB Display, provides a 512- by 384-pixel display. This new monitor was designed because Apple thought that existing color monitors didn't provide a sufficiently good picture with low-resolution 8-bit color and were too expensive. Thus, the new monitor has a smaller screen that displays 8-bit and 16-bit color crisply and clearly.

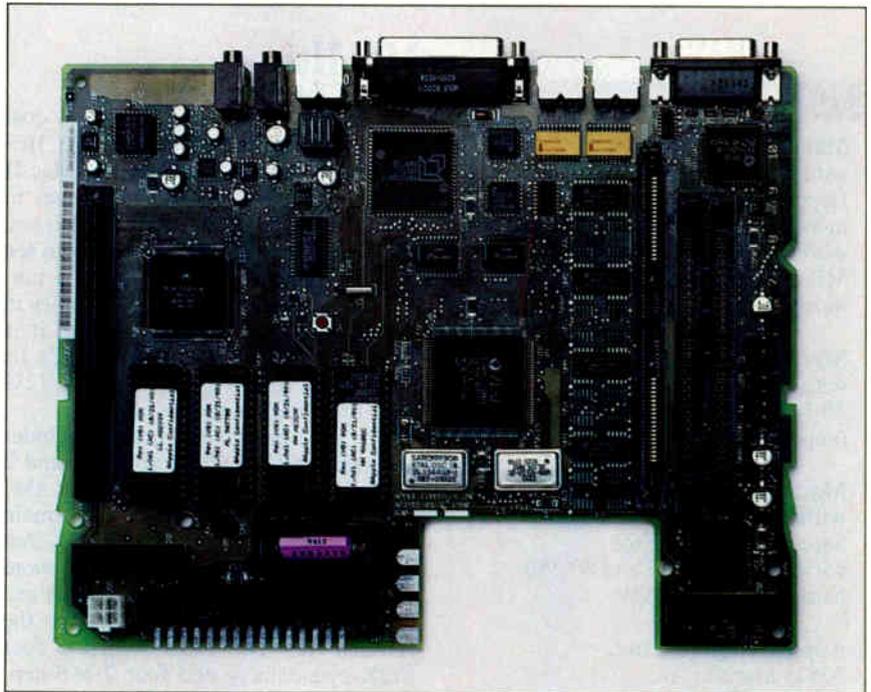
The LC uses 512K bytes of video RAM on the main logic board as the video frame buffer. With this frame buffer, you get 16 colors or gray scales on the 640- by 480-pixel monitors and 256 colors on the 12-inch RGB monitor. You can expand the buffer by plugging 512K bytes of additional VRAM into SIMM sockets. At the maximum frame buffer



size, the LC can get 256 colors or gray scales on the larger displays, 16-bit color (over 32,000 colors) on the new 12-inch RGB monitor, and 256 gray scales on the 12-inch monochrome monitor.

The LC also includes one expansion slot, a 68020 Direct Slot. This slot is similar to the 68030 Direct Slot on the SE/30 and allows direct access to the CPU bus. However, the LC's 68020 Direct Slot is not compatible with the SE/30's 68030 Direct Slot. Because the LC

doesn't have a socket for a paged memory management unit, one possible use of this Direct Slot might be to add a 68030 processor board to make use of the virtual memory technology in System 7.0. Apple also plans to introduce an Ethernet board for under \$400 and an Apple IIe compatibility board that will cost less than \$250. The latter unit would let the LC run Apple IIe software at full speed and would provide support for Apple IIe peripherals. For example, with a IIe



**Photo 1:** The Mac LC's logic board has a low component count due to the high level of logic integration. On the left edge is the 68020 Direct Slot; near the right edge are the SIMM sockets for RAM and the SIMM-mounted ROM.

compatibility board, an LC mouse emulates an Apple II mouse.

Why the Apple IIe compatibility? Apple sees the LC as tapping into the education markets. With a retail price of \$3000 for a complete system, the LC might appeal to schools that currently use Apple IIe, especially since Apple is also planning to make single and dual floppy disk drive versions of this system available at a lower price to the educational market only.

Apple says that the LC has the same

computing power as a 16-MHz 386SX system and is comparable in price to SX systems from IBM and Compaq; the company admits, though, that PC clone makers offer complete SX/VGA systems for far less than the LC's \$3000 retail price. The LC with 2 MB of RAM and an internal 40-MB hard disk drive will cost approximately \$2400. With the new 12-inch RGB color monitor costing \$600, it is possible to get a color Macintosh system for \$3000. The 12-inch monochrome monitor costs \$300, so a usable

LC system could actually be purchased for as little as \$2700. The street price of a color LC will probably be around \$2300 to \$2400, making it competitive with high-end 386SX machines from major manufacturers.

Unfortunately, the Mac LC will not be available until January 1991. It is being manufactured at Apple's facilities in Singapore. This delay means that the prices of reasonably competitive IBM PC-compatible systems might fall still further before the LC is released.



an ADB port, a SCSI port, an external disk drive port, two serial ports, a video port, one stereo sound output port, and the new sound input port. Interestingly, the IIsi has a single expansion connector that can be set up as either a NuBus slot or a 68030 Direct Slot. This trick is accomplished by special adapters (sold separately for \$200) that attach to the connector and provide a slot that's parallel to the system board. Through this maneuver, a NuBus board can fit inside the IIsi's smaller housing. Both adapters also provide a 68882 FPU. Why only one expansion slot? Apple claims that most Mac II users have only one board in their machines anyway—usually a video board. So Apple added built-in video to the IIsi system board, leaving the expansion slot open for more esoteric options.

Like the new Classic and the LC, the IIsi offers tight logic-board integration (see photo 2). The board is three-quarters the size of the IIcx board. Apple is able to offer the IIsi for \$2200 less than the IIcx by removing much of the original system logic from the main logic board and by limiting expansion capabilities and making them an option. Despite the size reduction, however, the IIsi offers the same performance as the IIcx and includes many features that the IIcx doesn't have, including built-in 8-bit color video and support for 32-Bit Color QuickDraw in ROM. (The IIsi can generate 24-bit color video by using a 24-bit video board in a NuBus slot adapter.) The IIsi logic board now includes a ROM SIMM socket to simplify future firmware upgrades (the IIcx's ROM chips were soldered to the main logic board). The machine's 512K bytes of ROM includes 32-bit memory support.

#### Sound Investment

This brings us to one of the most interesting features on both the LC and the IIsi: built-in sound input. Apple sees sound as a natural extension to the Mac platform.

#### THE FACTS

##### Mac Classic

with keyboard, 1 MB of RAM, floppy disk drive, and built-in monochrome monitor, \$999;  
with keyboard, 2 MB of RAM, 40-MB hard disk drive, and monochrome monitor, \$1499

##### Mac LC

with keyboard, 2 MB of RAM, and 40-MB hard disk drive, \$2400 (approximate)

##### Mac IIsi

with 2 MB of RAM and 40-MB hard disk drive, \$3769;  
with 5 MB of RAM and 80-MB hard disk drive, \$4569

##### Apple Computer, Inc.

20525 Mariani Ave.  
Cupertino, CA 95014  
(408) 996-1010  
Inquiry 1080.

## Mac IIsi:

### Lower Cost, More Options

The Mac IIsi is Apple's new low-cost Mac II. Designed to replace the IIcx (currently Apple's most popular Mac II model), the IIsi has some big shoes to fill. To fully appreciate the new IIsi, you must first compare it with the IIcx to see the differences between the two machines. The 10-pound Mac IIsi comes in a slimmer, smaller box (although it is larger than the pizza-box-shaped LC). Its dimensions are 4 inches high by 12½ wide by 15 inches deep.

The IIsi's basic configuration includes a 20-MHz 68030 CPU, no FPU, and 2 MB of 100-ns, fast paged-mode RAM. One MB of RAM is on the IIsi's main logic board; the other is on a SIMM. You can add up to 16 MB by installing more SIMMs. Apple is introducing 2-MB and 8-MB memory-expansion kits for the IIsi and IIci. These kits consist of four 512K-byte-density and four 2-MB-density SIMMs, respectively. (The Mac IIcx uses nonstandard 64-pin SIMMs, so it cannot use the new expansion kits.)

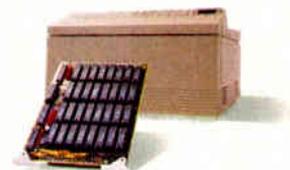
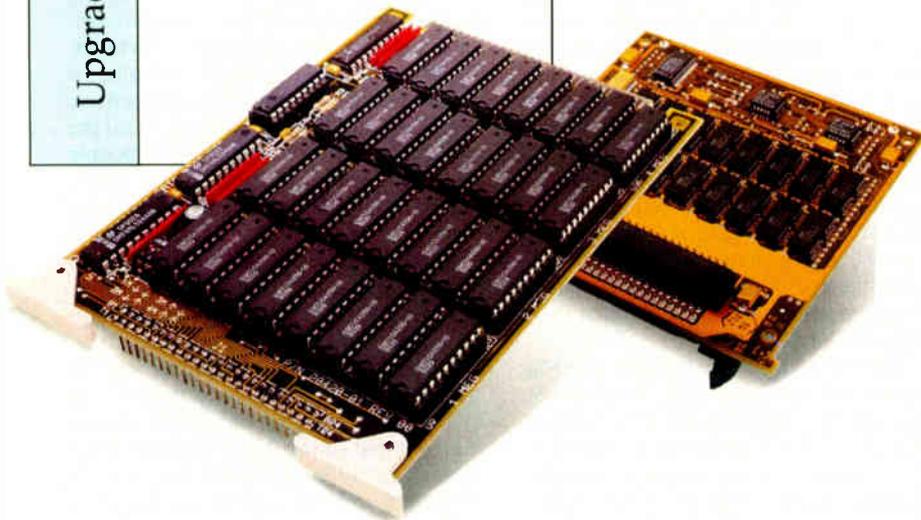
The IIsi includes eight built-in ports:

# There's more to comparing LaserJet memory boards than just the name

	Pacific Data Products	Hewlett-Packard
Price	<p>1 MB/\$199</p> <p>2 MB/\$299</p> <p>4 MB/\$499</p>	<p>1 MB/\$495</p> <p>2 MB/\$740</p> <p>4 MB/Not Available</p>
Warranty	Lifetime	One Year
Upgradeability	Fully Upgradeable to 4 MB	Not Upgradeable

**D**on't settle for less just to buy the HP label. Get more for less with Pacific Data Products Pacific 4 Memory for HP LaserJet IIP and III printers. With Pacific 4 Memory you get 4 MB of memory for only four dollars more than the price of 1 MB from HP. You also get a lifetime warranty, and upgradeability so you can start with 1 MB of memory, then simply upgrade when you need more. Just use the Pacific Data Memory Upgrade Kit (\$99.00). It contains 1 MB of thoroughly tested DRAM chips specifically for Pacific 4 Memory and our 2 Plus 2 memory

To learn how you can get more for less, call your nearest dealer or contact: Pacific Data Products, 9125 Rehco Rd., San Diego, CA 92121, (619) 597-3114 Fax (619) 552-0889.



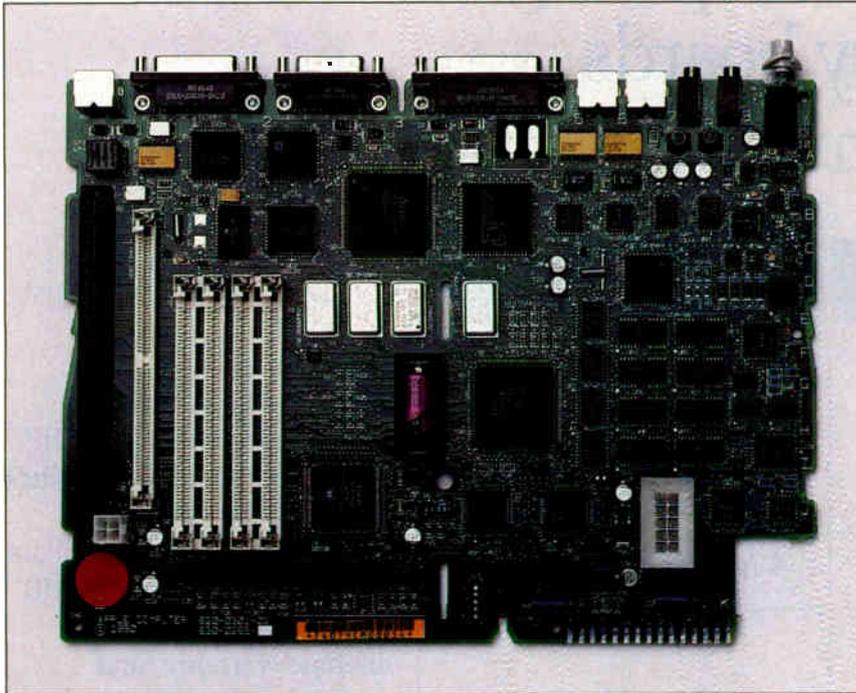
See us at  
 **COMDEX/Fall '90**  
 Booth #W818 November 12-16, 1990  
 Las Vegas, Nevada

**PACIFIC**  
 DATA PRODUCTS

Prices are suggested retail list price. Pacific 4 Memory and 2 Plus 2 are trademarks of Pacific Data Products, Inc. All other company and product names are trademarks of the company or manufacturer respectively.  
 © 1990 Pacific Data Products, Inc.

Circle 270 on Reader Service Card (RESELLERS: 271)

World Radio History



**Photo 2:** The Mac II Si board combines on-board video and support for either a NuBus slot or a 68030 Direct Slot via a special adapter. This adapter plugs into the connector on the board's left edge. By the connector is one socket for SIMM-mounted ROM and four SIMM-mounted RAM sockets. At the center are crystal oscillators for the on-board video and bus clock. The sound I/O jacks are at the upper right.

Both the II Si and the LC come bundled with an Apple electret microphone and phono jack. The microphone is a simple, button-shaped device (roughly the size of a silver dollar) that offers 8-bit monaural sound. It's a simple, omnidirectional microphone for recording messages; you can clip it to your clothing or place it on top of the Mac monitor. The sound input is via a standard phono adapter jack, so alternative microphones or other audio devices can be used.

One problem with the new microphone is that it connects to the back of the Mac box; a keyboard-based port for the mike would have been far more convenient. The NeXT Computer, for example, has a sound input port on its monitor stand.

With these devices and the appropriate software, you could annotate sound messages to documents and spreadsheets, for example. Apple demonstrated a pre-alpha version of an Ashton-Tate word processing program that lets you annotate sound messages to a document. Sounds are sampled at 11 or 22 kHz. The sound is filtered through a custom filter/pre-amplifier chip, converted to digital form, and stored in memory or directly on the hard disk. Also included is the Macintosh Audio Compression Expansion sound utility, which compresses sounds

at ratios of 3 to 1 or 6 to 1. MACE lets you store up to 3 hours of sound on a 40-MB hard disk. The new sound capabilities do not include stereo sound.

An application programming interface for sound is included with the system, and Apple has attempted as much as possible to keep its sound extensions compatible with existing sound products from third parties, like Farallon's MacRecorder. The Control Panel desk accessory now has sound capabilities, including the ability to record your own alert sounds to replace the standard system sounds. Apple plans to eventually upgrade the rest of the Mac II family to include the same sound features that come with the II Si and LC.

The II Si is also the least expensive Mac capable of running A/UX, Apple's version of Unix: Apple is introducing a version of A/UX 2.0 that supports the II Si.

In conjunction with Apple's new aggressive pricing strategy for hardware, some software vendors have banded together to provide a low-cost software solution for Apple users. A bundle consisting of WriteNow 2.2, SuperPaint 2.0, Full Impact 1.1, and Record Holder Plus will retail for \$349.

The II Si is available now. The standard configuration with 2 MB of RAM and a

40-MB hard disk drive is \$3769. Add an Apple high-resolution monitor and the standard keyboard, and the price jumps to \$4869. The II Si minus monitor and keyboard and with 5 MB of RAM and an 80-MB hard disk drive will be \$4569. (As with other Mac IIs, the buyer must choose between the standard or extra-large keyboard. However, as mentioned earlier, the keyboard comes bundled with the new Classic and LC systems.) Apple thinks the street price for a bare-bones II Si, including monitor and keyboard, could drop to around \$3600.

### Apple Gets Price Wise

Along with introducing the new models, Apple is discontinuing three Macs. The Mac Plus and SE are being replaced by the Classic, and the IIcx by the II Si. And to prove it's serious about its new competitive image, Apple has reduced the prices of existing IIci and SE/30 configurations.

Apple's goal with its new Macs and lower prices is to reach more people by increasing unit sales and market share. Indeed, the pricing of the new Macs is competitive, and Apple has a leaner, meaner desktop lineup these days. The new Macs offer impressive features for their price, and Apple should attract a lot of new customers. However, if viewed from a strict price-per-raw-computing-performance perspective, these systems still don't match up with the lower-cost IBM PC compatibles.

What should not be forgotten in the equation is the ease of use of Apple's systems and the extras that come with them. These are Apple's strengths and also its Achilles' heel. It is impossibly expensive to add into an IBM PC compatible all the extras that Apple provides. But do people want these extras or ease of use? Apple still has to persuade buyers that the integrated philosophy behind its systems is best. The new systems and prices just make this task a lot easier.

Probably the biggest drawback of Apple's new low-price systems is the relative lack of expansion options on the cheaper Macs. Apple based its decision to leave out expansion options on market research that shows that most users don't want or need the expansion. But it could be a problem farther down the line when users eventually want to upgrade. ■

*Owen Linderholm is a BYTE news editor in San Francisco. He can be reached on BIX as "owenl." Jeff Bertolucci is a BYTE associate news editor in San Francisco. He can be reached on BIX as "bertolucci."*



# Take the Oops & Downs out of your next presentation.

Tired of fumbling with slides? Fiddling with transparencies? Losing your audience?

Well, it's time to use an LCD projection panel from In Focus Systems. It lets you project information just as it appears on your computer screen. Even bright, brilliant colors.

So you make stronger presentations. And easily hold any audience. What's more, the 640x480 display works with IBM<sup>®</sup> compatibles, and the Macintosh<sup>®</sup> family, too. For more information or the name of the dealer nearest you, call 1-800-327-7231, today.

Then take the oops and downs out of your next presentation. And put the audience in the palm of your hand.

1-800-327-7231.

See it. Believe it.

**IN FOCUS SYSTEMS, INC.**

Circle 171 on Reader Service Card  
(RESELLERS: 172)

7770 Southwest Mohawk Street, Tualatin, Oregon 97062.  
1-800-327-7231. Oregon, 503-692-4968. FAX, 503-692-4476.

IBM and Macintosh are registered trademarks of their respective companies.

World Radio History



# Introducing this year's best performance. Solo.



Once again, Compaq unleashes a series of stunning performances.

The new COMPAQ DESKPRO 486/33L and COMPAQ DESKPRO 386/33L Personal Computers are single-user PCs that deliver the utmost in power.

And 33-MHz 486 models of the COMPAQ SYSTEMPRO Personal Computer System strengthen its position as the network server without equal.

For individuals, our powerful new desktops extract the highest performance from Intel's 33-MHz 486 and 386 micro-

processors. So you can run the most complex CAD/CAE, scientific and business applications faster than ever. You can also take advantage of SCO's UNIX operating system and Microsoft's Windows. Plus run the thousands of industry-standard software products available under Microsoft's MS-DOS and MS OS/2.

Both machines fulfill your need for speed. They're optimized with high-speed cache memory designs, fixed disk drives and powerful Extended Industry Standard Architecture (EISA). So nothing slows you down.

Both offer unequaled growth potential with seven EISA expansion slots plus internal room for up to 100 MB of RAM and 1.3 GB of mass storage. The COMPAQ DESKPRO 386/33L also offers an upgrade path to



# And this year's best performance. Group.



**COMPAQ  
SYSTEMPRO**

the power of  
486 technology.

For networks, the COMPAQ SYSTEMPRO Family now delivers the ability to employ one or two 33-MHz 486 or 386 microprocessors. It's power you can put to work in the broadest range of connected environments, from resource sharing to departmental database management.

Inside you'll find innovations like a 512-Kbyte ServerCache design, EISA I/O performance and drive array technology. Plus the ability to use up to 11 expansion slots and store up to 4.28 GB of data.

These innovations are complemented by the COMPAQ DESKPRO 386N and COMPAQ DESKPRO

286N Personal Computers, PCs designed with specific network features. Put them all together with Novell's NetWare, Microsoft's LAN Manager, SCO's UNIX or other industry-standard network or multiuser operating systems and you'll get the greatest performance to ever hit the networks.

And the one place to see these performances live is your Authorized COMPAQ Computer Dealer. For the nearest location and more information, call 1-800-231-0900, Operator 131. In Canada, 1-800-263-5868, Operator 131.

**COMPAQ**

It simply works better.

# A New Status Quo for Quattro

Andrew Reinhardt

The newest version of  
Borland's spreadsheet  
features 3-D graphics  
and a simple solver

**D**islodging an entrenched market leader like Lotus 1-2-3 requires rivals to produce software that is fundamentally a better deal. With a new version of its popular Quattro Pro spreadsheet, Borland International continues to achieve just that: Quattro Pro 2.0 offers an expanded set of features over the previous version, while maintaining the advantages it already enjoyed over 1-2-3.

Quattro Pro provides more features and better performance than 1-2-3—and at a lower price—yet it will run on any DOS machine (e.g., an 8088-based XT with 512K bytes of RAM). Quattro Pro does not use the multilayered “three-dimensional” architecture of 1-2-3 release 3.0 (nor can it read Lotus .WK3 files), but it does offer a reasonable alter-

native: easy spreadsheet linking and the ability to have several spreadsheets stacked or tiled on the screen at once.

The ability to run comfortably in conventional DOS memory (by comparison, 1-2-3 release 3.0 requires 1 megabyte of installed RAM and uses a built-in DOS extender) is due to Borland's Virtual Real-Time Object-Oriented Memory Management architecture, a technique that breaks the program code into small chunks that are swapped in and out of memory as needed. VROOMM's efficient memory management makes it possible to load larger spreadsheets in conventional RAM than is possible under 1-2-3 release 2.2. And for very large spreadsheets, Quattro Pro supports up to 8 MB of EMS 4.0 memory.

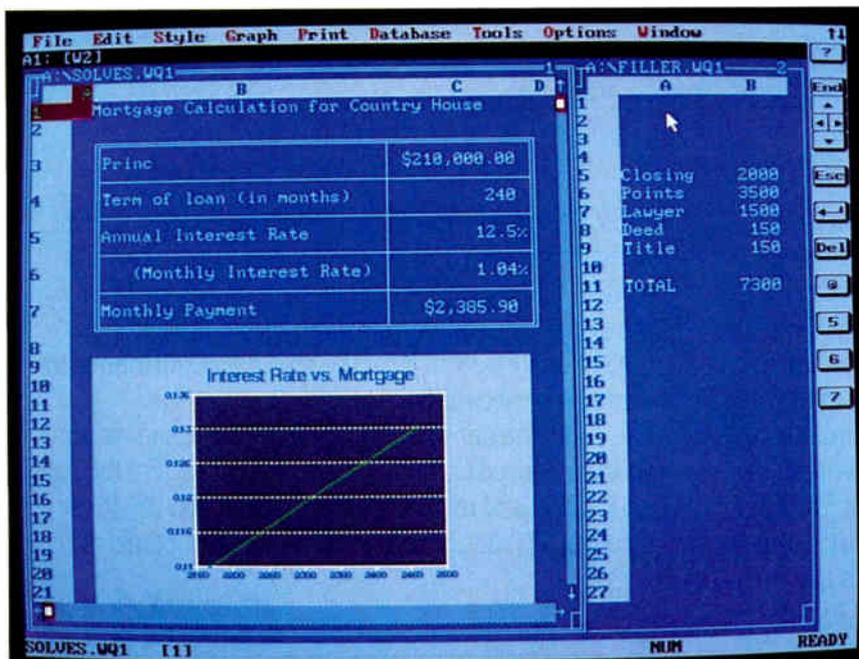
Aside from its speed and small memory needs, the main advantages of Quattro Pro are superior graphics and spreadsheet publishing. For example, it comes with a Graph Annotator. This is a graphics program that is as sophisticated as the 1-2-3/G Graph Tool and is easier to use. You can also mix data and live charts on the same worksheet.

These capabilities have been enhanced with four new 3-D graph types (i.e., bars, step, area, and ribbon) and faster LaserJet drivers that support downloadable Bitstream fonts. Quattro Pro also now offers a 132-column mode (on EGA/VGA cards that support extended character sets), so you can view 12 months of a budget calculation on one screen.

However, Quattro Pro does have one important drawback compared with release 3.1 of 1-2-3: The Lotus spreadsheet now has a WYSIWYG mode that shows fonts and other graphical attributes on-screen as they will appear in printed output. By contrast, Quattro Pro will show colors, boxes, shading, and graphs, but not fonts.

## Interactive Slide Shows

One of the most distinctive capabilities of Quattro Pro is the ProShow presentation



*Quattro Pro lets you display multiple, linked worksheets and live graphics on the screen at the same time.*

tool, which lets you create slide shows using spreadsheet data, graphs, and text. In version 2.0, ProShow presentations can become interactive and nonlinear: By clicking on "graph buttons" added to the screen, you can branch to other graphics or run macros.

Because ProShow is integrated into Quattro Pro, it can be an easier way to create presentations than exporting worksheets and graphics to a slide-show package (especially when the data is frequently updated), but it's not as graphically rich as Microsoft PowerPoint.

Quattro Pro 2.0 also adds a capability unmatched in any DOS-based spreadsheet: a Solve For tool that is similar to the Backsolver utility that is found in 1-2-3/G. Both Solve For and Backsolver can tweak a single input variable to produce a specified result, sparing you from trial-and-error goal seeking. However, Solve For doesn't match the power of the full 1-2-3/G Solver, which uses separate OS/2 threads to jiggle multiple factors constrained by numerous criteria.

Finally, Quattro Pro has added better support for networking, file import/export, and data access. It offers more printer drivers and graphics import/export formats, as well as a choice of international character sets with correct sorting for non-English text.

Quattro Pro now works better with Lotus 1-2-3. Release 2.2 files can be read into Quattro Pro with their cell-linking attributes preserved.

For networked installations, Quattro Pro 2.0 permits a single, shared set of large font files to reside on the server, saving disk space. The software includes user license management, which automatically monitors the number of simultaneous users of the program on a LAN.

And for spreadsheet users who want to access Structured Query Language databases, Borland has strengthened the ties between Quattro Pro, Paradox 3.5, and the Paradox SQL Link, which talks to SQL Server, IBM OS/2 Extended Edition, and Oracle Server. Now, if you have at least a 286 machine and 2 MB of RAM, you can load both Quattro Pro and Paradox, toggle between them with a hot key, and easily load Paradox or SQL data tables into a Quattro Pro spreadsheet for analysis or graphics.

In the interest of compatibility with industry-standard 1-2-3, you still have a choice of user interfaces: the 1-2-3 menu tree or a Common User Access-compliant pull-down Quattro menu tree. Having Lotus menus available is a comfortable fallback for those users bred on 1-2-3, but the Quattro menus are actually

more efficient and easier to use. Borland is now the target of a lawsuit by Lotus for allegedly copying the look and feel of 1-2-3, but even without 1-2-3 menus, Quattro Pro would be a snap to learn for any experienced spreadsheet user.

### One Size Fits All

Perhaps the most important point in Quattro Pro's favor is that while most of its features are available in some release of 1-2-3 (i.e., release 2.2 with the Allways add-in, release 3.1 with the Impress add-in, or 1-2-3/G for OS/2-Presentation Manager), no one package has them all.

In fact, the various releases of 1-2-3 are starting to get quite confusing for customers and technical-support personnel: The releases are segmented by hardware platform, each offers features the others lack, and they all use different commands and file formats for their presentation and publishing modules.

Quattro Pro, on the other hand, runs on any DOS platform with the same set of features. If you have a large investment in 1-2-3 data files, a lot of older-generation PCs, and a desire to tap into the latest spreadsheet capabilities, Quattro Pro is probably your best answer. ■

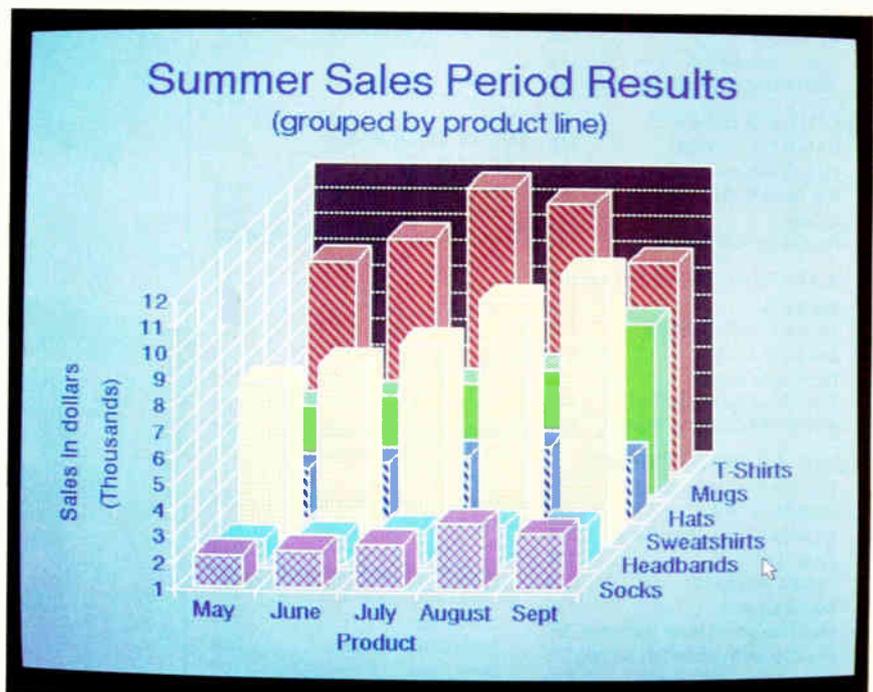
*Andrew Reinhardt is BYTE's associate news editor in New York City. He can be reached on BIX as "areinhardt."*

### COMPANY INFORMATION

**Quattro Pro 2.0**  
\$495

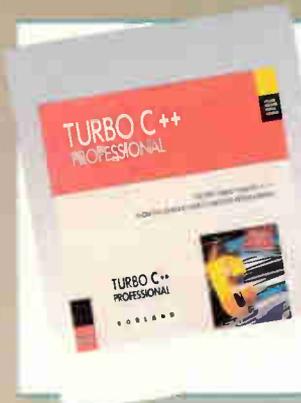
*Requirements:*  
IBM XT or compatible  
with a hard disk drive and  
512K bytes of RAM.

Borland International, Inc.  
1800 Green Hills Rd.  
P.O. Box 660001  
Scotts Valley, CA 95066  
(408) 438-8400  
**Inquiry 1166.**



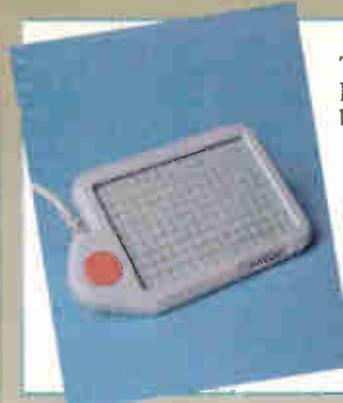
*The new release of Quattro Pro supports 3-D bar charts (above), as well as 3-D ribbons, steps, and area plots.*

# Professional developers require



## TURBO C++ Professional by Borland International

Be objective! Object-Oriented Programming is programming in the '90s. Let Borland take you there with a native, AT&T 2.0 compatible C++ compiler, an ANSI C compiler, the VROOMM overlay manager, and documentation and tutorials. You also get the Programmer's Platform with open architecture for integrating your own tools, integrated debugging with Turbo Debugger 2.0, Turbo Assembler 2.0 with NOP squishing and 486 support, the new Turbo Profiler, and much, much more.  
LIST: \$300 PS Price: \$259  
FastFacts 777-082



## The UnMouse - More Speed in Less Space by MicroTouch

The UnMouse is a touch-sensitive tablet that gives you faster cursor speed -- in a fraction of the space a mouse takes up. Plus you can slip templates under its glass to access up to 60 Power KeyPad functions or use its stylus to draw, trace or input graphics.

LIST: \$235 PS Price: \$219  
FastFacts 2918-001

## 386 DEVELOPMENT

	Price	Visible Analyst	585
386 Max 5.0	\$109	<b>COBOL</b>	
386 ASM/LINK by Pharlap	495	MS COBOL V3.0	639
DESQview 386	189	Realia COBOL	859
F77-EM32 + Lahey Ergo	1055	<b>COMMUNICATIONS</b>	
FoxBASE+/386	479	<b>ADD-ONS</b>	
Metaware High C 386/486	919	C Asynch Manager 3.0	139
MetaWare Pascal 386/486	839	Essential COMM by S. Mtn.	259
NDP Fortran w/VM	829	Greenleaf Comm Library	329
NDP C - 386	829	QuickComm	129
QEMM 386	95	<b>DBASE</b>	
VM-386	229	Clipper 5.0	550
WATCOM C8.0 386 Prof.	1155	dBASE IV	499
WATCOM C8.0 386 Stand.	795	dBFast/PLUS	315
Zortech C++ 386 Dev.	865	dBMAN V	275

## AI-LANGUAGES

ARITY Combination Package	989	FoxPro	495
LISPC	269	FoxBASE + - V2.1	279
PC Scheme LISP	85	QuickSilver	399
TransLISP PLUS w/source	99	<b>DBMS</b>	
PDC Prolog Compiler	239	Cause Professional	499

## ASSEMBLERS

MS MASM	105	CLARION Prof. Dev. V2.1	549
Turbo Debugger & Tools	119	D the data language	359
Visible Computer:80286	85	Magic PC	349
		Paradox V3.0	479
		R:BASE 3.1	499

## BASIC & ADD-ONS

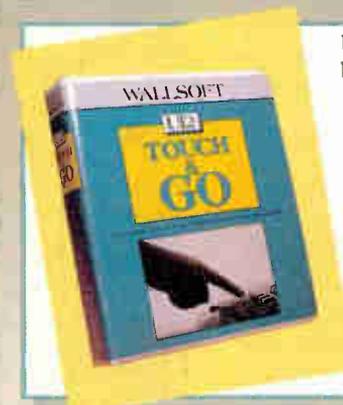
BAS-C Commercial	439	<b>DBMS TOOLS &amp; LIBRARIES</b>	
dB/LIB Professional	179	AdComm for Clipper	279
MS QuickBASIC V4.5	69	Artful.Lib	200
QBase	139	BALER Spreadsheet Compiler	399
QuickPak Prof. V3.16	189	CLEAR + for dBASE	179

## C LANGUAGE COMPILERS

Instant C	769	dBASE BlackBox	65
Lattice C - 6.0 Compiler	189	dBASE Online	129
Microsoft C 6.0	349	BRIEF w/dBRIEF	Call
Microsoft QuickC	69	dBX/dBport	549
WATCOM C8.0/286 Prof.	429	dGE 4.0	279
WATCOM C8.0/286 Stand.	359	dQUERY MU	179

## CASE & PROTOTYPERS

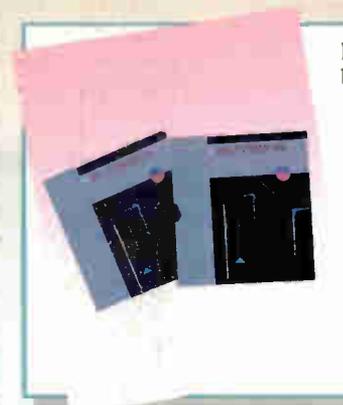
Dan Bricklin Demo II	185	dSalvage Professional	195
EasyCase Plus	275	FLIPPER Graphics Library	179
EasyCase Plus Prof. Pack	365	FUNCKY.LIB	179
EasyFlow	135	Genlifer - code generator	269
Instant Replay III	119	Net Lib	229
Matrix Layout	179	Pro Clip	149
MetaDesign by Meta Software	295	R&R Relational Reportwriter	139
Pro-C 2.0w/Workbench Combo735		R&R Code Generator	129
ProtoFinish by Genesis	279	Scrimmage	139
Show Partner F/X	279	SilverComm Library	229
		SilverPaint	100
		Steve Straley's Toolkit	169



## UI2 Touch & Go by Wallsoft

UI2 Touch & Go is a subset of The UI Programmer 2, Developer's Release for less experienced programmers. It has a screen painter and integrated data dictionary and comes with the GENSYS template system, customized application generation without programming. GENSYS handles almost all application development needs, 'right out of the box'. UI2 Touch & Go generates dBASE III+ and IV, Clipper, FoxBASE+, FoxPro, Quicksilver and dBaseX programs.

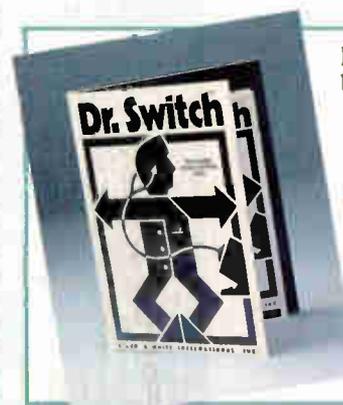
LIST: \$395 PS Price: \$319  
FastFacts 212-011



## RM/FORTRAN by Ryan McFarland

RMFORTRAN is a high resolution ANSI 77 FORTRAN compiler for DOS and OS/2. It includes RM/ForTe, an advanced programming environment giving you instant access to editing, compiling, linking, debugging, and file management utilities at a single keystroke. You easily move between tasks and the tools you need, productively developing your solutions.

LIST: \$595 PS Price: \$499  
FastFacts 437-009



## Dr. Switch-ASE by Black & White Int'l, Inc.

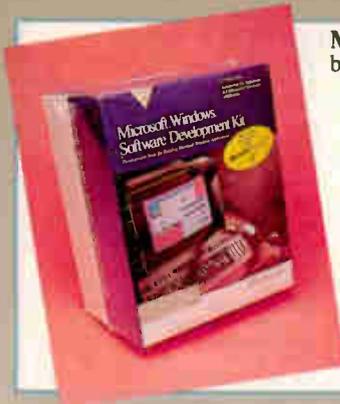
Dr. Switch-ASE turns any size Dbase application into a RAM resident (TSR) program that occupies only 16-20K of RAM; Supports Clipper, dBASE III PLUS, dBASE IV, FoxBASE + and FoxPro. Dr. Switch-ASE includes Cut, Paste, Timer, Alarm and Macro functions. It supports Expanded and Extended memory and is fully network compatible.

LIST: \$100 PS Price: \$95  
FastFacts 1178-006

Circle 390 on Reader Service Card

# THE PROGRAMMER'S SHOP 1-800-421-8006

# more than just products...



## Microsoft Windows SDK by Microsoft Corp.

You're only as good as the tools you use, so shouldn't you use the new Microsoft Windows Software Development Kit? The SDK is a set of tools tailor-made to build applications for Windows. It includes a CodeView debugger for Windows, sophisticated analysis tools and resource editors, and extensive hard copy and online documentation. There's only one way to build Windows applications, and that's with the SDK. What else would you expect from the people who brought you Windows? LIST: \$500 PS Price: \$365 FastFacts 502-072



## OPEN ACCESS III by Software Products Intl.

Turn your ideas into market-ready applications in just weeks with Open Access III! Easily edit, run, and debug your programs in the integrated programming environment. Get data entry and report forms and support for windowing, light-bar menus, and 3-D graphics to make creating your applications a snap! Open architecture with a C language interface lets you add change or add features. And Open Access III even has its own compiler! LIST: \$695 PS Price: \$489 FastFacts 1759-007



## WATCOM C 8.0/386 Prof. by WATCOM

WATCOM C 8.0/386 is 100% ANSI C optimizing compiler/runtime library for Intel's 80386 architecture, generating applications for 32-bit protect mode. Features include: protected mode version of the compiler; VIDEO full-screen source-level debugger; MS library- & source-compatibility; execution profiler; high performance linker; graphics library; supports MetaWare High C 386 runtime calling conventions; SAA compatible. LIST: \$1295 PS Price: \$1155 FastFacts 1044-005



## EDT+ by Boston Business Computing

EDT+ 5.0, the only complete emulation of DIGITAL's VAX EDT, is 50% faster than its predecessor and features multiple windows, interfaces for EVE, EMACS, vi and WPS, 132-column mode, status line and ruler, keystroke macros and much more. 30-day, money-back guarantee and free customer support and updates for 60 days. For MS-DOS and UNIX systems. LIST: \$295 PS Price: \$279 FastFacts 342-001

Tom Rettig's Library 85  
UI2 Developer's Release 479

## DEBUGGERS/ DISASSEMBLERS

DASM 225  
Dis Doc Pro 229  
Multiscope for DOS 149  
Periscope IV Varies  
RE:Source by Genesoft 119  
SoftProbe 86/TX 345  
Source 486 w/BIOS pre-proc. 149  
Trapper 189

## DEVELOPMENT TOOLS

ASMFLOW 89  
C-DOC 139  
CLEAR+ for C 169  
Codan 349  
Buzzwords dANALYST 269  
The Documentor 245  
INSIDE! 119  
MKS Lex & Yacc 199  
MKS RCS 175  
PC-Lint 120  
Plink/LTO 439  
PolyMake 159  
PVCS Professional 439  
ROM Link 339  
.RTLINK - by Pocket Soft 279  
.RTLINK Plus 419  
Source Print 97  
TLIB 89  
Zortech C++ Tools Call

## EDITORS

BRIEF Call  
Cheetah 195  
Epsilon 119  
KEDIT 139  
QEdit TSR 89  
Sage Professional Editor 249  
SPF/PC - V2.1 129  
Vedit + 139

## EXPERT SYSTEMS

Eclipse 386 560  
Exsys Professional 695  
Logic Gem by Sterling Castle 89  
Personal Consultant Plus 1999

## FILE ADD-ONS

Accsys for Paradox w/source 739  
CBTREE 179  
C-Data Manager 279  
CodeBASE 4 279  
CQL - w/ source 359  
c-tree by Faircom - source 329  
C-TRIEVE 229  
db\_FILE/RETRIEVE - SU 229  
Faircom Toolbox Prof. 889  
Faircom Toolbox Special 539  
WKS Library 149  
XQL 649

## FORTRAN

FOR\_C w/source 789  
Lahey FORTRAN F77L 549  
Lahey Personal FORTRAN Call  
MS Fortran Opt. Compiler 309  
RMFORTRAN 499

## GENERAL ADD-ONS

C Tools Plus - V6.01 98  
C Utility Library 189  
Greenleaf SuperFunctions 239  
Opt-Tech Sort 119  
Turbo C Tools by Blaise 109

## GRAPHICS

Bar Code Library w/Source 369  
Essential Graphics v3.0 349  
GraphiC 319  
graphics-Menu 165  
GSS Graphics Dev't Toolkit 525  
Halo 279  
HSC Sunscan 289  
LaserControl 139  
MetaWINDOWS 209  
MetaWINDOW/PLUS 289  
PCX Programmer's Toolkit 229

## HARDWARE

Aegis 55  
ALL Chargecard 399  
Capital Equipment Corp.  
OS/RAM32 0M 225  
OS/RAM8 0M 299  
OS/RAM4 0M 179  
DigiCHANNEL COM/8i 875  
DigiCHANNEL MC/8i 949  
DPT  
SmartCache ST506 1099  
SmartCache RLL 1099  
SmartCache ESDI 1099  
Disk Mirroring Module 685

Emerson UPS  
Model 10 UPS 169  
Model 20 UPS 319  
Model 40 UPS 699  
AccuCard 209  
AccuSaver 69  
EtherCard Plus 239  
EtherCard Plus/A 349  
Erasable Optical Drive Call  
Hardlock Kit by Glenco 369  
IIT Adv. Math Coprocessors

3C87-25 450  
3C87-33 559  
2C87-20 329  
2C87-12 279

Intel Math Coprocessors  
80387-25 555  
80387-33 675

J T Fax 9600 595  
KickStart I 179  
KickStart II 399  
KickStart III 689

LANStor LAN150S 1599  
LaserStor WORM Drive 3295  
Personal Modem 2400 179  
QX/12K Modem 699  
QX/V.32c Modem 1349

Seagate ST-125-1 20M 299  
Seagate ST-4096-1 80M 639  
Seagate ST-251-1 40M 339

SentinelScout (kit of 10 keys) 265  
SpeedStor AT 320S 1999  
Smartmodem 2400 (Ext.) 359  
The Shadow SVGA1024K 319  
VGA WONDER 512K 359

Circle 391 on Reader Service Card

# THE PROGRAMMER'S SHOP 1-800-421-8006

# The Programmer's Shop is



## C-Worthy Interface Library by Solution Systems

Create a clear, high quality user interface with minimal overhead to your code. Benefit from 400 tight, ready-to-use functions for Windows, Menus, Text Editing, Message System, Mouse Support, Help and much more. cwARCHITECT is included to let you interactively design and test forms without coding. Best of all it's flexible to your needs, providing high level functions for immediate results, yet power and functionality for the long-term.

LIST: \$399 **PS Price: \$359**  
FastFaxes 732-095



## BLINKER by Blinkinc

"Fastest dynamic overlay linker for Clipper Summer '87 and 5.0. Automatically structures overlays and reduces program memory requirement by up to 50%. Features incremental linking in fractions of a second, dynamic overlaying of C & ASM, source code of Clipper profiler for performance analysis, memory defragmentation, "burning in" of Clipper environment variables/serial numbers and creation of demo versions."

LIST: \$189 **PS Price: \$179**  
FastFaxes 937-001

## NETWORKS

dBXL/LAN	519
Btrieve Dev. Kit	479
Netware SQL	519
Netware C Interface	239

## OBJECT-ORIENTED/C++

Intek C++ 80386	469
Smalltalk/V	85
Smalltalk/V-286	185
Turbo C ++	159
Turbo C ++ Prof.	259
Zinc Interface Library	179
Zortech C ++ w/ source	269
Zortech C++ Debugger	150
Zortech C ++ Dev. Edition	399

## OS SUPPORT

DESQview	109
OS/286	589

## OTHER LANGUAGES

Logitech's Modula-2 Dev. Syst.	229
RPG II Dev. Systems	1469
TopSpeed Modula-2	189
StonyBrookProf. Modula-2	249

## OTHER PRODUCTS

Carbon Copy Plus	159
Dan Bricklin's PageGarden	89
Fast!	89
File Shuttle	109
Flow Charting III	199
HEADROOM	89
HiJaak	139
LapLink III	129
Link & Locate ++ - ROM MSC	349
Math Advantage	475
Norton Utilities 5.0	149
pcANYWHERE III	129
PC Tools Deluxe 6.0	119
PC-KWIK Power Pak	119
Pre Cursor	96
Remote2	139
SpinRite II	89
Systat & Sygraph Combo	839
System Sleuth	89
The Duplicator Toolkit-Pro 3.0	119
Time\$heet Prof.	135

## TURBO PASCAL

Turbo ASYNCH PLUS	119
Turbo Pascal 5.5 by Borland	109
Turbo POWER TOOLS PLUS	98

Turbo Professional	109
--------------------	-----

## TEXT SCREEN ADD-ONS

AEWINDOWS	459
C Communications Toolkit	129
C Worthy w/Forms w/ARCH	359
Greenleaf DataWindows	339
HI-SCREEN XL Professional	289
MEWEL Window System	169
POWER SCREEN by Blaise	99
Vitamin C - source, menus	169
VC Screen - painter	119
Vermont Views Obj. + source	819

## UNIX/XENIX

C++ Compiler for Unix 386 by Zortech	439
C++ for Unix by SCO of Canada	829
Computer Innovations C++	469
db_FILE/RETRIEVE SU	569
Edix - editor	409
EDT+ for Xenix 386	275
ESIX Systems	
ESIX/V 386 Dev. (2 user)	569
ESIX/V 386 Dev. unltld	769
Guidelines C++ for 386 V2.0	479
Informix SQL	Varies
Interactive Systems	
Architect Wrkstn Platform	1199
Architect Wrkstn Developer	1850
Norton Utilities for Unix	279
Oregon C++ by Oregon SW	979
Recital Standard SU	699
WordTech Quicksilver Diamd.	839
XENIX 386 Dev. Sys.	689

## WINDOWS & OS/2

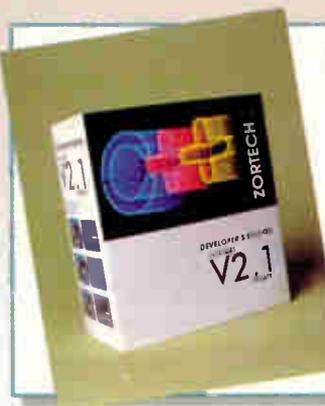
Actor 3.0	639
Brief for OS/2	Call
Case: W	905
Case: PM (for C or C++)	1469
C_talk/Views	419
C-Trieve/Windows	349
dBFast/Windows	315
Graphics Server SDK	455
Instant Windows	895
KnowledgePro Windows	589
MKS Toolkit	229
MS Windows 3.0	119
MS Windows Dev. Dr. Dev. Kit	365
MS Windows Soft. Dev. Kit	365
Multiscope OS/2 Debugger	375



## dBXL by WordTech

A superior alternative to dBASE, dBXL relational database is an easy to use interpreted environment adding extended language (XL) features to the dBASE language. It includes WordTech R&R Relational Report Writer, full dBASE compatibility (files & syntax), and special menus for first time database builders. Also has memory swapping, advanced memo field handling, macros, true windowing multi-dimensional arrays, graphing and EMS support. Requires 440K memory.

LIST: \$249 **PS Price: \$209**  
FastFaxes 971-003



## ZORTECH C++ V2.1 UNIX 386 Compiler by Zortech, Inc.

Zortech's C++ V2.1 386 compiler for UNIX makes it easy to port applications among DOS, DOS 386, OS/2, and SCO UNIX 386. With the same tight, fast, globally optimized code of the DOS and OS/2 versions, the compiler takes full advantage of the 386. Included is an ANSI/UNIX/Zortech C++ compatible library.

LIST: \$500 **PS Price: \$439**  
FastFaxes 1108-045



## Clarion Prof. Dev 2.1 by Clarion Software

A powerful, easy-to-use DBMS application developer, can cut development time by 50%. Imports/exports dBase, BASIC, and DIF files; interfaces with routines from C and Assembler. Includes Report Writer for creating ad-hoc reports and queries. Built-in LAN support: no run-time system required for distribution. Recent winner of PCWeek poll of corporations using programmable databases.

LIST Price: \$845 **PS Price \$549**  
FastFaxes 1005-004

# THE PROGRAMMER'S SHOP 1-800-421-8006

# your source for solutions!



**LOTUS MAGELLAN 2.0**  
by Lotus Development Corp.  
Lotus Magellan 2.0 is the fastest way to organize and use PC information. It combines the most requested utilities in an easy-to-use package. Magellan 2.0 works the way you do, focusing on the information in your files rather than the files themselves. A simple, powerful viewing environment lets you look at the contents of a file right alongside its name--without loading the application that created it. And this includes word processing files, spreadsheets, databases, graphic files, and more.  
LIST: \$139 **PS Price: \$119**  
FastFacts 1917-012



**RYBS HI386 Complete**  
by RYBS Electronics, Inc.  
RAM cram is eliminated in all DOS computers with AMS memory managers by providing up to 928K off conventional DOS memory. Move networks, TSRs, device drivers and DOS utilities out of conventional memory to give full use of 640K. Run large applications in a LAN environment without memory intrusion from the network. Compatible with all 386s and can be used on 286s with EMS boards on C+T chip sets. For PC, XT, AT, 386 and PS/2 Micro Channel computers.  
LIST: \$100 **PS Price: \$89**  
FastFacts 808-002



**Greenleaf Comm Library**  
by Greenleaf Software  
The Greenleaf Comm Library is an asynchronous communications library w/ interrupt-driven, circular buffered service for up to thirty-five ports. Features include: Modem control functions, XMODEM, YMODEM, & KERMIT protocol support; XON/XOFF & RTS/CTS flow control & security against data loss. CommLib™ offers support up to 115Kbaud. Included free; source and PDOPlus Online Help System. Supports all major compilers.  
LIST: \$359 **PS Price: \$329**  
FastFacts 55-007



**Clipper 5.0**  
by Nantucket Corp.  
Clipper's open architecture lends unprecedented freedom to application development. Its language is fully extensible with user-defined functions and new user-defined commands. You can extend the language with routines written in Clipper itself, or integrate code from other languages like C, Assembler, dBASE, and Pascal. Develop applications larger than available memory, without defining overlays. Clipper's compiler generates stand-alone, executable files for cost-free, unrestricted distribution.  
LIST: \$795 **PS Price: \$550**  
FastFacts 1139-003

**FREE Catalog!**

## THE PROGRAMMER'S SHOP CATALOG

is the definitive source book for serious software development professionals.

Over 1,700 development products listed, including:

- applications
- books/training
- communications
- hardware
- languages
- LANs
- libraries
- operating systems
- tools
- UNIX/XENIX
- utilities

Over 1,700 development products listed, including:



**Call today for this valuable guide to programming productivity.**

## What is FastFacts?

You now have access to literature on any of our products via FAX machine. **FREE!**

1. Call 617-740-0025 from your FAX machine's phone.
2. Follow the voice computer's instructions and enter your product's code number (listed in each product box or in our catalog).
3. Hang up the phone and await your instant print out of product literature.

**Call 617-740-0025 from any fax phone!**

# THE PROGRAMMER'S SHOP

**800-421-8006** National Accounts **800-446-1185**

South Shore Park, Spencer Bldg., Hingham, MA 02043 • Canada 800-446-3846 • Mass. 617-740-2510 • FAX: 617-749-2018  
Credit card orders processed *only* when product is shipped. All prices subject to change. Int'l. prices will vary. **BY1190**



# The ALR MPS: Modular Micro Channel

Advanced Logic Research

gambles that it can  
take a byte out of  
the True Blue market



Stan Miastkowski



prices—\$1995 with no hard disk drive or graphics. And there's a well-chosen selection of upgrade options. For example, a 33-MHz 386-based MPS with a 16K-byte static RAM cache, an 80-megabyte hard disk drive, a Super VGA card, and a 14-inch color monitor costs about \$4500. That's nearly half the price of a comparably equipped IBM PS/2.

ALR's entry is a compact 6 by 15 by 17 inches, weighing in at about 35 pounds. The motherboard in the preproduction MPS that I looked at still had hand-wired patches, but careful layout and construction were evident. Packing all this circuitry into a small case isn't a trivial undertaking, and it requires surface-mount fabrication techniques. ALR has used the Intel Micro Channel chip set and has ended up with considerably more expansion space than you find in the PS/2s. The MPS has a total of eight expansion slots (versus three in a comparable PS/2). Two of these are proprietary ALR slots, but there are four 16-bit and two 32-bit Micro Channel slots.

**The World Gets Smaller**

ALR has also opted for a semimodular case layout. As with a true PS/2, you pop out a few plastic buttons, and the drive bays lift off. But you still need to fiddle with cable connectors. And speaking of drives, ALR has also decided to emulate the PS/2 approach of eschewing 5¼-inch drives. You have a choice: Take 3½-inch drives or leave them. Period. But there's lots of room for them: space for four half-height units on the front panel, and room for two 3½-inch hard disk drives (mounted vertically) inside the case.

Just when you thought you had a handle on all those computer terms, here's another acronym for you: MPS. It stands for Modular Personal System, and it's Advanced Logic Research's latest PC incarnation on the way to that ever-elusive system nirvana.

ALR has carved out a solitary and comfortable niche for itself with well-built systems notable for their easy-to-upgrade processor cards. It started off last year with the 286-based PowerFlex and kept the industry hopping earlier this year with the PowerVEISA, a 386-based machine with the Extended Industry Standard Architecture (EISA) bus.

With "Logic" in your corporate moniker, I guess you make logical business decisions. So it's no surprise that the latest ALR machine has taken the "logical" step of jumping headfirst into the Micro Channel market. The ALR MPS is essentially a nicely built PS/2 clone (see photo 1) that offers several features that Big Blue's entries do not, such as truly easy upgrade. A basic MPS unit comes equipped with a 33-MHz 386. Want more power later? No problem. All you need to do is pull the 386 CPU board out of its proprietary slot and plug in an i486 (either 25 or 33 MHz) (see photo 2). Once you get the case off, the whole process takes about 30 seconds. And unlike the processor upgrade schemes that other manufacturers have opted for, ALR's requires no change of software or BIOS ROM upgrade. It's truly plug and play.

**Riding the Micro Channel**

Of course, other ALR systems upgrade in the same way. So what's the point of the MPS? Mainly, the Micro Channel. While the folks at IBM probably aren't quaking in their collective wingtips over ALR's Micro Channel entry, ALR has frosted the competitive cake with lots of sweet goodies, especially for the steely-eyed bean counters of the bottom line. Stripped MPS systems start at lowball

**COMPANY INFORMATION**

**Advanced Logic Research, Inc.**  
 9401 Jeronimo  
 Irvine, CA 92718  
 (800) 444-4257  
 (415) 581-6770  
**Inquiry 1081.**

Despite all the circuitry crammed onto the MPS's motherboard (including an Intelligent Drive Electronics hard disk drive interface), there's plenty of room for expansion. A basic MPS comes with 1 MB of surface-mounted RAM on the motherboard. Add 256K-byte, 1-MB, or 4-MB single in-line memory modules to the four on-board sockets, and you can upgrade to 2, 5, or 17 MB in one fell swoop. Still not enough for you? Add an ALR 32-bit RAM card (that takes up to 22 MB), and you end up with a total system capacity of 49 MB.

**Adding Processing Power**

At press time, the cost of upgrading an MPS machine to a 486/25 was pegged at \$1995; moving up to a 486/33 was a wallet-clearing \$3195. But that's likely to change quickly; 486/25s are becoming more available, while 486/33s are likely to be hard to come by for some time. ALR also offers a trade-in rebate for processor modules. The rebate varies as the market changes, so check with the company for the latest details.

Those who are truly power (or is that status?) hungry can equip the MPS with a high-end TMS34010-based graphics

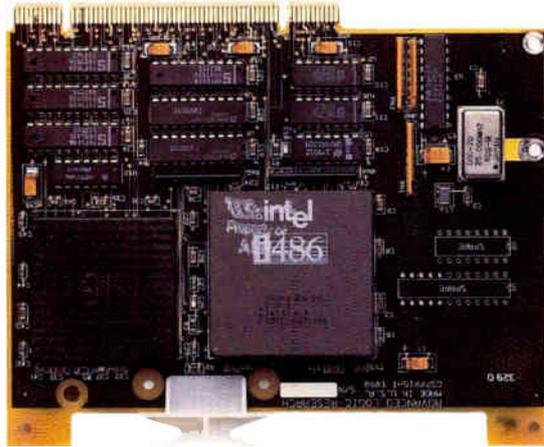
**PRELIMINARY BYTE LOW-LEVEL BENCHMARK SCORES**

*We tested the ALR MPS with three different plug-in processor modules. Although its CPU results were on the low side of competing machines (and the video results were usually fast), note that the ALR was a prototype and the final production versions may (and probably will) differ.*

	CPU	FPU	Disk I/O	Video
<b>ALR MPS 386/33</b>	4.83	14.35	1.61	11.77
<b>ALR MPS 486/25</b>	5.07	24.73	2.63	13.52
<b>ALR MPS 486/33</b>	6.82	32.98	2.68	17.13
<b>ALR PowerVEISA 386/33</b>	9.69	37.03	3.48	4.02
<b>Compaq Deskpro 386/33</b>	6.09	15.50	2.90	4.53
<b>AST Premium 486/33</b>	8.21	37.10	N/A	3.40
<b>Cheetah Gold 33 (486/25)</b>	6.52	21.49	9.49	5.57

Note: Benchmark results are indexed to show relative performance; higher numbers indicate better performance. For all indexes, an 8-MHz IBM PC AT running MS-DOS 3.30=1.

**Photo 1:** *The ALR MPS is highly modular, although not to the extent of the IBM PS/2 series, with which it directly competes. The drive bays detach with three pop-up plastic buttons, giving you easy access to the motherboard.*



processor that emulates the 8514/A (\$3300 with a 15-inch monitor; \$5300 with a 21-inch monitor). And if the MPS is going to see duty as a network file server, there's a 330-MB hard disk drive that will add \$2100 to the system price.

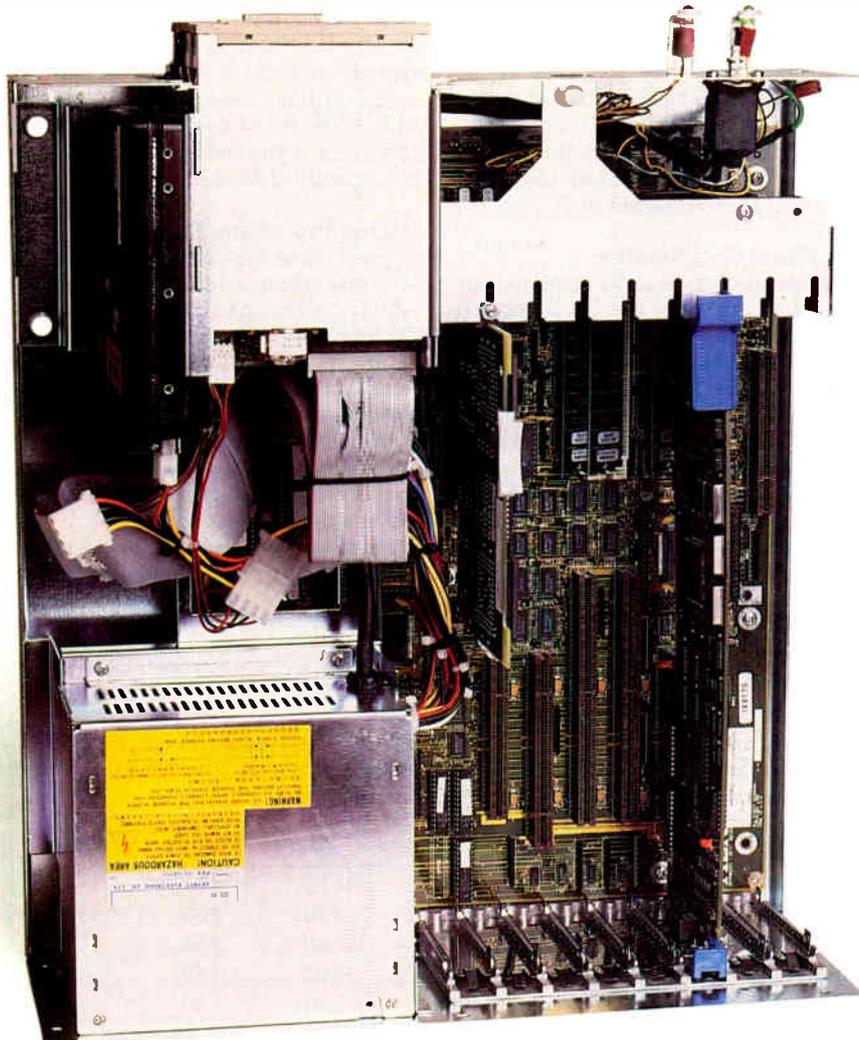
### Mass Transportation

EISA? Industry Standard Architecture (formerly the AT bus)? Micro Channel architecture? Sometimes I feel like a confused commuter trying to decide which bus to take. An ALR spokesperson told me that ISA is essentially dead. That's an understandable statement on the company's part, because it wants to sell lots of EISA and Micro Channel machines. But ISA-based systems are far from obsolete, especially since the high-bandwidth, multiprocessing promises of both EISA and Micro Channel remain largely a dream. Many more add-in boards are available for the Micro Channel than for the EISA bus, but most are simple repackages of ISA products that offer little (or, more often, nothing) in the way of increased performance.

That situation will change, of course; and ALR is in a particularly good position to be a strong contender as the PC market eases leisurely toward high-power processors and high-bandwidth buses—complementary technologies that are just plain made for each other. The ability to upgrade your PC's processor in the future remains an intriguing one. (There will be an i586 one of these days.)

If you're considering going for a bus upgrade, the choice between EISA and Micro Channel is a somewhat thornier issue. Except for ever-true, ever-blue IBM users, Micro Channel-bus PCs haven't taken off since their introduction some 2½ years ago. Other non-IBM Micro Channel machines, such as those made by NCR, Reply, Tandy, and Wang, have largely been rolled out so that the companies can tout their "complete lines" to Big Corporate Buyers. I have a hunch that the ALR MPS is very much the same.

The MPS is well designed and well built, and it shows a high degree of engineering expertise and sophistication. But for the time being, its user base is likely to be confined to large companies who specify Micro Channel yet are looking for a lower-priced (and upgradable) alternative. While EISA and Micro Channel slug it out, ALR can profitably work both sides of the street. ■



**Photo 2:** *You can upgrade ALR's CPU module (the 486/25 with a Weitek socket is shown here) in about 5 minutes. You don't need to upgrade the software or firmware.*

*Stan Miastkowski is the BYTE senior editor for new products. He can be reached on BIX as "stanm."*

# Hire The CompuAdd 316sl For Your Team

## Get Fast, Versatile, Dependable 386SX Power

The CompuAdd 316sl can be the most valuable member of your team. In the office or in the field, this compact laptop delivers fast, versatile, dependable 386SX power.

Powered by a 16MHz 386SX microprocessor, the 316sl sports a fast (28ms) 40MB hard drive and a 3.5" floppy drive and a crisp advanced-technology VGA screen.

You can use the versatile 316sl as a powerful desktop system in your office. You'll appreciate the feel of the spacious 85-key keyboard, with 12 function keys and cursor keypad. When you require a standard 101-key keyboard, simply connect the keyboard cord to the external socket. You can even fold the high-resolution LCD screen back flat and plug your color monitor into the external VGA port.

The rugged, reliable 316sl lets you take your office to the field. The compact, 11.5-pound system comes preloaded with FREE CompuAdd Windows 3.0, CompuAdd MS-DOS 4.01 and LapLink II. You can add an optional internal modem/send-only fax to keep in touch with the home office.

You'll always have critical data and schedules at your fingertips. The 316sl operates from the AC wall outlet or runs up to three hours on batteries alone. You can replace the battery pack with a charged-up spare in a matter of seconds. The 316sl also comes with Power Management Software that manages vital functions to conserve battery power.

Run the latest multitasking 386 applications or your favorite 286 software. Work on your Lotus 1-2-3 spreadsheet, track your sales contacts with ACT! or get your points across with Microsoft Powerpoint. Keep your business in order, whether your applications run under MS-DOS®, OS/2® or SCO XENIX® operating systems.

Call today. CompuAdd's 316sl will work for you wherever you work.



### CompuAdd's 316sl Features:

- ▲ 386SX microprocessor rated at 16MHz
- ▲ 2MB DRAM expandable to 6MB
- ▲ 0 wait-state page-mode memory
- ▲ 40MB (28ms) hard disk drive
- ▲ 3.5" 1.44MB high-density diskette drive
- ▲ Dedicated internal modem/send-only fax expansion slot
- ▲ Dedicated 80387SX math coprocessor socket
- ▲ Built-in serial, parallel printer, external VGA monitor, keyboard and 5.25" diskette drive ports
- ▲ High-resolution 640 x 480 monographics VGA display with 7" x 5.25" sidelit, super-twist LCD screen
- ▲ 85-key keyboard with 101-key emulation, 12 function keys and 4 cursor keys
- ▲ FREE CompuAdd serial mouse
- ▲ FREE CompuAdd Windows 3.0
- ▲ FREE CompuAdd MS-DOS 4.01
- ▲ FREE LapLink II data transfer software with serial cable
- ▲ Base System Price: \$2895 (62202)

### CompuAdd 316sl Options:

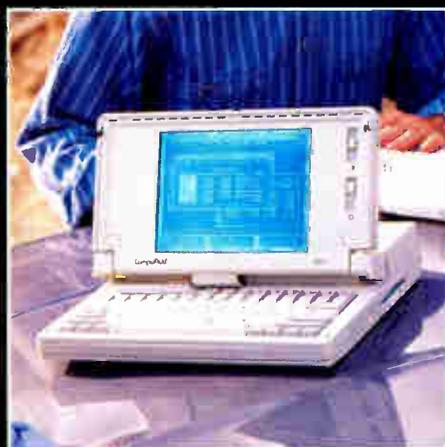
Internal 2400 Baud Modem/ Send-Only Fax .....	62218—\$249
External Floppy Disk Drive .....	62219—\$215
Replacement AC Adapter .....	62216—\$85
Spare Battery Pack .....	62217—\$65
Carrying Case .....	62215—\$55

Get 386SX Power, Laptop  
Convenience and CompuAdd Value!

Call 800-456-6008

**CompuAdd**<sup>®</sup>  
Customer driven, by design.<sup>™</sup>

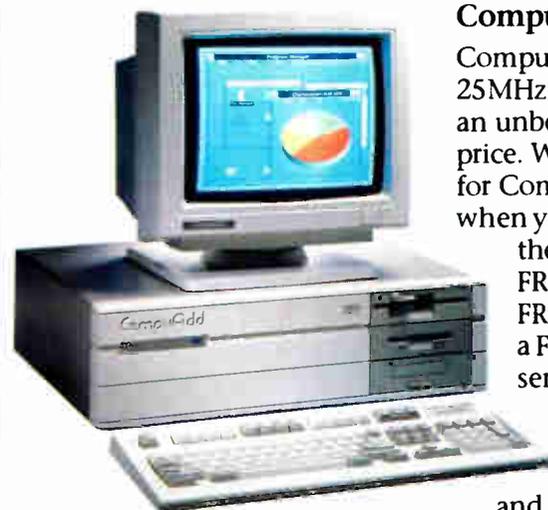
# If You Discovered A Worker That



- Works Hard in the Field and Office
- Never Misses a Workday
- Fits in Any Department
- Outperforms the Competition
- Even Manages the Project

## We Bet You'd...

# CompuAdd's Top-of-the-Line Technology at Bottom-Line Prices



### CompuAdd 325

CompuAdd's 325 gives you 25MHz 386 processing power at an unbeatable CompuAdd value price. Why pay almost \$2000 more for Compaq's equivalent system, when you get so many extras with the CompuAdd 325? Extras like **FREE** CompuAdd Windows 3.0, **FREE** CompuAdd MS-DOS 4.01, a **FREE** mouse and **FREE** onsite service for one year. Plus you get CompuAdd designed reliability, backed by toll-free telephone support and the convenience of 89

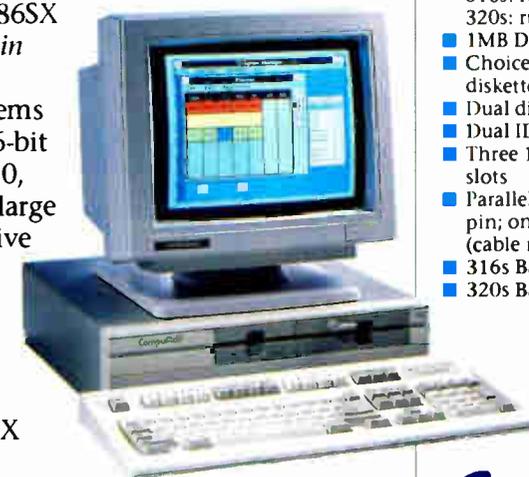
CompuAdd Superstores across the country. With the CompuAdd 325, you'll master RAM-intensive applications such as accounting, database management, desktop publishing and CAD. Pick from a variety of hard drive and monitor options to get exactly what your work requires.

### CompuAdd 316s and 320s

CompuAdd designed these systems around the Intel® 386SX microprocessor, running at 16MHz on the 316s and 20MHz on the 320s. *PC Magazine* (Jan. 30, 1990) says the 386SX processor is "perfect for entry-level users in today's corporate market."

The CompuAdd 316s and 320s systems give you 32-bit processing power at 16-bit prices. Get the most from Windows 3.0, work with complex spreadsheets and large databases, or run computation-intensive applications like CAD/CAM. Both systems are compatible with MS-DOS, SCO XENIX, OS/2 and Novell operating environments.

Call today and get advanced computing power with CompuAdd's 386SX systems. Remember to ask about our 316s-based SX Success Kit. All at an unbeatable CompuAdd value.



### CompuAdd 325 Features:

- 80386 microprocessor rated at 25MHz (8MHz, and 25MHz)
- 1MB DRAM expandable to 16MB
- 0 wait-state cache memory
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Dual diskette drive controller
- Dual IDE hard drive interface
- Six 16-bit and two 8-bit expansion slots
- Parallel port and two serial ports
- Real-time clock/calendar
- **FREE** CompuAdd serial mouse
- **FREE** CompuAdd Windows 3.0
- **FREE** CompuAdd MS-DOS 4.01
- **FREE** one-year onsite service
- Base System Price: \$1695 (64834)

### CompuAdd 316s and 320s Features:

- 386SX microprocessor
- 316s: running at 16MHz (8, 16MHz)
- 320s: running at 20MHz (7, 20MHz)
- 1MB DRAM expandable to 4MB
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Dual diskette drive controller
- Dual IDE hard drive interface
- Three 16-bit and two 8-bit expansion slots
- Parallel port, two serial ports (one 9-pin; one 25-pin), game port interface (cable required 48954)
- 316s Base Price: \$1195 (64787)
- 320s Base Price: \$1395 (66537)

Think Technology, Think CompuAdd

CALL TODAY! or  
visit a CompuAdd  
Superstore for these  
savings.

# 800-456-6008

Hours: Monday - Friday 7:00am to 9:00pm CST; Saturday 9:00am to 5:00pm CST

## CompuAdd®

Customer driven. by design.™

12303 Technology, Austin, Texas 78727

Telex: 763543 COMPUADD AUS  
Fax: 512-335-6236  
Technical Support: 800-999-9901  
Outside US: 512-258-5575  
Canada: 800-387-3266  
Mexico: 95-800-010-0401  
United Kingdom: 0800-373535  
Germany: 0130-6009

We accept MasterCard, VISA, money orders, certified checks and personal checks (please allow ten days for processing). CODs (\$50 minimum order), company and institutional purchase orders (minimum initial purchase \$500, thereafter \$50), and wire transfers. Please add 2% to all purchases for shipping and handling (minimum \$3 shipping outside the continental United States will increase cost). Add 8% for shipping and handling to APO/FPO addresses (minimum \$10). AZ, CO, CT, DC, FL, GA, IL, IN, KS, LA, MA, MD, MI, MN, MO, NC, NE, NJ, NY, OH, OK, PA, RI, SC, TN, TX, UT, VA and WI residents, please add appropriate local sales tax. Thirty-day money-back guarantee does not include return freight or shipping and handling. Opened software, videotapes, other consumables and shipping costs are nonrefundable. All return items must be accompanied by a return merchandise authorization (RMA) number. Prices and product descriptions are subject to change without notice. CompuAdd is not liable for damage due to omissions or typographical errors. Call 800-666-1872 for a copy of CompuAdd's complete warranty.

# Fast New Systems from NeXT

In addition to considerable fanfare and praise, the original NeXT Computer received a fair share of criticism. It had been faulted for its lack of color options, high price, a perceived lack of performance, and—most often—its lack of a floppy disk drive. With the new NeXT systems that were introduced in September, NeXT has built on its past achievements and addressed the majority of these weaknesses.

NeXT now has a product line that features the new 68040 microprocessor running at 25 MHz, an MS-DOS-compatible 2.88-megabyte floppy disk drive, a new “slim-case” desktop model that retails for the relatively low price of \$4995, and color options due out early next year.

According to NeXT’s numbers, the 68040 has a performance rating of approximately 15 million instructions per second and 2.8 million floating-point operations per second (MFLOPS), about three times faster than the 68030 used in the original NeXT Computer. The 68040 also includes memory management and floating-point coprocessors on the main chip.

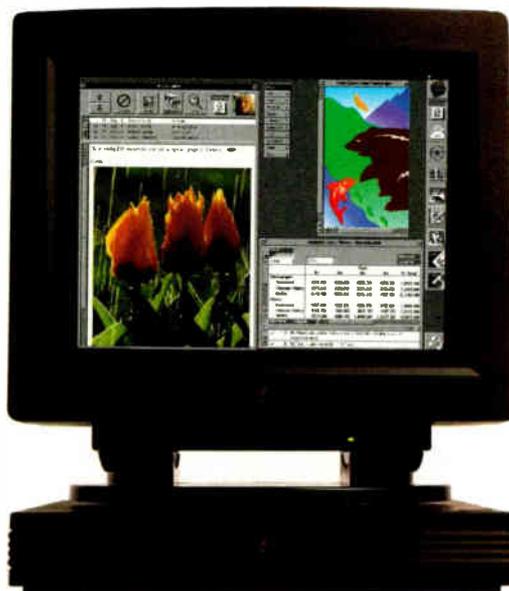
When the NeXT Computer was introduced in 1988, one of its primary features was an erasable 256-MB optical disk drive, which Steve Jobs touted as the floppy disk drive of the nineties, allowing users to “take their whole world in their backpacks.” But the optical drive has proved to be too slow for use as a main storage device, and the cartridges are too expensive for use as a data-exchange medium: No one wants to send a file on a \$50 storage medium. In addition, the price of the optical cartridges jacks up the price of third-party software. Nevertheless, the optical

The new NeXT systems  
sport lower price tags,  
more speed,  
and a long-sought  
floppy disk drive

■  
Nick Baran and  
Owen Linderholm

#### Photo 1:

*Unlike the original NeXT Computer, the new Nextstation Color features a slim-case, or “pizza-box,” system unit. Inside is a powerful 68040 processor and 12 MB of RAM.*



drive is excellent as a backup device and will be offered as an option for that purpose.

The floppy disk drive of the nineties is now the good old 3½-inch drive, but with an increased capacity of 2.88 MB and the capability to read and write files in 1.44-MB and 720K-byte MS-DOS formats. This floppy disk drive is now standard equipment on all NeXT machines and will be the primary medium for the distribution of software and data. The new NextStep operating-system software automatically mounts the floppy disk and displays its files in the system’s Directory Browser. In addition, the software supports CD-ROM drives (see the text box “A New Version of NextStep” on page 167).

While the new 2.88-MB drive cannot read and write Macintosh-formatted files directly, the high-density floppy disk drive (SuperDrive) available on Macintoshes can convert to MS-DOS format; thus, Macintosh file compatibility should not be a big problem.

NeXT’s system boards now include a twisted-pair 10-Base-T Ethernet port, as well as the thin Ethernet port that is on the current system board. Another change is the use of the 50-pin SCSI-2 standard rather than the older 25-pin SCSI standard. SCSI-2 offers greater reliability and faster transfer rates than does standard SCSI. SCSI-2 is backward compatible so that existing SCSI devices can be attached using a cable adapter. The new system boards also support parity memory checking, a feature that has been requested by scientific and engineering users.

It should be noted that the new system board still uses

the Motorola 56001 digital signal processor, despite speculation that the new machine would have the 96002 DSP, a successor to the 56001 that includes floating-point capability. NeXT says that the 96002 isn't currently fully backward compatible with software for the 56001. However, NeXT has added a single in-line memory module socket for up to 192K bytes of memory addressable by the DSP.

#### The Nextstation Pizza Box

The new Nextstation is clearly NeXT's answer to the SPARCstation. Made from magnesium with a cosmetic plastic shroud, the slim-case, or "pizza-box," system unit is about 15 inches square and 2½ inches thick, and it sits under the system's display. The system board is slightly larger than the original NeXT system board; the two are not interchangeable. The board includes two serial ports, a display port, the SCSI-2 port, and both thin and 10Base-T Ethernet ports. The Nextstation is cooled by a virtually silent "whisper fan" that passes air over heat-dissipating fins built into the bottom of the case. These lie directly under the power supply—a major heat source. The power supply is a 120-watt unit that uses a new technology called "parallel resonance switching," which allows a much smaller form factor than conventional power supplies.

#### THE FACTS

##### Nextstation

with 8 MB of RAM, 105-MB hard disk drive, 2.88-MB floppy disk drive, and 17-inch monochrome display, \$4995

##### Nextcube

with 8 MB of RAM, 105-MB hard disk drive, 2.88-MB floppy disk drive, and 17-inch monochrome display, \$7995

##### Nextstation Color

with 12 MB of RAM, 105-MB hard disk drive, 2.88-MB floppy disk drive, and 16-inch color display, \$7995

##### Nextdimension

with 8 MB of RAM, \$3995

##### NeXT, Inc.

900 Chesapeake Dr.  
Redwood City, CA 94063  
(415) 366-0900  
Inquiry 1066.

## The Nextstation is a welcome addition to the NeXT product line.

The Nextstation comes standard with 8 MB of memory (expandable to 32 MB), a 105-MB hard disk drive, and the 2.88-MB floppy disk drive. With the 17-inch black-and-white MegaPixel display, this system costs \$4995. A reduced version of the operating system is shipped installed on the 105-MB hard disk drive and takes up about 75 MB on the disk, including 16 MB of swap space required for virtual memory mapping by the operating system. Unless connected to a network file server, a system with the 105-MB drive will require an additional hard disk drive for storing much third-party software and data. An internal 340-MB hard disk drive is available as an option instead of the 105-MB drive, in which case the system costs \$6995, a rather hefty price increase for an added 235 MB of storage.

The Nextstation is a welcome addition to the NeXT product line. It is ideal for end users who don't need the storage or expansion capabilities of the NeXT Computer. The Nextstation was supposed to begin shipping in October.

#### A New Cube

The other new NeXT system is the Nextcube, the familiar cube but with a floppy disk drive instead of an optical drive, and space for one half-height and one full-height storage device (either two hard disk drives or a hard disk drive and a CD-ROM or optical drive). The 105-MB and 340-MB drives are half-height devices, while the 660-MB and 1.4-gigabyte units are full-height devices.

The Nextcube system board has the same features as the Nextstation system board, including parity memory and the SCSI-2 and 10Base-T ports, but memory can be expanded on-board to 64 MB. An 8-MB system with the 2.88-MB floppy disk drive, the 105-MB hard disk drive, and the 17-inch monochrome display costs \$7995. The 340-MB drive option boosts the price to \$9995. The Nextcube was scheduled to ship in September.

#### Color Options

NeXT will offer two "color solutions": a low-end system for business applica-

tions, presentation graphics, and two-dimensional CAD, and a high-end system for scientific imaging, professional graphics production, 3-D modeling, and so forth.

At the low end will be a color version of the Nextstation with 16-bit-per-pixel color, allowing 4096 colors on-screen simultaneously (12 bits for color and a 4-bit "alpha channel" for specifying transparency). At the high end will be an add-in board with 32-bit color, its own graphics processor, and a processor for compressing and decompressing graphics images, allowing 16 million colors on-screen simultaneously (24 bits for color and an 8-bit alpha channel for specifying transparency).

#### The Nextstation Color

The Nextstation Color (see photo 1) is the same slim-case machine as the Nextstation, except that it supports 16-bit color. It comes standard with 12 MB of RAM and 2 MB of video memory. NeXT increased the memory bandwidth somewhat on this model to improve video performance. The Nextstation Color is designed for use with NeXT's new color MegaPixel display, which is a 16-inch Sony Trinitron display with 1120- by 832-pixel resolution (the same resolution as the black-and-white display). The 12-MB system with the color display, a 105-MB hard disk drive, and the 2.88-MB floppy disk drive will cost \$7995. As with the Nextstation, an additional hard disk drive will be necessary unless the system has access to a network file server.

The Nextstation Color does not require NeXT's color MegaPixel display. By purchasing NeXT's ColorConnect adapter, you can connect any size color display that is capable of showing images in the correct resolution. The ColorConnect adapter provides the sound and speaker functions that are normally built into the MegaPixel display. Pricing for the ColorConnect adapter was not available at the time of this writing, but a Nextstation Color without a monitor will cost \$4995. There is no upgrade path between the black-and-white Nextstation machine and the Nextstation Color. Unfortunately, the Nextstation Color will not ship until early 1991.

#### Upgrading Existing Cubes

As NeXT announced several months ago, current NeXT users will be able to obtain a 68040 upgrade for their NeXT Computers for \$1495. This will involve swapping the 68030 system board for the new 68040 system board. NeXT has also

## A New Version of NeXTStep

In conjunction with the new hardware in its product line, NeXT is providing a major upgrade to its operating-system software. NextStep 2.0 includes support for the new hardware components, such as the 2.88-megabyte floppy disk drive, CD-ROM drive, color display, and 10Base-T Ethernet, as well as a host of improvements to the interface and development environment.

To accommodate the comparatively small 105-MB hard disk drive that is standard on all the Nextstation models, NeXT has split NextStep into two versions: release 2.0 and release 2.0 Extended.

The extended version includes all the current developer's tools, such as the Application Kit and the Interface Builder, as well as some new enhancements aimed at application developers. However, neither version will include Mathematica, Common Lisp,

or the Sybase database manager. Release 2.0, a reduced version of NextStep, does not include the Interface Builder or the Application Kit, and it has a reduced version of Webster's Ninth New Collegiate Dictionary without the illustrations or the full text index. The reduced version also has fewer demonstration programs and does not include the Shakespeare plays or The Oxford Dictionary of Quotations.

NeXT may find that most customers want the extended version and opt for a larger hard disk than the 105-MB unit. However, for networked users who have access to a file server, the reduced version simply reduces the local storage requirements. In any case, release 2.0 and release 2.0 Extended are functionally equivalent so that users will be able to move to the extended version simply by installing a larger disk capacity and copying the missing files.

### An Improved Interface

NextStep 2.0 addresses several major weaknesses of release 1.0. Of particular importance, the Workspace is now multithreaded so that file operations such as copying and moving can be done in the

background, allowing the user to continue working on other tasks.

The printing interface has also been redesigned to operate at a lower priority so that the screen doesn't lock during print operations. The trade-off is slower printing performance in exchange for a live screen. In addition, the printer interface now includes an option for sending fax documents. If you have a fax modem, you can fax anything that can be printed by simply clicking on the new Fax option in the Print menu.

The Workspace has received some cosmetic changes in release 2.0. The Directory Browser has been redesigned and now includes a "shelf" at the top of the browser window where users can place frequently used files and folders. The Browser also includes a new window that shows the "icon history," or status, of applications and folders that are in use. Clicking on an icon in the window displays the path of the file or the folder graphically in the Directory Browser. The icon history window replaces the icon well in the current Directory Browser.

The Mail application has been improved in release 2.0. Mail now includes an archive facility for storing mail messages. A return receipt function has been added, as well as support for sending mail to recipients with non-NeXT systems that require a standard font, wrapped lines, and carriage returns for 80-column text. Release 2.0 in-

cludes spelling checking and rulers built into the Text Object, so that these features are now supported in Mail.

The development environment has been improved in release 2.0 and includes support for color. A new object called the Color Picker works similarly to the font panel and allows you to select and mix colors. The window server supports frame buffers of different size and depth to accommodate the use of third-party color monitors. NeXT plans to support the RenderMan scene-description language for three-dimensional rendering in a future release of NextStep, due early next year.

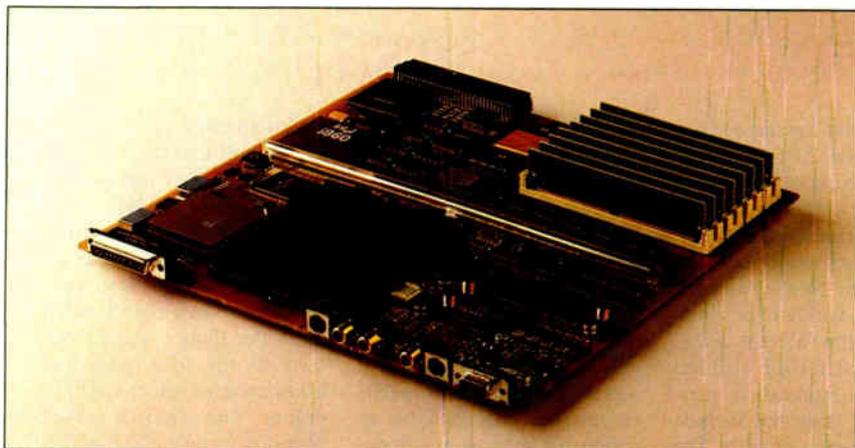
Release 2.0 supports loadable device drivers, allowing developers to create custom applications for peripherals like video and sound equipment and special-purpose display and output devices. All text objects now automatically include a spelling checker and rulers.

Other new features include an improved MIDI driver that supports arbitrary sampling rates and PostScript composite fonts, a feature of Adobe's PostScript level 2. Composite fonts allow support for kanji and other alphabets.

### Availability and Upgrades

NeXT was optimistically hoping to have release 2.0 ready in September. At press time it was still not finished, but NeXT was confident it would be ready in time. In any event, the new machines won't run without it, so completion is a top priority.

The system software will be shipped preinstalled on hard disks, relieving the user of the time-consuming Build Disk operation. Current users of release 1.0 will be able to upgrade to 2.0 on an optical drive for \$195, which includes new manuals.



**Photo 2:**  
*The Nextdimension board provides the Nextcube with high-performance color graphics. On the board is an Intel i860 RISC processor, 4 MB of video RAM, and room for up to 32 MB of memory.*

contracted with a third-party supplier to provide an external 2.88-MB floppy disk drive for current NeXT Computer owners. Pricing and availability of the floppy disk drive have not been announced as of this writing, but, according to sources at NeXT, it will be available within the next couple of months.

To go along with all this new hardware, NeXT is cutting the price of its high-resolution 400-dot-per-inch laser printer almost in half. Originally selling for a retail price of \$3495, the printer is now priced at \$1795, representing a substantial reduction in the cost of a complete NeXT system.

### Doing Color Right

NeXT president Steve Jobs promised from the beginning that NeXT would eventually support color, but not until it's "done right." And indeed, NeXT has done color right. Using the PostScript imaging model, color on the NeXT is device independent; in other words, applications written using color PostScript specifications can be displayed on any output device that supports PostScript, whether it's a screen or a printer supporting black and white, gray scale, or various resolutions of color.

In addition, PostScript offers excellent performance in color. When you compare Color QuickDraw on the Mac IIx and color PostScript on a 68030-based NeXT Computer, you find that screen refresh and movement of color images are much faster on the NeXT. And, unlike with Apple's QuickDraw and TrueType image and font models, there is no need

for conversion routines to display PostScript images on PostScript devices.

### High-End Color: The Nextdimension

NeXT's high-end color solution is an add-in board called the Nextdimension (see photo 2). The board plugs into one of the three NextBus slots in the NeXT Computer, and it features Intel's i860 microprocessor, which is rated at 80 MFLOPS and offers high-speed graphics processing. The board has 4 MB of video memory, plus up to 32 MB of RAM for increasing the display's windowing capacity (i.e., the number of windows that can be displayed on the screen simultaneously).

In addition, the board includes the C-Cube Microsystems CL550 image-compression processor, which can compress video and bit-mapped images in ratios of up to 30 to 1 using the Joint Photographic Experts Group image-compression algorithm. The board supports NTSC and SVideo (SuperVHS and High 8mm) images for both input and output, as well as RGB color. One 640- by 480-pixel window can display live NTSC or SVideo images. In conjunction with the C-Cube image-compression processor, the live window can display 30 frames per second for true real-time motion video.

Like the Nextstation Color, the Nextdimension supports the new color MegaPixel display and, using the ColorConnect adapter, third-party color displays. The color display can run simultaneously with the black-and-white MegaPixel display, allowing a contiguous work space

consisting of the two screens. Images or text can be dragged from one screen to the other as if the two screens made up a single display. For intense graphics users, up to three Nextdimension boards can be installed in one NeXT Computer, each with a separate monitor.

The Nextdimension will be priced very competitively at \$3995, which includes 8 MB of RAM. A complete color system (a Nextcube with the color MegaPixel display and the Nextdimension board) will cost about \$15,000, making the system very competitive with similar systems from Sun and Apple. The Nextdimension should ship early in 1991.

### High-Speed Color at a Low Cost

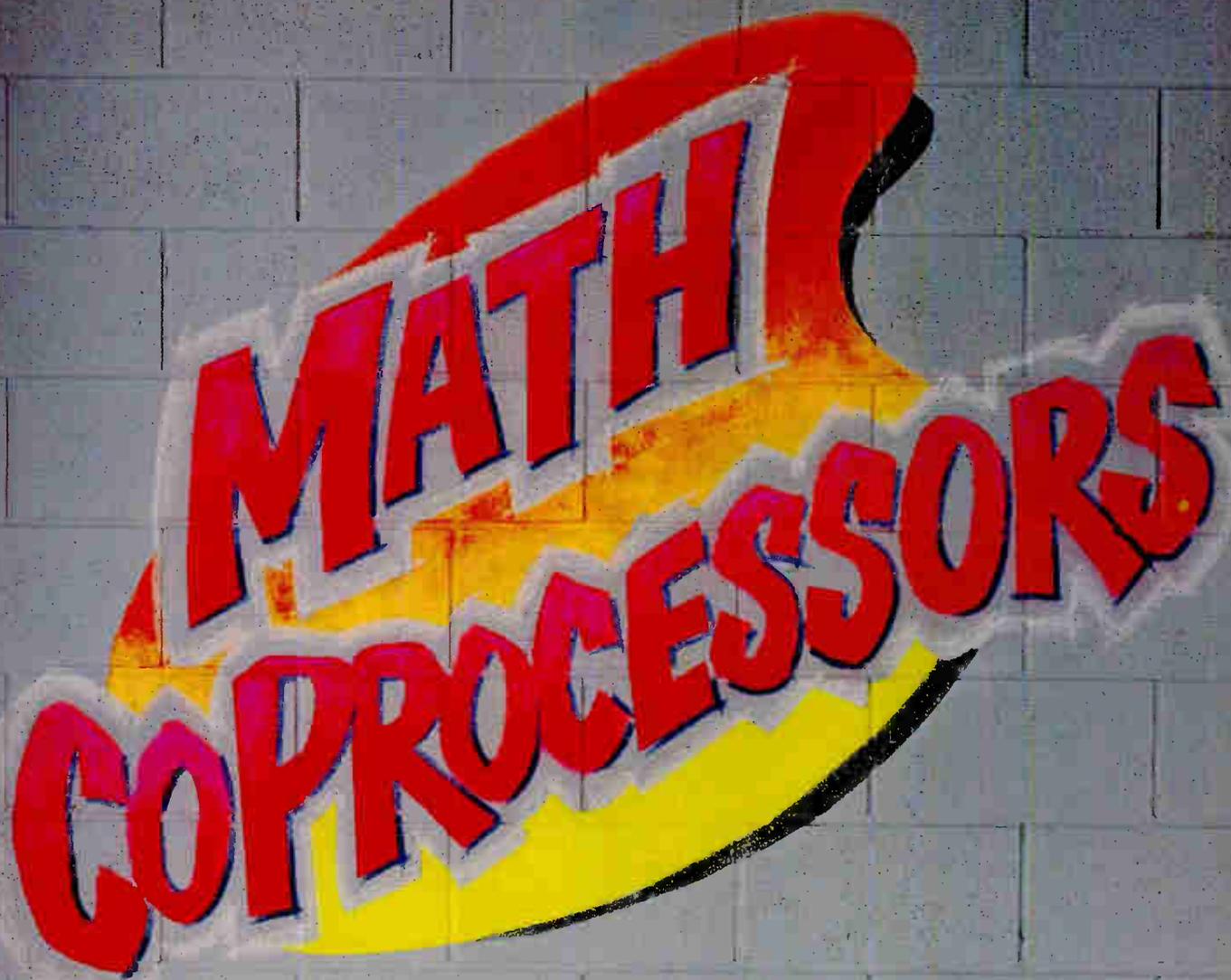
These new systems and the updated NextStep software give NeXT a very powerful, well-rounded, and extremely competitive product line. The Nextstation system may now be the workstation with a laser printer makes a powerful desktop publishing setup.

But where NeXT has really taken a lead is in the color arena. NeXT's decision to go with Display PostScript is paying off in a big way. The system has one consistent model for both displaying and printing. And, despite rumors to the contrary, its performance is outstanding.

The new NeXT systems are going to be extremely competitive with high-end desktop personal computers, especially high-end Macintoshes. The products will also compete well in the low-end workstation market. And since educational establishments and developers continue to get a 30 percent discount, these systems will be even more competitive in universities.

Perhaps the biggest task left to NeXT is to persuade software vendors to write programs for NeXT systems. But that is changing, as Lotus and Ashton-Tate have announced new spreadsheet programs in conjunction with the new systems' introduction in September. Lotus's spreadsheet in particular shows why the NeXT systems are so important. The program is completely innovative in every way and is pointing the way ahead for the future of software and hardware—just like the NeXT machines themselves are. ■

*Nick Baran is a consulting editor for BYTE and editor of Baran's Tech Letter, a newsletter covering the NeXT Computer. He can be contacted on BIX as "nickbaran." Owen Linderholm is a BYTE news editor based in San Francisco. He can be contacted on BIX as "owenl."*



# MATH COPROCESSORS

You know what you need  
to speed up your  
power applications.  
There's just one more thing  
you should know.

*Circle 177 on Reader Service Card (RESELLERS: 178)*

To get a V.32  
9600 modem with  
V.42bis data compression,  
you can pay their  
standard price.



The price of our new 9600EX makes the price other 9600bps modems look, well, rather inflated. Especially when you consider the quality and features the 9600EX offers.

Features like V.42bis, which compresses data up to 400% and speeds throughput to up to 38.4Kbps (It's also downward-compatible with MNP5). And V.42 LAP-M and MNP Level 1-4 error control that detects when data is being garbled and automatically retransmits—so you get error-free

communication. Or full-compliance with V.32, the industry standard 9600 modem protocol, as well as downward compatibility with 4800, 2400, 1200 and 300bps modems. The 9600EX also gives you the option to operate on standard phone lines or two-wire leased lines and offers both synchronous and asynchronous transmission.

Fact is, at \$799, the 9600EX rivals the price of high-end 2400 modems. Yet, it offers 16 times the performance. Or in other words, more modem for the money.



And that added performance saves you money, too. With the increase in throughput speed, the 9600EX spends less time on the phone so you spend less money on your phone bill. You'll also spend less time waiting for it to finish transmitting—and if time is money—you'll save a bundle.

Plus, like our entire family of 2400 modems, the 9600EX comes with a full, five-year warranty. The new 9600EX modem: another example of Intel's commitment to affordable quality. For

more information or dealer near you, call: 800-538-3373. To have information faxed directly to you, call: 800-525-3019 and request Doc.#9989. And don't be swayed by those over-priced modems, because with everything the 9600EX offers for the money, you might say it just burst their bubbles.

**intel**<sup>®</sup>

Circle 179 on Reader Service Card (RESELLERS: 180)

World Radio History

# Massive Storage for Multiple Platforms

**The BYTE Lab rates high-capacity hard disk drives for DOS, Macintosh, NetWare, and Unix applications**

*Steve Apiki, Stan Wszola, Rick Grehan, and Tom Yager*

**D**evotees of Macintoshes, NetWare 386 file servers, single-user DOS systems, and Unix machines have something in common: Sooner or later, they all see a disk error message that means "insufficient space."

This month, the BYTE Lab looks at 15 high-speed, high-capacity hard disk drives that offer relief from overcrowded data. Along with new levels of performance, the SCSI connector that these drives share also promises easier upgrades when a drive no longer seems as roomy as it did in the showroom.

The SCSI bus protocol defines how peripherals talk to the host and to each other. SCSI is fast—4 megabytes per second at the top end—and that is driving its acceptance across the four major operating systems. But SCSI also lets you chain drives together, so today's investment in a 300-MB drive can be the foundation of a larger system years down the road.

The BYTE Lab compared SCSI drives with capacities of between 300 and 420 MB in configurations ranging from barebones OEM systems to full plug-and-play packages. We tested each in single disk drive configurations under MS-DOS, NetWare 386, Unix, and the Mac OS (not all drives were compatible with

all operating systems). The text box "How to Measure Drives Across Four Operating Systems" on page 176 explains our benchmarks.

You're not likely to find the OEM units from Fujitsu, Western Digital, and Micropolis at your corner computer store, but larger mail-order houses might stock them. Their performance, however, provides a good point of comparison for retail products built around them. Western Digital purchases its WD380 SC drives from IBM, so the WD380 SC should give a reasonable indication of IBM's SCSI system performance.

## Interface Heritage

SCSI controllers trace their lineage to Shugart Technology's ST506 interface, introduced by that company in 1980 to support its 5-MB hard disk drive. ESDI, which is more or less a direct descendant of ST506, appeared in 1983 and offered double the throughput rate of its ancestor. More recently, the Intelligent Drive Electronics (IDE) interface has grown in popularity, because it requires less circuitry on the host, allowing engineers to design smaller-footprint systems.

SCSI drives handle communications between computer and disk drive at a higher level. For example, when applications talk to a SCSI drive, they are unaware of the drive's configuration details, such as the number of cylinders, heads, and sectors. The drive appears as a collection of sequentially numbered blocks. Thus, SCSI moves a substantial amount of intelligence onto the drive. Consequently, SCSI is far more flexible than the other interfaces. (See the text box "The Fuzzy Side of SCSI" on page 186.)

This doesn't mean that traditional measures of performance—seek and access times—are obsolete. The drive still needs to physically seek the requested tracks and wait for the requested sector to come around. However, SCSI makes some traditional benchmarks obsolete.

Timing track-to-track seeks and attempting to factor in seek latency is no longer possible from an application perspective.

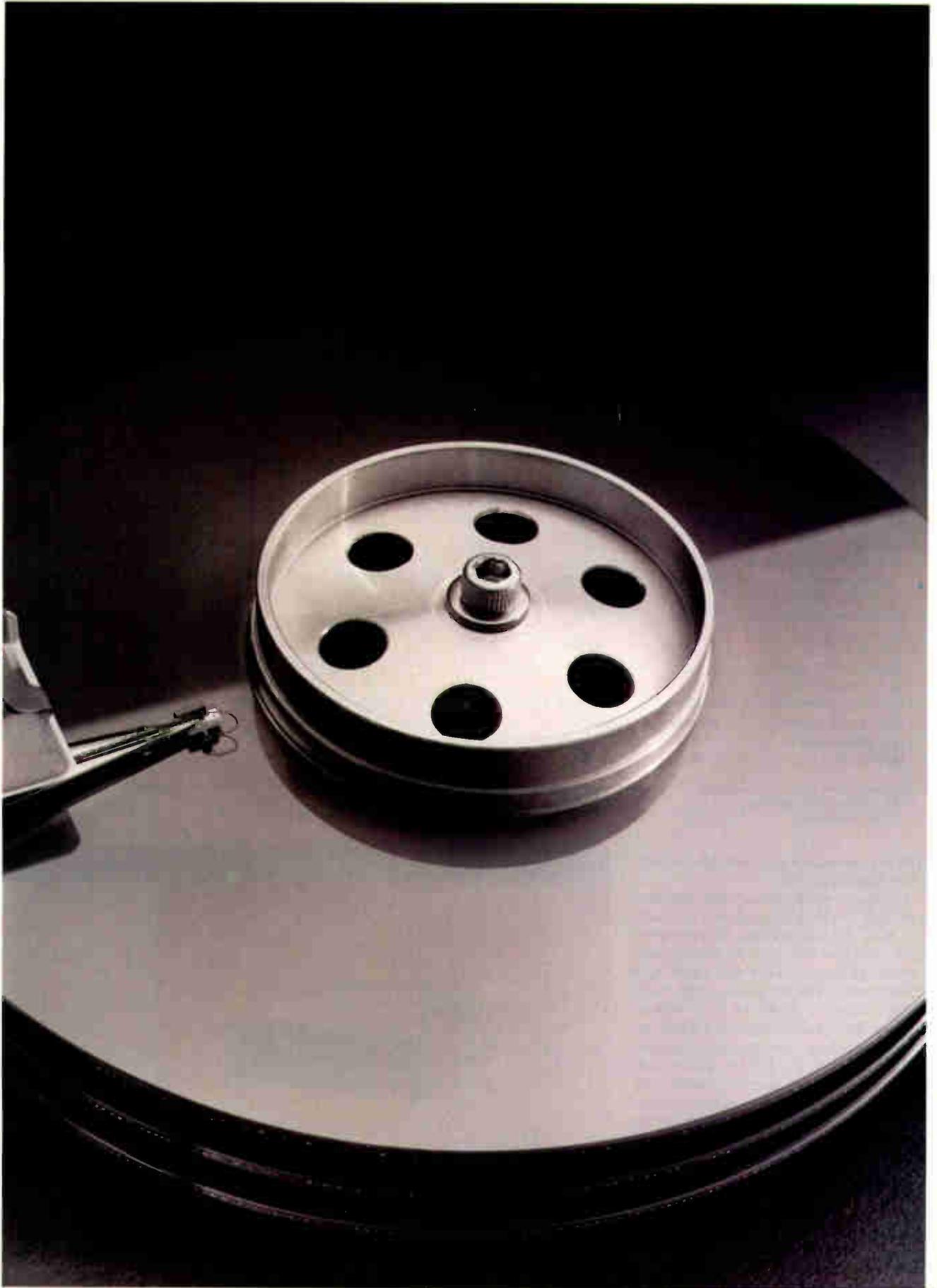
Since the drive's geometry can be hidden from the host computer, manufacturers can optimize controller electronics for the drive itself without having to pass any resulting customizations on to the host. This lets a single host adapter talk to a wide variety of drive types. Additionally, drive manufacturers can place cache memory directly on the drive controller; any system RAM that you might have been using for a disk cache can go back to running programs.

## Points for SCSI

SCSI sports a few other features favored by systems integrators and others who are faced with rising disk space and performance demands. First, SCSI easily handles large-capacity drives. As an example, the SCSI extended read command accepts a 32-bit block number. Given a block size of 512 bytes (the standard with the drives we tested), a single disk drive could hold 2 terabytes of data.

Second, multiple drives can be daisy chained on the SCSI bus. This is handy for network administrators, who can easily add drives as network users demand more storage space. One SCSI bus can accommodate eight devices: one host computer and seven peripherals. Consequently, the maximum number of drives that you can hang off a single SCSI port typically is seven. However, each device on a SCSI bus can incorporate eight logical units, which in turn can incorporate 256 logical subunits.

Third, SCSI supports multiuser and multitasking operating systems. Devices on a SCSI bus are either initiators (i.e., the host computer) or targets (i.e., the disk drives). Once the host computer passes a request to the disk drive, the host can disconnect from the drive rather than wait for the request's completion. The host then can perform other processing while the drive services the request.



SCSI DRIVE FEATURES

In addition to performance, other features that can help determine the right high-capacity SCSI drive for you include formatted capacities, failure rates, and warranties. Compare these vendor-supplied average seek times with results obtained in the BYTE Lab, shown in figure 1 (● = yes; ○ = no).

Model	Prevall 325	SLAN 310	M226 ISA	hammer300	ZPF 300	Micro/Stack	1684
Vendor	CMS Enhancements	Core International	Fujitsu America	FWB	La Cie	MicroNet Technology, Inc.	Micropolis Corp.
Drive manufacturer	CMS	Core	Fujitsu	Seagate Wren	Seagate Wren	Seagate Wren	Micropolis
Formatted capacity (MB)	340	330	415	300	332	423	340
Price (specific configuration)							
DOS	\$4195	\$3890	*	\$3395	*	\$4290	\$2410
Mac	*	\$3890	*	\$3495	\$1699	\$3795	\$2410
Novell NetWare	\$4195	\$3890	*	\$3595	*	\$4389	\$2410
Bare drive	*	\$3295	\$2950	\$2995	*	*	\$1995
Host adapter manufacturer	Adaptec	Western Digital	*	Always	*	MicroNet	Adaptec
Model	1540	WD7000		IN2000		HA-01	AHA-1542B
Dimensions (inches)	5x5¼x8	14½x5½x4¾	3¾x5½x8	2½x9½x9¾	9½x9½x4½	3¾x10x3¾	1¾x5¼x8
Weight (lbs.)	7	9.89	7.7	7.6	12.2	8.75	5
Power consumption (watts)	33	16	30	16	16	30	15
Mean time between failures (hours)	150,000	150,000	200,000	100,000	100,000	100,000	150,000
Warranty (years)	2	5	5	1	2	1	1
Internal or external installation	Int./ext.	Int./ext.	Int./ext.	Int./ext.	Int./ext.	Ext.	Int.
SCSI-1 or SCSI-2 support	SCSI-2	SCSI-1	SCSI-2	SCSI-1	SCSI-1	SCSI-1	SCSI-2
Sync. data transfer rate (MB/sec.)	N/A	4	4.8	4	4.7	N/A	4
Async. data transfer rate (MB/sec.)	1.6	2	2	2.5	N/A	1.5	1.6
Burst or sustained?	Sustained	Sustained	Burst	Sustained	Sustained	Sustained	Sustained
Average seek time (milliseconds)	16.5	18	14.5	14	14	16	14
Average latency (milliseconds)	7.5	8.33	8.3	8.33	8.33	8.3	8.33
Recoverable error rates (bits read)	1x10 <sup>11</sup>	1x10 <sup>14</sup>	1x10 <sup>11</sup>	1x10 <sup>10</sup>	1x10 <sup>10</sup>	1x10 <sup>14</sup>	1x10 <sup>13</sup>
On-board cache (K bytes)	*	*	*	*	*	*	*
Look-ahead buffer (K bytes)	64	64	64	48	48	64	64
Dedicated or embedded servo	Embedded	Embedded	Dedicated	Dedicated	Dedicated	Dedicated	Dedicated
Drive-select configuration	Switches	Switches	Jumpers	Switches	Switches	Switches	Jumpers
Automatic head parking	●	●	●	●	●	●	●
NetWare-ready	●	●	○	○	*	●	○

N/A = Information not available.  
 \* = Not applicable.

The two reconnect at a later time to complete the transaction.

Optional synchronous data transfers can also improve throughput. Ordinarily, SCSI devices perform asynchronous data transfers that require request/acknowledge handshakes for each byte transferred. Synchronous transfer lets a sender transmit bursts of data without waiting for acknowledgment signals between each byte. An agreed-upon number of acknowledge signals are left outstanding, and the receiver catches up with the sender at the end of the transfer.

Finally, there is the promise of the backward-compatible SCSI-2, which a few of these drives support partially (see the features table). SCSI-2 provides for optional 16- and 32-bit data transfers. In its 32-bit incarnation, SCSI-2 can howl along at up to 40 MB per second. (For a complete discussion of SCSI protocols, see "The SCSI Bus," Parts 1 and 2, in the February and March BYTE.)

SCSI Enters the DOS World



Photo 1: MicroNet's Micro/Stack and the Micropolis 1684 led the field in performance under DOS.

## SCSI DRIVE FEATURES

HCS300E	Diskovary 325	ED 330 SC	Cobra 330e	X/Stor xsh1-330S1	MacInStor MAC325-S1	DataFrame	WD380 SC
N/Hance Systems, Inc.	Optima Technology	Priam Systems	Rodime Systems, Inc.	Storage Dimensions	Storage Dimensions	SuperMac Technology	Western Digital
Seagate Wren	Optima Technology (OEM)	Atasi	Micropolis or Maxtor	Seagate Wren	Seagate Wren	Seagate or Micropolis	IBM
299	321	330	330	330	325	320	320
\$3995	\$4390	\$3122	*	*	*	*	*
\$4195	\$4190	*	\$3999	*	\$3499	\$3399	*
*	\$4190	\$3714	*	\$4160	*	\$3299	\$3800
*	\$3995	\$2714	*	*	*	*	*
Future Domain TMC-860	Adaptec AHA-1542B	Future Domain TMC-870	*	Adaptec AHA-1542B	*	*	*
3¼ × 5¼ × 8	2½ × 11½ × 10½	7¼ × 4¾ × 13¾	7 × 14¾ × 4¼	1¾ × 5¾ × 8	14¾ × 7¾ × 5¾	5 × 8 × 9½	1¾ × 5¾ × 4
7.2	9	13	13	4.2	18	24	2.2
26	20	35	30	16	16	37	11.9
100,000	100,000	50,000	50,000	100,000	100,000	100,000	150,000
1	1 or 3	1	2	2	2	1	1
Int./ext.	Ext.	Ext.	Int./ext.	Int./ext.	Int./ext.	Int./ext.	Int.
SCSI-1	SCSI-2	SCSI-1	SCSI-1	SCSI-1	SCSI-1	SCSI-1	SCSI-2
N/A	4.8	4	N/A	5	4.75	2	4
14.3	2	N/A	14.3	2	N/A	N/A	4
Burst	Burst	Burst	Sustained	Burst	Burst	Sustained	Burst
16.5	14	18	14.5	14	14	17	12.5
8.33	8.33	8.3	8.3	8.33	8.3	8.33	6.95
1 × 10 <sup>14</sup>	1 × 10 <sup>14</sup>	1 × 10 <sup>19</sup>	1 × 10 <sup>10</sup>	1 × 10 <sup>9</sup>	1 × 10 <sup>9</sup>	1 × 10 <sup>21</sup>	1 × 10 <sup>10</sup>
*	48	*	*	48	48	32	*
32	*	64	45	*	*	*	64
Dedicated	Dedicated	Dedicated	Dedicated	Dedicated	Dedicated	Dedicated	Dedicated
Switches/jumpers	Switches	Switches	Switches	Switches/jumpers	Switches/jumpers	Switch/software	Jumpers
●	●	●	●	●	●	●	●
○	○	●	*	○	*	*	○

Three hundred megabytes may seem like overkill for DOS, where the typical system is called upon to serve only one user, one task at a time. But with the growing popularity (and practicality, with faster machines) of large databases, scanned documents and other image files, and extensive programming environments, even DOS users occasionally find themselves hunting around for truly massive storage.

DOS's relatively simple, single-user, single-tasking nature makes the quickest drives really stand out. Under DOS, your requests for sequential sectors are likely to actually read sequential regions on the disk, whereas a multitasking operating system may have background processes that interfere with this sequential access.

Setting up each of the drives was straightforward. A BIOS ROM mounted on the host adapter scans the SCSI bus for active drives; no device drivers are necessary in single-drive DOS configura-

tions. None of the drives had any operating or installation problems.

Each subsystem provides DOS services via the boot ROM mounted on the host adapter. At boot time, the option ROM installs itself, supplanting the built-in drive BIOS. The host-adapter ROM then processes BIOS requests and converts them into requests that are appropriate for the given drive.

To some extent, the performance of these drives depends on the host adapter. Except for the Fujitsu America, Micropolis, and Western Digital units, which were delivered in bare-drive configurations, we tested each drive with its own host adapter. The bare drives ran with an Adaptec AHA-1542B host adapter, a high-performance controller that should not impose any limits on drive performance.

Of course, the ultimate performance determinant is the drive itself. Several manufacturers use sophisticated tech-

niques for improving both seek time and throughput. Seek time can be improved through the use of a dedicated servo architecture, where one face of one platter is dedicated to maintaining head-positioning information.

Some drives improve throughput using a technique known as *read-ahead buffering*, which speeds sequential disk-read access by bringing in more data than you requested. The disk can sometimes guess that you'll want to see the sectors that follow the one you asked for. Often, the drive controller will bring in the whole track. That's not as wasteful as it sounds. On a 1-to-1-interleave disk, it takes only a single revolution of the platter to read an entire track. On a freshly formatted disk (such as those used for these tests), sequential reads and writes almost certainly will fall in contiguous sectors.

A number of drives posted excellent DOS test results, but two stood out. The Micropolis 1684 combined exemplary

## How to Measure Drives Across Four Operating Systems

Testing high-capacity hard disk drives on four diverse operating environments makes constructing relevant, accurate tests a unique challenge. Our performance evaluations focus on responsiveness at the file system level, because that's where users in each environment directly experience the relative speed or sluggishness of each drive. You can track these test results in figure 1.

The heart of our test suite is the file I/O benchmark, which consists of four separate tests: random and sequential writes, and random and sequential reads. Sequential tests record a drive's flat-out read and write throughput, while random tests provide a harsher but more realistic determination of application performance. Note that our random read and write test results are combined, using an average, to simplify our graphs.

The file I/O benchmark first creates a large file, allocating enough space on the drive for the entire file at its inception. Then the file I/O benchmark times a rewrite of the entire file in a sequential fashion. Each chunk of data is of random length (but a multiple of 512 bytes to keep the writes sector-aligned) to avoid favoring any drive geometry.

Next, the program conducts the random read and write tests to break up any cached sectors that the drive may have after completing the sequential write. Random reads and writes occur entirely within the large file, and we made no effort whatsoever to keep the file offsets or length requests sector-aligned. This method causes repeated seeks and might cause additional read-before-writes to occur on write requests, but we think it best reflects the way applications actually access data in files.

Finally, the file I/O test

reads back the entire file sequentially. The tests cover basic writing and reading activities, but they do little to measure how drives respond when you impose the added burden of updating directories and allocation information. Our second file system test makes that measurement: It's the time it takes to copy a large directory structure. Under DOS and for NetWare clients, this means XCOPY; on the Macintosh, we accomplish the tree-copy test via an MPW (Macintosh Programmer's Workshop) script; and on Unix, we use `find` coupled with `cpio` to complete the task.

Our one low-level test measures seek time, a basic parameter that will affect drive speed in any application. A Flex-Star 3000s dedicated test system measured seek times (see figure A).

Unfortunately, we were unable to obtain meaningful results for the Western Digital WD380 SC. We used a canned seek-test routine, which issues a number of SCSI seeks. The Western Digital drive, because of its small form factor, must "rest" between seeks for better heat dissipation; this occurs only on seeks, not on reads or writes.

We ran DOS 4.01 and NetWare 386 tests on 33-MHz 386 systems from Club American and Arche Technologies. For drives shipped without a host adapter, we used an Adaptec AHA-1542B card. Each test setup used the drive under test as its sole hard disk drive.

To test the SCSI drives under Unix, we added the Adaptec controller to an Everex Step 33-MHz 386 system with 4 megabytes of memory. The system used an internal 150-MB hard disk drive, which we loaded with version 2.2 of Interactive Unix System V. We configured Unix to treat the Adaptec as a secondary controller. We built a 150-MB file system on the Unix partition of each SCSI drive.

Our Macintosh test setup included a Mac SE/30 that was equipped with 2 MB of memory and running System 6.05. We simply connected each drive in turn to the Mac's external SCSI port and formatted them using vendor-supplied software.

Our benchmarks are relevant only for comparison. In Unix, for example, our 4-MB system left little room for the all-important kernel buffers, and we made no effort to tune each system for maximum performance. With each operating system, your performance will probably be better with a fully tuned system. The important thing to consider when making comparisons is that each drive should be run on an identical system, as these were.

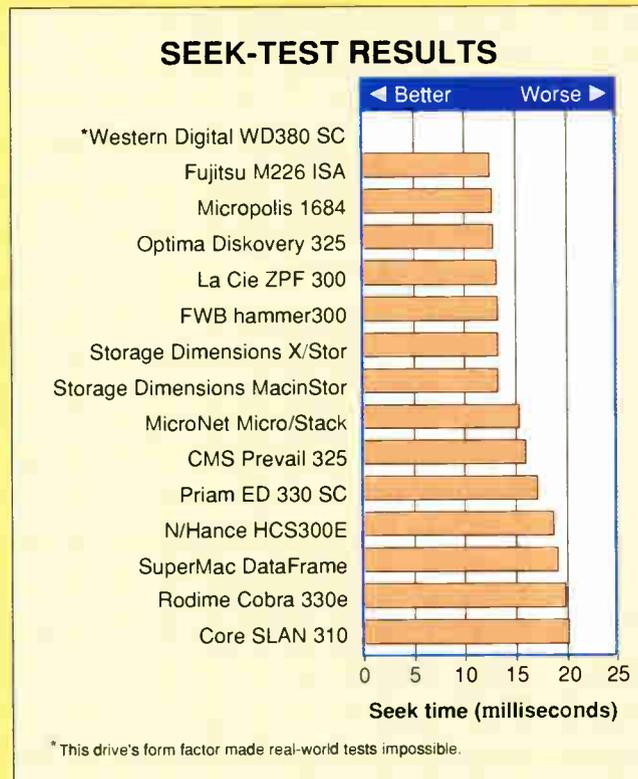


Figure A: Raw seek times measured by the BYTE Lab compare roughly with vendor-specified average seek times, shown in the table. Shorter lines indicate better results.

sequential write numbers and killer results on the tree-copy test, to earn first place overall. MicroNet's Micro/Stack posted the best sequential read time and performed very well on the tree-copy test (see figure 1 and figure A).

Micropolis claims that its proprietary cache feature enhances performance. The cache is especially sensitive to directory and file allocation table (FAT) use on the drive, and it attempts to keep these locations buffered as much as possible. Excellent numbers on the tree-copy

test, which makes the most use of directory entries, confirms this claim. Short seek times helped performance, as well.

MicroNet's Micro/Stack drive did very well on the tree-copy test, despite a lackluster seek time. However, the outstanding read throughput more than made up the difference. The Micro/Stack included a bundled host/adaptor/driver combination, which MicroNet optimized for use with the drive. MicroNet's solid performance can also be attributed to its low-level format optimi-

zations, which remap the drive geometry to one that makes better use of available head/cylinder combinations.

Fujitsu, FWB, Optima, and Western Digital drives made up the middle of the group, all with respectable times. Fujitsu's M226 ISA and Western Digital's WD380 SC should provide a solid basis for an OEM system. To its credit, the Western Digital drive is much smaller and quieter than the Fujitsu drive. As in our other environments, the Optima and FWB drives paralleled each other in speed.

## SCSI Slakes Unix's Thirst for Storage



**Photo 2:** *Unix system honors went to FWB's hammer300, Optima's Discovery 325, and Storage Dimensions' X/Stor.*

With its massive appetite for storage and performance, Unix is a good match for SCSI. Its single-rooted file system structure lets you place new devices anywhere you want them. The multitasking nature of the operating system also maps well to SCSI's asynchronous nature.

Our file I/O tests showed off the strengths and weaknesses of Unix as related to the other test environments. The DOS and Macintosh numbers for sequential read and write, for example, seem positively astonishing compared to Unix. The only other multitasking environment we tested, NetWare 386, shows some similarity to Unix's numbers. On a single-tasking machine, it's acceptable to have the system "go away" for up to several seconds while disk I/O is being done. The amount of data that can be written before making the system responsive again is greater, because the user expects the system to freeze up briefly.

When you start multitasking, how-

ever, things get more complicated. Responsiveness becomes a priority; you don't want your keyboard to lock up while the disk is active. Under Unix, as with NetWare, more users (or processes) pound on the disk than under DOS, and the size of the atomic disk operation is much smaller. So, while a DOS system might be content to go blind for 5 seconds while it spews a huge block of data out to disk, Unix demands that a device driver finish its work in a few milliseconds.

Developers of Interactive Unix grafted device drivers and some specific changes onto standard System V Unix to improve performance. Interactive Unix's Fast File System (FFS) attempts to optimize sequential I/O by dynamically adjusting the amount of data read from disk in a single operation. It assigns as much I/O as possible to clusters of contiguous disk blocks. The more sequential your data access patterns, the more the file system adds to your I/O block size. As you return to random access, the file system

quickly scales down, limiting the read-ahead.

The other half of Interactive Unix's optimization lies in the High Performance Disk Driver. This unified driver works from a table that lists the capabilities of supported disk controllers. The HPDD tries to squeeze maximum performance from each controller. In the case of the Adaptec AHA-1542B used in our tests, the HPDD takes advantage of the controller's *scatter-gather* capability. It optimizes disk access by collecting disjoint requests, sorting them in sector order, and getting them on or off the disk with a minimum number of seeks.

Scatter-gather also applies well to Unix's buffering scheme. An application rarely writes data directly to a disk. Instead, data resides in one of a number of kernel buffers. When the number of available buffers gets low, or when a periodic timer expires (whichever comes first), the "dirty" buffers are written to disk. Each buffer remains as long as possible until some other process needs to write to it. The driver tags each buffer with the disk ID and sector number from which it was loaded. If a read request comes in later for that same sector, the buffer supplies the data without requiring a read from the disk. Because each buffer is tagged with a sector number, buffers can readily be grouped and sorted. Interactive Unix enhanced this standard Unix mechanism by combining contiguous buffers into one to increase the amount of data that can be written in one operation.

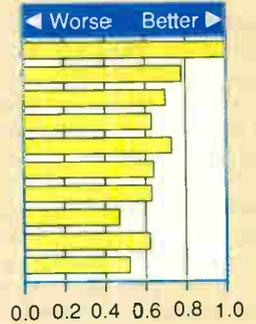
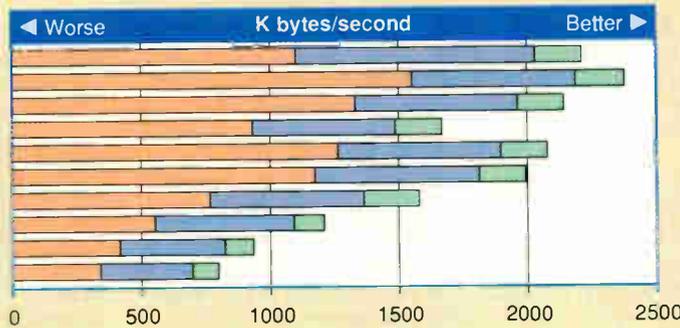
Last on the list of technical considerations is the concept of *asynchronicity*. SCSI drives are intelligent, each one possessing its own built-in controller and, optionally, cache, and they can perform certain operations asynchronously. Most notably, seeking can take place on several drives simultaneously. The SCSI host adapter sends the seek commands to the drives and doesn't bother to wait for the drive to say, "I'm there." Instead, it

## MULTIPLATFORM PERFORMANCE

Low-level index

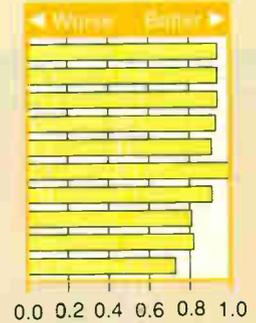
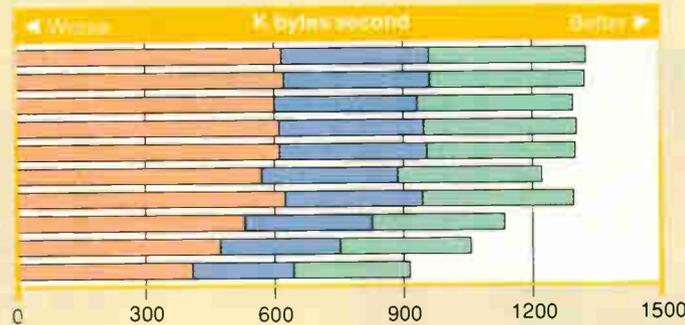
(a) DOS

Micropolis 1684  
 MicroNet Micro/Stack  
 Optima Discovery 325  
 Fujitsu M226 ISA  
 FWB hammer300  
 Western Digital WD380 SC  
 CMS Prevail 325  
 Core SLAN 310  
 N/Hance HCS300E  
 Priam ED 330 SC



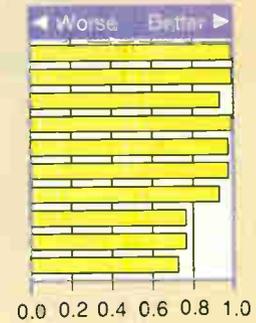
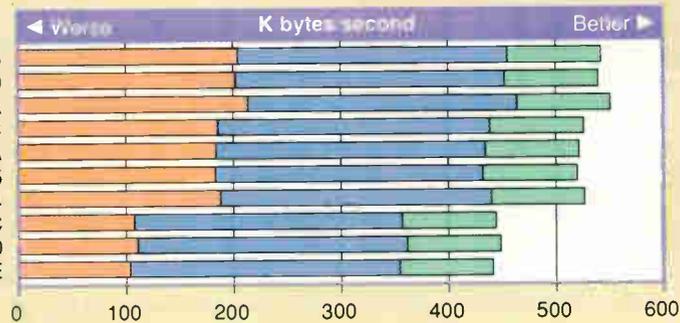
(b) Unix

FWB hammer300  
 Optima Discovery 325  
 Storage Dimensions X/Stor  
 MicroNet Micro Stack  
 Micropolis 1684  
 Fujitsu M226 ISA  
 Western Digital WD380 SC  
 Core SLAN 310  
 Priam ED 330 SC  
 N/Hance HCS300E



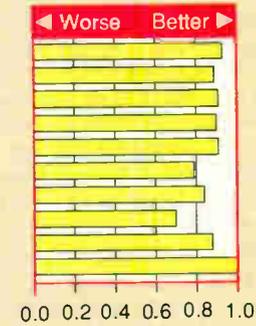
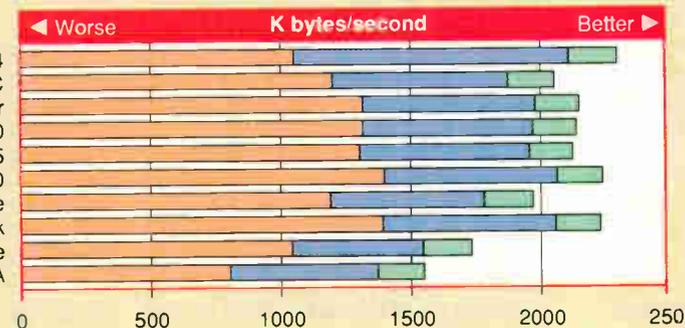
(c) NetWare 386

Optima Discovery 325  
 FWB hammer300  
 MicroNet Micro/Stack  
 Western Digital WD380 SC  
 Fujitsu M226 ISA  
 CMS Prevail 325  
 Micropolis 1684  
 Priam ED 330 SC  
 Core SLAN 310  
 N/Hance HCS300E



(d) Macintosh

Micropolis 1684  
 Western Digital WD380 SC  
 Storage Dimensions MacinStor  
 FWB hammer300  
 Optima Discovery 325  
 La Cie ZPF300  
 Rodime Cobra 330e  
 MicroNet Micro/Stack  
 SuperMac DataFrame  
 Fujitsu M226 ISA



Sequential read Sequential write Random read/write Tree copy

**Figure 1:** The tree-copy test measures how well a drive copies a large directory structure; sequential tests gauge flat-out read and write throughput; and random tests exemplify application performance. (a) Under DOS, the Micropolis 1684 and the MicroNet Micro/Stack are notable for their excellent tree-copy and sequential-read throughput. (b) Under Unix, the FWB and Optima drives had superior overall results. (c) Although performance differences under NetWare 386 were less dramatic than those under DOS or Unix, drives from FWB, Optima, and MicroNet stood out again. (d) On the Macintosh, drive performance clustered quite tightly, although drives from Storage Dimensions and Micropolis turned in the best results overall. Longer bars indicate better performance.



486/25  
\$4,860

- Intel 80486, 25 MHz, 4MB
- 128K SRAM cache

“Without a doubt, the Tangent is the overall price/



- Fastest Super VGA adaptor in the industry
- 1024 x 768 VGA monitor
- 80 MB (19ms), w/cache
- 1.2 MB or 1.44 MB Teac
- 1 parallel & 2 serial ports; Enhanced 101 keyboard

performance winner of the group, and perhaps even



386 SVGA Systems  
(2MB, 42MB HD):

- 80386SX, 20 MHz \$1995
- 80386, 25 MHz \$2295
- 80386, 33 MHz \$2995 w/cache

of 486 systems in general.” (Personal Workstation,



For a Quote or to Order,  
Call 800-223-6677

415-342-9388

FAX 415-342-9380

Corporate P.O.s accepted



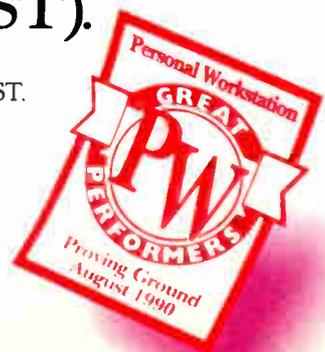
8/90 review of Tangent, Compaq, and AST).

In Personal Workstation's review, the Tangent 486/25 clearly outperformed both Compaq and AST. And Tangent was priced as much as 67% less! Get breathtaking graphics and unparalleled hard disk performance. Plus a 30-day unconditional money-back guarantee, and a lifetime, toll free technical support hotline. Call today, for this and other Tangent review reprints, and for a quote on a wide choice of EISA and ISA configurations.



Tangent Computer, Inc., 197 Airport Blvd., Burlingame, CA 94010.

© Copyright 1990 Tangent Computer, Inc.



Circle 335 on Reader Service Card

moves on to the next request. The advantages of asynchronicity are not seen in single-drive configurations, such as those that appear in these tests. The real gains become apparent when you use advanced configurations such as *striping*, in which multiple disk drives are treated as one.

### Unix Picks

The preceding information is meant to help you draw your own conclusions from the table, but we have our own favorites—some obvious, others less so.

The drives that fell in the "obvious choice" category surprised us. They were the ones that had it all: small size, external case and power supply, and near-silent operation. We didn't expect these tiny drives to be the top performers, but FWB's hammer300 and Optima's Diskovery 325 were clear winners in overall speed. We were also pleased with MicroNet's Micro/Stack, another small, silent drive. You have to pay for the convenience that reduced size brings—these drives are quite expensive

for the storage they offer. The FWB drive holds a slight edge over the other small external drives in both price and performance, earning the nod for best in its class.

Heading up the big-drive category is the Storage Dimensions X/Stor system. This is actually up to four drives in a single case that can place over a gigabyte of storage at your system's disposal. The company has managed to construct a case that takes up barely more room than the drives themselves, and it is attractive enough that you won't be ashamed to have it seen on your desk.

The rest of the pack included a smattering of internal and external drives. Of these, the Micropolis half-height internal drive seemed to have the best overall showing. The only factors that would bring us to a heavy full-height drive would be performance and price, and the Micropolis 1684 makes both these arguments moot. At a suggested list price of \$1995 for the bare drive, it's a good starting point for building a system. Western Digital's WD380 SC also per-

formed quite well.

The Fujitsu full-height internal drive is this roundup's enigma: Its performance pushed it out of the top five, but it still managed to skunk the others in *only* the tree-copy test. This may be thanks to the drive's fast seek time, and the tree-copy test does a blessed lot of seeking. The drive's noise level was the worst of all the drives we tested, producing loud snaps during seeks and emitting an annoying whine during normal operation. Unless you plan to drop it in acoustic foam or in another room, save your ears the torment of the Fujitsu drive.

Another disappointment was the CMS Prevail 325 drive. Prevail it didn't, because, of all the drives in the test, the Prevail was the only one that wouldn't work with Unix. The very same drive and controller worked perfectly with DOS and NetWare, but when we attempted to install the drive under Unix, even the simple reading of the drive's geometry failed. We notified CMS of the problem, but the company was unable to provide a solution.

## NetWare 386 Optimizations Boost Disk Performance



**Photo 3:** Among NetWare 386 drives, the FWB hammer300, Optima Diskovery 325, and MicroNet Micro/Stack 404/LAN were outstanding.

Only CMS, MicroNet, and Optima were offering NetWare 386 drivers for their drives by the time we went to press. We tested the other drives under NetWare 386 using the Adaptec Host Adapter and its supplied driver.

Installing these drives was easy, but that was due more to NetWare 386 itself than to any innovation on the part of the drive vendors. Once we cabled the drive to the host adapter, we just ran Novell's Server program and loaded the host

adapter's driver, which each manufacturer supplies as an NLM (NetWare Loadable Module). A few floppy disk swaps are all that is required to install the remaining NetWare utilities onto the hard disk drive.

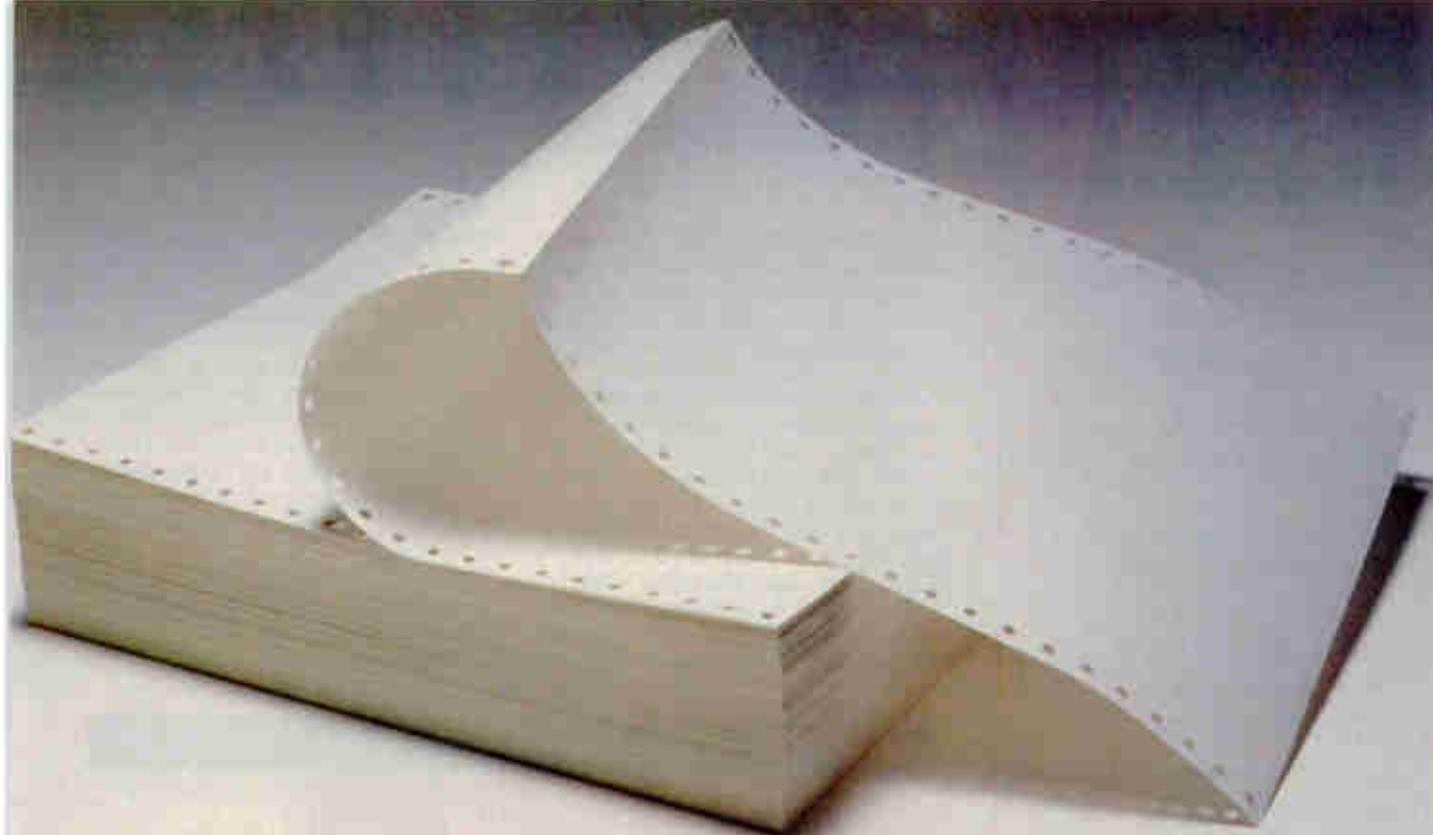
We didn't test these drives under Advanced NetWare, but you can expect a much more involved installation process with Advanced NetWare than with NetWare 386. The most time-consuming part of a NetWare installation often is

running Novell's COMPSURF utility, which does a very detailed surface analysis to mark out defects. Some of the drives, including the ones from CMS and MicroNet, were "NetWare Ready" and didn't require COMPSURFing for any NetWare installation. NetWare Ready, a Novell certification, also indicates that some NetWare configuration information is already present on the disk; Advanced NetWare versions 2.15 and higher can read drive information directly off the disk and do not require additional drivers.

Each of these drive/host-adapter combinations supports NetWare's disk-mirroring capability, which reserves one disk as a copy of another to guarantee data integrity.

NetWare 386 and Unix have some similarities when it comes to managing disk drives. NetWare 386 keeps caching buffers for both files and directories, caching both reads and writes. NetWare and these host adapters also support SCSI disconnect, which provides performance gains in multiple drive configurations by allowing a controller to move on to other tasks while one drive is finding its data.

Some performance features, however, are unique to NetWare 386. The operating system makes a number of dynamic optimizations to crank up disk performance. NetWare dynamically allocates memory for directory cache buffers to tune them to the pattern of actual disk



# The argument for buying our new laser line printer is full of holes.

Consider the facts and you'll agree. The

Laserfold is the logical conclusion for departmental computing environments. Particularly where high-speed printing of high-quality text is an everyday requirement.

That's because the Laserfold ends the trade-offs between high-speed line printers and high-end page printers. It simply gives you the best of both... at a lower cost than either.

It combines laser-quality character resolution, a fast 16-pages-per-minute output,

extremely quiet operation and desktop size.

So when you're printing high-quality text on fanfold

paper for business, technical or accounting applications, there's simply no argument against choosing the Laserfold.

Pentax Technologies,  
100 Technology Drive,  
Broomfield, CO 80021.  
Phone 303-460-1600.  
FAX 303-460-1628.



**PENTAX**  
TECHNOLOGIES

**Advanced  
Microsource**  
Hopkinton, MA  
(508) 435-5800  
(800) 232-9920

**Nimax**  
San Diego, CA  
(619) 566-4800

**Computer Source**  
Hauppauge, NY  
(516) 348-7474  
(800) 222-5022

**Nimax**  
St. Louis, MO  
(314) 427-1919

**Great Lakes  
Electronics  
Distributing**  
Buffalo, NY  
(716) 675-9611

**Nimax**  
Livonia, MI  
(313) 427-1010

**Technology  
Marketing Group**  
Minneapolis, MN  
(800) 688-7000

**Proven Solutions**  
Olympia, WA  
(206) 352-4512  
(800) 541-0183

**Technology  
Marketing Group**  
Bensenville, IL  
(708) 595-4600

**Q/Cor**  
Norcross, GA  
(404) 923-6666  
(800) 548-3420

**Technology  
Marketing Group**  
Phoenix, AZ  
(602) 340-9000

**Chess**  
Denver, CO  
(303) 573-5133

© 1990 Pentax Technologies

Circle 279 on Reader Service Card  
World Radio History

# PROMISE? PROMISE!

We don't **PROMISE** anything unless we can keep our **PROMISE!**

Our **CACHING DISK CONTROLLERS** promise Hard Disk Access in no time flat.

- Pay only 5% more. Gain 300% more performance!
- 512K-4MB cache on-board, expandable to 16 MB
- 0.5ms data access time
- Available for **MFM, IDE, & ESDI** Hard Drives

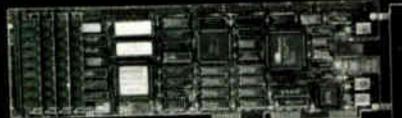
Limited time only **\$199.00**

Special Offer for MFM Caching Disk Controllers with Zero K. Add \$50.00 for 512K.

Regular List Price: \$395.00 (with 512K)

**Upgrade your existing PC/AT system now!**

**PROMISE TECHNOLOGY PROMISES** more . . . Delivers more for 386 and 486 systems! Reps and Distributors wanted



See us at  
**COMDEX/Fall '90**  
Booth R8327 November 12-16  
Las Vegas Nevada

**PROMISE TECHNOLOGY, INC.**

1430 Koll Circle, #103  
San Jose, CA 95112  
Phone: 408-452-0948  
FAX: 408-452-1534

## PRODUCT FOCUS

## SCSI DRIVES

usage. It also indexes files with many FAT entries, to speed random accesses. And NetWare handles elevator seeks, a technique that queues disk requests so that sector requests seen by the disk involve as few seeks as possible.

All this optimization in the operating system conspires to make performance quite similar from drive to drive. As the figures show, performance differences among drives under NetWare were not nearly as dramatic as those shown under DOS. Optima's Discovery 325, FWB's hammer300, and MicroNet's Micro/Stack finished in a virtual dead heat when you consider both tree-copy and file read/write performance. Both the

Discovery 325 and hammer300 drives had shown good speed in our other environments, so it was no surprise that they did very well on the tree-copy test.

The Micro/Stack drive's optimizations, which made the drive a leader in the DOS benchmarks, apparently helped here, as well; it finished head and shoulders above the rest on sequential reads. MicroNet claims that the optimizations are specifically designed for better performance with the small block sizes used by NetWare.

The CMS Prevail 325, Western Digital WD380 SC, and Fujitsu M226 ISA scored quite well—only slightly behind the top three finishers.

### Mac and SCSI: A Venerable Relationship



**Photo 4:** The La Cie ZPF 300 shined for its economy, while the Micropolis 1684 and the FWB hammer300 turned in superior performance among Macintosh drives.

Utility software played a key role in our evaluation of Macintosh drives. Although disk drives for other environments neither require nor supply utilities, drives on the Mac thrive on them. Mandatory components of the packages were disk formatting and disk partitioning utilities.

Disk formatting readies the hard disk surface for accepting data. Unusable sectors are usually located at this stage and mapped out. All the packages we tested either allowed you to select an interleave factor or picked one for you, based on the speed of the host machine.

Disk partitioning divides the physical disk surface into one or more logical volumes. Many of the manufacturers suggest that, for performance's sake, you limit partitions to around 80 MB. This stage also builds the initial directory structure (directory B-tree and bit maps)

for the partition. Most of the systems we looked at supported A/UX partitions, as well as Mac OS partitions. A few supported ProDOS.

Before the Macintosh can access a volume (i.e., make it appear on the Desktop), you must *mount* the partition associated with that volume. Partitions on a Macintosh drive can be tagged to mount either at start-up time, called *automounting*, or in response to an explicit mount request. All the utility packages that we examined handled automounting. Additionally, all the packages allowed us to lock individual partitions; locked partitions are read-only, which offers some virus protection for sensitive applications. Finally, nearly every package provided some level of password protection.

Silverlining, the La Cie ZPF 300's accompanying driver software, included an autopark feature. It also provided a disk

# BIG IS OUT.



# SMALL IS IN.

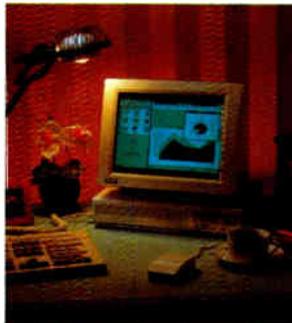


## Introducing the Falco Infinity Desktop Computer. The Smallest 386SX Desktop.

If you're sizing up desktop computers, you'll immediately see the advantage of the Falco Infinity™ Desktop. It gives you 386™SX power and performance without dominating your desk space.

Half the size of a standard PC, the Infinity Desktop has everything you need on-board: Peripheral interfaces like disk controllers. Memory expansion. Communication ports. And VGA® level graphics up to 1024 x 768 resolution. Plus, two AT® compatible, 16-bit expansion slots.

It runs DOS™ 4.0, UNIX™, OS/2™ and Microsoft®



Windows 3.0. What's more, you can choose from four configurations, including a diskless network node and a full-featured model with 1.44MB floppy and the option of 40, 100 or 200 MB hard drive.

The only thing we left out is the noise. The Infinity Desktop runs so quietly, you'll hardly know it's on.

Whether you work in close quarters or spacious surroundings, the Falco Infinity Desktop covers all your needs. Without covering your desk. And that's about the size of it. To get one for your desk, call us today.

1-800-FALCO4U



# A HARD DRIVE IS A TERRIBLE THING TO WASTE.

For only **\$6 per hour**, you can download onto your hard disk from DELPHI's library of over **10,000 programs**. Join now for **\$9.95** and your first hour is **free**. There is no surcharge for downloading at 2400 baud and no premium for dialing locally via *Tymnet*. If you have a really large disk, choose the 20/20 Advantage Plan and enjoy **20 hours for \$20**.

To join, with your computer and modem:

- Dial 1-800-365-4636
- At *Username*: type JOINDELPHI
- At *Password*: type BYTE

## DELPHI

POPULATING HARD DRIVES SINCE 1982

800-544-4005 • 617-491-3393

### PRODUCT FOCUS

optimizing (i.e., defragmenting) capability. Unleashing the optimizer on a volume shows you a percentage figure that indicates that volume's level of fragmentation, as well as how many bytes the optimizer will have to move around on the drive to clean things up.

The Rodime Cobra 330e's utility software included FastBack II backup software (from Fifth Generation Systems). Although you can assign passwords to partitions on the Rodime drive, you can't password-protect a boot partition. This was mildly annoying, but it's critical if you don't want anyone to get into your machine.

The software with SuperMac's Data-Frame is as extensive. You select the size of a disk's partitions using a unique, movable pie chart. Once you've built your partitions, not only can you attach individual passwords, but you can select partitions to be automatically encrypted using the data encryption standard. The encryption occurs transparently, which means that once you've turned the encryption on, you don't have to do anything additional—all your software will work as it normally does. If someone else swipes your drive, all he or she will see are piles of encrypted data. This protection, however, comes at the expense of speed. With DES activated on a partition, the file I/O tests that we ran yielded a sequential read throughput of about 28,000 bytes per second and a sequential write throughput of about 27,000 bytes per second. Compare this to the over 1 million bytes per second that we obtained on reads without DES.

FWB's hammer300 arrived with an impressive array of software: each program accompanied by a small manual. Not only can you password-protect and encrypt partitions on the fly, but FWB's Hard Disk Deadbolt software lets you perform after-the-fact encryption using the DES algorithm, as well as a faster proprietary encryption scheme called Quickbolt. Deadbolt also includes Blackout, a software utility that lets you temporarily lock your Mac for short trips away from your desk. You activate Blackout and enter a password, and your Mac is frozen until someone reenters that password. (And Blackout is intelligent about how it "freezes" your machine—background tasks can continue to run.)

Optima's software, which is called DiskMount, handles the essentials: formatting, partitioning, and attaching passwords to partitions. The password control can mount access to a partition, and you can specify that a partition remain locked until the proper password is

## People are talking about us.

### F77L-EM/32

Port 4GB mainframe programs to 80386s with this 32-bit DOS-Extender compiler. The Winner of *PC Magazine's* 1988 Technical Excellence Award just got better. New Version 3.0 and OS include: Editor, Make Utility, Virtual Memory Support, DESQview Support, New Documentation and Free Unlimited Runtime Licenses. F77L-EM/32 \$895 OS/386 \$395

### F77L

The compiler of choice among reviewers and professionals. Includes a Debugger, Editor, Profiler, Linker, Make Utility, Weitek and 386 Real-Mode Support, Graphics. \$595

### Lahey Personal Fortran 77

New Version 3.0: Full ANSI 77, Debugger, Editor, Linker, Library Manager, Microsoft and Borland C interfaces, 400 page Manual, Unbeatable Price. \$99

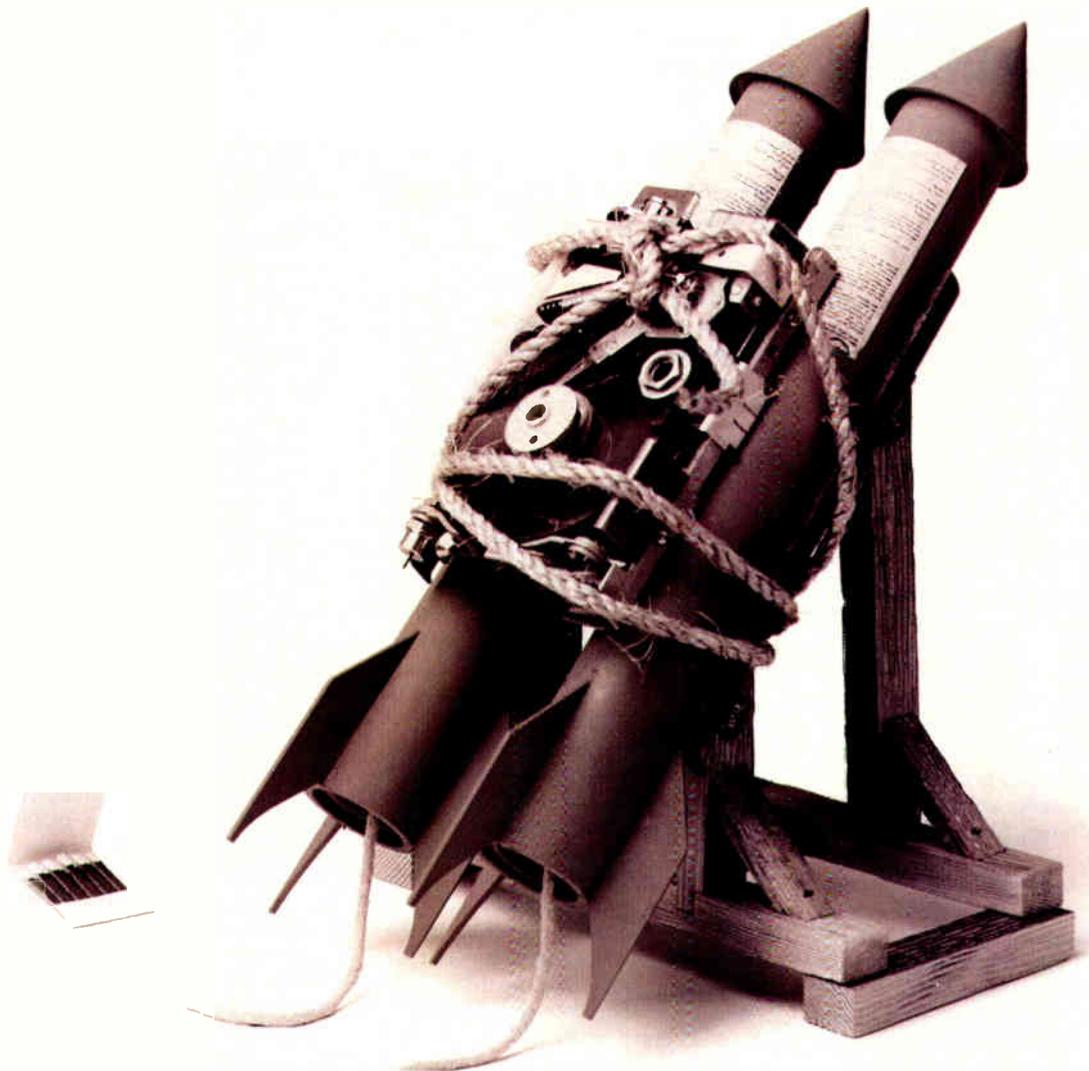


When people talk about FORTRAN the name mentioned most often is



Contact us to discuss our products and your needs. (800) 548-4778  
 Lahey Computer Systems, Inc. P.O. Box 6091, Incline Village, NV 89450  
 Tel: (702) 831-2500 FAX: (702) 831-8123 Tlx: 9102401256

**FORTAN IS OUR FORTE**



# THE ONLY WAY COMPETITIVE DRIVES CAN GO FASTER THAN 9MS.

With effective access times as low as 9ms, the Plus Impulse® AT® Series, hard disks don't need rockets to fly. They're the perfect match for today's disk-intensive applications.

Impulse isn't only fast, it's affordable. Compare it to any other disk drive in its class and you'll see how competitively priced it is.

Impulse isn't only fast and affordable, it's compatible with all leading 286/386 PCs. And it's available now. In 40, 80, 105, 120, 170 and 210 megabytes (330 and 425MB shipping soon). With integrated IDE-AT or SCSI controllers.

Get in touch with your Impulse reseller today. For more information, call 800-624-5545 in the U.S. and Canada.

Leave the rockets to them. And the flying to Plus.

Plus 



# I M P U L S E

© 1990 Plus Development Corp. Plus Impulse and the Plus logo are registered trademarks of Plus Development Corp. AT is a registered trademark of IBM.

Circle 285 on Reader Service Card

World Radio History

## The Fuzzy Side of SCSI

Communication between the SCSI bus and a disk drive or other device has two segments: computer to host-SCSI controller and host-SCSI controller to SCSI device.

The SCSI protocol makes the second step efficient and relatively painless, because every device speaks the same language, and switching in units from different vendors (ideally) presents no problems.

But computer to host-SCSI controller communication is a different story. Each host adapter vendor for the PC XT/AT family of machines shows a different interface to software running on the host machine. On SCSI-equipped Macs, the built-in SCSI chip means that there is only one way to talk to SCSI devices, but the programming method is radically different from anything seen on the PC.

Common Access Method promises to straighten out this uncivilized side of SCSI communication, at least for the PC. But the CAM committee hasn't yet hammered out a final standard. The standard that the CAM committee adopts may also make it possible for drivers for more exotic devices such as CD-ROMs, tape drives, and scanners to share the same host adapters through a common interface.

The BYTE Lab has been working on SCSI testing software designed for the Macintosh SCSI chip and three popular PC-host adapters: the Western Digital WD7000-ASC, the Adaptec AHA-1542B, and the Future Domain TMC-885. None of these devices makes writing software a terrible chore. But as far as we're concerned, writing for three interfaces is writing for two interfaces too many, which leaves us hoping for a well-defined CAM in the near future.

Western Digital's family of host adapters relies on the Standard Device Level Protocol interface developed by

Columbia Data Products. SDLP defines commands for reading, writing, information gathering, and other tasks.

Under MS-DOS, software has access to SDLP through a software interrupt, INT 11 hexadecimal, which the adapter's ROM steals from the equipment determination routine in the machine's BIOS. To send a SCSI command, the calling software simply fills registers with appropriate values and fires off the interrupt. OS/2 and Unix applications access similar commands through `ioctl` calls to the SDLP kernel device driver, which in turn talks to the host adapter hardware through an adapter-specific device driver.

The Advanced SCSI Programming Interface provides Adaptec's host adapters with a common software interface for device drivers and applications. DOS, OS/2, and NetWare applications talk to the ASPI driver by pushing the address of a command block onto the stack and then issuing a call to the driver. The process differs between the operating systems only in the way in which the calling software determines the ASPI entry point. ASPI supports a number of information request calls and standard SCSI I/O commands.

Future Domain provides developers with an OEM kit to ease the process of writing software that supports Future Domain host adapters. The kit consists of object modules that developers can link into their own code. We also found it relatively easy to write directly to the card's TMC-950 SCSI controller chip, a memory-mapped device for which Future Domain provides documentation.

On the Mac, you can take comfort in there being only one programming interface to SCSI: the Mac's SCSI manager. Unless you're trying to do some *real* low-level SCSI programming, the SCSI manager provides all the functions that you need. The SCSI manager sup-

ports bus arbitration, device selection, and message transfer. Apple has even provided an extremely simple programming language for high-speed buffer copies that you can use to control what the SCSI manager does with data sent to or taken from a target device. (For a detailed description of programming to the Mac's SCSI manager, see "Foreign File Systems," March BYTE.)

If you are really desperate to go straight to the SCSI hardware, you'll have to dig up whatever documentation you have on the NCR 5380, the SCSI controller chip used by Macintoshes since the Mac Plus. You'll also want to go spelunking into all your *Inside Macintosh* volumes. There is a variety of ways to effect a transfer on the SCSI bus using the 5380. You've probably heard of "blind" transfers: data exchange on the SCSI bus in which the system checks only a handshake bit in association with the first byte of a packet transfer and then sends the rest of the bytes at top speed (i.e., without explicitly checking handshaking). You may have also heard of the 5380's "pseudo-DMA" mode, in which the transfer of bytes to and from the chip triggers the handshaking signals on the SCSI bus.

As compatible as Macs may seem, the sad truth is that even though all Macs use the 5380 to control the SCSI bus, the 5380 is wired differently for different Macs. For example, in a Mac Plus, the base address of the 5380 is at 580000h; it's at 5FF000h on a Mac SE and at 50F10000h on the Mac II. Furthermore, the Mac Plus must use software handshaking in the pseudo-DMA mode, which means that you might run into invalid data being transferred if you choose to use blind transfers on that machine.

The moral: Unless you're developing your own custom SCSI hardware, stick with the SCSI manager.

given. DiskMount's disk verification performs a nondestructive read test of the hard disk surface. You can specify that the disk drive's internal error correction be turned off for the duration of the test so that "marginal" blocks (i.e., those likely to fail soonest in the future) are reported. Once you've collected your list of questionable blocks, DiskMount

lets you map good blocks in the place of bad ones. As an extra level of protection, the Optima system keeps duplicates of the disk's partition information and device driver. In that way, if either should somehow become corrupted, a utility program called QuickFix can replace the original with the duplicate.

The installation software on Storage

Dimensions' MacinStor isn't loaded with frills, but it has everything you need. You can password-protect partitions, toggle them as read-only, and even flag a partition to use write verification. We were also very happy to see that the MacinStor disk included a `cdev` (a Control Panel device) version of the installation software. This allows you access to the

# Now 4 can share HP's LaserJet III printer...



## ...with BayTech's LaserShare® — expansion is made easy!

LaserShare is an expansion card that allows four users to connect simultaneously to one laser printer. Just check out our outstanding features:

### ✓ HP LASERJET III COMPATIBILITY

Also works with HP LaserJet II, IID, Canon LPB8II, LPB8III, Brother HL8e, and Wang LDP8 laser printers.

### ✓ 256KB, 1MB OR 4MB BUFFER

### ✓ SIMPLE INSTALLATION

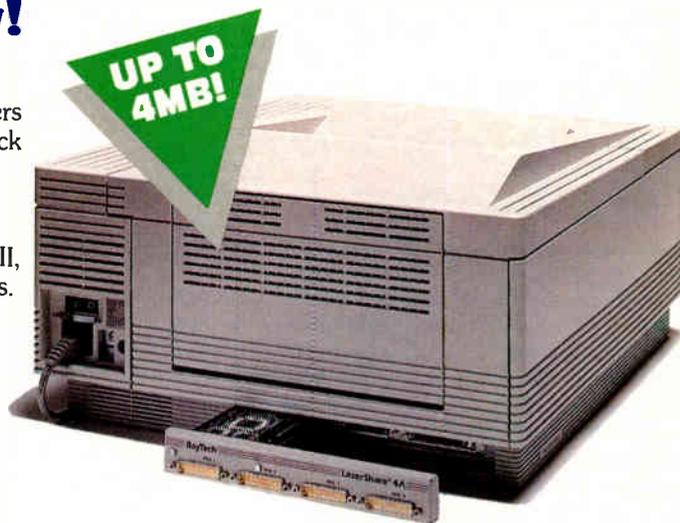
### ✓ AVAILABLE MODELS

- 4A - 4 parallel ports
- 4C - 4 serial ports
- 4E - 2 parallel/2 serial ports
- 4CB - 4 serial (256KB, Brother)

### ✓ SAVES MONEY AND TIME

### ✓ UNMATCHED PRODUCT SUPPORT

With several users having access to one laser printer, the per-user cost of your laser printer is dramatically reduced. And there's no more waiting for the printer. With LaserShare, everyone's printing needs are accommodated. BayTech's LaserShare — it's worth checking out! Call now for details!



Because Resources Should Be Shared.



Data Communications Products Division  
200 N. 2nd St., P.O. Box 387 Bay St. Louis, MS 39520  
Fax 601-467-4551 Phone 601-467-8231 or toll-free

**800-523-2702**

\*All product or company names are trademarks of their respective holders.

#### INTERNATIONAL DISTRIBUTORS

**Australia**  
Melbourne  
Shuttle Technologies, Ltd.  
(03) 587 4920

Melbourne  
Goya Tech, Pty., Ltd.  
(03) 747-8455

**Belgium**  
Multiway Oata Belgium  
016-29 22 78

**The Netherlands**  
Multiway Oata Netherlands  
079-424 111

**Denmark**  
Trend Communications  
53 65 23 45

**Finland**  
Genine Oy Impdata  
(921) 335700

**France**  
Suresenes  
Komdex International  
(1) 47 72 63 11

Paris  
Gradco France  
(1) 42 94 99 69

**Germany**  
Munich  
AMS Computech GmbH  
(089) 126806-0  
Ousseldorf  
Multiway Oata Germany  
0211-25 18 75

**Italy**  
Torino  
BRM Italiana  
(011) 771.00.10

**Milano**  
I.T.O.  
(02) 749.0749

**Norway**  
A/S Kjell Bakke  
47-6-832000

**Singapore**  
Mark Systems (FE) Pte., Ltd.  
65-2261877

**Spain**  
Vidmar Control  
(93) 2454803

**Sweden**  
Solna  
Microcom/Maldata  
(08) 7344100

Sollentuna  
Beon Oata  
08-626 92 26

**Switzerland**  
Sengstag Computers AG  
0041.1.950.54.44

**United Kingdom**  
Leicester & London  
A-Line Oataspeed Ovices, Ltd.  
0533-778899

Buckinghamshire  
Trend Oatalink, Ltd.  
(06285) 30611

Circle 41 on Reader Service Card (RESELLERS: 42)

World Radio History

## COMPANY INFORMATION

**Adaptec, Inc.**

(AHA-1542B)  
691 South Milpitas Blvd.  
Milpitas, CA 95035  
(408) 945-8600  
**Inquiry 1111.**

**CMS Enhancements**

(Prevail 325)  
1372 Valencia Ave.  
Tustin, CA 92680  
(714) 259-9555  
**Inquiry 1112.**

**Core International**

(SLAN 310)  
6500 East Rogers Cir.  
Boca Raton, FL 33487  
(305) 997-6033  
**Inquiry 1113.**

**FlexStar**

(3000s)  
2040 Fortune Dr.  
San Jose, CA 95131  
(408) 433-0770  
**Inquiry 1114.**

**Fujitsu America**

(M226 ISA)  
3055 Orchard Dr.  
San Jose, CA 95134  
(408) 432-1300  
**Inquiry 1115.**

**Future Domain**

(TMC-885)  
1582 Parkway Loop, Suite A  
Tustin, CA 92680  
(714) 259-0400  
**Inquiry 1116.**

**FWB**

(hammer300)  
2040 Polk St., Suite 215  
San Francisco, CA 94109  
(415) 474-8055  
**Inquiry 1117.**

**La Cie**

(ZPF 300)  
19552 Southwest 90th Court  
Tualatin, OR 97062  
(800) 999-0143  
(503) 692-0771  
**Inquiry 1118.**

**MicroNet Technology, Inc.**

(Micro/Stack 404/LAN,  
Micro/Stack MS-404)  
20 Mason  
Irvine, CA 92718  
(714) 837-6033  
**Inquiry 1119.**

**Micropolis Corp.**

(1684)  
21211 Nordhoff St.  
Chatsworth, CA 91311  
(818) 709-3300  
**Inquiry 1120.**

**N/Hance Systems, Inc.**

(HCS300E)  
908R Providence Hwy.  
Dedham, MA 02026  
(800) 289-9676  
(617) 461-1970  
**Inquiry 1121.**

**Optima Technology**

(Diskovery 325)  
17526 Von Karman  
Irvine, CA 92714  
(714) 476-0515  
**Inquiry 1122.**

**Priam Systems**

(ED 330 SC)  
1140 Ringwood Court  
San Jose, CA 95131  
(408) 954-8680  
**Inquiry 1123.**

**Rodime Systems, Inc.**

(Cobra 330e)  
901 Broken Sound Pkwy., NW  
Boca Raton, FL 33487  
(407) 994-5585  
**Inquiry 1124.**

**Storage Dimensions**

(MacinStor MAC325-S1,  
X/Stor xsh1-330S1)  
2145 Hamilton Ave.  
San Jose, CA 95125  
(408) 879-0300  
**Inquiry 1125.**

**SuperMac Technology**

(DataFrame)  
485 Potrero Ave.  
Sunnyvale, CA 94086  
(408) 245-2202  
**Inquiry 1126.**

**Western Digital**

(WD380 SC, WD7000-ASC)  
8105 Irvine Center Dr.  
Irvine, CA 92718  
(714) 932-5000  
**Inquiry 1127.**

most frequently used functions, such as mounting or dismounting a partition from the Control Panel. The MicroNet installation software builds A/UX as well as Macintosh partitions, and it easily initialized drives.

MicroNet drivers supported overlapping seeks on multiple disk drive configurations. Overlapping seeks logically chain two drives together and divide data between them. The process makes use of the drive's built-in read-ahead cache. For example, if software issues a large read request on a file (e.g., a multimegabyte image file), the first piece of the file comes from drive A, the second from drive B. MicroNet's engineers point out that even write accesses benefit from overlapped seeks: Since each drive fills up half as fast as it ordinarily would, seek distances are reduced.

It's not easy to pick the best Macintosh drive. In general, a winner in one test turned in a mediocre performance in other tests. Based on performance alone, we chose the Micropolis 1684 as the top drive because of its write throughput numbers (see figure 1). It scored the highest marks in both our sequential- and random-write throughput tests. (Be-

cause this was an OEM drive, we needed compatible driver software; we used La Cie's Silverlining in our tests.)

However, when we considered more than just raw speed, we gave top honors to the FWB hammer300. Although not a speed demon, it ranked in the top half of most tests. The amount of support software that came with the drive swayed our vote.

Finally, if you're cost-conscious and find yourself reeling from high prices, consider the La Cie ZPF 300 drive. It scored near the middle in most tests, and its Silverlining software, while not replete with features, is probably all the hard disk drive software you'll ever need. However, the drive stands out in price: It's \$700 to \$2500 less than other Mac drives.

**And the Winner Is . . .**

Picking an overall high-capacity hard disk drive winner depends, as always, on your individual application and environment. The FWB and Optima drives proved to be very solid. Both finished at or near the top for all four operating systems. Although it is slickly packaged and well documented, the Optima Diskovery

325 is too expensive for our tastes; we like the FWB hammer300 for both its price and performance.

Storage Dimensions' offerings turned out to be excellent performers, as well. Both the X/Stor and the MacinStor scored very well on their respective Unix and Macintosh platforms, and both carry prices lower than drives of similar performance and capacity.

If your platform is DOS or NetWare, we suggest MicroNet's Micro/Stack 404/LAN. At 423 MB and with excellent benchmark numbers, the \$4495 Micro/Stack may be worth the little larger up-front investment.

All the OEM drives had acceptable speed, but the Micropolis 1684 distinguished itself. Each drive had above-average mean-time-between-failure ratings, and the speedy Western Digital WD380 SC, at 3½ inches, fits in where others can't. ■

*Steve Apiki and Stan Wszola are BYTE Lab testing editors/engineers. Rick Grehan is the BYTE Lab technical director, and Tom Yager is a BYTE Lab technical editor. They can be reached on BIX as "apiki," "stan," "rick\_g," and "tyager."*

**RELIABLE**  
enough to forget about  
**COMPATIBLE**  
enough to work with any PC  
**AFFORDABLE**  
enough to fit any budget



## For complete data protection, our PC Might UPS says it all!

Now you can provide all the protection you will ever need for your valuable data with a PC Might UPS from UPSONIC. Designed to be unseen, unheard, but always on the job, the PC Might will protect your individual computers or network from blackouts, brownouts, spikes and surges. UPSONIC is one of the industry's largest, most successful manufacturers with over 280,000 units installed world-wide. Our products are time-tested and reliable and come with a complete one-year warranty.

The complete line of PC Might UPS products—the PC Might 25, 35 and 55—ensures you can have the ideal solution to any protection need. Whether it's a popular stand-alone micro, a file server or a network node, just connect a PC Might and forget about it. You and your data are completely protected!

To order or for more information, call and ask for Operator 42.

**UPSONIC®**

**1-800-UPSONIC**

UPSONIC, One Park Plaza, Suite 600, Irvine, CA 92714

**FAX 714-852-4480**

Circle 363 on Reader Service Card (RESELLERS: 364)

World Radio History

# BYTE REVIEWS

SYSTEM

Mark L. Van Name and Bill Catchings

REVIEW

## High-Performance 486 ATs

**W**ith all the coverage that the Extended Industry Standard Architecture (EISA) and Micro Channel architecture buses get, it's easy to believe that you need one of these new bus architectures to get great performance. Not necessarily. The three machines in this review—AST's Premium 486/33, Club American's Hawk III, and Everex's Step 486/33—combine a 33-MHz i486 with the standard AT bus, and the result in each case is a screamer.

These three machines also have a lot in common besides the AT bus and the 33-MHz i486 CPU. All contain a socket for a Weitek WTL4167 math coprocessor, a 5¼-inch 1.2-megabyte floppy disk drive, two serial ports, a parallel port, a 101-key keyboard, a 16-bit VGA card with 256K bytes of RAM, and a 14-inch color monitor. The main differences in the configurations that we tested were the size of the hard disk drive and the amount of RAM and external cache memory that each offered.

The Premium 486/33 had a 3½-inch 110-MB Imprimis Intelligent Drive Electronics (IDE) hard disk drive with a 16-millisecond average access time, 4 MB of system RAM, and no external CPU cache. The Hawk III had a 5¼-inch 158-MB Maxtor ESDI hard disk drive with a 16-ms average access time, 8 MB of RAM, and 256K bytes of external cache memory. The Step 486/33 had the greatest disk capacity of the group, with a 5¼-inch, 330-MB, 14½-ms Seagate ESDI hard disk drive, as well as 8 MB of RAM and a 128K-byte external processor cache. The Step 486/33 and the Hawk III also had multifrequency monitors, rather than the standard VGA monitor

that was included with the Premium 486/33.

Because the configurations of these machines are so similar, it can be difficult to choose among them. The key is to focus on three major criteria: price, performance, and reliability.

### Wide Price Spread

None of these systems is cheap, but you can't expect bargain-basement prices for top performers. To make a reasonable price comparison, we priced each system with a color VGA board and monitor, a 150-MB hard disk drive (or one as close to that size as possible), and 4 MB of RAM. In that configuration, the Everex Step 486/33 with a 160-MB drive is the most expensive of the group, with a list price of \$11,899. A comparable AST Premium 486/33 with a 110-MB drive costs \$10,619, which is roughly 10 percent less.

If price is your only consideration, however, you can read this paragraph and skip the rest of the review. The Hawk III in our comparison configuration costs only \$6989, and that's with a 158-MB drive. The others just can't compete with the Hawk III's rock-bottom mail-order price, even considering typical dealer discounts for the Premium 486/33 and Step 486/33.

AST's Premium systems have one unusual advantage over the others: You can start with a slower CPU and later upgrade to the 33-MHz i486, or whatever chip is the fastest Intel CPU at the time. Still, the price difference between the AST Premium 486/33 and the Club American Hawk III is too much to pay just for the upgrade privilege.

### Fast, But Not the Fastest

Price comparisons are fair only when the systems involved perform at about the same level. As the graph shows, these three systems definitely make price comparisons reasonable, because they produce very similar results on the BYTE benchmarks. On the overall DOS application index, the fastest machine of the bunch, the AST Premium 486/33, is less than 10 percent faster than the slowest, the Hawk III—there's not a dog in the group.

Still, none of them even comes close to the 65.2 application index of the Tangent Model 425 EISA bus machine that we reviewed last month—and the Tangent uses only a 25-MHz i486 CPU! To resolve this discrepancy, here's a closer look at the benchmark results.

On the CPU front, the Step 486/33, with a score of 9.0, is the clear winner. Its score is over 20 percent better than the 7.4 of the Hawk III and the 7.2 of the Premium 486/33. The Step 486/33 gets its strong CPU score primarily from Everex's Advanced Memory Management Architecture cache controller, which manages the system's external 128K-byte, 20-nanosecond static RAM (SRAM) cache.

By forgoing an external cache and relying solely on the i486's internal cache, the Premium 486/33 turned in the lowest CPU performance of the group. The Hawk III, like the Everex system, has an external cache. In fact, its 256K-byte cache of 20-ns SRAM is twice the size of the Step 486/33's. Because the Hawk III's larger cache didn't give it the CPU performance crown, we can only conclude that Everex's AMMA cache controller must be better than the Hawk III's cache manager.

CPU speed isn't the entire story, however, because all three machines beat the Tangent's 6.6 CPU score, and yet lost to the Tangent by a substantial margin in overall application-level performance. The answer, not surprisingly, lies pri-



*The Everex Step 486/33 (top), AST's Premium 485 (center), and the Club American Hawk III (bottom) put i486 power on an AT bus.*

marily in disk performance.

All three systems have less than spectacular disk scores. The slight edge goes to the Step 486/33, with a score of 3.2 on the low-level disk tests. The Hawk III and Premium 486/33 were close behind, at 3.0 and 2.3, respectively.

None, however, has a caching hard disk drive controller, and that's where the Tangent machine gets its performance. The Tangent's BYTE disk index of 10.1 is due, in large part, to its Mylex caching disk drive controller, with 4 MB of on-board RAM. The lesson is clear: If maximum performance is your goal, get a caching disk drive controller.

The Unix benchmark suite produced slightly different results. Here the Hawk III came out on top, neck and neck with the Step 486/33. Lower results in the System Loading and Tower of Hanoi tests dragged the Premium's cumulative index down to third place.

#### **The Ratings**

With performance so close, the Hawk III's price advantage looks more and



**Premium 486/33 Model 115****Company**

AST Research, Inc.  
16215 Alton Pkwy.  
Irvine, CA 92713  
(714) 727-4141

**Components (as reviewed)**

**Processor:** 33-MHz Intel i486; socket for 33-MHz Weitek WTL4167 math coprocessor  
**Memory:** 4 MB of SIMM-mounted RAM  
**Mass storage:** 5¼-inch 1.2-MB NEC floppy disk drive; 110-MB Imprimis IDE hard disk drive  
**Display:** AST-VGA Plus 16-bit card; AST Premium Display/VGA color monitor  
**Keyboard:** 101-key IBM Enhanced AT layout  
**I/O interfaces:** Two serial ports; one parallel port; one 8-bit and six 16-bit AT-bus expansion slots

**Price**  
\$10,619

**Inquiry 1108.**

**Hawk III****Company**

Club American Technologies, Inc.  
3401 West Warren Ave.  
Fremont, CA 94539  
(415) 683-6600

**Components (as reviewed)**

**Processor:** 33-MHz Intel i486; socket for 33-MHz Weitek WTL4167 math coprocessor  
**Memory:** 8 MB of SIMM-mounted RAM; 256K bytes of cache RAM  
**Mass storage:** 5¼-inch 1.2-MB Teac floppy disk drive; 158-MB Maxtor ESDI hard disk drive; Data Tech 16-bit ESDI hard/floppy disk drive controller  
**Display:** Everex Viewpoint 16-bit VGA card; Club multifrequency monitor  
**Keyboard:** 101-key IBM Enhanced AT layout  
**I/O interfaces:** Two serial ports; one parallel port; seven 16-bit AT-bus expansion slots

**Price**  
\$7674

**Inquiry 1109.**

**Step 486/33****Company**

Everex Systems, Inc.  
48431 Milmont Dr.  
Fremont, CA 94538  
(800) 356-4283

**Components (as reviewed)**

**Processor:** 33-MHz Intel i486; socket for 33-MHz Weitek WTL4167 math coprocessor  
**Memory:** 8 MB of SIMM-mounted RAM; 128K bytes of cache RAM  
**Mass storage:** 5¼-inch 1.2-MB Teac floppy disk drive; 330-MB Seagate ESDI hard disk drive; Everex 16-bit ESDI hard/floppy disk drive controller  
**Display:** Everex Viewpoint 16-bit VGA card; Everex multifrequency monitor  
**Keyboard:** 101-key modified IBM Enhanced AT layout  
**I/O interfaces:** Two serial ports; one parallel port; one 8-bit and six 16-bit AT-bus expansion slots

**Price**  
\$13,499

**Inquiry 1110.**

more important. Still, an inexpensive system is almost useless if it's not reliable, so we took a close look at each of the systems to see how well they're likely to hold up.

All three systems are based on stable architectures that their vendors have used in previous machines. Nonetheless, all three have change wires on the backs of their motherboards, with the Step 486/33's nine wires the worst of the bunch. We had no trouble with any of the systems, but the motherboards clearly could stand one more cleanup iteration.

All three motherboards also depend heavily on discrete logic rather than application-specific ICs, which are common in more mature machines. All three boards have the telltale signs of early designs, with over 100 chips on each board (many of which are socketed) and almost no surface mounting. The vendors had no choice—as we've noted before, they are ahead of the chip-set makers—but 486 systems are likely to become cheaper and more reliable when i486 support chips become commonly available.

A reliable system not only must stay up, it also must be able to run the programs you expect it to run and work with the boards you plan to put into it. These three machines did well on the first front, running over two dozen test applications without a hitch. Their hardware

results were almost as good. They had no trouble with our test add-in boards, but one problem did surface: None of the machines would work with our Xircom Pocket Ethernet Adapter. A Xircom spokesperson claimed that 33-MHz 486 systems are sometimes too fast for the Pocket Ethernet Adapter's control logic. Xircom fans can relax, though; Xircom is preparing a patch that should be available before this review sees print. Still, this problem serves to indicate the unusual difficulties that sometimes lurk in leading-edge systems.

Another aspect of reliability that you must consider is what to do when something goes wrong with the system. All three vendors offer the same basic solution to this problem: a one-year parts-and-labor warranty that requires you to ship the broken system or part to the vendor for repair. Service for the Premium 486/33 is also typically available from the nearest AST dealer.

Everex is the only one of these vendors that gives you the choice of on-site service as well. We've heard some computer vendors gripe about the quality of the on-site service from national third-party service firms, but we still think that systems as powerful as these three should come with on-site service.

The final reliability concern that any buyer—but particularly those in large or-

ganizations—must consider is the reliability of the vendor itself. The best service contract in the world is no good if the vendor offering it will be gone tomorrow. Fortunately, even Club American, the smallest vendor of the three, has sold over 200,000 systems and has annual sales of over \$250 million. No computer company is ever entirely safe, but these firms seem to have the critical mass necessary to stay in business long enough to fix any problems that you're likely to encounter.

**Extra Points**

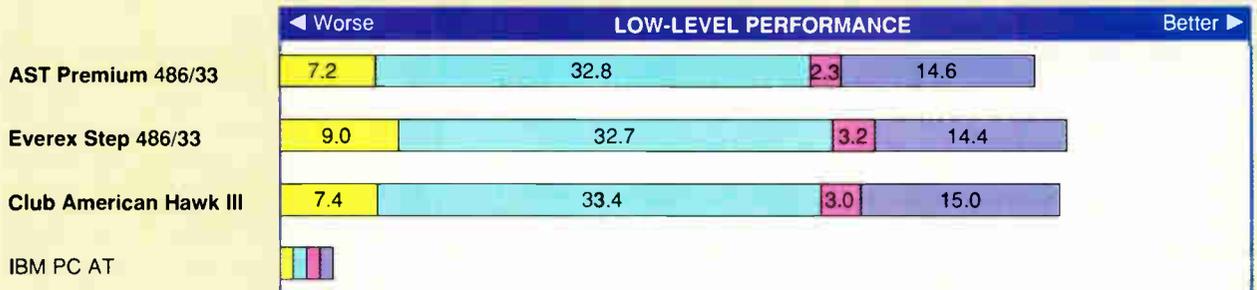
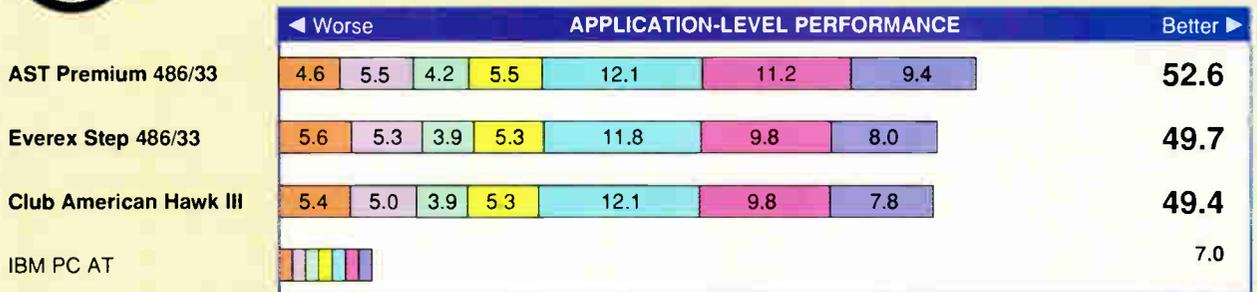
One kind of problem that can occur even in perfectly functioning systems is lack of room to grow. You never know when you'll need more disk storage space, expansion slots, or memory.

All three systems have reasonable disk expansion space, but here again, the Hawk III is the clear winner. Its floor-standing tower case is cavernous, with one full-height and five half-height 5¼-inch bays in front. If that's not enough, there's room for another full-height 5¼-inch drive on an arm that swings out behind the other drive bays.

The other two systems, by contrast, are more traditional desktop units. Each has five half-height 5¼-inch bays. With one of those bays dedicated to the floppy disk drive, each system can hold only two



## DOS BENCHMARKS



### CONVENTIONAL BENCHMARKS

	LINPACK (single) (MFLOPS)	Dhrystones (Dhry./sec.)
AST Premium 486/33	0.8947	25849.4
Everex Step 486/33	0.8959	26912.9
Club Hawk III	0.9263	27472.3
IBM PC AT	0.0210	2317.9

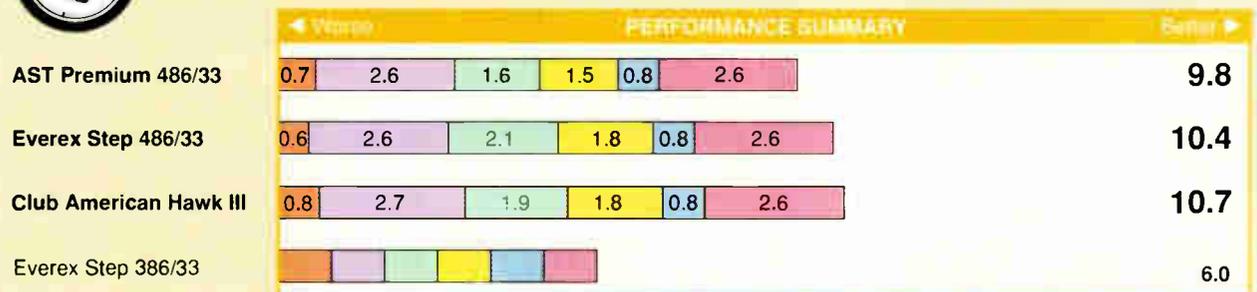
For application and low-level benchmarks, results are indexed and show relative performance; for each individual index, an 8-MHz IBM PC AT running MS-DOS 3.30 = 1. For all benchmarks, higher numbers indicate better performance.

The BYTE low-level benchmark suite identifies performance differences between machines at the hardware level; the application benchmarks evaluate real-world performance by running a standard test suite using commercially available applications. Application indexes include tests using the following programs: Word processing: WordPerfect 5.0; Desktop Publishing: Aldus PageMaker 3.0; Database: Borland Paradox 3.0 and Ashton-Tate dBASE IV; Compilers: Microsoft C 5.1 and Turbo Pascal 5.5; CAD: AutoCAD release 10 and Generic CADD level 3 1.1.5; Scientific/Engineering: Stata release 2, MathCAD 2.5, and PC-Matlab 3.5f; and Spreadsheet: Lotus 1-2-3 release 3.0 and Microsoft Excel 2.1.

The BYTE Lab introduced version 2.0 of the DOS benchmarks in the August issue (see "BYTE's New Benchmarks: New Looks, New Numbers"). Benchmark results for machines reviewed under previous versions aren't directly comparable. To obtain a copy of the benchmarks, join the listings area of the byte.bmarks conference on BIX or contact BYTE directly.



## UNIX BENCHMARKS



**Note:** The graph above summarizes the results of the Unix benchmarks (version 2.6). All results are indexed to show relative performance; for each test, an Everex Step 386/33 running Xenix 2.3.1 = 1. The cumulative index is formed by summing the indexed performance results for the tests. Comprehensive results are available by contacting BYTE.

# Space-Saver Keyboard



## REVIEW

full-height devices.

The three systems are identical when it comes to expansion slots. Each has seven AT-bus slots, five of which were open in our test units. All three systems put the serial and parallel port logic on the motherboard. Each used two slots, one of which always held the VGA card. The Step 486/33 and the Hawk III filled the second slot with a floppy/ESDI hard disk drive controller. The Premium 486/33 had its floppy/hard disk drive controller logic on the motherboard, but its processor card consumed a slot.

Memory expansion is the one area in which the Hawk III comes up a bit short. Its motherboard can hold eight 1-MB single in-line memory modules (SIMMs), and there is room for eight more on an optional memory board (\$135 with no RAM) that uses a proprietary slot. This 16-MB limit is more than enough for almost any DOS or OS/2 work, but if you plan to make the machine a LAN server or a multiuser Unix box, you might wish for a higher memory ceiling.

The Premium 486/33 wins the memory-expansion crown. It uses the same processor and memory arrangement as the other AST Cupid-32 systems that BYTE has reviewed. A processor card holds the i486 CPU and four SIMMs of either 1 MB or 4 MB each. The Premium 486/33 also can accommodate up to two 32-bit memory cards (which cost \$500 each, including 1 MB of RAM). Each card can house 16 1-MB SIMMs, for a maximum possible memory configuration of 48 MB.

The Step 486/33 is in the middle of the group, with a maximum of 32 MB of RAM. A single memory board, which goes into a proprietary expansion slot, can hold either 16 1-MB SIMMs or eight 4-MB SIMMs.

The high performance of these machines supports a claim that we've been making for some time: There's no reason to go to an EISA system unless you need a specific EISA card. Put a caching disk drive controller in any of these systems, and you will have one of the fastest PCs available.

Choosing a single winner in a comparative review is often difficult, but not this time. The low price and roomy cabinet of Club American's Hawk III make it the clear pick of this bunch. ■

*Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.*

**S**ave an amazing 60% of the desk or counter space now taken by a standard keyboard and enjoy improved functionality at the same time. Actual size is 10.75" x 6.0" (273 x 152mm). The new MICROTYPE keyboard is rapidly gaining acceptance as a truly advanced alternative to the original IBM layout for many applications. Reliability of the MICROTYPE has been amply proven through extensive use in trading areas of the NYSE, The New York and Chicago Mercantile Exchanges as well as in many banks, brokerages, stores and at factory work stations.

Space is saved by compressing rows (not columns) and eliminating wide borders. Re-arranging and elevating the auxiliary key clusters also saves space while improving accessibility with reduced eyescan and head movement. Keys have full travel with a light tactually responsive touch. All standard features such as auto-repeat, caps, num and scroll lock are included on the MICROTYPE.

PC XT/AT, PS/2 IBM and clone compatibility. Available in US and most European language versions. Made in USA with 1 year warranty.

... beautifully sensitive and handles both typists with light touch and those who really bang away ...

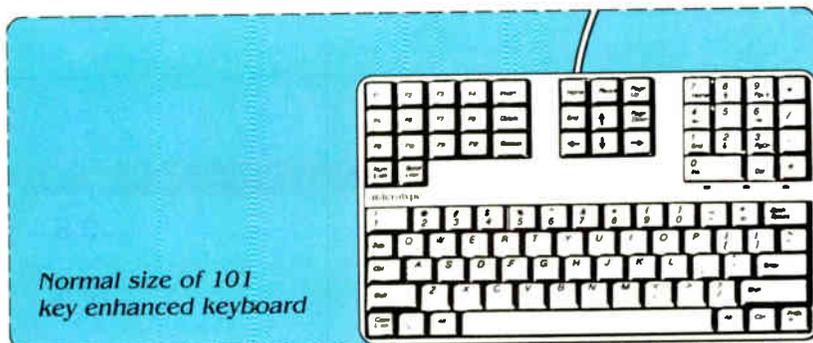
COMPUTER BUYERS GUIDE

... This could be the perfect layout for an enhanced keyboard that must fit into a small area ...

COMPUMAG

Order direct from stock with 15 day full return privileges. VISA, MasterCard, Eurocard charges accepted.

USA	1-800-DATALUX	Fax 703-662-1682	\$124.50 + 6.00 s/h	Extra charges for PS/2 adapters,
CANADA	514-694-0870	Fax 514-694-0871	\$189.00Cdn + s/h	air shipments. OEM and reseller
EUROPE	44 + 306-76718	Fax 44 + 306-76742	£99.00 + VAT + P&P	volume discounts available.



Normal size of 101 key enhanced keyboard

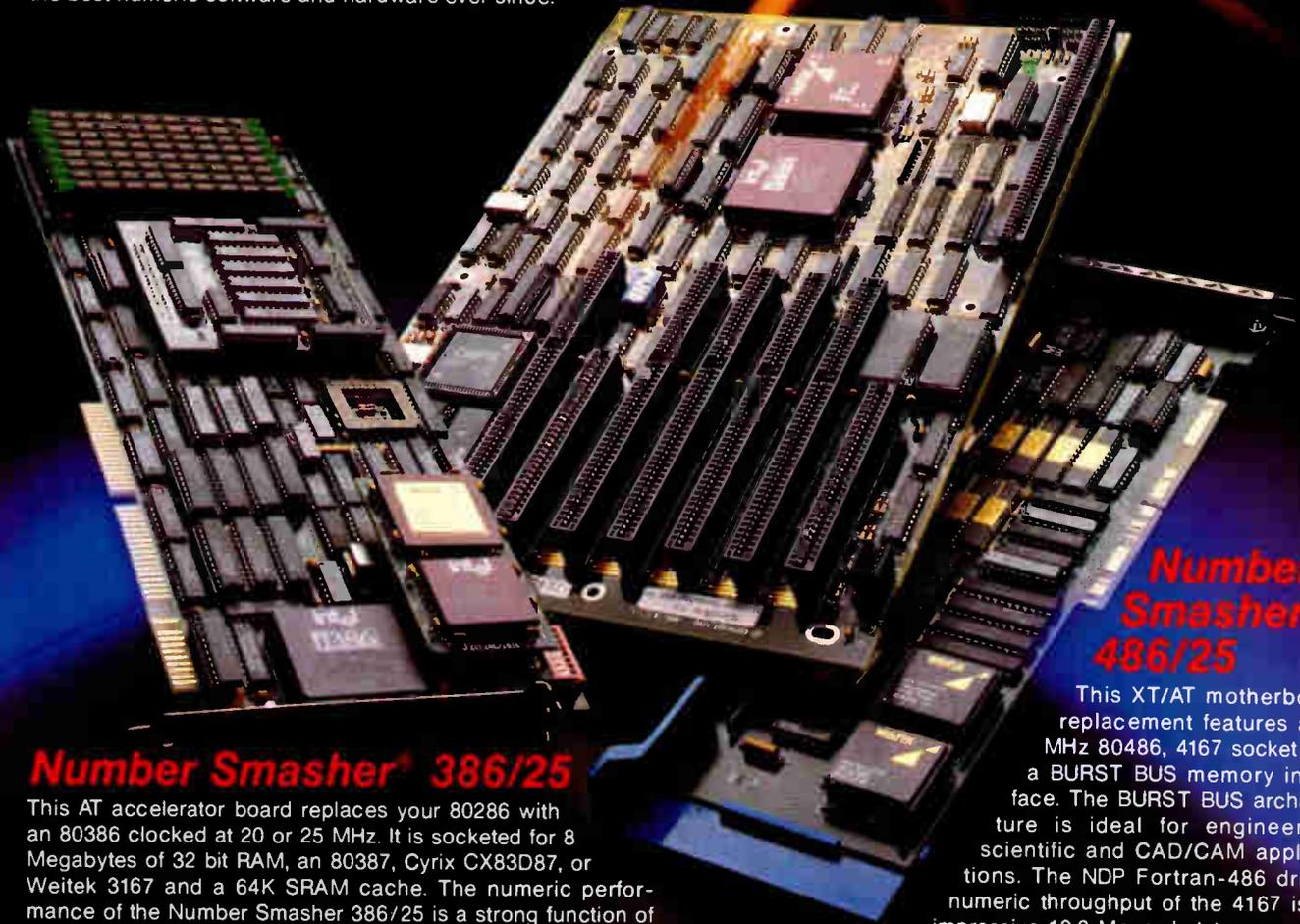
When it comes to saving space, there's no comparison.

# DATALUX

DATALUX CORPORATION 2836 Cessna Drive, Winchester, Virginia 22601

# 25 MHz 486 Speed For Your 286/386 System!

MicroWay manufactures a broad range of products that boost the speed and capacity of your current PC/AT. They include 386 and 386SX accelerators and 486 replacement motherboards. We also offer a complete line of Weitek accessories and stock all of the Intel, Weitek and Cyrix coprocessors. We created the PC numerics industry in 1982 and have been developing, selling and supporting the best numeric software and hardware ever since.



## Number Smasher® 386/25

This AT accelerator board replaces your 80286 with an 80386 clocked at 20 or 25 MHz. It is socketed for 8 Megabytes of 32 bit RAM, an 80387, Cyrix CX83D87, or Weitek 3167 and a 64K SRAM cache. The numeric performance of the Number Smasher 386/25 is a strong function of your application and the coprocessor you choose. The 25 MHz NDP Fortran-386 driven Whetstones are 2.1, 3.7 and 5.5 MegaWhetstones running on the 80387, CX83D87 and 3167.

## Number Smasher® 486/25

This XT/AT motherboard replacement features a 25 MHz 80486, 4167 socket and a BURST BUS memory interface. The BURST BUS architecture is ideal for engineering, scientific and CAD/CAM applications. The NDP Fortran-486 driven numeric throughput of the 4167 is an impressive 13.0 Megawhetstones, which is 100 times the throughput of an 80287 equipped AT!

### Number Smasher 486/25 Numeric Performance

	486	4167
Megawhetstones	5.9	13.0
Megawhetscales	4.1	9.9

MicroWay and Number Smasher are registered trademarks of MicroWay, Inc.. 80386, 80387, 80486 are trademarks of Intel Corp., Cyrix and CX83D87 are trademarks of Cyrix Corp., Weitek, 3167 and 4167 are trademarks of Weitek Corp.

## mW3167/MCA

Our MCA Weitek card runs in the IBM Model 70 and 80. At 20 MHz, its performance is 2 to 3 times that of an 80387.

*NDP Fortran-486 and C-486 are globally optimized main-frame compilers that have been fine tuned for the 80486 and 4167. NDP Fortran-i860 and C-i860 are available in August.*



**Coming in August: Number Smasher® i860**

**MicroWay**

**World Leader in PC Numerics**

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341  
32 High St., Kingston-Upon-Thames, U.K., 81-541-5466 USA FAX (508) 746-4678  
Germany 069-75-2023 Italy 02-74.90.749 Holland 40 836455 Japan 3 222 0544

# WE'VE TAKEN THE INDUSTRIAL PC TO EVERY EXTREME.

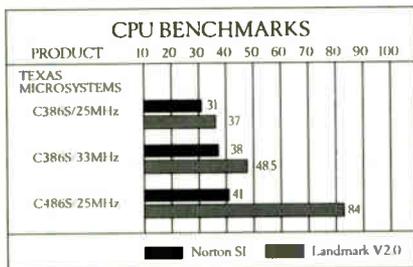
Companies don't make the Fortune 100 list by accident. It takes hard work and the wise investment of capital. Which is why when they buy industrial PCs, seven out of every ten Fortune 100 companies invest in Texas Microsystems.

## UNBEATABLE PERFORMANCE IN ANY ENVIRONMENT.

Most people assume that an industrial PC will give the reliability needed to run critical applications in harsh environments, but the trade off can be a lack of performance and high cost of entry. With Texas Microsystems the reverse is true.

Benchmark studies show that in harsh environments Texas Microsystems 25/33 MHz 386 & 25MHz 486 PCs perform as well as powerful desktop PCs do in office environments. Yet the cost of our systems can be a pleasant surprise.

DESKTOP PERFORMANCE UNDER EXTREME CONDITIONS.



## BUILT IN RELIABILITY FROM THE BOARD UP.

We build our systems from scratch, and take nothing for granted. We've been designing with Intel microprocessors since 1974. Design and manufacture most of our cards. And by using VLSI and PAL technology reduce component counts by 60% and drive MTBF numbers up to 100,000 hours.

Texas Microsystems innovations include passive backplane architecture to improve component reliability and reduce MTTR to less than 10 minutes. Our 16 point shock-



mounting techniques keep disk drives functioning at up to 25G velocities. And our 48 hour pre-test burn-in at over 130°F guarantees reliability.

## NO ONE HAS MORE INDUSTRIAL EXPERIENCE.

We've been in business for 16 years. And you'll find Texas Microsystems operating in harsh environments at 70 of the Fortune 100 companies, as well as delivering mission critical solutions to the US Government and Armed Services.

## MORE SYSTEMS MEAN MORE OPTIONS.

Two of our most popular systems are shown here. They can be configured with a vast choice of options

from CPUs, hard disks and drives, CMOS RAM, video cards and displays, and if none of these match your requirements we'll custom configure and test whatever system you need.

## TO US "INDUSTRIAL" IS MORE THAN A DESIGN PHILOSOPHY.

You can buy cheaper industrial PCs than ours, but they may be camouflaged desktops that do not perform in extreme environments.

At Texas Microsystems, that isn't the way we build systems. Industrial PCs and Mission Critical Micros™ are all we make. Repackaging office computers is not our business. We design and manufacture all our products from scratch, we don't adapt the designs of others. And

we're always here when you need us.

**NATION-WIDE SERVICE,  
FULL-TIME SUPPORT.**

We believe in offering exceptional support, including consultation during system design. After sales technical support 12 hours a day via an 800 number. On-site service from General Electric for a full year, including free parts and labor. A 30-day, no-questions-asked, money-back guarantee. And a way of ordering a Texas Microsystem that's most convenient and cost effective to you.

Opposite are two Texas Microsystems that offer an unsurpassed combination of price/performance. Order them direct or ask for a complete literature and information kit on all our systems by calling -800-627-8700 now.

**TWO EXTREMELY  
UNBEATABLE SYSTEMS.**

Here are two of our top selling systems for business environments that demand mission critical computing, regardless of operating conditions. Like all our systems they enjoy the same engineering pedigree that ensures a unique combination of performance, reliability and value. Which is, after all, what you should expect from America's leading industrial micro systems company.

And to put a little icing on the cake, each will include a one year, on-site, warranty.

To order, call the 800 number below and one of our representatives will discuss your needs with you, give you an instant quote on the configuration of your choice. Then the system will be built to your order, tested, and shipped.

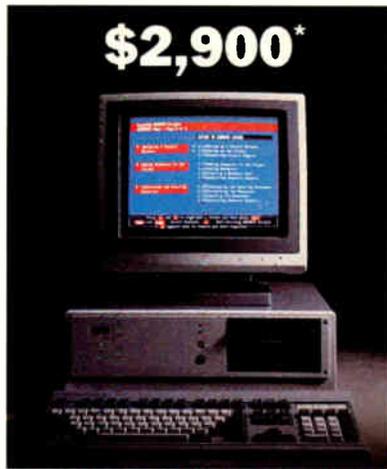
Mission Critical Micros is a trademark of Texas Microsystems Inc., other trademarks mentioned are registered, trademarked or vicemarked by their respected manufacturers.



Texas Microsystems, Inc.

1618 Rockley Rd., Houston, Texas 77099  
Tel: 713-933-8050. Fax: 713-933-1029

# EXCEPT PRICE.



**TEXAS MICROSYSTEM 4108  
MISSION CRITICAL OFFICE PC**

*Features*

- Choice of 80286, 80386, 80486 processors.
- Perfect for data acquisition, communications and networking applications.
- 8 full length ISA slots for industry standard cards.
- Up to 16MB of RAM on CPU, three half-height 5.25" bays for floppy/hard drives and one 3.5" hard drive.
- Super VGA graphics (1024 x 768 pixels) Also supports CGA, EGA.
- 1 parallel and 2 serial ports.
- 101-key enhanced keyboard with DIN connector on rear panel.
- 220 watt power supply.
- One year, on site warranty included.

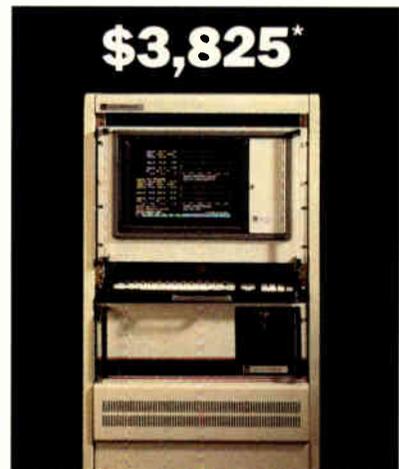
*Specifications*

- Dimensions: 6.5" x 17" x 16.5"; 30 lbs.
- Power 220 Watt, 110 V.
- Operating environment.  
Temperature: 0°C to 55°C. (32°F to 131°F)  
Altitude: 15,000 feet equivalent

*System Prices*

Model	CPU/ MHz-RAM	Storage	Price
4216	286/16-1	40MB HD, 1.2 or 1.44MB floppy	\$2,900
4320	386/20-1	40MB HD, 1.2 or 1.44MB floppy	\$3,755
4325	386/25-1	104MB HD, 1.2 or 1.44MB floppy	\$4,530
4333	386/33-2	104MB HD, 1.2 or 1.44MB floppy	\$5,135
4425	486/25-4	104MB HD, 1.2 or 1.44MB floppy	\$5,995

\*From \$2,900. Monitor not included.



**TEXAS MICROSYSTEM 3014  
RUGGEDIZED RACK-MOUNT PC**

*Features*

- Choice of 80286, 80386, 80486 processors.
- 18-gauge nickel plated, steel chassis.
- 14 full length ISA slots for industry standard cards.
- Boards bracketed and braced on all four edges.
- Two 110 CFM fans.
- Up to 16MB of RAM on CPU, and five half-height storage bays for hard drives, floppy and/or tape backup.
- Super VGA graphics (1024 x 768 pixels) Also supports CGA, EGA.
- 1 parallel and 2 serial ports.
- Built in speaker, door lock, power and CPU reset switch.
- 101-key enhanced keyboard with DIN connector on front panel.
- 225 watt power supply.
- One year, on site warranty included.

*Specifications*

- Dimensions: 19" x 22.18" x 6.96" Wt. 45 lbs.
- Power 95-132/180-264 VAC, 47 to 63Hz.
- Operating environment.  
Temperature: 0°C to 55°C. (32°F to 131°F)  
Humidity: To 95% at 40°C non-condensing  
Altitude: 15,000 feet equivalent  
Vibration: .25G, 5-100Hz operating  
5G, 5-100Hz non-operating  
Shock: 1.0G operating at 10 Msec duration

*System Prices*

Model	CPU/ MHz-RAM	Storage	Price
3216	286/16-1	40MB HD, 1.2 or 1.44MB floppy	\$3,825
3320	386/20-1	40MB HD, 1.2 or 1.44MB floppy	\$4,650
3325	386/25-1	104MB HD, 1.2 or 1.44MB floppy	\$5,430
3333	386/33-2	104MB HD, 1.2 or 1.44MB floppy	\$6,040
3425	486/25-4	104MB HD, 1.2 or 1.44MB floppy	\$6,895

\*From \$3,825. Rackmount monitor not included.

**EVEN ORDERING IS EXTREMELY EASY. CALL**

# 1-800-627-8700

Circle 340 on Reader Service Card

World Radio History

## REVIEW

## FPU Face-Off

**S**ometimes there's no way out. Unless you want to fossilize in front of your PC waiting for that CAD drawing to complete, a math coprocessor is your only hope. Not long ago, the only choice was to buy an Intel coprocessor. No longer. Several coprocessor vendors now are trying to fill that empty socket next to your 286, 386, or i486.

Whether you have a 286-, 386-, or i486-class machine, you've probably got at least one application—possibly a critical one—that could use the kind of speed boost that only an FPU can give. CAD and other scientific and engineering programs, spreadsheets, and, to a lesser extent, some database programs, can benefit from an FPU.

I looked at a sampling of coprocessors for 286-, 386-, and i486-class machines that should fit anybody's needs. The 80287-class chips include the 80287XL from Intel, the 80C287 from Advanced Micro Devices (AMD), and the 2C87 from Integrated Information Technology. The 80387-class chips include the Intel 80387DX, the Cyrix FastMath 83D87, the IIT 3C87, and the Weitek Abacus 3167. In the i486 arena, I measured the Weitek Abacus 4167 against the i486 CPU's built-in FPU. I then rounded up a group of test machines and put the FPUs through a battery of tests (see the figure). Before reviewing the test results, though, you'll want to understand how these FPUs work and the features that differentiate each chip from its competition.

**Intel**

Intel hasn't been sitting on its laurels; while other vendors have been introducing 80287 and 80387 clones, Intel has quietly refined its own FPUs. Its new 80287XL and 80387DX chips run substantially faster than the chips the company shipped just six months ago.

Intel's 80287XL, the successor to Intel's 80287, is an 80387 in 80287 clothing. Though hardware-compatible with the 80287, the 80287XL incorporates the numerics core of the 80387 coprocessor family. This means that you can access all the 80387's advanced instructions. However, your applications software must be aware of the 80287XL to take advantage of its added capabilities. But from a developer's standpoint, it's easy to construct a routine that detects the presence of an 80387-class coprocessor

by carrying out a prescribed set of operations and examining the results. Best of all, the 80287XL is a CMOS component. It consumes about one-third the current of a standard 80287 and is 50 percent faster, according to Intel.

Intel's 80387 needs no introduction: It's at work in more 386 systems than any other coprocessor. The new 80387DX chip, introduced earlier this year, takes advantage of an improved chip manufacturing process that Intel claims provides 20 percent faster performance than its predecessors. The 80387 is a direct descendant of Intel's 80287 and 8087 coprocessors. However, the 80387 carries an improved instruction set. Some improvements are minor, while others are an application builder's dream. In particular, the 80387 beefs up trigonometric functions, which are particularly critical to two-dimensional and 3-D CAD applications.

Intel's 25-MHz i486 processor looks much like a 386/80387 combination. In the tests I ran, there's a significant performance hike between the 386/80387 and the i486, thanks to the integration of the coprocessor into the CPU. (For more on the i486, see "The 80486: A Hardware Perspective," *IBM Special Edition*, Fall 1989.)

**AMD**

At press time, AMD only offered 80287-class coprocessors. Its 80C287 is more or less a faithful reproduction of the Intel 80287. Like Intel's 80287XL, it has CMOS internals, so power consumption is less than that of a typical 80287: At 10 MHz, the AMD 80C287 consumes about 100 milliamperes of current, while a stock 80287 takes somewhere in the neighborhood of 400 mA.

The AMD 80EC287, which I did not test for this review, is essentially an

80C287 with a low-power sleep mode. The 80EC287 enters sleep mode whenever the coprocessor isn't executing an instruction. In this mode, the 10-MHz version draws only about 10 mA. Both the 80C287 and 80EC287 are likely inhabitants for 286 laptops. The AMD chips require no minimum on their clock speeds, and since power consumption is tied to clock speed, a clever, energy-conscious design can result in an even lower average power usage. The 80EC287 is also fully static, so you can actually stop its clock, which drops the power draw down to about 5 mA.

**Weitek**

Weitek's FPUs operate exclusively on 386 and 486 systems. The Abacus 3167 and 4167 coprocessors are not Intel clones. Their internal structure is markedly different from that of the 80x87-series coprocessors, and they're not pin-compatible with the 80x87, so to use them your computer must have a Weitek socket. On the other hand, since the Abacus chips don't respond to 80x87 instructions, you can run both an 80387 and a 3167 in the same machine.

An x-ray view of Intel's FPUs reveals a set of eight 80-bit data registers. Although you can address the registers individually, you can also treat the entire set as an eight-element stack. The Abacus FPUs have no stack architecture, so you can only address each of the 31 registers individually. The registers also have a dual nature: Ordinarily, each is 32 bits wide; however, you can pair 30 of the registers (starting with number 2) into 15 64-bit megaregisters for double-precision mathematics.

The Abacus chips are also memory-mapped. As such, they don't look for Intel coprocessor instructions. Instead, the chips occupy a 64K-byte window in

**80C287  
80EC287****Company**

Advanced Micro Devices, Inc.  
901 Thompson Place  
P.O. Box 3453  
Sunnyvale, CA 94088  
(408) 732-2400

**Price**

80C287-10: \$99  
80EC287-10: \$109

**Inquiry 1061.****80287XL  
80387DX  
i486****Company**

Intel Corp.  
1900 Prairie City Rd.  
Mail Stop FM2-18  
Folsom, CA 95630  
(916) 351-2747

**Price**

80287XL-10: \$370  
80387DX-33: \$994  
i486-25: \$722 each in quantities of 1000

**Inquiry 1062.**

physical memory (starting at address 0C000000 hexadecimal). The Abacus chips decode locations within that window to trigger specific instructions. For example, writing into the memory address at offset 800h within the window causes the Abacus chips to execute a single-precision multiply instruction.

The advantage to using a memory-mapped architecture is speed. The conventional approach—taken by Intel and the Intel clone vendors—requires both instructions and data to pass to the coprocessor via the data bus. Furthermore, the FPU must decode coprocessor instructions coming down the data bus, which creates additional time overhead. The memory-mapped approach puts the instruction on the address lines. So, a single MOV instruction transfers the instruction *and* the data to the FPU.

One Abacus feature not highlighted in my tests is the coprocessors' matrix capabilities. While the coprocessor decodes addresses in its memory window to determine which operation to perform, the situation is actually more complex. The Abacus chips perform further decoding on the address lines to select source and target registers. And Weitek's designers have constructed the coprocessors so that those address lines that select the target registers fall on doubleword boundaries. The upshot of all this is that you can use fast REP STOSD and REP MOVSD instructions to do rapid vector operations. For example, I can quickly load the eight single-precision registers starting with register 1 using

```
LEA   ESI,ARRAYSTART
MOV   ECX,8
MOV   EDI,0C0000404H
REP   MOVSD
```

where I'm assuming the code is execut-

ing in the 386's "flat" addressing mode. Applications software that is aware of this feature should realize a performance gain beyond what the benchmark tests reveal.

### IIT

IIT offers both 80287- and 80387-class chips. The 2C87 and 3C87 are CMOS parts; as an example of the reduced power requirements, the 3C87 uses 25 percent less current than an 80387. Both are fully hardware and software compatible with their Intel equivalents, although IIT claims both have better performance than Intel coprocessors. Both have low-power sleep modes that make them attractive to laptop designers.

But the IIT coprocessors aren't just faster and cooler (lower power consumption means less heat dissipation). Where Intel coprocessors possess a single set of eight floating-point registers, the IIT chips hold 32 registers, grouped into three banks of eight registers each. When you power up an IIT chip, its bank pointer sets to bank 0. The coprocessor recognizes four custom instructions that look like 80x87 instructions but aren't defined for the 80x87 instruction repertoire. Three of these custom instructions set the bank pointer to each of the three register banks. It's like having three chips in one, reducing the overhead of memory-to-FPU (and back) instructions.

Ordinarily, there's no cross talk between the register banks; the coprocessor is aware of only the currently active bank. The fourth custom instruction, F4X4, however, does operate on more than one bank. The F4X4 instruction multiplies two 4x4 matrices in a single instruction. (Matrix multiplication is common in 3-D graphics applications, such as CAD and animation software.) The elements of the matrices are spread

throughout the register banks. The result—a four-element vector—lands in bank 0. This instruction reduces 16 multiplications and 12 additions (using classical matrix multiplication formulas) to a single instruction.

### Cyrix

Cyrix makes only an 80387-class FPU. The differences between the Cyrix FastMath 83D87 and an Intel 80387 are subtle. The 83D87 uses CMOS circuitry for lower power consumption and automatically kicks into low-power mode when idle (the company claims that this reduces the chip's overall power draw to 5 percent of that of an 80387). The 83D87 is also faster than a standard 80387.

However, the engineers at Cyrix are proudest of the 83D87 processor's accuracy when calculating transcendental functions (i.e., exponentiation, logarithm, and trigonometric). The Intel coprocessors—and the AMD clones—perform transcendental operations using a variation of an algorithm known as the CORDIC routine. This algorithm is an approximation technique that—at least for the trigonometric functions—arrives at its solution via a series of angular rotations. Intel publishes the relative error bound for such approximations at the sixty-second bit position.

The Cyrix coprocessor evaluates transcendental functions using a polynomial approximation. Ordinarily, this would be prohibitively expensive in terms of execution time, since a polynomial evaluation requires a series of floating-point multiplications and additions, while the Intel FPUs' CORDIC algorithm uses only shifts and adds. However, the Cyrix chip's execution unit is built into the circuitry and is therefore much faster than the Intel chips' microcode sequencer. Simply put, where the Intel chips have to

#### FastMath 83D87

##### Company

Cyrix  
P.O. Box 850118  
Richardson, TX 75085  
(800) 327-6284

##### Price

83D87-33: \$994

Inquiry 1063.

#### 2C87 3C87

##### Company

Integrated Information Technology, Inc.  
2445 Mission College Blvd.  
Santa Clara, CA 95054  
(408) 727-1885

##### Price

2C87-10: \$319  
3C87-33: \$779

Inquiry 1064.

#### Abacus 3167 Abacus 4167

##### Company

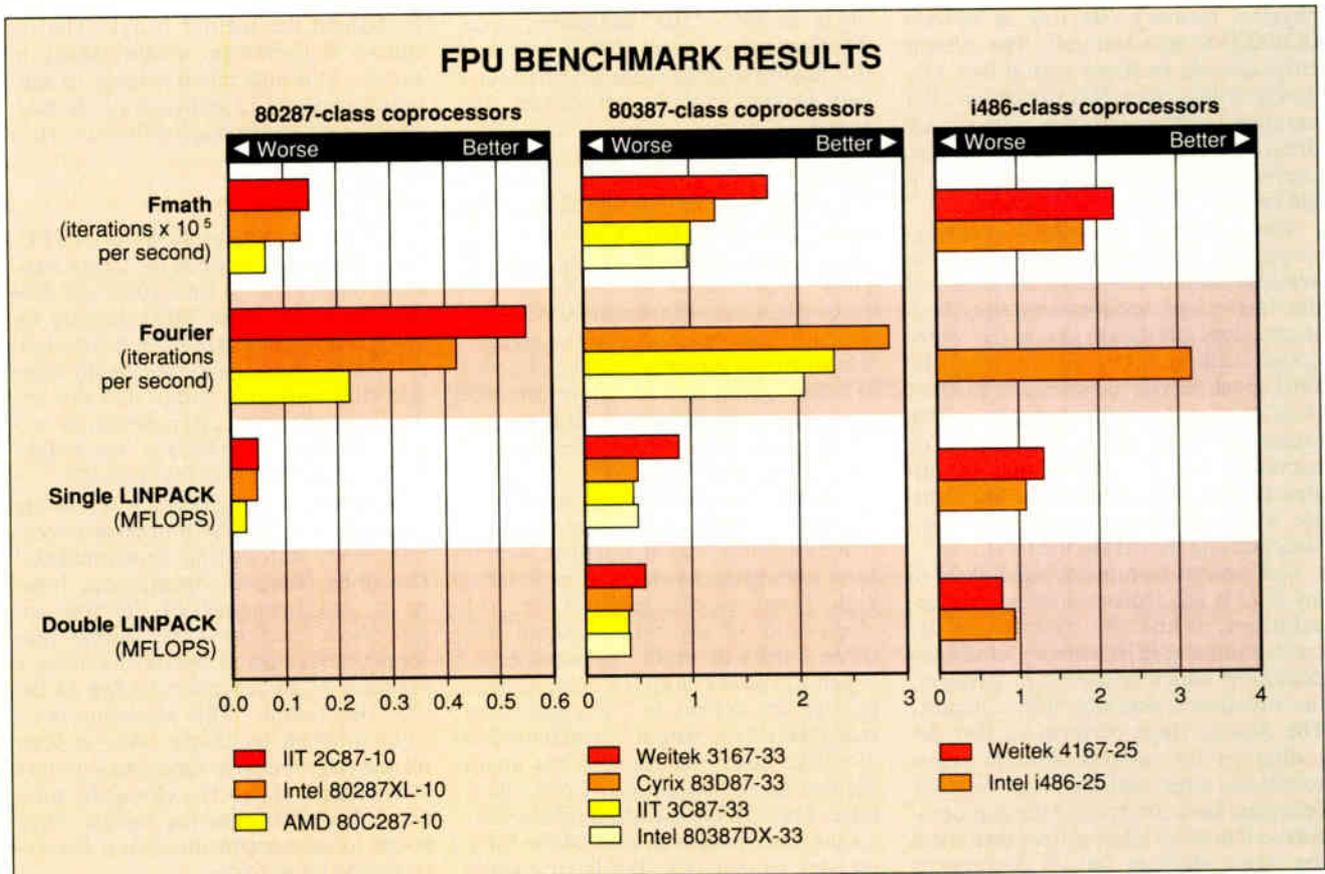
Weitek  
1060 East Arques Ave.  
Sunnyvale, CA 94088  
(800) 468-3167

##### Price

3167-33: \$995  
4167-25: \$995

Inquiry 1065.





In the 80287-class category, the IIT 2C87 clearly outperformed both Intel's 80287XL and the AMD 80C287. Surprisingly, the 80C287, a CMOS chip, was slower than the 80287XL—the new CMOS version of Intel's 80287 FPU. Since the 80287 can't perform 32-bit moves, the double LINPACK test doesn't apply. The Abacus 3167 performed best overall in the 80387-class category, but it's not 80387-compatible, so your application has to support it. In the 80387-compatible category, Cyrix's FastMath 83D87 posted strong results across the board. The 3167 has no Fourier results because it doesn't directly support trigonometric functions (see the text for details). Weitek's Abacus 4167 outperformed Intel's i486 in the Fmath and single LINPACK tests but came up short on the double LINPACK. There are no Fourier results for the 4167 because it doesn't directly support trigonometric functions (see the text for details).

run itty-bitty programs to perform multiplications, the Cyrix chip does the multiplication in hardware.

The advantage of polynomial approximation is that it keeps errors below the sixty-fifth bit. IIT also uses polynomial approximation and a hardware multiplier but claims an upper error bound in only the sixty-second bit. An error difference between the sixty-second and sixty-fifth bit ( $2^{62}$  and  $2^{65}$ ) may seem minor, and for most business applications—which carry, at best, 53 bits of precision—it certainly is. If you're heavily into scientific or engineering number crunching, however, you may want to consider the Cyrix chip.

Cyrix also provided me with an early version of its new EMC87 coprocessor, which is best described as an Intel/Weitek hybrid. (Since this chip was a prototype, I didn't include the test results in

the figure.) The EMC87 has all the internals of the 83D87, so you get the benefit of Intel compatibility plus the Cyrix speed and accuracy. But, as with the Abacus chips, you can also access the EMC87 in memory-mapped mode. I ran a preliminary test on the EMC87 in both Intel-compatible mode and memory-mapped mode and saw a performance increase on the order of 20 percent.

#### The Gauntlet

I used three machines as my testing arsenal. For the 80287-class coprocessors, I used a 10-MHz Microserve AT clone. A Club American Hawk 33-MHz 386 system served as my test machine for the 80387-class coprocessors. Finally, I used a Compaq Deskpro 486/25 for generating the i486 and Weitek 4167 tests. If you have a 25-MHz 386 system or an 8-MHz 286 system, don't despair; vendors

offer their FPUs in several speeds, and the relative performance numbers should be the same within each processor class.

Testing math coprocessors is messy work, for several reasons. It requires wading into DOS extenders and 32-bit programming. I lived in constant fear that a statically charged and misplaced finger would bring testing to a halt. And I quickly discovered that coprocessor sockets aren't designed to let you take chips back out. This is especially true of the monstrous grid-array sockets that hold the 80387 clones and the Weitek chips. The expression "like pulling teeth" is all too appropriate.

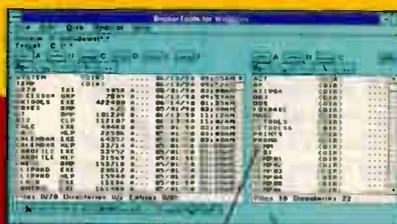
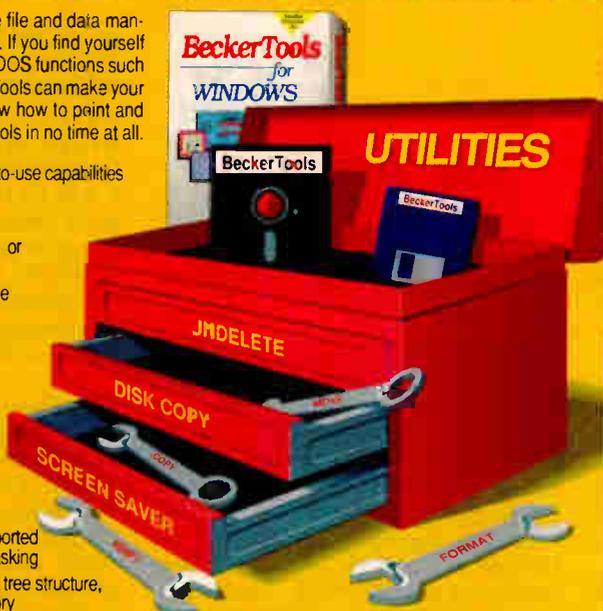
I ran two different groups of benchmarks. First, I ran the FPU components of BYTE's low-level benchmarks on those coprocessors that would readily accept them (see "BYTE's New Benchmarks: New Looks, New Numbers,"

# Utilities for WINDOWS 3.0 Users

BeckerTools is a set of indispensable file and data management utilities for the Windows user. If you find yourself "dropping" out of Windows to perform DOS functions such as copying or undeleting, then BeckerTools can make your life easier. And since you already know how to point and click, you'll know how to use BeckerTools in no time at all.

BeckerTools adds these and more easy-to-use capabilities to Windows 3.0:

- Undelete - lets you recover deleted files
- Delete files - single or groups of files or directories, including read-only files
- Backup (pack files) hard disk - to multiple diskettes with password protection
- Duplicate diskettes - read in diskette once, make multiple copies
- Edit text - built-in editor with search and replace
- Copy diskettes - in single pass
- Compare diskettes - in single pass
- Wipe diskette - for maximum security
- Verify diskettes - handy security check
- Format diskettes - in any capacity supported by your drive and disk type while multitasking
- Displaying - displays a neatly formatted tree structure, with memory allocations of each directory



Select both the source and target file or directory from convenient single screen

Perform these operations by just clicking on an icon

- Convenient one button command menu.
- Easily switch source/target directories.
- Sort by your filenames or extensions.
- Select all files in your source directory.
- Deselect just as easily.
- Select files and directories.
- See only the files you want to see.
- Select multiple files using your patterns.

Available through Radio Shack's Express Order Service, Waldens Software and other retailers nationwide. Or order direct from:

**Abacus**

Dept. B11, 5370 52nd Street SE, Grand Rapids, MI 49512  
Orders: 1-800-451-4319 • Phone: (616) 698-0330 • Fax: (616) 698-0325

Customer comments: "Great program. Just what I was looking for to replace Norton Commander T.K., CA"

"Great" R.P., FL  
"Excellent Program" S.J., IN

"Very useful program! I've been waiting for this; it's just a shame Microsoft can't develop something this great!" P.G., MI

System Requirements: IBM AT, 386 or compatible and Windows 3.0. Windows not included.

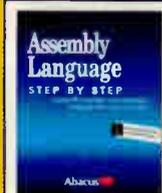
Suggested retail price: \$79.95

In US and Canada add \$4.00 postage & handling. Foreign orders add \$12.00 postage per item. We accept Visa, Mastercard or American Express. Call or write for your free catalog.

Order Toll Free 1-800-451-4319 Ext. 211

# Computing Know How

From these bestselling books



**Assembly Language: Step by Step**  
For lightning execution speed, no computer language beats assembly language. Teaches PC assembly and machine language the right way - one step at a time. Companion diskette contains unique simulator, shows how each instruction looks as the PC executes it. Includes companion diskette. Available December.  
ISBN 1-55755-096-4. **\$34.95**

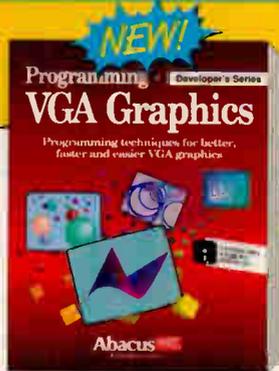
**Upgrading & Maintaining Your PC**  
Shows how to turn your PC into a high performance computing machine. Learn how to add a hard drive, increase memory, upgrade to a higher resolution monitor, or turn your XT into a fast AT or 386 screamer without having to be an electronics wizard.  
ISBN 1-55755-092-1. **\$24.95**



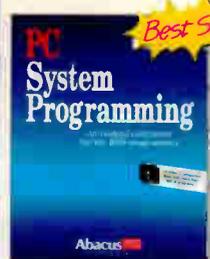
**Turbo Pascal Internals**  
Gives you "know how" to program faster, easier, tighter and better. Find out how to use Turbo for system programming tasks-writing TSRs, performing multitasking, using SAA windowing, implementing expanded and extended memory. Learn how Turbo generates machine code, handles the mouse, scans the keyboard, uses UNITS and OOPS, performs fast screen display and more. 750 pages with 2 disks - more than 800K of source code. ISBN 1-55755-080-8. **\$49.95**

## Programming VGA Graphics

Learn to program impressive VGA graphics. Includes both routines and language extensions for Turbo Pascal and BASIC programmers. Dozens of "new" DOS commands let you experiment with graphic techniques without programming. Includes applications and commented source code for over 84 programs in BASIC and Pascal. Includes 2 companion disks. 600 pages.  
ISBN 1-55755-099-9. **\$49.95**



Coming soon  
"Word for Windows Know How"



## PC System Programming

An encyclopedia of PC technical and programming knowledge. Features parallel working examples written in Pascal, C, assembly and BASIC. Explains memory layout, DOS operations, using extended, expanded memory, writing device drivers, hard disks, PC ports, mouse drivers, fundamentals of BIOS, graphics and sound, TSR programs, complete appendices. 920 pages and 2 disks with more than 1 meg of programs in compressed format. A Best Seller.  
ISBN 1-55755-036-0. **\$59.95**

**Abacus**

Dept. B11, 5370 52nd Street SE, Grand Rapids, MI 49512

Orders: 1-800-451-4319 • Phone: (616) 698-0330 • Fax: (616) 698-0325

In US and Canada add \$4.00 postage & handling. Foreign orders add \$12.00 postage per book. We accept Visa, Mastercard or American Express. Call or write for your free catalog of other PC books

Circle 8 on Reader Service Card (RESELLERS: 9)

Order Toll Free: 1-800-451-4319 Ext. 211 In US and Canada

August BYTE). The exceptions were Weitek's Abacus chips and the Cyrix EMC87 when it was operating in memory-mapped mode.

The BYTE FPU benchmarks expect 80x87 compatibility, so I had to craft a separate set of benchmarks for these chips. To do this, I used Phar Lap's 386|ASM assembler and Run386 DOS extender, accompanied by some assembly language macros from Weitek. When you execute Run386, it senses the presence of an Abacus chip and creates a selector that you can use to address the coprocessor. Using Weitek's macros, I easily constructed an Abacus equivalent of the Fmath benchmark. I didn't build a version of the Fourier benchmark for the Abacus chips, because they don't directly support trigonometric functions.

If you need transcendental functions, Weitek provides a software library that it claims is faster than on-chip operations. The Cyrix EMC87 appears in the same memory-mapped region as the Abacus chips, and I discovered that you can force Run386 to build the selector as though an Abacus chip were present. So, a few modifications to the Abacus benchmark

**T**he FPU benchmarks produced some clear leaders in each category.

yielded an EMC87 version of Fmath.

I also ran the LINPACK, a popular floating-point benchmark written in FORTRAN. I chose Lahey F77L FORTRAN as the compiler, since it is available in a 32-bit version bundled with Eclipse Systems' OS/386 DOS extender. I ran both single-precision and, for the 386 and 486 systems, double-precision versions of the LINPACK. The double-precision LINPACK is so large that it can only run in 32-bit mode. Hence, I could run only the single-precision version on the 286 machines. The results of all the tests are shown in the figure.

If your applications consist primarily of spreadsheets and bookkeeping calcu-

lations, the Fmath results should give you a good picture of the chips' rankings. Fmath tests the fundamental operations: addition, subtraction, multiplication, and division. If your work involves scientific or engineering calculations, or if you're a 3-D CAD user, the Fourier test is a good indicator of coprocessor performance in the more esoteric areas of transcendental calculations. The results of the LINPACK test provide an overall measurement of the coprocessors' floating-point throughput.

**FPU Finalists**

The FPU benchmarks produced some clear leaders in each category. Weitek's Abacus 4167 proved an able companion for the Deskpro 486/25, outperforming the i486's integrated FPU on all but the double LINPACK test. One possible explanation: The 4167 must perform two doubleword moves to load its chip registers with double-precision values. By contrast, the i486 requires only a single instruction. With a list price of \$995, the Abacus 4167 isn't cheap, but it's your only choice if you need to enhance your 486's math performance.



714 855-0411 FAX 714/855-8504

ALR • APPLE • AST • AT&T • COMPAQ • DELL • EVEREX • HP • IBM • NEC • SUN • TOSH

ESTABLISHED 1985  
VISA MASTERCARD SAME DAY SHIPPING

LOW, LOW PRICES  
CORPORATE & SCHOOL P.O.S. WELCOME OAC

# DYNAMIC ELECTRONICS

<p><b>SIMM AND SIPP MODULES</b></p> <p>256 x 9-10 \$19.50              1 MEG x 8-10 (MAC) \$55.00              1 MEG x 9-10 \$60.00              1 MEG x 9-80 \$63.00</p> <p><b>ORCHID BOARDS (FOR ALL PS/2'S)</b></p> <p>RAMQUEST EXTRA 16/32 2 MEG \$519.00</p> <p><b>NEW</b> PRODESIGNERII W/1 MEG <b>NEW</b> \$345.00</p> <p><b>INTEL MATH COPROCESSORS</b></p> <p>8087 -1, 2              80287 -6, 8, 10 <b>NEW</b> 80287XL              80387 -16, 20, 25, 33 80287XL              80387-SX</p> <p><b>BOCA RESEARCH</b></p> <p>BOCARAM/AT PLUS              2 MEG \$345.00              4 MEG \$425.00</p> <p>BOCARAM/AT              512 \$189.00              2 MEG \$329.00</p> <p>BOCARAM/AT 10 PLUS              2 MEG \$370.00              4 MEG \$470.00</p>	<p><b>IBM PS/2 MODEL 70 &amp; 80</b></p> <p>6450603 1 MEG-80NS \$99.00              6450604 2 MEG/70-E61, 121 \$199.00              6450608 2 MEG/70-A21 \$199.00              6450379 2 MEG/80-111, 311 \$279.00              30F2933 4 MEG \$875.00</p> <p><b>COMPAQ MEMORY</b></p> <p>1 MEG ADD-ON MODULE \$129.00              DESKPRO 386/20, 25              4 MEG ADD-ON MODULE \$349.00              DESKPRO 386/20, 20E, 25</p> <p><b>H.P. LASER JET UPGRADES</b></p> <p><b>II &amp; IID</b></p> <p>1 MEG \$104.00              2 MEG \$169.00              4 MEG \$309.00</p> <p><b>LAPTOP MEMORY</b></p> <p>5 12K FOR TOSHIBA T3100E \$149.00              2 MG FOR TOSHIBA T1600 \$279.00              2 MG FOR TOSHIBA T3100E \$279.00              2 MG FOR TOSHIBA T3100SX \$279.00              2 MG FOR TOSHIBA T3200SX \$279.00              2 MG FOR TOSHIBA T5100 \$279.00              2 MG FOR TOSHIBA 15200 \$279.00              3 MG FOR TOSHIBA T3200 \$479.00</p>	<p><b>IIP &amp; III</b></p> <p>1 MEG \$119.00              2 MEG \$189.00              4 MEG \$329.00</p>
---	--	---

714 855-0411
DYNAMIC ELECTRONICS, INC.
FAX 714 855-8504

Distributing Computer Upgrades Worldwide  
PRICES SUBJECT TO CHANGE

# "SPEED TO BURN"

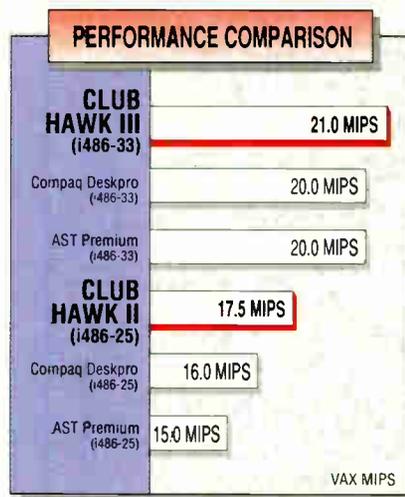
## CLUB HAWK 486 SERIES



The time of DOS mainframe has arrived! Running at a blazing speed of 21 VAX MIPS, CLUB's award winning HAWK family, based on Intel's i486 CPU, achieve the mainframe horse-power that out-performs any RISC or SPARC based systems in their class.

With such extraordinary value, price/performance, and compatibility, the HAWK line of systems break through new benchmark barriers in UNIX/XENIX, DOS, and Novell environments. Combine this with our family of 386 based computers and peripherals, you receive the widest selection of systems from a single major world class manufacturer.

It's no wonder that hundreds of thousands of these systems have



been installed in corporations world wide. That's why CLUB's systems are called the Ultimate Business Computers. Put yourself on the fast track and call today for more information.

*"CLUB AT prides itself on being an authorized Novell reseller, making the tower model a good choice for LAN server applications. ... [ CLUB ] combines field-leading performance, solid construction, and knowledgeable technical support at an exceptionally low price." PC Magazine, February, 1990*

*"When it comes to the basics - price, performance, and ... capacity - [ CLUB ] delivers outrageous value."*

*PC World, Best Buy Award 1989*

**For more information call:**  
 Continental USA, Hawaii, and Alaska:  
**(415) 683-6600**  
 Fax: (415) 490-2687  
 CLUB Canada, Toronto: (416) 609-8121  
 International Sales: (415) 683-6623  
 Call for Corporate and Educational Discounts  
 GSA # GS00K90AG55260

# CLUB

American Technologies, Inc.

The Ultimate Business Computers

Ad 9 v 1/9-90

The above mentioned brands and names are trademarks of their respective companies.

Circle 70 on Reader Service Card  
 World Radio History



# Scalable fonts in a cartridge. No longer just a dream.



Imagine how your documents would look if you could substitute ordinary printer fonts with typeset style fonts. Instead of Times®, you could use distinctive CG Palacio®. Or add flair with Letraset® Revue™. Imagine choosing from up to 51 different fonts, including CG Bodoni®, CG Palacio, Shannon™, Revue and ITC Bookman®, that can be scaled to any size, in quarter point increments from 0.25 to 999.75.

You've dreamed about such things for your Hewlett-Packard LaserJet™ III. Pacific Outlines® make the dream real.

These easy-to-use cartridges eliminate the need for soft fonts, accelerating your work and saving disk space. Pacific Outlines offer quality scalable type from Agfa/Compugraphic, and ready-to-use software drivers for several major software applications.

Offered at a price that won't cause nightmares. To learn more, call or write: Pacific Data Products, 9125 Rehco Rd., San Diego, CA 92121, (619) 552-0880. FAX: (619) 552-0889.



**PACIFIC**  
DATA PRODUCTS

© 1990 Pacific Data Products, Inc. Made in the U.S.A. Pacific Outlines is a trademark of Pacific Data Products, Inc. LaserJet is a registered trademark of Hewlett-Packard Company. Scalable type outlines are licensed from Agfa Corporation, Agfa Compugraphic Division. CG Bodoni and CG Palacio are registered trademarks and Shannon is a trademark of Agfa Corporation. Letraset is a registered trademark and Revue is a trademark of Esselte Pendaflex Corporation. ITC Bookman is a registered trademark of International Typeface Corporation. All other company and product names are trademarks of the company or manufacturer respectively.



See us at Booth #W818  
**COMDEX/Fall '90**  
November 12-16, 1990  
Las Vegas, Nevada

Circle 272 on Reader Service Card (RESELLERS: 273)



# Buy our IBM-compatible color printer and get this Mac-compatible color printer free.

The new Phaser PX Color Printer from Tektronix.  
Only \$7995

The price is as much of a breakthrough as anything else. The Phaser PX offers PostScript-language compatibility and 300 dpi thermal-wax color that's brighter and bolder than that of pricey competitors. And not only can you hook it up to an office full of PCs via serial or parallel, but it will also accommodate any

Macs that might come along. Automatically switching from port to port to keep everybody happy.

Add to that certified PANTONE\*\* Color that can be printed on paper or transparencies, and you've got a color printer that will do more for less money than ever before.

So call 1-800-835-6100, Dept. 11J to find out how to get your hands on the new Tektronix Phaser PX. Then you can kill two birds with one color printer.

The New **Tektronix Phaser PX**®

\*Pantone, Inc.'s check-standard trademark for color reproduction and color reproduction materials. Copyright © 1990 Tektronix, Inc.



# Buy our Mac-compatible color printer and get this IBM-compatible color printer free.

The new Phaser PX Color Printer from Tektronix.

**Only \$7995**

The price is as much of a breakthrough as anything else. The Phaser PX offers PostScript-language compatibility and 300 dpi thermal-wax color that's brighter and bolder than that of pricey competitors. And not only can you hook it up to an office full of Macs via AppleTalk, but it will also accommodate the PCs and

workstations that might come along. Automatically switching from port to port to keep everybody happy.

Add to that certified PANTONE\*\* Color that can be printed on paper or transparencies, and you've got a color printer that will do more for less money than ever before.

So call 1-800-835-6100, Dept. 11J to find out how to get your hands on the new Tektronix Phaser PX. Then you can kill two birds with one color printer.

**The New Tektronix Phaser PX®**

All rights reserved. Phaser is a trademark of Tektronix, Inc. All other trademarks mentioned herein belong to other companies.

**Circle 393 on Reader Service Card (RESELLERS: 394)**

World Radio History

Same Day  
Shipping!

# ALTEC TOWERS ABOVE THE REST

Now you can have the power and performance of Altec's fully loaded 486 EISA Tower delivered to your door! Check out these outstanding features:

## 486 EISA TOWER **CALL** for more information

Intel 486-25 CPU □ 4 Meg RAM □ 1.2 MB 5.25" drive □ 1.44 MB 3.5" drive □ 150 MB 18ms ESDI hard drive □ ESDI controller w/32K cache □ 16-bit VGA card □ 14" VGA monitor (1024 x 768) □ 2 serial, 1 parallel & 1 game ports □ 101-key Keyboard □ Genius Mouse □ MS-DOS 3.3 or 4.01 □ Eight 32-bits EISA slots



"AltecZip 386s are solid machines featuring brand-name parts. A good buy, they are clearly affordable"

PC Magazine, May 30, 1989

"Computer users should find Altec machine an excellent value with good performance."

PC Magazine, July 1990

Altec sets the standard for the highest quality design and manufacturing of all our products. We're fast, friendly, and ready to help you select the right features for your needs. Take a look at some of our other great systems:

### 386/33 VGA **\$3,595**

Intel 386-33 CPU □ 32K Cache □ 4 Meg RAM □ 1.2 MB 5.25" drive □ 1.44 MB 3.5" drive □ 150 MB 18ms ESDI hard drive □ ESDI controller w/32K cache □ 16-bit VGA card □ 14" VGA monitor (1024 x 768) □ 2 serial, 1 parallel & 1 game ports □ 101-key Keyboard □ Genius Mouse □ MS-DOS 3.3 or 4.01

(25 Mhz Cache System deduct \$400)

### 386/25 VGA **\$2,795**

Intel 386-25 CPU □ 4 Meg RAM □ 1.2 MB 5.25" drive □ 1.44 MB 3.5" drive □ 105 MB 18ms IDE hard drive □ 16-bit VGA card □ 14" VGA monitor (1024 x 768) □ 2 serial, 1 parallel & 1 game ports □ 101-key Keyboard □ Genius Mouse □ MS-DOS 3.3 or 4.01

### 386/SX VGA **\$1,895**

Intel 386SX-16 CPU □ 2 Meg RAM □ 1.2 MB 5.25" drive □ 1.44 MB 3.5" drive □ 66 MB 25ms hard drive □ 16-bit VGA card □ 14" VGA monitor (640 x 480) □ 2 serial, 1 parallel & 1 game ports □ 101-key Keyboard □ Genius Mouse □ MS-DOS 3.3 or 4.01

(20 Mhz 386/SX version add \$150)

### 286/12/66 MB VGA COMBO **\$1,795**

1 Meg RAM □ 1.2 MB 5.25" drive □ 1.44 MB 3.5" drive □ 66 MB hard drive □ 16-bit VGA card □ 14" VGA monitor (640 x 480) □ 2 serial, 1 parallel & 1 game ports □ 101-key Keyboard □ Genius Mouse □ MS DOS 3.3 or 4.01 □ Panasonic 1180 printer w/cable □ Surge Protector

### 286/12 VGA STAR **\$1,295 NEW**

□ 1 Meg RAM □ 1.2 M or 1.44 M drive □ 40 MB hard drive □ 16-bit VGA card □ 14" VGA monitor (640 x 480, .41 mm) □ 2 serial/1 parallel & 1 game ports □ 101-key Keyboard □ MS-DOS 3.3

Various hard drive capacity available.



Technology Corp.

1-800-255-9971

#### Altec's Guarantee:

- 30 day money-back guarantee
- 1 year warranty for parts and labor
- Free 4 months on-site service
- Lifetime toll-free technical support



Policy: Same day shipping with standard configurations for orders before 3 PM EST. Shipping and handling extra. Personal and company checks require 10 days to clear. Prices are subject to change, and all items are subject to availability. All returns must be shipped prepaid, insured, in original condition and complete with documentation. All returns must have RMA number. 30-day money back guarantee does not include shipping. No surcharge for Visa & MasterCard, 2% for American Express.

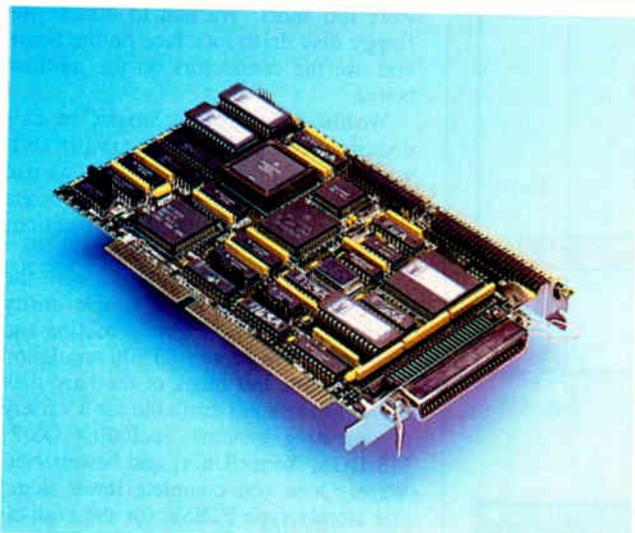
Altec Technology Corporation • 18555 East Gale Avenue • Industry, CA 91748 • 818/912-8688 • FAX: 818/912-804

World Radio History

Circle 19 on Reader Service Card

## REVIEW

# New Controller Makes SCSI Palatable to PCs



*For ATs with large chassis, the SmartConnex/ISA can take the hassle out of SCSI upgrades.*

If you're accustomed to conventional PC interfaces, SCSI is a strange breed. Neither the original PC architecture nor the current version of DOS was designed for SCSI devices. So, before your PC can capitalize on SCSI's speed and flexibility, you may find yourself mixing and matching specialized software drivers, hard disk drive controllers, hard disk drives, and motherboard ROMs.

Distributed Processing Technology's SmartConnex/ISA SCSI controller can bridge this gap between IBM ATs and SCSI (DPT also announced a SmartConnex for Extended Industry Standard Architecture that wasn't shipping commercially in time for this review). The 16-bit SmartConnex/ISA uses the Western Digital WD1003 disk drive controller interface, which makes your computer see the controller as a common ST506 AT-compatible device without your having to install special driver software. The SmartConnex also works with your other drive interfaces. An associate and I installed it and an external hard disk drive in a 386SX with an internal hard disk drive that used a motherboard-based Intelligent Drive Electronics interface, and both drives worked fine.

The SmartConnex also includes internal and external interface connectors, so you can attach SCSI hard disk drives either through a rear panel or from inside the computer. And because the board uses a 10-MHz 68000 CPU, it can outperform some SCSI controllers in read-

and write-throughput speed.

However, problems with the board's design and documentation mean that SCSI installation still isn't headache-free. Nevertheless, if you're a PC user who's interested in adding a SCSI-based high-capacity hard disk drive, the SmartConnex is worth considering.

### Why SCSI?

SCSI's advantages center on speed and flexibility (see "The SCSI Bus," Parts 1 and 2, February and March BYTE). SCSI's speed is due to the fact that it is a parallel interface, not a serial interface like the ST506. SCSI is flexible because it was designed to be more than just a hard disk drive interface. More and more devices—including tape drives—are showing up with SCSI compatibility. And while the serial ST506 limits you to two physical disk drives, SCSI supports up to eight devices—seven peripherals and a controller board.

The major problem for PC users is that MS-DOS doesn't include a generic interface that supports all the devices available with a SCSI connection. That means that when you install a SCSI connection, you usually must also install a software driver that is compatible with both the device you are controlling and the applications you want run. This is still true with the SmartConnex for everything except a hard disk drive, although DPT says that it is developing device drivers for tape and optical disk drives (release dates

### SmartConnex/ISA

#### Company

Distributed Processing Technology  
132 Candace Dr.  
Maitland, FL 32751  
(407) 830-5522

#### Hardware Needed

IBM AT or compatible

#### Software Needed

MS-DOS, OS/2, NetWare 286 or 386,  
SCO Xenix or Unix, or Sytos Plus

#### Price

As tested (with floppy disk drive controller): \$365  
Without floppy disk drive controller: \$330

#### Inquiry 1105.

were not available at press time).

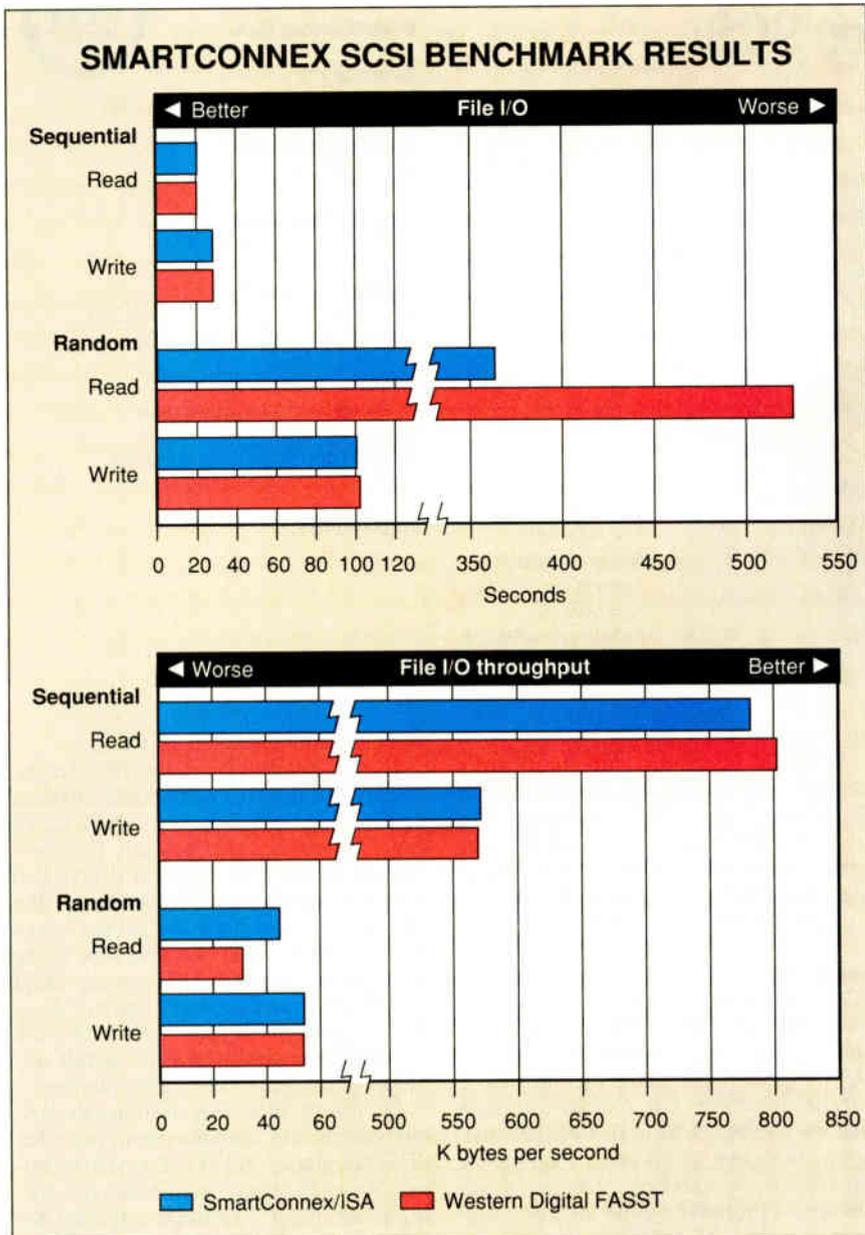
If you want more than two disk drives, you have to install a compatible software driver in your MS-DOS CONFIG.SYS file. The catch is that not only must you depend on DPT to supply a driver that supports your particular hardware, but you also have to hope the driver works with the application that you'll be using with the hardware. If DPT (or any SCSI controller manufacturer) doesn't have drivers for your hardware and software combination, you'll have to install another controller or find another device.

But this problem may diminish as various groups and manufacturers push for SCSI standards. An ANSI CAM (Common Access Method) committee is working to establish a software interface for SCSI that would be installed in a variety of operating systems. If such an interface is successful, hardware vendors would only have to write their interfaces to the common software standard instead of to every operating system and application.

### Tight Squeeze

In addition to having a SCSI connection, the SmartConnex can include an optional floppy disk drive interface that is compatible with 5¼- and 3½-inch devices. The SmartConnex's ST506 compatibility is built in, which means that you can plug the board into the PC bus, hook up the floppy and hard disk drive cables from your standard drives, and go. Actually, a software driver stored on the disk





*Although the SmartConnex/ISA can simplify upgrading to SCSI, its performance was only marginally better than that of the Western Digital controller that shipped with the test 300-MB SCSI hard disk drive.*

and transparent to the user handles ST-506 emulation. A DPT utility controls driver installation and use.

But installing the board can present problems. First of all, it's 4½ inches high, not including the bus connect pins. That was too tall to fit into our CompuAdd 316s slim-line test machine. The internal connectors and the top of the board stuck out beyond the edge of the chassis (we installed the board in this box, and it worked fine with the cover off).

The board also was too tall when we

used the internal interface connectors in our private-label 20-MHz 386 clone with a full-size AT case. If no cables are attached to the internal connectors, the case fits—but just barely. However, with this particular clone, we could not attach the external connector because of the width of the slots in the rear of the case. SCSI uses a large 50-pin, D-shell connector, which requires the maximum slot width. For comfortable use, you'll need an oversize AT-type case for this board.

Yet another problem occurred when

we tried to use the board in an Austin 12-MHz 286 and a CompuAdd 216—small-footprint PCs with internal bus risers that accept boards sideways. In these machines, the cables that connected the SmartConnex to the floppy disk drive were too short. We had to disable the floppy disk drive interface on the board and use the connectors on the motherboard.

We also found that the SmartConnex's documentation and supporting utility software seemed unfinished. In fact, we had considerable difficulty getting the board up and running, because the instructions for using the utilities were not clear.

To install a hard disk drive with the SmartConnex, you run a simple utility that calls a low-level format routine and then stores the proper ST506 emulation driver on the last block of the hard disk drive. Drivers are available for a variety of operating systems, including OS/2, MS-DOS, Xenix/Unix, and Novell NetWare. Once you complete these steps, you simply type FDISK (or the equivalent, depending on your operating system), perform a high-level format, copy the system over, and load your files.

However, when we repeated this process during testing with a Core International Model 310 SCSI hard disk drive, we received numerous drive not ready and no boot device messages. Nothing in the documentation explains these errors. As it turns out, the emulation software that is stored in the final drive block cannot be erased, and the utility software is not smart enough to know what to do when it discovers that the driver software already exists. This was the source of our numerous error messages, according to DPT technical-support personnel. (DPT sent us a utility that will erase the driver software. The company doesn't ship the utility in the basic package on the theory that once you conduct a low-level format and install the driver, you don't need to remove it unless you change controllers.)

The documentation lacked a "quick start" section, forcing you to uncover installation instructions obscurely embedded in page after page of technical discussion. When we put aside the manual and anonymously called the company, technical support proved to be quite good. On one call, we received 20 minutes of support time without complaint.

Aside from poor on-screen instruction and incomplete documentation, we liked the SmartConnex. Although DPT rates the SmartConnex's transfers at only 4 megabytes per second, we found that it operated relatively quickly. It rapidly

# Smaller Computers. Bigger Applications.



## Storage To Match.

The dimensions of computing are changing. Today's lower profile, higher-end 286 and 386 computers are taking up less desktop space and taking on much bigger applications. Matching these new computing dimensions with new dimensions in storage has never been more important. And once again, it is a company called Storage Dimensions that is doing that matching.

We call it *performance matching*, actually. And our new 100, 200 and 320 megabyte internal SpeedStor® subsystems are three solid examples of how we put you well in front of today's 286/386 power curve. Because you get smartly engineered half-high storage

matched not only to the new smaller computer enclosures, but to their larger performance demands. With our proprietary SCSI-based architecture, host bus adaptor and on-board look-ahead caching for added speed. Plus an optional floppy port for cost effective installation and expansion.

Whether you measure your storage needs in square inches, megabytes or milliseconds, you'll find the dimensions you require are the ones we deliver. The ones that have put our products on more desktops than any other storage solution. Call us at (408) 879-0300. Storage Dimensions, 2145 Hamilton Avenue, San Jose, CA 95125.



**STORAGE DIMENSIONS**

See us at Rotunda Booth #4214.  
**COMDEX/Fall '90**  
November 12-16, 1990  
Las Vegas, Nevada

SpeedStor is a registered trademark of Storage Dimensions © 1990 Storage Dimensions

*Call me, I'm interested, circle 324 on Reader Service Card.*

B-SS2

*Please send literature, circle 325 on Reader Service Card.*

# AccSys™ for PARADOX

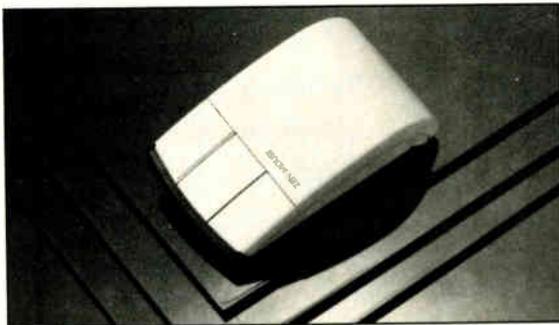
- Set of C libraries for easy access to Paradox data and index files.
- No need to concern yourself with internal files format.
- Increased performance shortens processing time.
- Total control over table files primary and secondary index files.
- Network and single-user versions available.

## Copia International Ltd.

1964 Richton Drive, Wheaton, Illinois 60187  
708/682-8898 FAX: 708/665-9841

Instant info via FaxFacts: 617/740-0025 Press: 1625007#

## THE MOST ADVANCED CORDLESS MOUSE



### THE ZEN MOUSE

Available in cordless and corded models for  
IBM PC's, PS/2's, and compatibles.

- Dynamic Tracking
- 10-1000 dpi
- No Cleaning Required
- Rechargeable
- Compatible with Microsoft™, Logitech™, and MSC Mice
- No Mouse Pad Required
- Compatible with virtually all application software
- Made in USA



**ZENY  
COMPUTER  
SYSTEMS INC.**

4033 Clipper Court  
Fremont, California 94538

Tel 415/659-0386  
Fax 415/659-0468

10% OFF WITH THIS AD

## REVIEW

**O**nce  
you get past the  
installation difficulties,  
the SmartConnex  
performs as promised.

completed long menus and data-file searches. BYTE Lab benchmarks of the board with the Core hard disk drive showed random-read throughput of about 45K bytes per second; random-write throughput came in at around 54K bytes per second (see the figure). For comparison, we ran the same tests using the Western Digital FAST SCSI controller that ships with the drive. We found the Western Digital controller considerably slower on reads and nearly identical on writes: Random-read throughput was approximately 31K bytes per second; random-write throughput was more than 53K bytes per second.

### Guarded Recommendation

Once you get past the installation difficulties, the SmartConnex performs as promised: It's somewhat faster than the interface that comes with the drive we tested, and the board's ST506 drive emulation makes for what should be an easy installation. We also liked the internal and external connections and the optional built-in floppy disk drive controller that lets you replace your existing controller, if that's what you need.

However, we are concerned that the board did not fit easily into four of our test machines, and the lack of easy-to-understand documentation and on-screen prompts made the installation much more difficult than it should be.

If you want to enhance your PC with SCSI, the SmartConnex can simplify the installation. Just make sure your computer's case is large enough to hold the board and that you have DPT's technical-support number in your telephone's auto-dialer. ■

*Corey Sandler is president of Word Association, a consortium of high-technology writers and consultants headquartered in Nantucket, Massachusetts. He can be reached on BIX c/o "editors." He worked with Word Association technical editor Tom Badgett in testing the DPT board.*

# Power Computing For The 90's?



**PC**  
MAGAZINE  
EDITORS'  
CHOICE  
SEPTEMBER 11, 1990  
NORTHGATE ELEGANCE  
486/25

ISA

DRAM

Circle 258 on Reader Service Card

# Only Northgate™ Makes Sense Of It All!



**D**on't be puzzled about computing for the 90's... call the company who speaks your language: Northgate. We're your problem-solving partners. We listen to your needs, analyze options, then recommend solutions.

We use a "modular systems" approach that allows us to custom configure your system to meet your current and future needs.

**Now, let's shatter a few myths...**

**Northgate is a true manufacturer of computing systems ... not an**

assembler. Our R&D Department works day in and day out, developing new technologies to keep Northgate on the cutting edge of high performance computing.

**We design and manufacture our own motherboards in the U.S.A. If you hear otherwise, hang up ... you deserve the truth!**

**A word about price.** Northgate is the performance/price leader in systems for home and office. No, Northgate computers aren't the cheapest. Why? Because we don't take shortcuts in technology to get performance gains and hold prices down. Some companies cut corners

to get speed improvements. Shadow RAM is one such technique.

Shadow RAM sets aside room in RAM for temporary storage of system and video I/O instructions normally stored in system ROM. By running these routines in RAM, instructions can be executed at the micro-processor's fastest speed.

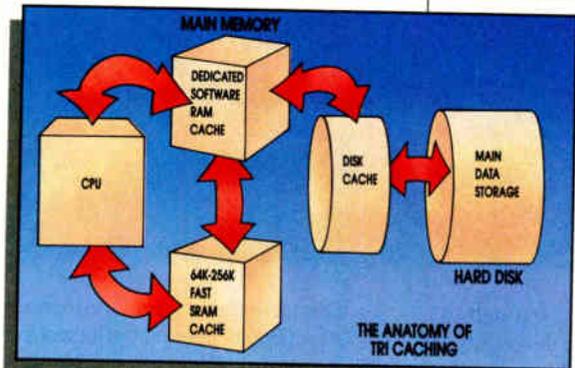
However, this RAM is best used for extended memory needs like disk caching, RAM disk, and spoolers. When Shadow RAM eats up this space, you can experience software compatibility and operating problems. You'll never experience shortcut-related problems with a Northgate system. Call toll-free 800-548-1993.

# Northgate™ Brings It All Together And Puts Power For The 90's In Your Hands!

**N**orthgate exemplifies power! IBM! Compaq! Dell! All the others! The unquestioned industry leader is Northgate! Why? Only Northgate solves the puzzle! Nowhere else can you get the blistering combination of triple caching power ... industry's fastest components and peripherals ... performance boosting software ... power services and technical support ... all for incredible factory-direct prices!

## Tri-Caching technology breaks performance barriers!

**Caching guarantees power computing into the 90's!** Northgate uses three types of caching technology to extend total system performance. Each system has a minimum of 64K SRAM memory cache, 32K-64K cache hard disk controllers and caching software—all for enhanced performance and speed.



**SRAM Memory Cache!** Northgate uses high-speed 64K-256K static SRAM cache to buffer frequently requested data from slower memory storage areas. RAM cache reduces the main processor's idle time (wait stage) while data is transferred to and from main memory. Our external 486 SRAM cache operates in true burst mode for 33Mb/second execution of instructions. Boosts the hit rate for data finding to 99%!

**Hard Disk Caching Controllers!** Disk caching improves performance by relieving the bottle neck caused by hard drives. When reading and writing to hard disk, the information passes through a RAM cache buffer. This buffer retains data after it has been sent to its destination. If the same data is needed again, it is drawn from the cache

instead of the disk. Result? Accelerated I/O transactions!

**Caching Software!** Northgate uses disk caching software for enhanced performance. Here's how it works. During a session the software "learns" to anticipate what data you'll need next and brings it into the cache for quick retrieval.

## Industry's most powerful components and peripherals!

System speed is not based on the CPU alone. Hard drives, floppy drives, video cards and other peripherals all play a part in enhancing overall performance. One slow element slows the whole system down. Northgate solves this problem by using the latest in AT interface technology to maximize system performance.

**Hard disks made just for Northgate customers—fastest in the world!** For Northgate (and you!) only the fastest hard drives will do. Our complete selection of hard drives—featuring our exclusive Maxtor 200Mb—use AT technology with disk caching controllers for fast, efficient throughput.

**Fastest video combinations on the market—screens appear almost before you release "Enter"!** Northgate's 16-bit Super VGA lets you zip through desktop publishing, windowing and other bit-mapped graphics operations. Select from our broad range of high performance monitors and video cards to meet the most demanding design and engineering applications!

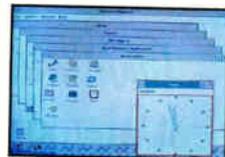
## Now ... performance software unleashes the power of your Northgate!

To make the most of our awesome power, we're including FREE performance software with our Elegance™ 386™ and 486™ Power User's systems. This \$1139.00 suggested retail value includes Microsoft® Windows™ 3.0, Samna® Ami™ Professional word

processing and Informix® Wingz™ graphics spreadsheet.

## Microsoft® Windows™ 3.0!

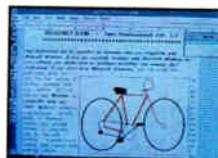
You've heard about the point-and-click ease of Apple computing. Now Windows brings it to the DOS world!



Windows speeds through even the most demanding 32-bit software ... makes program operation and multi-tasking a breeze!

## AmiPro™—word processing and desktop publishing

**in one!**



You get sophisticated word processing features including 130,000 word

spell check, dictionary, thesaurus, search and replace, editable page views, multiple fonts, integrated graphics and more! And you get the look and feel of expensive desktop publishing packages!

## Wingz™—powerful graphics spreadsheet and database program!

**Wingz for Windows 3.0**

is the first spreadsheet program that lets you take full



advantage of today's powerful windows/graphics based environments. You get unsurpassed number-crunching power and page perfect presentations.

FOR MORE INFORMATION, CALL TOLL-FREE 24 HOURS EVERY DAY

**800-548-1993**

Notice to the Hearing Impaired: Northgate has TDD capability. Dial 800-535-0602.



7075 Flying Cloud Drive, Eden Prairie, MN 55344

New Northgate Elegance 486i™ System...

“Editors’ Choice” said *PC Magazine!*\*

(Adding: “Northgate stops at nothing to please its customers...97% would buy again!”\*\*)

*InfoWorld* labs scored it 9.1—top rating ever!†

Incredible power and unmatched performance at a price you’d expect to pay for a 386™!

**\$5895<sup>00</sup>**

Delivered to Your Home or Office

Whether 80286, 386 or 486 technology, Northgate consistently brings you top rated systems. Our value and performance is unexcelled when you look at the experts’ opinions. Northgate is a company in which you can place your trust — perhaps our most important advantage!

In January, 1988, Northgate won its first Editors’ Choice for the 286/12 SuperMicro. Northgate leadership prevailed again when *PC Magazine* benched 386 systems. One couldn’t do better. Three Editors’ Choice — one for each speed in our Elegance line of 20, 25 and 33MHz systems. Northgate is the only company who can make this claim!

*PC Magazine* then called for 486 ISA systems for review. Result: there was no question about it. “Only one machine stands out,” they said, “you could pay less for a 486 system, but not get the bonuses that are offered with the Elegance.”\*\*

Along the way, we added another Editors’ Choice of our *OmniKey*® keyboard. There you have it ...

A record five Editors’ Choice Awards in one year’s time!



About the same time, the tough testers at *InfoWorld* were thoroughly and methodically examining Elegance 486i. They reported you could buy the next highest ranked system (scoring 8.2 vs. our 9.1) but you’d also pay three times as much!†

*InfoWorld*’s editors concluded that Northgate’s 486i “leads the pack by a comfortable margin. It offers impressive performance, exceptional expandability and it is tops in support and value.”†

A subsequent issue of *InfoWorld* (July 30, 1990) showed Elegance 486i leading the pack again as a network file server and stand-alone system as well.

And, as if we had planned it, *PC Magazine* came along with its Service and Reliability issue in which Northgate’s dedication to

customer support was well evidenced. “As we learned more about its service policies, it became clear that Northgate stops at nothing to please its customers.” No wonder “Northgate was the hands-down winner when it came to customer loyalty.”\*\*

That’s the story. Designed and built to perform. Proven by the industry’s most demanding testing. Fairly priced. And backed by people with a passion to serve you with a support policy that inspired one magazine columnist to say:

“What WordPerfect is to software support, Northgate is to hardware and there are even a few things that WordPerfect could learn from the folks in Minneapolis. Northgate is fast becoming the Nordstrom of the computer world.”††



# Complete with the Spectacular 200MB Maxtor "Power Max" Super-fast hard drive! (Maximized performance exclusively for Northgate and you!)

The secret to Northgate's state-of-the-art power! The 486 processor combines the capabilities of an enhanced 386, an advanced internal cache controller and 8K of supporting static cache memory. The chip also incorporates an enhanced 387 FPU (Floating Point Unit). You get increased performance for the most demanding math-based applications.

Northgate caching enhancements give you greater speed! We've added a 64K read write-back SRAM cache (expandable to a Northgate exclusive

256K) to further accelerate the execution of instructions. I/O transactions are faster than ever thanks to a 32K hard drive cache controller. Finally, we armed Elegance 486/25 with Smartdrive DOS disk caching software. Result? Processing speed you must see to believe!

Elegance 486i ISA is the perfect high performance graphics/software workstation or network server. Its multi-stage caching is an excellent match for tough number-crunching operations.

Look at everything you get! Elegance 486i comes with 4Mb of RAM, a

200Mb Maxtor hard disk with 15ms access, 1.2Mb 5.25" and 1.44Mb 3.5" floppies, desktop case, 14" monochrome monitor, exclusive *OmniKey* keyboard and Microsoft® Windows™ 3.0.

Or select our Power System with seven bay tower case, 14" SVGA color monitor with 1024 x 768 resolution, 16-bit SVGA adapter with 512K video memory, and 220 watt power supply. PLUS! Microsoft Windows 3.0, Samna® Ami™ Professional word processing software and Wingz™ graphics spreadsheet and database software. A \$1139.00 value software is yours at NO EXTRA CHARGE!

Support power! Your Elegance 486i ISA is backed by expert toll-free technical support 24 hours a day, seven days a week. PLUS, free on-site next day service to most locations if we can't solve your problems over the phone AND a 1 year parts and labor warranty (5 years on *OmniKey* keyboard).

Use Elegance 486i ISA RISK FREE for 30 days! If it fails to meet your expectations, return it for a full refund ... no questions asked!

ORDER TODAY! Call toll-free 24 hours every day.

Complete Elegance 486i System

**\$5895<sup>00</sup>**

ONLY Power User's System Just \$6495<sup>00</sup>

Delivered to your home or office

EASY FINANCING: Easy payment options. Use your Northgate Big 'N', VISA, MasterCard ... or lease it. Up to five-year terms available.

CALL TOLL-FREE 24 HOURS EVERY DAY

**800-548-1993**

Fax your order. (612) 943-8338

Notice to the Hearing Impaired: Northgate has TDD capability. Dial 800-535-0602.

 NORTHGATE COMPUTER SYSTEMS "We hear you!"  
7075 Flying Cloud Drive, Eden Prairie, MN 55344

## Elegance 486i ISA System Features

- ◆ 25MHz Intel® 80486 processor
- ◆ 4Mb of 32-bit RAM (expandable to 8Mb on motherboard; total system RAM of 16Mb with optional 32-bit memory card)
- ◆ Proprietary, U.S.-made motherboard
- ◆ 200Mb Maxtor hard drive with 15ms access; 16-bit controller with 1:1 interleave; 32K disk read-look-ahead cache buffer
- ◆ 64K SRAM memory cache; read/write-back caching
- ◆ High density 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives; also read/write low density disks
- ◆ Eight expansion slots; one 32-bit slot; six 16-bit and one 8-bit slot
- ◆ Weitek math coprocessor support
- ◆ One parallel and two serial ports
- ◆ High-resolution monochrome monitor
- ◆ Clock/calendar chip rated at 5 years
- ◆ 200 watt power supply (220 watt power supply in tower case)
- ◆ Desktop case with room for 3 exposed and 2 internal half-height devices
- ◆ Front mounted reset and high/low speed controls
- ◆ Exclusive Northgate *OmniKey*/ULTRA keyboard
- ◆ MS-DOS 4.01 and GW-BASIC software installed
- ◆ On-line User's Guide to the system and MS-DOS 4.01
- ◆ QA Plus Diagnostic and Utility software
- ◆ Microsoft Windows 3.0 and mouse
- ◆ 1 year warranty on system parts and labor; 5 years on keyboard
- ◆ Unlimited 24-hour toll-free technical support
- ◆ Free on-site service for one year
- ◆ FCC Class B Certified

Select the options you need... let Northgate custom build them into your system today!

- ◆ Hard drives up to 1.2 Gigabytes
- ◆ Laser quality and dot matrix printers
- ◆ Tape back up devices
- ◆ SVGA color monitors and cards
- ◆ Floppy, CD ROM and optical drives
- ◆ Weitek coprocessors
- ◆ Modems

©Copyright Northgate Computer Systems, Inc. 1990. All rights reserved. Northgate, *OmniKey* and the Northgate 'N' logo are registered trademarks of Northgate Computer Systems. 80386 and 80486 are trademarks of Intel. All other products and brand names are trademarks and registered trademarks of their respective companies. Prices and specifications subject to change without notice. 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.  
\*PC Magazine, September 11, 1990 \*\*PC Magazine, September 25, 1990  
HighWorld, July 30, 1990 †Computer Currents, August, 1990

# Northgate® Elegance™ 386™/33 System...

“...combines top performance, good components and aggressive pricing... excellent performer all around.”

PC Magazine  
October 31, 1989



**A**ward winning 386 performance! Sizzling Northgate Elegance 386/33 and 386/25 systems both won *PC Magazine* Editor's Choice awards, been rated #1 and #2 products (respectively) in *InfoWorld* AND received *Computer Shopper* "Best Buy" recognitions. No other company can make that claim! Here's how we did it!

Elegance 386's high performance motherboard is designed and manufactured by Northgate. With a 16Mb 32-bit DRAM capacity, it's consistently rated in the top 1% of performance — at 25 and 33MHz, Elegance 386 is the fastest in its class!

Tri-caching started here! Elegance was Northgate's first triple caching

machine. It comes with 64K read write-back SRAM cache to accelerate the execution of instructions. And, as your needs increase you can expand Elegance's SRAM to a Northgate exclusive 256K! A 32K hard drive cache controller accelerates I/O transactions while Smartdrive DOS disk caching software increases overall system throughput.

**Z**ip through demanding programs. Multi-stage caching easily handles even a heavy overhead of video programs, I/O intensive tasks, network servers, large data bases and advanced desktop publishing programs.

**Desktop or tower. . . your choice!** Elegance 386 comes standard in our elegant five bay desktop case. Our popular seven bay tower case is also available. Either way, you get plenty of room for all kinds of I/O boards, and internal/external peripherals.

**Start with our base system!** Northgate's base system includes 1Mb of RAM, a 40Mb fast access hard drive, 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives, a 14" high resolution monochrome monitor and our exclusive *OmniKey*®/PLUS keyboard.



Tell us what you need . . . we'll build your system! Performance options include: hard drive options up to 1.2 gigabytes with 15ms access; VGA and SVGA color cards and monitors; Intel and Weitek math coprocessors; CD ROM and optical drives; tape backups; printers and a host of others!

Or select our **Power System** with 4Mb of RAM, a 200Mb Maxtor hard drive with 15ms access, 1.2Mb 5.25" and 1.44Mb 3.5" floppies, a 14" Super VGA color monitor and an *OmniKey* keyboard. Comes complete with Microsoft® Windows™ 3.0, Samna® Ami™ Professional word processing software, Wingz™ graphics spreadsheet and database software and a mouse. This \$1139.00 suggested retail value software is yours at **NO EXTRA CHARGE!**

**Industry's finest 24-hour toll-free technical support!** Your Elegance 386 is backed by expert technical support any time you need it. Call toll-free, 7 days a week, 24 hours a day. **PLUS**, free on-site next day service to most locations if we can't solve your problems over the phone.

Elegance 386 is backed by a one year warranty on parts and labor; five years on the *OmniKey* keyboard. If a part fails, we'll ship a replacement to you overnight at our expense — before you return your part!

**Use Elegance 386 25 or 33MHz RISK FREE for 30 days!** If it fails to meet your expectations, return it. No questions asked.

**ORDER TODAY!** Call toll-free 24 hours every day.

**25MHz Base System Model**

**\$2999<sup>00</sup>**

Power User's System \$4699<sup>00</sup>

**33MHz Base System Model**

**\$3499<sup>00</sup>**

Power User's System \$5199<sup>00</sup>

Delivered to your home or office

**EASY FINANCING:** Easy payment options. Use your Northgate Big 'N', VISA, MasterCard . . . or lease it. Up to five-year terms available.

**CALL TOLL-FREE 24 HOURS EVERY DAY**

**800-548-1993**

Fax your order. (612) 943-8338

Notice to the Hearing Impaired: Northgate has TDD capability. Dial 800-535-0602.

 **NORTHGATE COMPUTER SYSTEMS** *"We hear you!"*

7075 Flying Cloud Drive, Eden Prairie, MN 55344

## Elegance 386 Base System Features:

- 25 or 33MHz Intel® 80386DX processor
- 1Mb of 32-bit RAM (expandable to 8Mb on motherboard; total system RAM of 16Mb with optional 32-bit memory card)
- Proprietary, U.S.-made motherboard
- 40Mb fast access hard drive; 16-bit controller with 1:1 interleave; 32K disk read-look-ahead cache buffer
- 64K SRAM memory cache; read/write-back caching
- High density 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives; also read/write low density disks
- Eight expansion slots; one 32-bit slot; six 16-bit and one 8-bit slot
- Weitek math coprocessor support
- One parallel and two serial ports
- Hercules compatible video adapter
- Clock/calendar chip rated at 5 years
- 200 watt power supply (220 watt power supply in tower case)
- Optional seven bay upright Tower case; room for three exposed and four internal half-height devices or desktop case with room for three exposed and 2 internal half-height devices
- Front mounted reset and high/low speed controls
- Exclusive Northgate *OmniKey*/ULTRA keyboard
- 14" high resolution monochrome monitor
- MS-DOS 4.01 and GW-BASIC software installed
- On-line User's Guide to the system and MS-DOS 4.01
- QA Plus Diagnostic and Utility software
- 1 year warranty on system parts and labor; 5 years on keyboard
- FCC Class B Certified

© Copyright Northgate Computer Systems, Inc. 1990. All rights reserved. Northgate, *OmniKey* and the Northgate 'N' logo are registered trademarks of Northgate Computer Systems. 80386 and 80486 are trademarks of Intel. All other products and brand names are trademarks and registered trademarks of their respective companies. Prices and specifications subject to change without notice. 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-PIR8.

Northgate® Announces ...

# SlimLine™ 386/25-



**F**irst time ever! Now you can have Northgate Elegance™ power, speed and performance in our popular space-saving SlimLine case! Elegance 386 computers shocked the industry with a #1 and #2 sweep of *Infoworld's* 1989 best product awards; AND three Editors' Choice awards from *PC Magazine*.

**Cache! Cache! Cache!** Like our powerful Elegance systems, SlimLine 386 features 64K SRAM cache to zip through the execution of instructions. For even faster speed, we've added a hard drive

cache to make quick work of I/O transactions. To top it off, SlimLine 386 comes with Smartdrive DOS disk caching software that anticipates the information you'll need next and brings it into the cache for fast access.

**Better features across the board!** SlimLine's motherboard is highly integrated, allowing maximum system features in the smallest possible space. It includes space for up to 8Mb of 32-bit RAM, one parallel and two serial ports, fully integrated floppy disk controller and IDE hard drive

controller. Plus an integrated SVGA with 512K Video RAM to speed up bus throughput — makes the system faster and more reliable! And there is still room for expansion with five open slots.

**Three speeds!** SlimLine 386 comes with your choice of 386DX 25 or 33MHz processors. For faster math-based applications — budgets, forecasts, spreadsheets and databases — all models feature 80387 coprocessor support to allow you to easily add floating point unit (FPU) performance.

# 33 Cache Systems!

**A**ll purpose systems! SlimLine Cache is the perfect network workstation or stand-alone unit for business and home use. It provides excellent support for advanced desktop publishing and graphics.

Base system includes 1Mb of RAM (expandable to 8Mb on the motherboard), a 40Mb fast access hard drive, 1.2Mb 5.25" and 1.44 3.5" floppy drives, a 12" VGA monochrome monitor and our exclusive *OmniKey*®/PLUS keyboard.

**You name it, we'll build it!** Performance options include hard drives up to our super-fast 15ms 200Mb Maxtor hard drive, monitors and video display cards, math coprocessors, tape backups, printers and a host of other choices.

Or select our **Power System** with 4Mb of RAM, a 200Mb fast access hard drive, 1.2Mb 5.25" and 1.44Mb 3.5" floppies, a 14" Super VGA color monitor and an *OmniKey* keyboard. Comes complete with Microsoft® Windows™ 3.0, Samna® Ami™ Professional word processing software, Informix® Wingz™ graphics spreadsheet and database software and a mouse to maximize system performance. This \$1139.00 suggested retail value software is yours at **NO EXTRA CHARGE!**

**Industry's finest 24-hour toll-free technical support!** Your SlimLine 386 Cache is backed by expert technical support any time you need it. Call toll-free, 7 days

a week, 24 hours a day. PLUS, free on-site next day service to most locations if we can't solve your problems over the phone.

## Slimline 386 Base System Features:

- 25 or 33MHz Intel® 80386DX processor
- 1Mb of 32-bit DRAM (expandable to 8Mb on motherboard)
- Down-scaled, proprietary, U.S.-made motherboard
- 40Mb fast access hard drive; AT bus interface; 1:1 interleave; 32K or 64K look ahead disk caching
- 64K SRAM memory cache; read/write-back caching
- High density 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives; also read/write low density disks
- Five open expansion slots; three full length 16-bit and 2 half length 8-bit
- 25 or 33MHz 80387 or Weitek coprocessor support
- One parallel and two serial ports
- Built-in 16-bit SVGA with up to 1024 x 768 resolution; 512K video memory
- Clock / calendar chip rated at 5 years
- 100 watt power supply
- Small footprint SlimLine case with room for two exposed and 1 internal half-height devices
- Front mounted reset and high / low speed controls
- Exclusive Northgate *OmniKey* / PLUS keyboard
- 12" VGA monochrome monitor
- MS-DOS 4.01 and GW-BASIC software installed
- On-line User's Guide to the system and MS-DOS 4.01
- QA Plus diagnostic and utility software
- Smartdrive caching software
- 1 year warranty on system parts and labor; 5 years on keyboard
- FCC Class B Certified

**More great support!** Your new SlimLine 386 Cache comes with a one year warranty on parts and labor; five years on the *OmniKey* keyboard. If a part fails, we'll ship a replacement to you overnight at our expense — before you return your part!

Use SlimLine 386 Cache **RISK FREE for 30 days!** If it fails to meet your expectations, return it. No questions asked!

**ORDER TODAY!** Call toll-free 24 hours every day.

25MHz Base System Model

**\$2999<sup>00</sup>**

Power User's System \$4499<sup>00</sup>

33MHz Base System Model

**\$3499<sup>00</sup>**

Power User's System \$4999<sup>00</sup>

Delivered to your home or office

**EASY FINANCING:** Easy payment options. Use your Northgate Big 'N', VISA, MasterCard... or lease it. Up to five-year terms available.

**CALL TOLL-FREE 24 HOURS EVERY DAY**

**800-548-1993**

Fax your order. (612) 943-8338

Notice to the Hearing Impaired: Northgate has TDD capability. Dial 800-535-0602.

 **NORTHGATE  
COMPUTER  
SYSTEMS** *"We hear you!"*

7075 Flying Cloud Drive, Eden Prairie, MN 55344

© Copyright Northgate Computer Systems, Inc. 1990. All rights reserved. Northgate, *OmniKey* and the Northgate 'N' logo are registered trademarks of Northgate Computer Systems. 80386 and 80486 are trademarks of Intel. All other products and brand names are trademarks and registered trademarks of their respective companies. Prices and specifications subject to change without notice. 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-PIR8.

# New From Northgate... 20 MHz Powered Up



Buy now...  
no payments  
for 90 days!  
When charged to  
your Big 'N' card.  
See credit offer  
for details.

**Y**es, we're a bit late to the party with SX systems. How come? We just couldn't bring ourselves to market another ho-hum SX.

So we put our research and development team on it. Boy, did they rise to the challenge! Now you can get an SX 16 or 20 MHz machine with the power to run Microsoft® Windows™ and other 32-bit software at flashing cache-enhanced speeds. And, they packaged all this power and performance into our

exclusive space-saving case — a favorite of Northgate customers!

**The secret to SlimLine's space-saving design?** A fully integrated motherboard designed and manufactured by Northgate! This design reduces bus load — makes the system faster and more reliable!

Motherboard features include a built-in VGA adapter (with 512K Video RAM), parallel and two serial ports, fully integrated floppy disk

controller and IDE hard drive controller. Motherboard integration also makes it easier to install modems or add-in cards.

**Triple cache boosts performance to zero wait state!** You get a built-in 64K memory SRAM cache to accelerate the execution of instructions; hard drive caching accelerates I/O transactions; and disk caching software speeds the movement of data to and from the CPU.

# SlimLine™ 386SX 16 Or With 64K Cache!

**S**limLine 386SX is perfect for office environments and home use. It handles word processing, spreadsheet, database management and most graphics applications with ease.

**Slimline 386SX base system includes** 1Mb of RAM (expandable to 8Mb) on the motherboard, a 40Mb fast access hard drive, 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives, and a 12" VGA monochrome monitor. Plus, you get Northgate's award-winning *OmniKey*®/102 keyboard.

**Or, we'll build your system to your specs!** There's room for three half-height devices including floppy drives, hard disk or tape backup. Choose from 80, 100, or our 200Mb hard drive with 15ms access. And, you still have five open expansion slots (3 full-length 16-bit, and 2 half-length 8-bit) for all of your peripherals.

**Exceptional support!** SlimLine 386SX is backed by expert technical support any time you need it. Call toll-free, 7 days a week, 24 hours

a day. **PLUS**, free on-site next day service to most locations if we can't solve your problems over the phone. Of course, you get a one year warranty on parts and labor; five years on the *OmniKey* keyboard. If a part fails, we'll ship a replacement to you overnight at our expense before you return your part.

**Use a SlimLine 386SX RISK FREE for 30 days!** If it fails to meet your expectations, return it!

**Order Today!** Call toll-free 24 hours every day. Ask about custom configurations, leasing and financing programs.

## SlimLine 386SX System Features:

- 16 or 20MHz Intel® 80386SX processor
- 1Mb of 32-bit DRAM (expandable to 8Mb on motherboard)
- Down-scaled, proprietary, U.S.-made motherboard
- 40Mb hard drive; AT bus interface; 1:1 interleave; DisCache: 64K look ahead disk caching; 19ms access
- 64K SRAM memory cache; read/write-back caching
- High density 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives; also read/write low density disks
- Five open expansion slots; three full length 16-bit and two half length 8-bit
- 16 or 20MHz 80387SX or Weitek coprocessor support
- One parallel and two serial ports
- Built-in 16-bit SVGA with up to 1024 x 768 resolution; 512K video memory
- Clock/calendar chip rated at 5 years
- 100 watt power supply
- Small footprint SlimLine case with room for two exposed and one internal half-height devices
- Front mounted system reset and high/low speed controls
- Exclusive Northgate *OmniKey*/102 keyboard
- 12" VGA monochrome monitor
- MS-DOS 4.01 and GW-BASIC software installed
- On-line User's Guide to the system and MS-DOS 4.01
- QA Plus diagnostic and utility software
- Smartdrive disk caching software
- 1 year warranty on system parts and labor; 5 years on keyboard
- FCC Class B Pending

16 MHz Base System Model **\$1999<sup>00</sup>**

20 MHz Base System Model **\$2199<sup>00</sup>**

Delivered to your home or office.  
Call for other configurations and pricing.

**EASY FINANCING:** Easy payment options. Use your Northgate Big 'N', VISA, MasterCard ... or lease it. Up to five-year terms available.

**CALL TOLL-FREE 24 HOURS EVERY DAY**  
**800-548-1993**

Fax your order. (612) 943-8338

Notice to the Hearing Impaired: Northgate has TDD capability. Dial 800-535-0602.

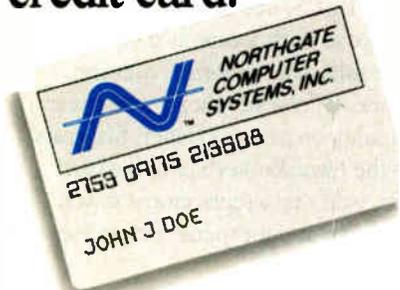
 **NORTHGATE COMPUTER SYSTEMS** *"We hear you!"*

7075 Flying Cloud Drive, Eden Prairie, MN 55344

©Copyright Northgate Computer Systems, Inc. 1990. All rights reserved. Northgate, *OmniKey* and the Northgate 'N' logo are registered trademarks of Northgate Computer Systems. 80386 and 80486 are trademarks of Intel. All other products and brand names are trademarks and registered trademarks of their respective companies. Prices and specifications subject to change without notice. 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-PIR8.

# Order Your Northgate® Computer Today, Make No Payments For 90 days!\*

Just say "charge it"  
to your Big 'N'  
credit card!



Get your new Northgate without  
spending a penny this year!

Simply fill in the Big 'N' information  
form and send it to Northgate. You'll  
get prompt attention! Once you're  
approved, call our systems consultants,  
toll-free, to select the Northgate  
configuration that perfectly matches  
your needs!

You'll free your other credit cards!  
Big 'N' lets you easily increase your  
credit power. Best of all, you'll make  
no payments for your new computer  
for 90 days after shipment! But, don't  
delay, computers must be ordered  
by December 31, 1990 to qualify for  
deferred billing!

Northgate leases systems too!  
Choose from flexible terms up to five  
years in length. It's never been easier  
to get Northgate computer systems  
than it is now!

Call Northgate Now!  
**800-548-1993**  
HOURS: Monday - Friday 7 a.m. - 8 p.m. CST



## OPEN YOUR CREDIT CARD ACCOUNT BY FILLING OUT THE APPLICATION BELOW.

Please complete all appropriate sections, providing at least two years residence and employment history. If you are self-employed, please be sure to complete section d. **THIS IS NOT A CREDIT AGREEMENT!** One will be sent to you upon authorization of an account. (This Form Must Be Signed To Process Your Order.) All Financed Purchases Are Subject To Credit Approval. If You Have Any Credit Questions, Please Call For Assistance. Thank You!

A married person may apply for individual credit. I am applying for (check one box, please):

- JOINT CREDIT with another person. Complete entire application.
- INDIVIDUAL CREDIT complete only individual section.
- INDIVIDUAL CREDIT but rely on income of another. Complete entire application.

\*If you are a married Wisconsin applicant, you must provide your spouse's information as indicated, even though your spouse may not be signing the contract.

**NOTICE TO WISCONSIN APPLICANTS**  
You must disclose your marital status:  
 married  
 unmarried  
 legally separated

### a. Personal Information

NAME \_\_\_\_\_ HOME PHONE (\_\_\_\_) \_\_\_\_\_  
 SOCIAL SECURITY NUMBER \_\_\_\_\_ DATE OF BIRTH \_\_\_\_/\_\_\_\_/\_\_\_\_  
 PRESENT ADDRESS \_\_\_\_\_ CITY \_\_\_\_\_ ST \_\_\_\_\_ ZIP \_\_\_\_\_  
 DATE OF RESIDENCE MO. \_\_\_\_\_ YR. \_\_\_\_\_ BUY  RENT  OTHER   
 PREVIOUS ADDRESS \_\_\_\_\_  
 EMPLOYER \_\_\_\_\_ DATE OF EMPLOYMENT MO. \_\_\_\_\_ YR. \_\_\_\_\_  
 MONTHLY GROSS SALARY \$ \_\_\_\_\_ BUSINESS PHONE (\_\_\_\_) \_\_\_\_\_  
 PREVIOUS EMPLOYER \_\_\_\_\_ DATES OF EMPLOYMENT \_\_\_\_\_ TO \_\_\_\_\_  
 Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as basis for repaying the obligation.  
 ADDITIONAL MONTHLY INCOME \$ \_\_\_\_\_ SOURCE \_\_\_\_\_

### b. Credit Information

PLEASE TELL US IF YOU HAVE: CHECKING ACCOUNT (Y/N) \_\_\_\_\_ SAVINGS ACCOUNT (Y/N) \_\_\_\_\_  
 BANK LOAN (Y/N) \_\_\_\_\_ HOW MANY? \_\_\_\_\_ VISA (Y/N) \_\_\_\_\_ HOW MANY? \_\_\_\_\_  
 MASTERCARD (Y/N) \_\_\_\_\_ HOW MANY? \_\_\_\_\_ FINANCE COMPANY LOAN (Y/N) \_\_\_\_\_ HOW MANY? \_\_\_\_\_  
 DEPT. STORE CHARGE CARD (Y/N) \_\_\_\_\_ HOW MANY? \_\_\_\_\_ CREDIT UNION ACCOUNT (Y/N) \_\_\_\_\_ HOW MANY? \_\_\_\_\_  
 OTHER MAJOR CHARGE CARDS (Y/N) \_\_\_\_\_ HOW MANY? \_\_\_\_\_

### c. Joint Applicant's Personal Information

JOINT APPLICANT'S NAME \_\_\_\_\_ HOME PHONE (\_\_\_\_) \_\_\_\_\_  
 SOCIAL SECURITY NUMBER \_\_\_\_\_ DATE OF BIRTH \_\_\_\_/\_\_\_\_/\_\_\_\_  
 ADDRESS \_\_\_\_\_ CITY \_\_\_\_\_ ST \_\_\_\_\_ ZIP \_\_\_\_\_  
 DATE OF RESIDENCE MO. \_\_\_\_\_ YR. \_\_\_\_\_  
 JOINT APPLICANT'S EMPLOYER \_\_\_\_\_ DATE OF EMPLOYMENT MO. \_\_\_\_\_ YR. \_\_\_\_\_  
 MONTHLY GROSS SALARY \$ \_\_\_\_\_ BUSINESS PHONE (\_\_\_\_) \_\_\_\_\_  
 NAME AND ADDRESS OF NEAREST RELATIVE NOT LIVING WITH YOU \_\_\_\_\_  
 RELATIONSHIP \_\_\_\_\_

### d. Self-Employment Information

BUSINESS NAME \_\_\_\_\_ BUSINESS PHONE (\_\_\_\_) \_\_\_\_\_  
 TYPE OF BUSINESS  Proprietorship  Partnership  Corporation IN BUSINESS SINCE \_\_\_\_\_  
 YOUR ANNUAL INCOME FROM BUSINESS Gross \$ \_\_\_\_\_ Net \$ \_\_\_\_\_  
 PERSONAL BANKER'S NAME \_\_\_\_\_ BANKER'S PHONE (\_\_\_\_) \_\_\_\_\_

### e. Customer Authorization

I authorize Northgate Computer Systems or its assigns to investigate credit records and to report my performance hereunder to credit agencies. I hereby certify that the following information is furnished to you for the purpose of obtaining credit and is true and correct of the best of my knowledge and belief. There are costs associated with the use of this credit card. To obtain more information about these costs, call us at 1-800-548-1993 or write to P.O. Box 59080, Minneapolis, MN 55459-0080.

NY—A consumer credit report may be requested in connection with this application or in connection with updates, renewals or extensions of any credit granted as a result of this application. If I subsequently ask for this information, I will be informed whether or not such a report was requested and, if so, the name and address of the agency that furnished the report.

OH—THE OHIO LAWS AGAINST DISCRIMINATION REQUIRE THAT ALL CREDITORS MAKE CREDIT EQUALLY AVAILABLE TO ALL CREDIT-WORTHY CUSTOMERS AND THAT CREDIT REPORTING AGENCIES MAINTAIN SEPARATE CREDIT HISTORIES ON EACH INDIVIDUAL UPON REQUEST. THE OHIO CIVIL RIGHTS COMMISSION ADMINISTERS COMPLIANCE WITH THIS LAW.

APPLICANT'S SIGNATURE \_\_\_\_\_ DATE \_\_\_\_\_

JOINT APPLICANT'S SIGNATURE \_\_\_\_\_ DATE \_\_\_\_\_

FOR MARRIED WISCONSIN APPLICANTS:  
I acknowledge that the obligation described herein is being incurred in the interest of my marriage or family.

BUYER'S SIGNATURE \_\_\_\_\_ DATE \_\_\_\_\_

\* You must request deferred billing when ordering. Payments will be deferred for three billing cycles after shipment. Interest will accrue during the deferred period at a rate of 1.5% per month (18% APR).  
 This is not an application. A completed application and agreement must be on file prior to approval for credit.

## REVIEW

## Windows Takes On WingZ



**Photo 2:** WingZ gives you powerful control over presentation graphics. You can even adjust the perspective and rotation of three-dimensional graphs.

**Photo 1:** With WingZ, it's easy to generate splashy graphs, text boxes with attached scroll bars, and user-defined buttons.



If there is a medium for gauging the graphical prowess of Windows 3.0, WingZ is it. One look at WingZ on the Macintosh proves just how graphical a spreadsheet can be. But can it do the same tricks on top of DOS? And, more important, is all this graphical wizardry more than an aesthetic diversion? Namely, will it make your spreadsheet chores easier or more effective?

The WingZ for Windows 3.0 comes bundled with an OS/2 version (the complete package is called WingZ PC).



## WingZ PC

## Company

Informix Software, Inc.  
16011 College Blvd.  
Lenexa, KS 66219  
(913) 492-9922

## Hardware Needed

2 MB of RAM (3 MB recommended); 2 MB of hard disk space; VGA, EGA, or 8514/A monitor

## Software Needed

Microsoft Windows 3.0

## Price

\$499

Inquiry 1226.

When I began working with WingZ for Windows, I was immediately struck by its versatility and ease of use. Presentation features approach desktop publishing capabilities, and making graphs is downright fun. WingZ fits effortlessly into the Windows 3.0 environment, including support of Dynamic Data Exchange links and importing graphics metafiles. In the constrained arena of spreadsheets, WingZ apparently can leap through hoops of fire.

Once I got down to work, though, some annoying limitations sprouted up. WingZ spreadsheets are as big as you want them to be. You'd use up memory before you could use up those billion or so cells. You would think, given this potential mass of data, that you could easily change defaults and reformat an entire sheet. Not so. I selected an entire sheet by clicking on a box in the corner of the sheet. Easy enough. But when I made format changes with the whole sheet specified, WingZ balked. The changes would affect any data already entered in the sheet, but newly entered data would revert to the default format. You have to highlight a range and change formats manually each time (or write a macro to do it for you).

## Taking Inventory

As a model, I set up three monthly inventory worksheets and a quarterly summa-

ry. The summary sheet used results from the three monthly sheets. I've found this type of operation easier to perform on a true three-dimensional spreadsheet such as Lotus 1-2-3 release 3.0. With true 3-D, all the sheets are combined into one structure resembling a cube. You can then "cut through" the cube to total the three monthly sheets. WingZ, on the other hand, uses external references to link the sheets. To reference a cell in an external sheet, you specify the filename and the cell reference (external.ref:a1).

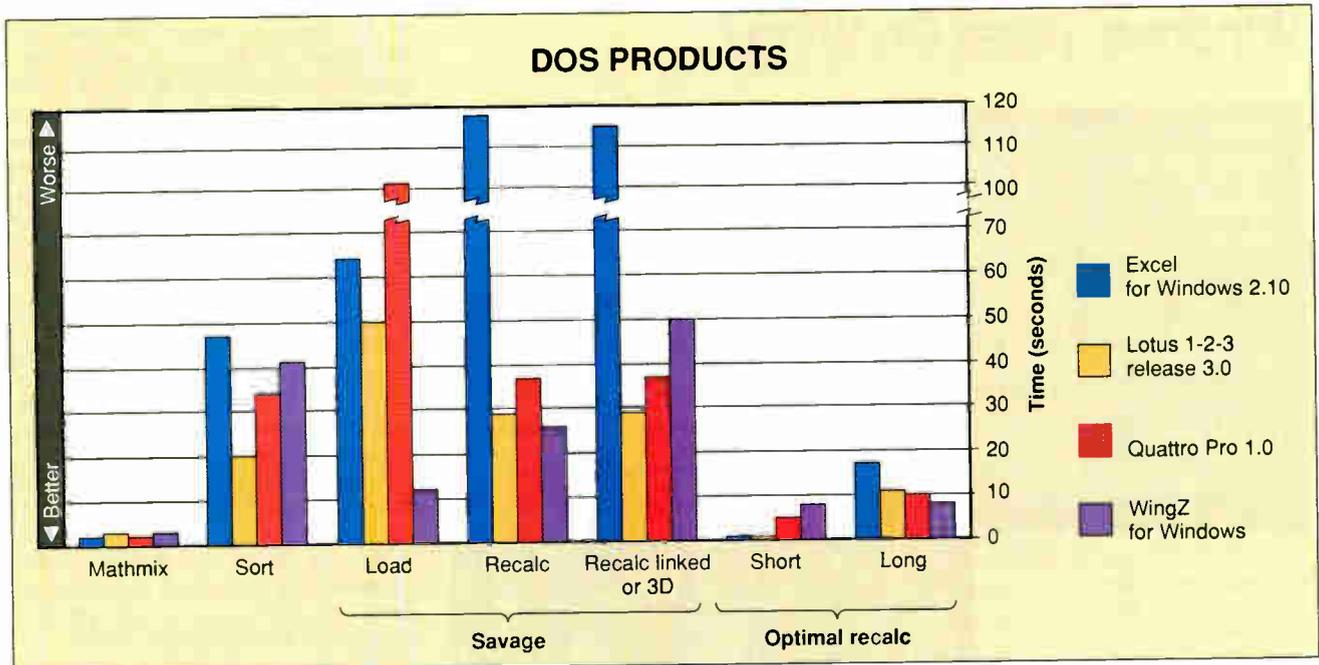
WingZ linking facilities are disappointing for such a full-featured product. First, there is no way to use the mouse to specify links. Other linking spreadsheets, such as Quattro Pro and the inexpensive Lucid 3-D, let you pull up the external sheet and click on the cell you want to reference. WingZ forces you to manually enter the filename (including extension) as well as the cell reference. This can get tiring when you need to reference a lot of external sheets.

There are a couple more troublesome limitations when you link sheets. You can't, for instance, link to a sheet on disk. All referenced sheets must be open. And WingZ does not automatically update the references. To negotiate the recalc benchmark for the linked Savage worksheets, I had to write a script that called each sheet and recalculated them one at a time.

Sometimes WingZ seemed surprisingly intuitive; other times, not at all. When I typed in "Feb 90," it understood that as a date and put the data in the default date format. Pretty smart. But when I added two cells together, both of them formatted as currency, it did not format the result as currency. Sometimes it even seemed to outsmart itself. When I added a blank column into the worksheet, WingZ adjusted my external cell references. I then had to go back and change them so that they referred to the cells in my external sheets—cells that, of course, did not change location.

## The Graphical Advantage

Start churning out graphs, though, and you may just forget all about WingZ's shortcomings. You just block off a range of data, click on the graph icon, and specify the area for the graph by simple click and drag. WingZ generates a graph on your sheet wherever you want it. There is a full grab bag of graphs to choose from, including scatter, contour, 3-D, and wire-frame graphs, to name a few. Once your graph has been created, you can resize it, move it, or revise it from the Graph menu.



WingZ performed admirably on our standard spreadsheet benchmarks. All times are in seconds. Shorter bars indicate faster execution.

## DOS IN EPROM

Or any other code, for that matter! PromKit allows you to create Eproms that look like read-only disk drives in your PC-compatible systems. Use PromKit even if you're not a programmer. Just use PromKit to convert any disk into EPROM images for your Prom blaster! Copy system files, batch files, data files, or anything else you want. Use Proms for read-only, SRAMS for read-write! Includes source code in C. Over 180 pages, including disk, only \$179. Includes schematics for add-in boards.

**FREE** We'll include a free copy of the pocket-sized XT-AT Handbook by Choisser and Foster with each PromKit if you mention this ad when you order. Of course, this \$9.95 value is also available by itself. Or buy five or more for only \$5.00 each.



**800-462-1042**  
619-271-9526



**Annabooks**  
12145 Alta Carmel Ct., Suite 250  
San Diego, CA 92128

FAX 619-592-0061  
**Money-back guarantee**

# Are you looking into other peoples' Windows?

**Write your own Windows™ 3.0 applications Quickly and Easily with Software Engineer™.**

- A complete LISP programming environment including a LISP-aware program editor.
- Supports Dynamic Data Exchange (DDE) at a higher level than the SDK. Create both client and server applications.
- Supports GDI, the clipboard, dialog boxes and menus.
- Sample programs supplied include DDE sessions with Microsoft® Excel and Micrografx™ Charisma®.
- Requires 386-based or fast 286-based machine and Windows™ 3.0.

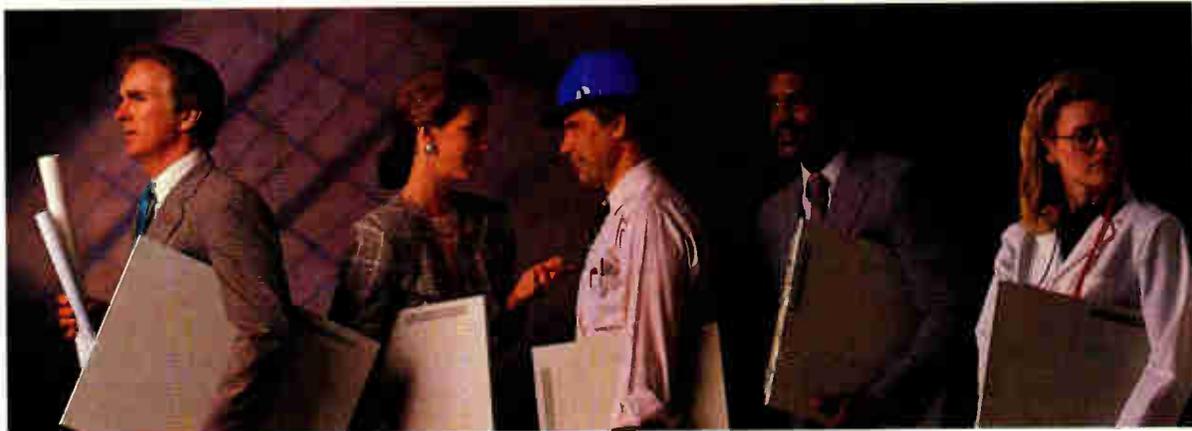
**\$249.95**

To order Software Engineer or for more information, Call (214)234-2611 or FAX (214)234-2674

**RAINDROP SOFTWARE**

845 Arapaho Road • Suite 105 • Richardson • Texas • 75081  
Some names mentioned above may be trademarks or registered trademarks of their respective holders.

# Finally. An input device based on your input.



## Introducing SummaSketch® II.

New Limited  
Lifetime Warranty

The new SummaSketch II tablets were created with one thing in mind—you, the people who use tablets every day. You said you wanted a complete plug and play package, so we're giving you the works—both in PC and Macintosh® SE and II versions. A 12" x 12" or 18" x 12" graphics tablet with a 4-button cursor and 2-button stylus, or 16-button cursor for the PC.

The PC version includes interface cables for the IBM® PC, AT, PS/2 and compatibles. A utilities diskette with test and reset software, an Autodesk® Device Interface™ driver, Universal Mouse Emulator™ and a Microsoft® Windows driver. And an offer for

a free tablet template (US and Canada only) worth over \$245.

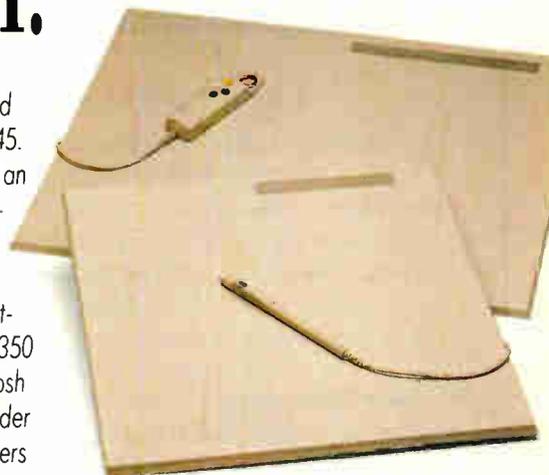
The Macintosh version has an Apple® Desktop Bus™ interface device to connect the tablet to the computer.

You'll also get the most software compatibility with over 350 PC programs and all Macintosh SE and II software written under the Apple Software Developers guidelines.

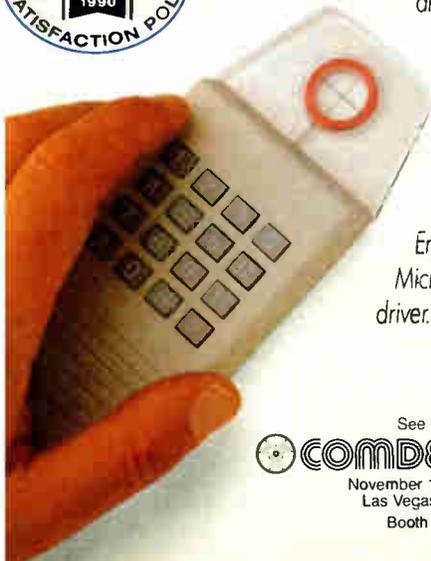
SummaSketch II tablets have a standard accuracy measurement of  $\pm 0.015$  inches, selectable resolution of up to 1,016 lines per inch and high proximity so you can trace from documents up to 1/2" thick. Add in convenience features such as a power/proximity light, on-off switch, wedge shape design for easy use, lightweight construction for portability—and it's easy to see why SummaSketch is the industry standard and the

obvious choice of today's computer professionals.

Best of all, you get all of these benefits at an affordable price. And that's why our new SummaSketch II is the easiest buying decision you have to make. Find out more about SummaSketch II today. For literature and the name of a local dealer call 1-800-888-2028, Ext. 304. For technical information call 203-881-5400.



November 28, 1989  
SummaSketch II



See us at  
**COMDEX/Fall '90**  
November 12-16, 1990  
Las Vegas, Nevada  
Booth #4224



## Summagraphics™

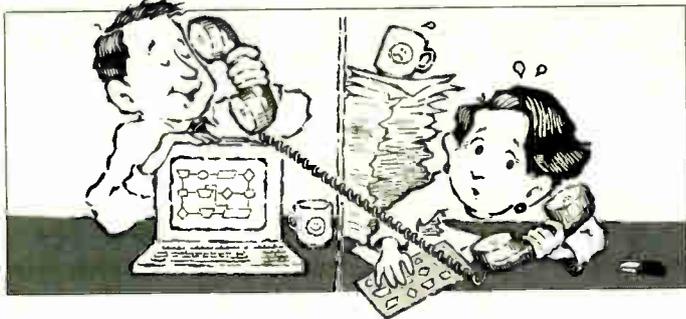
Every decision should be this easy.™

© 1990 Summagraphics Corporation.  
Seymour, CT 06483 • All rights reserved.

For IBM/Compatible information circle 326; For Macintosh information circle 327; For Reseller inquiries circle 328 on Reader Service Card.

World Radio History

# Word is getting around.



## The news is spreading fast!

Our 80,000 ecstatic customers are telling their friends about how much time they save on flowcharts and data flow diagrams.

**EasyFlow**, unlike most "screen draw" programs, is dedicated to fast composition and modification of flowcharts and data flow diagrams.

**They're spreading the news** about the automatic line routing, automatic text centering and the slick cut & paste.

**They say** you can create charts and then cleanly move them into a desktop publishing program.

**EasyFlow** works with most matrix printers, laser printers and plotters and comes with a 200 page manual. They say you get all this plus 350 context sensitive help messages on screen for only \$149.95 and RUSH delivery is available.

**They're telling their friends** but not their bosses. Their bosses think they had to sweat bullets to come up with these amazing results. You mean you still do?!

**With 80,000 customers talking**, it's amazing that you haven't heard. Give us a call and find out for yourself what everyone else is talking about! Then call a few friends and tell them about the wonders of **EasyFlow**.



**Flowcharting Made Easy!**

**HavenTree Software Limited**

P.O. Box 1093 - A Thousand Island Park, NY 13692

Order Desk: 1-800-267-0668

Info: (613) 544-6035 ext.80 Fax: (613) 544-9632

From our fax to yours... Info Fax: (613) 544-2049

## REVIEW

As flexible as these graphs are, they, too, suffer from surprising limitations. You must first block off a contiguous range of data and generate a chart before you can manipulate it. If you want to add a new series outside the selected range, you must first copy an existing series, select the copy, and then specify the new series. It would be much easier if you had the option to specify all your ranges up front, before the graph is drawn. As long as your data lies in contiguous columns or rows, you are all right, but once you start jumping around, things get complicated.

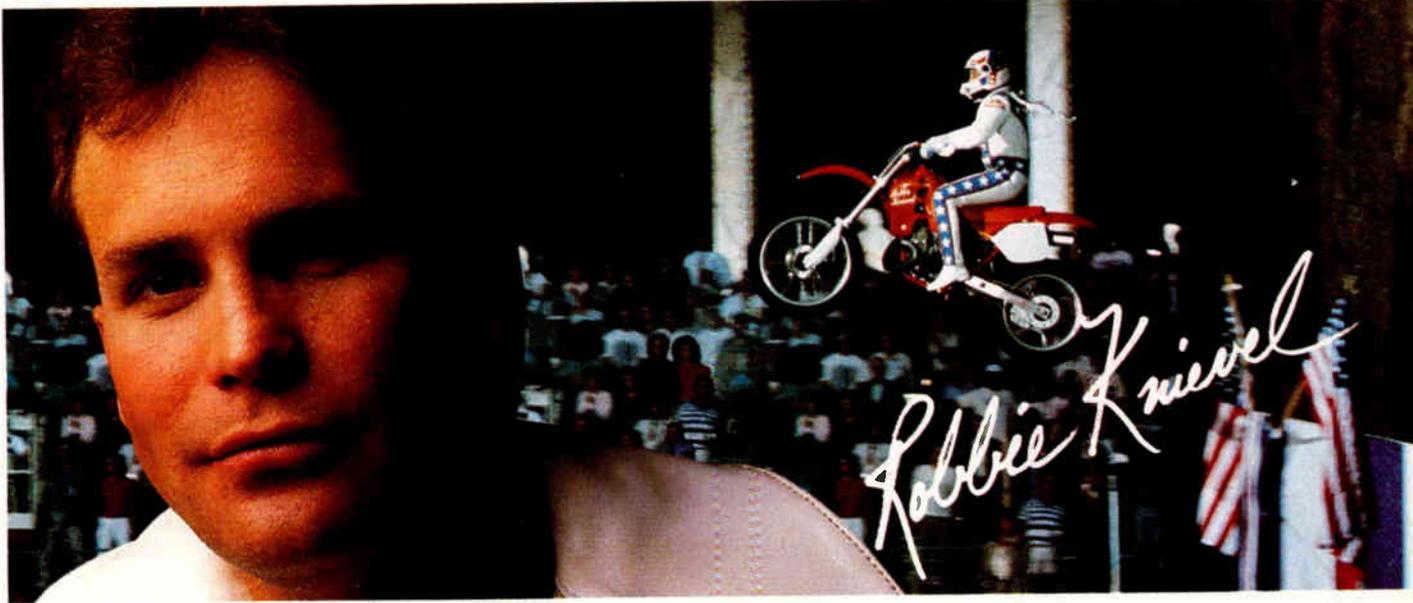
In any case, the graphing functions are flexible enough for you to come up with just about any presentation that you could possibly want. You can even select different objects in the graph (the legend, the title, or the actual graph itself), separate them from the graph borders, and put them anywhere you want. I drew a graph, removed the legend, and placed it to the left of the row labels. I then placed the bars to the right of the data.

WingZ really shines when it comes to manipulating graphical objects like this. You can easily create "buttons" by clicking on an icon, and then attach scripts to them for truly automated spreadsheets. You could have sales data on your sheet along with a button that, when clicked on, would bring up another spreadsheet with a breakdown of sales by salespersons. You can draw ovals, rectangles, and polygons and fill them with a range of patterns or attach a drop shadow to them. Text fields are just as easy to create, and you can attach scroll bars to them. WingZ also boasts tabling, matrix, and database operations, as well as an impressive scripting language. A full set of functions is available, but if you can think up any functions it doesn't have, you can define them yourself using the scripting language.

In the end, WingZ is a mixed blessing. It can certainly put Windows through its paces, and for presentation punch, WingZ can't be beaten. The Windows 3.0 version is not quite as snappy as the Mac version, but it performs admirably when compared to other DOS (and even OS/2) products (see the figure). It falters somewhat when it's faced with the nitty-gritty work of filling in formulas, linking sheets, and simple formatting. If you can put up with a little more up-front work, WingZ can make your final presentations soar. ■

*Stanford Diehl is a BYTE Lab testing editor/engineer and spreadsheet expert. He can be reached on BIX as "sdiehl."*

**“So, this punk comes up to me and says,  
‘Is there anything you won’t do for a buck?’  
And I say, ‘Sure. I won’t plug in my PC  
without a Proxima product to protect it.’”**



**“I may be crazy, but I’m not stupid.”**

**“W**hen people tell me I take foolish risks, I say to them: ‘At least I assess the risks, and I always take steps to protect myself. Do you?’

“Take many microcomputer users. They’re cool and calm, just cruising along until – wham! – they’ve crashed. Lost all their data, maybe even burned out a motherboard. Yet they sit there, stunned.



Whether you’re operating a home computer or a technical workstation, there’s a state-of-the-art Proxima ProLine to match your needs.

They had no idea they were at risk. “Or maybe they just thought it would never happen to them. Yet studies indicate that every AC outlet in America has a 97% probability of incurring at least one system-damaging event each year. “Whether it’s a Proxima® ProLine™ Surge Suppressor that clamps down on incoming surges and spikes – or a Power Director® that protects against power problems and acts as a surge control center – your microcomputer needs ultra-reliable protection against power problems that threaten your investment.

“So check out the entire range of innovative Proxima Surge Protection Products. And don’t forget the Proxima Lifetime Equipment Protection Policy. With the purchase of a ProLine 20 or 30, or a Power Director, it guarantees the survival of your hardware from a power problem for the life of your investment.”

Want to hear more about how to save the life of your computer? Just write, and I'll send you, free, "Five Ways to Stop Being a Computer Daredevil." Or call 800/582-2580 (800/582-0852 in CA).

Name \_\_\_\_\_  
 Company \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
 Phone \_\_\_\_\_

Return to: Computer Accessories Corporation, 6610 Nancy Ridge Drive, San Diego, CA 92121.



by Computer Accessories Corporation

**Circle 388 on Reader Service Card  
(RESELLERS: 389)**

Power Director and  
 Comput

are registered trademarks, and ProLine is a trademark, of Computer Accessories Corp. Proxima Corporation will change its name to Proxima Corporation in November, 1991.

# The FairCom® Servers The developer's client/server technology

Faircom Server

Faircom Server

## FairCom Server & SQL Server

■ Designed with developers in mind — you can incorporate the FairCom Servers directly into your applications. Something Oracle and MS/SQL Server won't let you do!

■ No other server can match the speed, flexibility or concurrency of FairCom Servers.

■ Multi-threaded design increases performance — the server utilizes all the previously unused time spent waiting for locks or I/O operations.

■ Industrial-quality transaction processing, including full commit and roll-back, intermediate save points and complete logging.

■ Compatible with c-tree plus, ANSI-standard SQL, QBE, our natural language query tool, and other interfaces.

■ Two configurations (FairCom Server or FairCom SQL Server) — each comes with a complete c-tree plus file handler; FairCom SQL Server also includes an ANSI-standard SQL engine.

FairCom introduced the first portable server to the developer community in 1988. Since then developers have been demanding increased user response time, faster server performance, more flexible interface options and industrial-quality transaction processing.

The kind of server technology that developers can incorporate into their applications to create more sophisticated, flexible and dependable DBMS products.

**FairCom Servers. The server technology developers have been waiting for.**

The FairCom Servers utilize high performance design features:

- **Multi-threaded design**
- **I/O minimization.** Sophisticated proprietary caching and compression algorithms reduces I/O functions
- **Key locks.** Minimizes interference between users while maintaining maximum data availability.

**Transaction Processing — The heart of the FairCom Servers.**

FairCom provides industrial quality on-line transaction processing (OLTP) and fully automatic recovery, including full commit and roll-back intermediate, save points and complete logging. No other server can match the speed, flexibility or concurrency of FairCom Servers.

**Complete interface flexibility.**

FairCom Servers offer developers two configurations. The FairCom Server is an ultra-high performance server utilizing the widely accepted c-tree™ and c-tree plus™ Application Programmers Interface (API). The FairCom SQL Server includes c-tree plus and a full ANSI-standard SQL, serving both SQL and non-SQL clients simultaneously.

The FairCom Server can also be used in a stand-alone (vs. a network) configuration — it can be tightly coupled with a developer's application.

**FairCom — A decade of performance and quality.**

This new client/server technology breakthrough will come as no surprise to the U.S. and international software developers who have been utilizing FairCom products during the past decade. Our file handling technology is incorporated in the products of many leading companies including 3Com, Hewlett Packard, NCR, Cray, Informix, Sharp, Digital Research, IBM and others.

Call (800) 234-8180 to get a complete technical overview of the latest generation of servers — FairCom Servers.

The developer's client/server.

Circle 131 on Reader Service Card

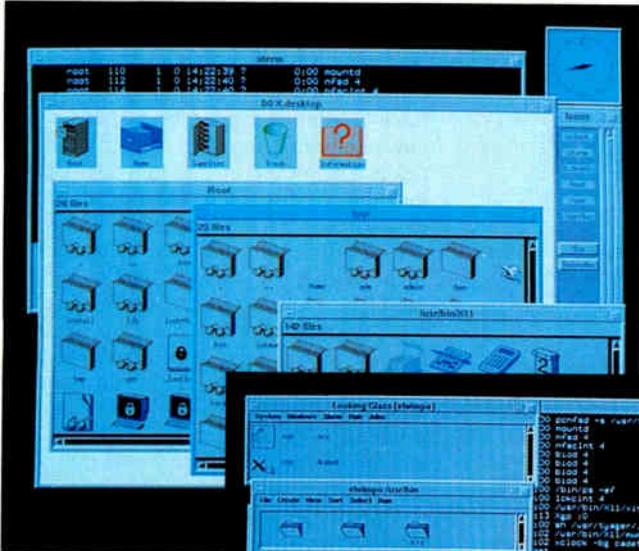


**FAIRCOM**  
corporation

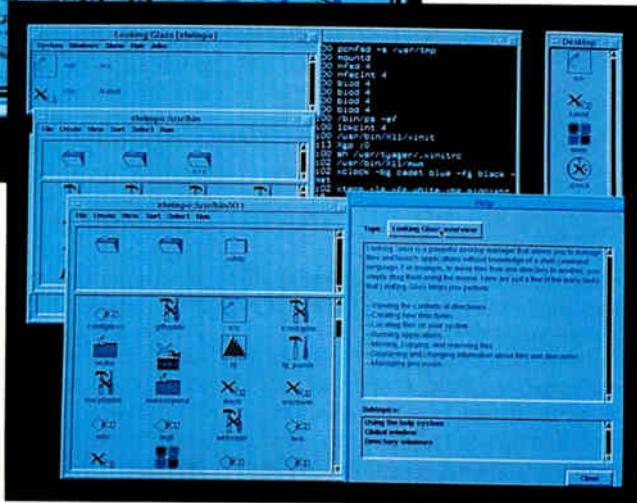
4006 WEST BROADWAY • COLUMBIA, MO 65203 • PHONE 314.445.6833 • 800.234.8180 • FAX 314.445.9698

## REVIEW

## Mac-ish Interfaces for Unix



◀ **Photo 1:**  
X.desktop's main  
desktop window  
and iconic  
directory views.



▶ **Photo 2:** Looking  
Glass's interface  
features pull-down  
menus and job  
control.

Those of us steeped in the Unix religious experience can't understand why everyone doesn't use it. In conversations with the anti-Unix crowd, they say, "It's too hard to use." Until now, there's been no debating that point.

It took someone else to do it, but a layer of simplicity has finally been added to Unix. Two products, IXI's X.desktop 2.0 and Visix Software's Looking Glass 1.0, are jockeying for position as the standard desktop environment manager. Both are being bundled with workstations.

These packages represent more than just a pair of pretty faces. Why all the excitement? Consider the Macintosh—it owes its success to the simplicity of its interface. After working with one Mac application, you learn the mouse actions and methods that drive virtually all programs for that environment.

Under the covers, however, the Mac OS is teeming with complexity. It's just hidden from the disinterested, and therein lies the key to a good operating envi-

ronment: Build in enough versatility to handle any job that comes along, but include a layer for those who "just want to run stuff." And that's just what Looking Glass and X.desktop do.

I installed the software on an ALR PowerVEISA 486/33 with 13 megabytes of memory and a 600-MB hard disk drive. A combination of Interactive Unix 2.2 and Interactive X Window 1.2 formed the software base, with the display served up by a combination of a Paradise 8514/A card with memory expansion, a 512K-byte Orchid ProDesigner VGA, and a Seiko CM-1440 high-resolution monitor.

If you're just starting out with Unix, you'll want to get experienced help in setting things up. Just getting the packages installed requires knowing a little about Unix. Since new users are the main target audience, the software should have been easy, even effortless, to install. While it's not all *that* difficult, I doubt that the average new user could handle it.

With Looking Glass, the necessary license server is not started automatically. Instead, a system has to be designated as the server and the vls program run from there. The documentation is lame on this point, and if you follow the directions for starting the program that appear in the front of the manual, they won't work. You'll get a message about a missing license server, but no information about how to start it. The section on the license server appears a few pages later.

### Turning the Key

Running either package involves the simple entry of a command, lg or xdt. X Window needs to be running before you enter these commands, and you can place either command in a user's default X start-up script for an automatic start.

Under X Window, windows cannot be manipulated (i.e., resized, moved, or iconified) without a *window manager*. Both packages conform to the OSF/Motif user interface specification, so the obvious choice is the Motif window manager (mwm). Interactive, like many Unix vendors, doesn't ship this standard with its X Window package (it is available separately). X.desktop fills this gap by providing its own window manager, which you can enable with the *-manager* switch from the command line. Looking Glass has no window manager, but it will add a Motif-like border to windows if you're using a window manager (like *uwm*) that doesn't add these adornments.

X.desktop opens one window, the desktop, where all the initial icons sit (see photo 1). The default configuration places icons representing the root and user's home directories, a supplies directory, and a trash can. You can add programs and files to the desktop by dragging them there. Files are not moved anywhere, but a file is marked as a "ghost" in its original location to indicate that it now lives on the desktop.

Double-clicking on any directory icon opens a new window with a view of the files in it. By default, files are represented by icons that convey some limited information. Directories are marked by familiar folder icons, executable files by a console display, X Window executable files by a big X, read-only files with a pair of glasses, and so on.

There are over 90 different icons, but a view of a typical directory is filled with little consoles (executable files) and

**X.desktop 2.0****U.S. Contact**

UniPress (U.S. distributor)  
2025 Lincoln Hwy.  
Edison, NJ 08817  
(800) 222-0550

**European Contact**

IXI, Ltd.  
62-74 Burleigh St.  
Cambridge CB1 1OJ  
UK  
44-223-462131

**Hardware Needed**

Graphical display and pointing device;  
4 MB of free disk space

**Software Needed**

X Window System 3.0 or higher; compatible  
Unix operating system (various); Motif  
window manager (optional)

**Price**

Single-user version: \$495  
(Site licenses available)

**Inquiry 1018.**

stacks of paper (regular files). A screen full of identical icons is just clutter. Thankfully, directory windows can also be set to display filenames. This is fast and useful. Each name has a tiny icon to its left with a symbol that clearly shows whether it is a directory, executable, or regular file.

Directory views can be sorted in a number of ways. All X.desktop menus appear as pop-ups; you hold down mouse button 1 in the background area of any X.desktop window. This can be a bit confusing—there's no clue that a menu lies in wait.

Whether in an iconic or text view, files are manipulated in the same manner. A single click selects a file, and a double click opens (with an editor, for example) or executes it. Dragging an icon to a different directory moves it, and dragging while pressing mouse button 2 copies it. Clicking on an icon's name brings up a window that lets you change the name.

Clicking on a file and invoking the View option from the pop-up menu displays that file's characteristics. If you have the access rights, you can modify a file's permissions with a few clicks. An annoyance is that the file type is represented as a four-character jumble that almost requires that you have a crib sheet nearby to decipher it.

The supplies directory, shown as an office supply cabinet, is intended to hold utilities for backups, printing, and other

**Looking Glass 1.0****Company**

Visix Software, Inc.  
11440 Commerce Park Dr.,  
Suite 600  
Reston, VA 22091  
(800) 832-8668

**Hardware Needed**

Graphical display and pointing device;  
4 MB of free disk space

**Software Needed**

X Window System 3.0 or higher; compatible  
Unix operating system (various); Motif  
window manager (optional)

**Price**

\$495 to \$1295, depending on platform

**Inquiry 1019.**

low-level needs. As it is an ordinary directory, any executable can be copied or linked into the cabinet.

Looking Glass's desktop metaphor is spread across the entire screen (see photo 2). It initially opens three windows: a control window with pull-down menus that control Looking Glass and perform other functions, a desktop window that holds frequently used application icons, and a directory view. Unlike X.desktop, Looking Glass uses pull-down menus exclusively. The control window and directory views have their own menu panes.

Icon actions are only slightly different from X.desktop; to copy a file, you drag it with mouse button 1 and the Control key pressed.

Looking Glass's directory view is its best feature. It is a dual-paned window, with a horizontal sash separating the directories from the files. The sash can be moved to any position, changing the ratio of visible directories and files.

There are hundreds of file icons, all well drawn and most of them explicit in their description of the file type. The level of detail is extraordinary—many icons map to specific named files. Opening a directory view on /bin, for instance, shows unique icons for the first twelve files in that directory. Most common (and some not so common) commands have icons bound to them. That is the first feature that makes Looking Glass a more useful iconic environment:

The default icons *mean* something.

The directory view can also be expanded to a list of names, and here, too, Visix outdid itself. The narrow view simply lists columns of files, similar to the output of `ls`. But selecting Wide from the pull-down menu brings up every piece of information Unix knows about the file, arranged in a useful columnar report. Each column is topped by a small window containing the title. The column titles can be picked up and moved to other locations or discarded, creating a totally customized viewing format.

One of the informational items shown in the Wide view is something that Looking Glass figures out for itself—the file type. In order to attach a descriptive icon to some files, Looking Glass tries to determine the file type. This can involve anything from looking up the filename in a table to opening the file and reading enough of its contents to guess the type (as the Unix `file` command does).

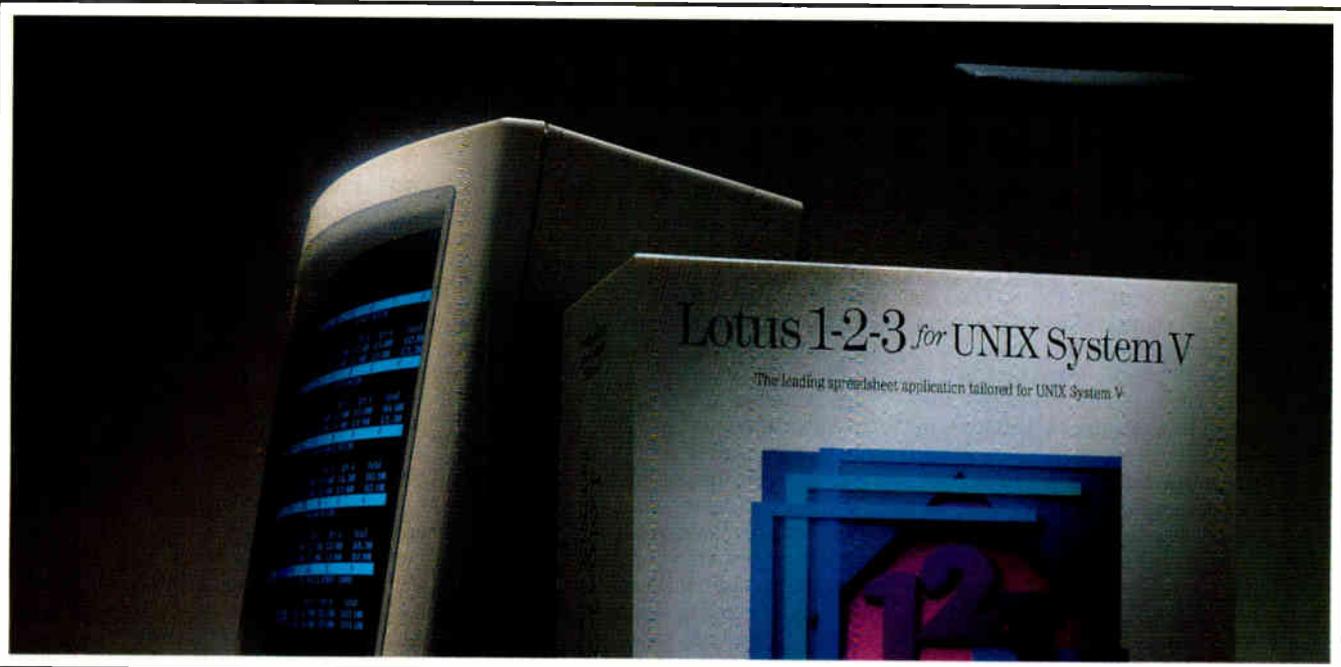
Opening a large directory for the first time can be slow as Looking Glass sifts through the files, attaching type data to each. File types are kept in a separate data file, `.lgdb`, to save the trouble of regenerating the types every time a directory is opened.

Looking Glass also has a virtual desktop window into which you can put commonly used programs and files. The control window, in addition to holding the main menu, serves another interesting purpose. Whenever an application is launched from within Looking Glass, its icon and associated command appear in the control window. Clicking on the icon there and selecting a menu option will let you kill the application, gracefully or forcefully. This may seem minor, but it makes Looking Glass a nearly complete environment. Killing errant processes is also one of the most confusing things for new users to learn; this makes it a snap (or, rather, a click).

**Making Them Your Own**

A large part of working with any graphical environment is tuning it to your own preferences. With Looking Glass, this is simplified somewhat by the set-it-and-forget-it approach: The window placements and settings you used during your last session are restored in later ones. But to go deeper than mere cosmetic adjustments, both packages give you two options: icon editing and rule files.

If you don't find an icon that expresses what you have in mind, you can create one. X.desktop uses the X Window program `bitmap`, while Looking Glass includes its own. The advantage to using



# A system with this much power doesn't deserve anything less.

UNIX\* System V/386 PC users no longer have to settle for a spreadsheet that's anything less than the industry standard.

Because now, Lotus® 1-2-3® for UNIX System V gives you all the power and performance of 1-2-3. Along with new features that let you make the most of your UNIX or XENIX® System V/386 PC.

So you can work with true 3D worksheets. Take advantage of file linking. Create high-impact business graphics. Access databases quickly and easily. In fact, do everything you can do with Lotus 1-2-3 Release 3.0.

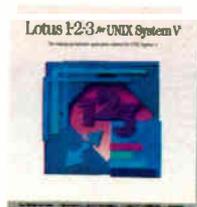
And macros, keystrokes, and files are compatible with other 1-2-3 releases. So you can not only use any work you've done with 1-2-3 up to

now, you can also share information with other 1-2-3 users, regardless of their platform or environment.

At the same time, you get full advantage of your UNIX system's capabilities. Like multi-tasking, so you can work on one job while your computer is completing work on others. Background processing, that lets you run 1-2-3 applications at preset times. And with the Multi-user Edition, you can even save money by having a group of users share a single spreadsheet package.

Call 1-800-343-5414, extension CDM-0112, for more information about 1-2-3 for UNIX System V.

And start using the best spreadsheet you can get. Instead of settling for just any spreadsheet you can get.



## Introducing Lotus 1-2-3 for UNIX System V

© 1990 Lotus Development Corporation. Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation.  
\*UNIX is a registered trademark of AT&T. XENIX is a registered trademark of Microsoft Corporation.

bitmap is that files are stored in a standard X Window bit-map format and can be generated and used by other X Window programs. Looking Glass stores its bit maps in a proprietary-format file.

Looking Glass rule files add recognition for file types that are unsupported by the base software. Attributes can be attached to file types to set whether they need to run in a terminal emulator window, whether a command can accept multiple filename arguments, and whether printing applies to the file and how it should be handled. These definitions are compiled for faster access. Even though Looking Glass can be extended with specialized file types, its *behavior* can't be changed. There is no way to attach a special meaning to mouse button 3, or to change the action taken when a file is deleted.

This is where X.desktop really shines. It comes complete with a full-featured programming language, which can be used to change every facet of X.desktop's behavior. Each icon type has program code associated with it that determines how mouse-clicks (including multiple clicks) and drags affect it, and

how it interacts with other icons.

Using the language, for example, a Gateway icon could be created and attached to a directory. Dropping files on that icon might copy them to another system on the network. Interaction with the user can be arranged through utilities included with X.desktop that pop up message windows and take user input from the keyboard.

The language is also extended to shell scripts and to the command line through the `tellxdt` command. Any X.desktop programming language command can be sent to `xdt` from the outside this way. Although it would take some doing, you could create entire domains of specialized icons that are tuned to a particular purpose. And since the scripts are all in plain text files, they are easily exchanged between systems.

#### Telling Them Apart

In general, I am impressed with both products. Looking Glass is much more useful out of the box. With more standard icons, job control, and flexible methods for looking at files, it can appeal to both new and experienced Unix

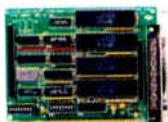
users. It doesn't pander, but neither does it force you to understand anything about Unix. Users at any level could live comfortably under Looking Glass.

X.desktop, on the other hand, is less immediately useful but much more adaptable to specific requirements. Experienced users will delight in tinkering with its programming language, wrapping themselves in a custom environment that is uniquely their own. New users can get by, but will gain little from X.desktop until a helpful hacker comes along and adds some new behavior. If I were a system administrator charged with placing 20 workstations in the hands of new Unix users, I'd spend the time to write custom X.desktop programs that would make the users' lives easier and cut down on the number of problem calls.

So if you stop me on the street to tell me how Unix isn't for you, you had better prepare yourself. With X.desktop and Looking Glass out there, you're clean out of excuses. ■

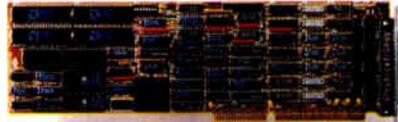
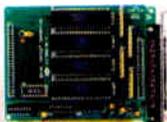
*Tom Yager is a technical editor and Unix expert for the BYTE Lab. You can reach him on BIX as "tyager."*

# Multiple-Choice



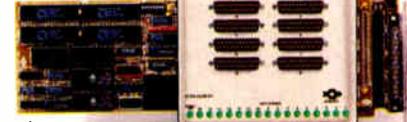
4-8

Our Hostess multiuser serial controllers are an excellent choice for up to eight occasional users. The Hostess 550 provides buffering for even higher performance. And for truly high performance, choose the Ultra 8.



16

Expand up to 16 users with the Ultra 16 high performance intelligent serial controller. But if your multiuser requirements are more modest a 16 port Hostess 550 controller makes an equally intelligent choice.

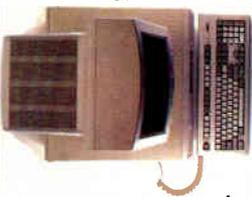
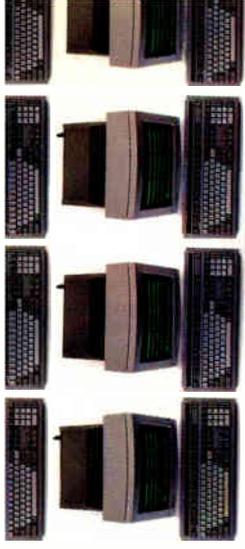


64+

Our Ultra Cluster gives you the flexibility and power for virtually limitless growth. Starting with an Ultra 8 base board, you can expand 16 users at a time, while maintaining current levels of performance every step of the way.

## MULTIPLY YOUR CHOICES

At Comtrol we pioneered multiuser technology. And we know that there are no single solutions to multiuser environments. That's why we offer more choices than any other company...from text to graphics...for modest users to over 64 users supported by a single PC. And we've not only multiplied your choices, we've multiplied performance, allowing you to expand without the high cost of adding computers.



## MULTIPLIED PERFORMANCE

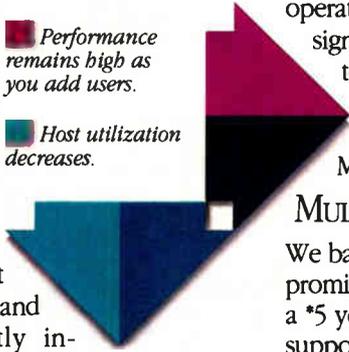
No company offers you more performance than Comtrol. In fact, our new DT Express driver transforms our Ultra Series into the highest performing controllers available today. DT Express dramatically



reduces host utilization and significantly increases throughput by managing all data transmission and data transfer functions on the controller. So now as you add users, no one gets caught in a wait state.

**Performance remains high as you add users.**

**Host utilization decreases.**



## MULTIVISION. FOR CHOICES BEYOND WORDS

When graphics enter the equation, MultiVision enters the picture. A fully functional multiuser system for up to 16 users, MultiVision speeds images to the screen at a blistering 100 megabits per second. As a result, you'll experience near instantaneous transmission of your graphics.

With software that enhances standard operating system graphics drivers, MultiVision is compatible with virtually any monitor, keyboard, mouse or VGA controller supported by the operating system. MultiVision can also run applications designed for the "X" environment. But unlike a LAN-based "X" terminal, MultiVision is a multiuser system that transfers data up to 100 times faster. When you compare that performance with the cost of an "X" terminal... MultiVision's advantages really compute.



## MULTIPLIED PROTECTION

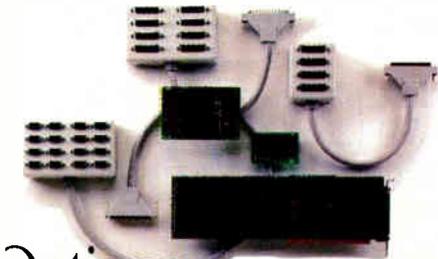
We back our products with an uncompromising 30-day satisfaction guarantee, a \*5 year warranty, complete technical support, and most importantly...a company that's easy to do business with. It all adds up to the best protection plan available. And if you're a VAR, call us about our Reseller Program that provides you with options designed exclusively for your needs.



\*1 yr. MultiVision

See us at  
**COMDEX/Fall '90**  
 November 12-16, 1990  
 in Bally's Booth B540  
 Las Vegas, Nevada

# for Multi-Users.



## Options

Our products offer serial port and memory options that are field upgradable; compatibility with ISA (AT), MicroChannel and EISA buses; 3232, 422, 485 and Current Loop interfaces and B 9, DB 25 and RJ 45 connectors.



## Graphics

When your needs move beyond text, MultiVision moves into view--a high speed (100 megabits per second) communications controller that offers near instantaneous multiuser graphics like you've never seen before.



**Comtrol**  
 A Comtrol Systems Company

Multiply your choices. Call Comtrol today.

**1-800-926-6876**

Comtrol Corp., 2675 Patton Road, P.O. Box 64750 St. Paul, MN 55164  
 © 1990 COMTROL CORPORATION. All rights reserved. All other brand names and product names are trademarks or registered trademarks of their respective holders.

Circle 82 on Reader Service Card

# CBr

Get set for smooth sailing. Because Microsoft® C Professional Development System version 6.0 is not only designed to be fast and powerful, but also easy to control.

Thanks in large part to Microsoft's unique Programmer's WorkBench. It integrates the debugger, editor and compiler, allowing them and all the other powerful programming tools to share data.

Tools like our Source Browser, that taps directly into the project database. This feature will give you instant access to the relationships between functions, macros, types and variables. It'll even give you a full call tree that literally draws you a map.

With our CodeView® Debugger, you'll save a lot of time. This powerful tool not only debugs any size DOS\* or OS/2 application program, on any 286 or 386™ machine, but also lets you explore nested structures and arrays.

The Programmer's WorkBench even has an open architecture that is supported by many third party tools.

Our online and hardcopy documenta-

tion are designed to complement each other. Together they provide you with an intelligent mix of professional guidance.

You'll find the C Advisor always online and ready to help. It's a hypertext-based reference system complete with sample coding solutions you can copy and paste directly into your program. You'll also find the hardcopy documentation offers many useful tips and techniques for advanced C programming.

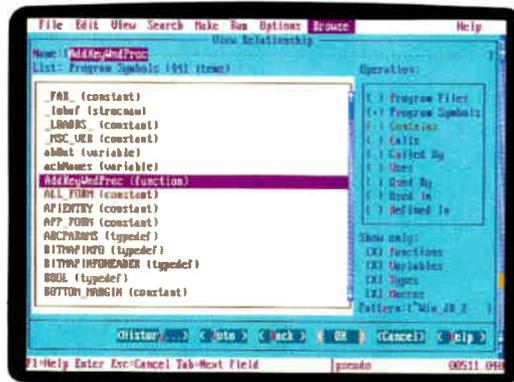
So whether you're developing applications for the MS-DOS®, Microsoft

Windows™ version 3.0 or MS® OS/2 Presentation Manager systems, our Programmer's WorkBench will allow you to write the fastest code around in the shortest amount of time possible.

For a free white paper with more details, just call (800) 541-1261, Department N19.

Then get your hands on Microsoft C version 6.0. It'll blow you away.

**Microsoft**  
Making it all make sense



Explore the relationships between functions, variables, types, and macros using information created by the compiler and stored in the project database.

# eeze.

For IBM PCs and Compatibles

## Microsoft C

Professional Development System



### **Compiler Performance**

- Based pointers access far data with size and speed of a 16-bit pointer
- Register-based parameter passing dramatically improves performance of function calls
- Optimization pragma lets you control what optimizations are in effect from within your code
- Integrated inline assembler
- Dramatically improved local code generation

### **Programmer's Work Bench**

- New Programmer's WorkBench 1.1 is faster than ever before
- Complete integration of edit, make, debug cycle
- Source Browser gives you access to information on all aspects of your source code
- Microsoft C Advisor provides fingertip access to the environment, C Language, and C Runtime Libraries
- Under OS/2, Programmer's WorkBench takes advantage of OS/2 virtual memory, protection, multitasking, and multiple threads to provide you the most productive development environment available

### **CodeView version 3.1**

- New version 3.1 is compatible with VCPI managers—CodeView can take advantage of extended memory along with VCPI applications like 386-Max™
- Completely redesigned user interface providing a multi-window, multi-file environment with views into source, data, local and memory
- Debugs nearly any size application on 286 or 386 machines
- CodeView takes only 15K from the I/O 640K address space

### **Documentation**

- Advanced Programming Techniques: Tips and techniques for professionals—to help you get more out of C 6.0
- C 6.0 Reference: Reference guide covering options and reference to runtime library routines
- Advisor: Complete reference material online, at your fingertips complements the C 6.0 Reference
- Installing and Using: Gets you up and running with the professional development system

Microsoft

Wed. Microsoft, MS, MS-DOS, the Microsoft logo and CodeView are registered trademarks and Windows and Making it all make sense are trademarks of Microsoft Corporation. 386 is a trademark of Intel Corporation. 386-Max is a trademark of Qualitas, Inc.

# INTRODUCING THE 4860<sup>®</sup> MOTHERBOARD. YOUR ULTIMATE BUILDING BLOCK.

**The Dynamic Duo.** The 4860 is an industry-first MotherBoard that packs the power of the Intel 80486 CPU with the Intel 80860 RISC processor (i486 + i860 = 4860). With it, you can build mainframe power into PC's for applications including CAD, LAN and desktop publishing. Equally impressive, our 4860 pumps up performance in your UNIX workstations.

**A PC Revolution.** In the PC environment, the 4860 is a 486-based MotherBoard which runs over 2 times faster than 386 computers. It's fully compatible with DOS, IBM's OS/2, Novell Netware and UNIX. What's more, Hauppauge's 4860 supports up to 64 MBytes of memory *without* a RAM expansion board!

**RISC-Y Business.** Thanks to the 4860's symmetrical architecture, both the i486 and the i860 processors can access the full range of memory, I/O system, and the 64-bit expansion bus. The result? Unprecedented dual processor performance.

You'll find that the i860 processor is ideal in graphics applications, performing up to 25 million floating-point operations per second. That's more than 10 times faster than the i486 processor alone! There's even an optional 64-bit frame

buffer card for ultra high-performance workstation graphics **For UNIX Workstations, Too.** The 4860 board makes a great foundation for high-performance RISC workstations that run advanced UNIX applications. Many workstation vendors are choosing the i860 processor as a standardized vehicle for CAD and simulation systems, and the 4860 is perfectly compatible with these applications.

**Technical Features:** • 4 Megabytes of high speed RAM expandable to 64 MBytes shared between i486 and i860 processors • Socket for optional 128K static RAM cache module for the i486 • Full size PC/AT form factor • Eight EISA I/O slots • 64-bit expansion slot • 1 parallel 2 serial ports.

The 4860 MotherBoard. Built with the world's highest performing microprocessors. So you can build the world's highest performing PC's and workstations.

Hauppauge Computer Works, Inc.  
91 Cabot Court  
Hauppauge, New York 11788  
Toll Free: 1-800-443-6284  
In New York: 516-434-1600  
In Europe: (49) 2161-17063

**Hauppauge!**

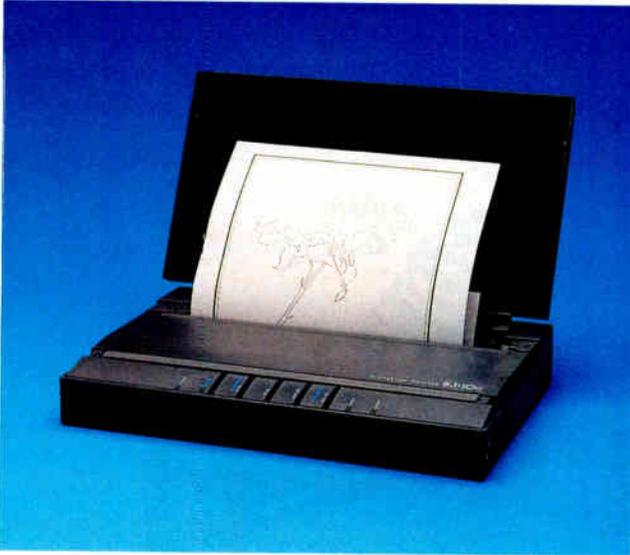


Trademarks: IBM AT and OS/2: IBM. Intel 386, i486 and i860: Intel Corp. DOS and NENIX: Microsoft Corp. 4860 MotherBoard: Hauppauge Computer Works, Inc.

Circle 155 on Reader Service Card

## REVIEW

# New Bubble-Jet Outpaces Portable Printers



*The BJ-10e uses a nonimpact bubble-jet print mechanism that can produce 360-by-360-dpi resolution text and graphics.*

If a colleague produces an important document with Canon's new BJ-10e printer and asks you to check the fine print, legalese may be the furthest thing from his or her mind. Instead, your cohort may be referring to the crisp, 360-dot-per-inch resolution coming from this impressive portable.

The BJ-10e serves users of PCs (and Macs, through third-party vendors) who print more than notes to themselves on cross-country flights or while hunkering down in a hotel room. The \$499 printer can deliver high-quality letters and reports that you'll feel fine about distributing to your business contacts. In return, you'll pay weight and size premiums

compared to portables like Kodak's Diconix 150 plus. Yet neither its 4 pounds (versus Diconix's 3 1/10 pounds) nor its 12 1/4-by-8 1/2-by-2-inch dimensions take the BJ-10e out of the portable arena. Its sharp, 360-dpi quality, however, does separate it from the portable pack. In fact, the BJ-10e surpasses the quality of some full-size, desktop ink-jet printers at four times the price.

## Bubble Brigade

The "BJ" in the printer's name stands for *bubble jet*, a nonimpact print mechanism closely related to ink-jet technology, except that air bubbles force ink from any of 64 nozzles. An electrical charge produces the bubble, and the resulting heat dries the ink almost as it hits the paper. Canon claims that the ink won't smear, but that's not entirely true. Careless fingers will cause smudges if you touch a fresh page. Let the ink dry for a couple of minutes, though, and a single pass of a highlighting pen won't do any damage. (Multiple passes will muddy your prose.)

To prevent ink evaporation, a small arm caps the print head when the BJ-10e is idle. I left the printer unused for three weeks and then reinstated it without any dried-ink problems.

This is Canon's second bubble-jet printer now on the market. Last year, the company began shipping the BJ-130e, a

desktop version capable of 132 characters per second in letter-quality mode. Canon hints that more bubble-jet printers are in the offing, possibly including a color model sometime in 1991.

Unlike the desktop BJ-130e's print mechanism, which consists of a separate ink cartridge and print nozzles, the BJ-10e uses a cartridge that integrates both elements. Canon rates BJ-10e cartridge life at 700,000 characters, or about 200 single-spaced pages, according to my calculations. The \$25 cartridges don't leak or spill ink, and they snap into place easily.

Using DIP switches, you can select either BJ-130e or IBM Proprinter X24E emulations. Currently, you must emulate the BJ-130e using packages that offer the correct software drivers to achieve full 360-by-360-dpi graphics resolution. Graphics in Proprinter X24E emulation are limited to 180-by-360-dpi resolution, although Canon says it is working with software vendors to develop drivers for full graphics resolution in that mode.

Software drivers written for the BJ-130e are compatible with the portable version, including Windows (Windows 3.0 drivers were being developed at press time), Microsoft Word, WordPerfect 5.0, QuattroPro, First Publisher, and three PostScript interpreters: UltraScript from QMS, TeleTypesetting's TScript, and GDT Softworks' JetLink Express 2.0. QMS, GDT Softworks, and TeleTypesetting also offer software drivers and serial-to-parallel interfaces that let you hook up Macs to the BJ-10e and print at full resolution.

## Clamshell Alliance

The BJ-10e's self-contained case and charcoal color resemble the clamshell portable computers on the market. While the BJ-10e is a natural for the road (a rechargeable battery pack weighing about 9 ounces is a \$50 option), Canon markets it as a portable that doesn't have to hibernate between business trips. A built-in stand and optional (\$90) 30-sheet paper feeder mean you can set it up on your desk as a backup printer to dash off short letters and memos that you don't have to track down at the networked printer.

You'll sacrifice little in the way of print quality. The BJ-10e prints in either a so-called economy or a high-quality mode. Print speed remains the same in either case, but in the economy mode less ink shoots out to print characters, for longer cartridge life. Characters sit on the page clearly defined; put a magnifying glass to them and their jaggies show, but the quality isn't too far from a laser



## BJ-10e

### Company

Canon U.S.A., Inc.  
One Canon Plaza  
Lake Success, NY 11042  
(516) 488-6700

### Hardware Needed

PC with parallel interface, or Macintosh with optional serial-to-parallel cabling interface

### Price

\$499

"Good-by, Grover's  
Corners...Oh,  
earth, you're too  
wonderful for  
anybody to realize."

"Good-by, Grover's  
Corners...Oh,  
earth, you're too  
wonderful for  
anybody to realize."

"Good-by, Grover's  
Corners...Oh,  
earth, you're too  
wonderful for  
anybody to realize."

Figure 1: Text samples from a LaserJet Series III (top), the Canon BJ-10e (middle), and Epson's EPI-4000 ink-jet printer rank the BJ-10e's output closer to laser-printer quality, thanks, in part, to fewer jaggies on the edges of characters.

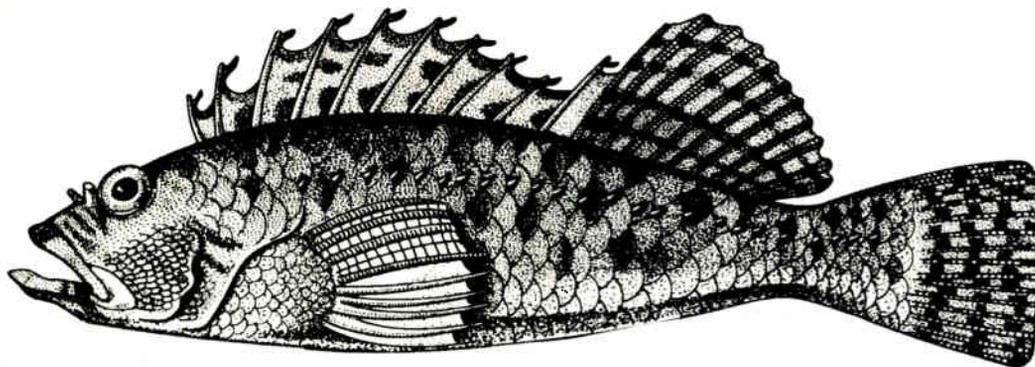


Figure 2: In its unidirectional graphics mode, the BJ-10e printed this 360- by 360-dpi line drawing from a file created by Canon.

printer's. In fact, when I pitted the BJ-10e's output against the Hewlett-Packard LaserJet Series III and a full-size Epson EPI-4000 ink-jet printer, the BJ-10e came in a comparatively close second to the laser printer (see figure 1).

I printed samples on plain xerographic stock and 25 percent bond letterhead with fine results. The BJ-10e will not break any speed records; mine averaged about 75 seconds to print a full page of text in high-quality mode. But the bidirectional print (in text mode) doesn't make you feel as though you're waiting an inordinate amount of time.

The automatic sheet feeder does away with the frustrations of loading paper one page at a time. It automatically handles letter-size paper; you can print on A4 sheets if you feed the paper in manually. The feeder doesn't accept envelopes, but the printer handles them easily through a rear path. Printing continuous forms is not part of the printer's capabilities.

The feeder worked without hanging up, even on a series of 10-page text files. However, printed pages tend to gather in a clump after they exit the printer and may foul exiting sheets.

I printed a line drawing in 360-dpi resolution and found the tones to be an impressive range from solid black to white,

with sharp definition of crosshatches and other patterns (see figure 2). The printer slows down a bit with graphics because it switches into a unidirectional print mode, but the clarity and resolution of the final image make the wait worthwhile.

Another plus is the printer's quiet operation. Step into a coworker's cubicle while the BJ-10e is running, and you're more likely to hear the occasional clank of the paper rollers than the print nozzle.

#### Bubble Trouble

Nevertheless, this handy peripheral is not without some unnerving flaws. The user's manual is so perfunctory that you will wish it came with Cliffs Notes to help you decipher it. I found myself reading some confusingly written sentences over and over, trying to glean their meaning. Don't scour the manual for a technical-support number, because one isn't listed. The manual tells you to call your service representative, but don't be deterred. Dial (800) 423-2366 and you will reach Canon's support line. I called anonymously and received immediate and knowledgeable service. Canon's fledgling BBS, at (516) 488-6528, posts a few new software drivers.

I also found myself cringing at the

printer's frequent chirping. The printer chirps in lieu of control-panel lights that tell you if you're in draft or letter-quality mode and whether you're set for pica, elite, or double-high characters. As you press control buttons, you hear a series of chirps in a variety of tones to guide you in your selections. The chirps attracted a stream of coworkers into my cubicle wanting to know what new computer game I had found. So hope that anyone sitting next to you on a crowded flight is patient or plugged into a headset.

Worst of all, I found these audio codes confusing and frustrating—I was never sure of the setting until the printer actually started producing text. If you're hearing-impaired, this printer may be impossible to use conveniently.

Over time, I grew more comfortable with the control panel, but I would still prefer a more intuitive visual display. Even so, Canon may have a hit. Laptop owners who want high-quality output from a portable printer that can serve double-duty on the desktop should consider this bubble-jet printer. The price alone should make you feel, well, positively effervescent. ■

Alan Joch is a BYTE technical editor. You can reach him on BIX as "ajoch."

# Expand Your Horizons With BayTech's Line of Statistical Multiplexers

BayTech invites you to expand your horizons to encompass a whole new world of data communications with our line of statistical multiplexers and modems. Our products will allow your communications capabilities to expand to their fullest extent. BayTech offers the highest quality and most cost-effective data communications products available. Let our new horizons lead you to product savings and satisfaction beyond your expectations!

## Convenience And Savings In Stat Muxes

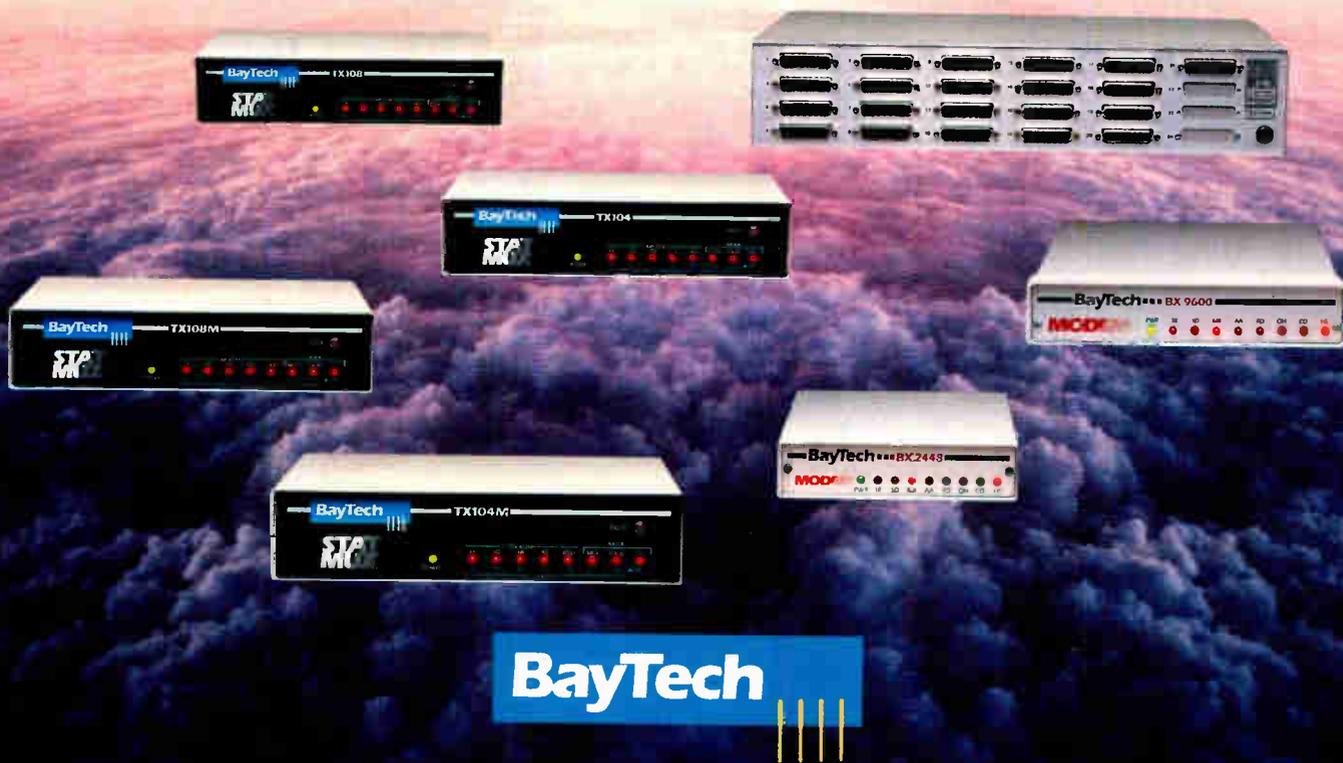
BayTech's statistical multiplexers offer convenient, cost-effective solutions for your communications requirements. Our units multiplex from four to twenty individual communication channels to a single dial-up or

leased telephone line, cutting phone line costs to a minimum. BayTech's stat mux line includes units with internal modems. Units without internal modems are designed for use with external modems, or they can be directly connected for distances to 4,000 feet. Quality 2400 and 9600 bps external modems are available from BayTech.

## Ultimate Product Support

All of BayTech's products are simple to set-up and to use. And all come with the most efficient technical support available, so BayTech's exceptional service continues long after the product is delivered. BayTech can help you tailor a system today to suit your specific application requirements. Call now to find out how BayTech's products can expand your horizons!

Circle 43 on Reader Service Card (RESELLERS: 44)



**BayTech**

Data Communications Products Division, 200 N. 2nd St., P.O. Box 387  
Bay St. Louis, MS 39520 USA FAX: 601-467-4551 PHONE: 601-467-8231 or toll-free

**800-523-2702**



# See the Future.

The ideal 16-inch ergonomic monitor for professional graphics and business applications.

Maximum performance for CAD/CAM, spreadsheets, databases, WYSIWYG word processors and desktop publishing. Designed for PCs and Macintosh II.

1024 × 768 resolutions. Supporting the new, higher refresh rate of 70Hz and above for a flicker-free display. No distortion. Sharply focused. Bright images across the entire screen.

An anti-static, non-glare screen. Low magnetic radiation. No interference between two monitors separated by a mere six inches, for dual-display applications.

Microprocessor-controlled configuration for your applications, memorizing size and position of the screen settings you prefer.

Other monitors compete against the standards.  
**FLEXSCAN®** sets them.

## NANAO®

**NANAO USA CORP.**

23510 Telo Ave., Suite 5  
Torrance, CA 90505 USA

Phone (213)325-5202

Fax (213)530-1679

Circle 236 on Reader Service Card  
(RESELLERS: 237)

### FLEXSCAN 9080I

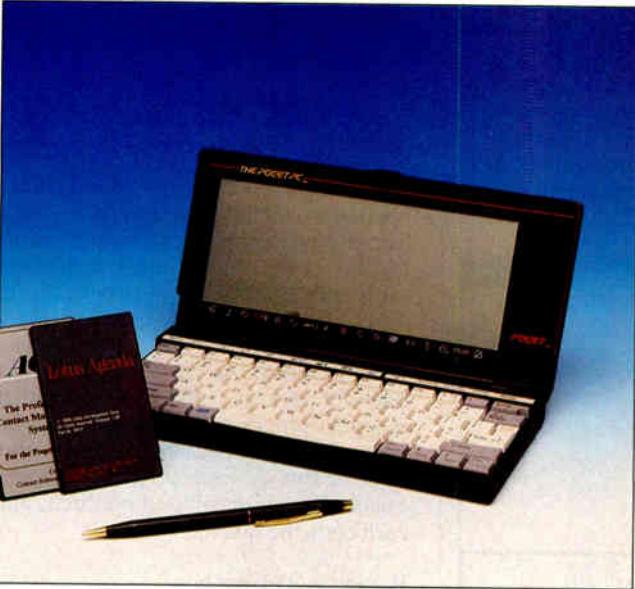
16" (15V), 0.28mm-dot pitch CRT  
1024 × 768 Super high resolution with 70Hz  
high refresh rate  
Scan Frequency: Automatic Adjustment  
H: 30-64kHz V: 50-90Hz  
VGA, 8514/A and Mac II Compatible

Images created by Jerry D. Flynn, Design Engineer,  
McDonnell Douglas Space Systems Company, Kennedy Space Center, Florida.  
Macintosh II is a registered trademark of Apple Computers Inc.  
NANAO and FLEXSCAN are registered trademarks of NANAO USA CORPORATION.

World Radio History

## REVIEW

# A Poqet Full of Power



*The Poqet PC weighs only 1 pound, and programs such as Lotus Agenda and Act are available on ROM cards made specifically for it.*



## Poqet PC

### Company

Poqet Computer Corp.  
650 North Mary Ave.  
Sunnyvale, CA 94086  
(800) 624-8999, ext. 1590  
(408) 737-8100

### Components (as reviewed)

Processor: 7-MHz 80C88  
Memory: 512K bytes of RAM; 640K bytes of ROM  
Mass storage: 64K-byte RAM card; 512K-byte RAM card  
Display: 7- by 2 $\frac{7}{8}$ -inch supertwist LCD; MDA mode 25 rows by 80 columns, CGA mode 640 by 200 pixels  
Keyboard: 77-key  
I/O interfaces: XT bus edge connector

### Size

8 $\frac{3}{4}$  × 4 $\frac{3}{10}$  ×  $\frac{9}{10}$  inches; 1 pound

### Price

\$2345

### Inquiry 1082.

**P**oqet Computer's Poqet PC is a remarkable device. Whether you see this tiny computer as a workhorse or an executive toy, a 1-pound, IBM PC-compatible computer slightly larger than a pocket calendar that runs for 100 hours on two AA alkaline batteries is indeed a technical achievement.

The basic Poqet includes 512K bytes of system RAM, 640K bytes of ROM, a 64K-byte RAM card, a file transfer cable, and a carrying case for \$1995. My test machine also included a 512K-byte RAM card (\$350) and special ROM-card versions of Act (\$395), XyWrite (\$495), and Lotus Agenda (\$395). Built around a 7-MHz 80C88, the machine is slightly faster than an IBM XT.

When BYTE first saw the Poqet (see "A PC in Your Pocket," November 1989), it was clear that this was not a machine for everyone. At the time, the computer's LCD had clarity problems, and the miniature keyboard was impractical for any task that required more than a few keystrokes. The display problem is fixed, and the keyboard is improved, but the keyboard's small size still limits the machine's usefulness.

The keyboard and screen are just two of the compromises required to create a computer the size of the Poqet. Another is the machine's 512K-byte system RAM limit—the Poqet simply doesn't have enough room inside for more memory. This limitation is less of a problem than it

sounds, however, since programs in the Poqet's 640K bytes of internal ROM (i.e., DOS 3.3, GWBASIC, PoqetTools, and PoqetLink utilities) or on optional ROM cartridges don't have to be loaded into RAM to execute.

### Tiny Typing

The Poqet's keyboard has a 77-key QWERTY layout with 10 function keys across the top and a numeric keypad superimposed over the letter keys on the right side of the keyboard. You activate the keypad by holding down the blue Poqet key next to the space bar. This key also activates several other secondary functions on the keyboard.

Some Poqet-key combinations simply invoke lesser-used keys on standard keyboards, such as the F11 and F12 keys. But the Poqet key also controls several special functions, including contrast and brightness controls, power management, the keyboard lock, and the alarm and speaker controls.

Pressing Poqet-Escape invokes PoqetTools, a SideKick-like pop-up menu that includes a calculator, a text editor, a scheduler, an address book, and a communications program. The menu also includes a setup utility that controls power management and other functions.

The keyboard, which measures just 8 $\frac{1}{2}$  inches wide, performs well for its size, although the  $\frac{1}{2}$ -inch-square key caps are so small and so closely spaced

that you probably won't want to do any touch-typing. Still, touch-typing is not impossible, as one of my coworkers (who has very small hands) demonstrated.

The Poqet never truly shuts off. Pressing the I/O key, just above the Return key, shuts off the display and CPU but continues to power memory to protect programs and data. When you reactivate the machine, it returns to the state it was in before you deactivated it. Even during normal operation, the CPU goes into sleep mode between keystrokes, and the system shuts down the display after sitting idle for 2 minutes.

### Peering Ahead

The 7- by 2 $\frac{7}{8}$ -inch screen presents a full 25 rows by 80 columns in either CGA or MDA mode. The default is MDA. The characters, while small, are crisp and easy to read: They're about the same size as the text on this page.

Although the screen does not have backlighting, it's still possible to use it under average lighting conditions. The screen folds to any angle, but it will not fold open completely if you have a serial cable or data transfer cable attached to the machine. Along the bottom of the screen are indicator blocks that tell, among other things, function-key status, when you're accessing the ROM disk, when the battery is low, and when the power management software is enabled.

The Poqet is free of external controls

and connectors, except for a single XT-bus edge-card connector at the rear of the unit that accepts a data transfer cable (which is included) or an optional serial or parallel cable, and two memory-card slots on the underside that hold RAM or ROM cards.

RAM cards, used for data storage, come in 64K-byte and 512K-byte sizes; a 1-MB card was still in development at press time. My test unit included a 512K-byte RAM card. Despite a recent price

cut (the 512K-byte card dropped from \$595 to \$350), the cards are an expensive way to store data. One alternative is to configure the Poquet's 512K bytes of system RAM as a RAM disk. Another is to buy Poquet's external 3½-inch 1.44-MB floppy disk drive for \$395, but this reduces portability and cuts battery life down to 20 hours. An optional memory-card reader for desktop PCs, which was unavailable at press time, should make using the cards more convenient.

### Moving Bits

The Poquet's file transfer cable attaches to the serial port of your desktop computer. Using PoquetLink, you can send and receive files at 115,200 bps. If you can find enough room in RAM, standard IBM PC software will work. I was able to use the Norton Utilities and WordStar 4.0 without problems. Other packages, including WordPerfect, wouldn't fit on a 512K-byte RAM card.

Poquet has received a great deal of cooperation from software vendors, who have ported their packages to ROM cards for use in the Poquet. ROM and RAM cards slide like tiny drawers into slots in the bottom of the Poquet's case.

I tested three ROM card applications: Lotus Agenda, Act (a business-contact tracking package), and XyWrite. Other available programs include Lucid 3-D, Lotus 1-2-3, AlphaWorks, and Lotus Metro/Express. Each program operates exactly like its disk-based brethren, and each costs the same.

### Poquet the Difference

Despite the Poquet's technical accomplishment, I didn't find the machine useful. I was unable to make it slide into an inside jacket pocket, so the computer had to stay in my briefcase, where it wasn't as handy as a scheduler. It's also too small for most people to type on to any extent. A Poquet user, it would seem, has to be satisfied with writing brief memos and working with small spreadsheets. That's a fairly limited use for a machine that costs about \$2000.

Poquet Computer markets the machine to field salespeople and some managers. But even these people are likely to be better served by a notebook-size computer, such as the Zenith MinisPort or the NEC UltraLite. Each of those machines has a more usable keyboard and a disk drive, and each is about twice the size of the Poquet. Each also costs less in its base configuration than the Poquet.

Whether the Poquet is an executive tool or an executive toy is for you to decide, but as powerful as it is for its size, the machine's form factor ultimately limits its effectiveness. In this case, the size seems just a bit too small. ■

*Wayne Rash Jr. is a BYTE contributing editor and avid laptop user. He is also technical director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as "wayne-rash," or in the to.wayne conference.*

## PC T<sub>E</sub>X Makes Your Best Work Look Its Best.

For professional publishing and the power to produce high-quality technical documents, scientific notation, mathematical formulas, and tables, rely on PC T<sub>E</sub>X to make your work look its best.

And with Personal T<sub>E</sub>X's Fontware Interface package, you have access to the complete library of Bitstream Fontware, for type selection and quality previously available only to professional typographers.

The next step beyond standard desktop publishing, PC T<sub>E</sub>X is the difference between average and expert. With PC T<sub>E</sub>X you'll get professional typesetting at amateur prices.

PC MAGAZINE wrote: "(With PC T<sub>E</sub>X)... you can achieve incredible precision in formatting text, especially mathematical expressions."

INFOWORLD said: "... No non-T<sub>E</sub>X-based program has such typographical aesthetics... enormously flexible..."

New PC T<sub>E</sub>X 3.0, with double the page-building capacity, is now available. For 386 computers, there's PC T<sub>E</sub>X/386 and Big PC T<sub>E</sub>X/386.

For a product catalog and free demo diskette, call

**415/388-8853. See the best for yourself.**

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	$\zeta(s) = \sum_{k=1}^{\infty} k^{-s} \quad (\Re s > 1)$

PERSONAL  
**T<sub>E</sub>X**  
INC

12 Madrona Avenue  
Mill Valley, CA 94941

PC T<sub>E</sub>X is a registered TM of Personal T<sub>E</sub>X, Inc. T<sub>E</sub>X is an American Mathematical Society TM. Bitstream and Fontware are trademarks of Bitstream Inc. Site licenses available to qualified organizations. Inquire about PT1 distributorships. This ad was typeset using PC T<sub>E</sub>X and Bitstream fonts.

# SHECOM

**386 SX-16 MHZ**

**386-25 MHZ 0 CACHE**

**386-25 w/64K CACHE**

**386-33 MHZ w/64K CACHE**

**BABY CASE W/200 WATT P/S**

- 1 MEG MEMORY
- 1.2 MB FLOPPY DISK DRIVE
- 40 MEG HARD DISK DRIVE
- 2 SERIAL/1 PARALLEL GAME PORT
- MONOCHROME GRAPHICS CARD
- 12" AMBER MONITOR
- 101 KEYBOARD
- 1st YEAR, PARTS & LABOR
- 2nd YEAR, LABOR

**STANDARD FEATURES:**

- 2 MEG MEMORY
- 1.2 MB FLOPPY DISK DRIVE
- 1.44 MB FLOPPY DISK DRIVE
- 65 MB HARD DISK DRIVE
- WA6 1:1 RLL CONTROLLER
- MONOCHROME GRAPHICS CARD
- 12" AMBER MONITOR
- 2 SERIAL/1 PARALLEL AND GAME PORT
- 101 KEYBOARD
- 1st YEAR, PARTS & LABOR
- 2nd YEAR, LABOR

**STANDARD FEATURES:**

- 2 MEG MEMORY
- 1.2 MB FLOPPY DISK DRIVE
- 1.44 MB FLOPPY DISK DRIVE
- 65 MB HARD DISK DRIVE
- WA6 1:1 RLL CONTROLLER
- 14" VGA MONITOR
- HI RES VGA CARD w/512K
- 2 SERIAL/1 PARALLEL AND GAME PORT
- 101 KEYBOARD
- 1st YEAR, PARTS & LABOR
- 2nd YEAR, LABOR

**STANDARD FEATURES:**

- 2 MEG MEMORY
- 1.2 MB FLOPPY DISK DRIVE
- 1.44 MB FLOPPY DISK DRIVE
- 65 MB HARD DISK DRIVE
- WA6 1:1 RLL CONTROLLER
- 2 SERIAL/1 PARALLEL AND GAME PORT
- 1024 x 768 MULTI SYNC MONITOR
- HI RES VGA CARD w/512K
- 101 KEYBOARD
- 1st YEAR, PARTS & LABOR
- 2nd YEAR, LABOR

**\$1,095.00**

**\$1,595.00**

**\$2,295.00**

**\$2,595.00**

## SIMM/SIP

256K X 8 70, 80, 100 NS  
256K X 9 70, 80, 100 NS

1 MEG X 8 60, 70, 80, 100 NS  
1 MEG X 9 60, 70, 80, 100 NS

4 MEG X 8 80 NS  
4 MEG X 9 80 NS

## MEMORY UPGRADES

IBM, COMPAQ, APPLE, MACINTOSH, EVEREX, HEWLETT PACKARD, TOSHIBA, ZENITH, AST, AT&T, EPSON, NORTHGATE, SHARP, MITSUBISHI, SUN MICRO SYSTEMS, ALR

## MATH CO-PROCESSORS

**IIT**

8087-3  
8087-2  
8087-1

**CYRIX**

80287-6  
80287-8  
80287-10

**80287-12**

80287-XL  
80387-SX-16

**INTEL**

80387-16  
80387-20  
80387-25  
80387-33



SHECOM  
HITEK  
KEYBOARD

**\$42**

DEXXA  
By Logitech

**\$35**

WA6  
1:1 MFM  
CONTROLLER  
w/Cables

**\$75**

HI RES  
VGA  
CARD  
w/256K  
(exp 512)  
**\$95**

**SHECOM COMPUTERS**  
22755-G Savi Ranch Parkway  
Yorba Linda, CA 92686  
Tel: 714-637-4800  
FAX: (714) 637-6293

**HOURS (PDT)**  
M-F 8 AM-6 PM



Quantity Pricing Available  
All Merchandise carries  
full manufacturers  
warranty.  
Prices subject to change  
without notice.

Circle 314 on Reader Service Card

**SALES ORDERS CALL 1-800-366-4433**

Every Day, Hundreds Of People Abandon  
Their Keyboard And Buy Northgate™ *OmniKeys*™.

**NOW! Find Out Why  
Risk Free For 60 Days!**

FULL  
5-YEAR  
WARRANTY

Order an *OmniKey* and put it to the test ... if you don't think it's worth every penny you paid, we'll buy it back!

There is no faster—or better—way to type! See for yourself! With *OmniKey*, you don't need to "eye check" the monitor to know you've made an entry. Crisp ALPS key switches let you know with sound and sensation!

Put an *OmniKey* to the test. You'll see, *OmniKey* is not just a replacement keyboard, it's a system upgrade! Order now and we'll deliver one to your home or office for 60 days **RISK FREE!** You have nothing to lose ... everything to gain!



### *OmniKey/ULTRA* With F-Keys On Top And Left!

#### All *OmniKeys* Have These Outstanding Features:

- Unmatched Compatibility; Ask us! We have a keyboard for your IBM type computer!
- LED Indicators show SCROLL, CAPS, and NUM lock status at a glance.
- FCC Class B Certified
- 5-Year Warranty—the industry's strongest! If you have any problems of materials or workmanship, Northgate will repair or replace your keyboard AT NO CHARGE!

PC Computing said "keyboards don't get any better than this." (July '90) *ULTRA* gives you 12 Function-keys on left. PLUS 12 programmable Special Function keys on top, for one-key macro commands.

*ULTRA*'s Interchangeable keys let you swap CTRL, ALT and CAPS LOCK keys on left—and the ASTERISK and BACKSLASH keys on right. *ULTRA*'s one-piece steel base is self-stabilizing for sure-handed typing. The ultimate keyboard for power users!

*OmniKey/ULTRA*

**ONLY \$149<sup>00</sup>**

#### *OmniKey/ULTRA* Features:

- Deluxe 119 key layout.
- 12 Function (F) keys on left.
- 12 Special Function (SF) keys on top—use them as duplicate F-keys or program them for macro commands.
- Interchangeable ALT, CAPS LOCK and CTRL keys on left.
- Switchable ASTERISK and BACKSLASH on right.
- Separate diamond-shaped cursor keypad.
- Calculator style numeric keypad with extra equals key.
- Period/comma lock—locks out <> , punctuation in!
- Lifetime quality double injected keycaps.
- Keys color coded for use with WordPerfect.

# F-Keys on left, top or both—it's up to you!



## OmniKey/102 With F-Keys On Left

First keyboard to get back to the basics! Most people learned to type with function keys on left for fast, one-hand combination commands.

*OmniKey/102* delivers this and more. That's why readers of *Computer Shopper* made *OmniKey/102* their

"Best Buy!" You can customize *OmniKey/102*, too! If you prefer the standard IBM enhanced layout, you can swap the CTRL, ALT and CAPS LOCK keys. The best 102 key keyboard available works with virtually every IBM-type personal computer.

### OmniKey/102 Features:

- Innovative 102 key layout.
- 12 Function keys on the left.
- Interchangeable ALT, CAPS LOCK, and CTRL keys.
- Large L-shaped ENTER key.
- Separate inverted T cursor pad.
- Calculator-style numeric keypad with added Equals key.
- Interchangeable Backslash and Asterisk keys.
- Lifetime quality double injected keycaps.
- Keys color coded for use with WordPerfect.

### OmniKey/102

**ONLY \$99<sup>00</sup>**



## OmniKey/101-I With F-Keys On Top

Many people have become accustomed to the standard IBM layout. For you, we've duplicated, well nearly, the IBM layout (we couldn't resist making a couple of improvements). We made *OmniKey/101-I* with a footprint 20%

smaller than IBM's—saves desk space! We also weren't willing to compromise *OmniKey's* double wide BACKSPACE key and large L-shaped ENTER key—they mean too much in terms of increased speed and accuracy. Customers worldwide agree!

### OmniKey/101-I Features:

- Enhanced 101 key layout.
- 12 Function keys on top.
- Interchangeable CAPS LOCK and left CTRL keys.
- Large L-shaped ENTER key.
- Double size BACKSPACE.
- Inverted T cursor control pad.
- Calculator-style numeric keypad with added Equals key.
- Lifetime quality double injected keycaps.
- Keys color coded for use with Wordperfect.

### OmniKey/101-I

**ONLY \$89<sup>00</sup>**

CHARGE IT! We accept VISA and MasterCard.

**800-526-2446**

HOURS: Mon.-Fri. 7 a.m. to 10 p.m.; Sat. 8 a.m. to 4 p.m. Central. Dealer and distributor prices available. **Se habla español por su conveniencia.**

FAX Your Order! 612-943-8332  
Notice to the Hearing Impaired: Northgate now has TDD capability: 800-535-0602

**NORTHGATE  
COMPUTER  
SYSTEMS**

*"We hear you!"*

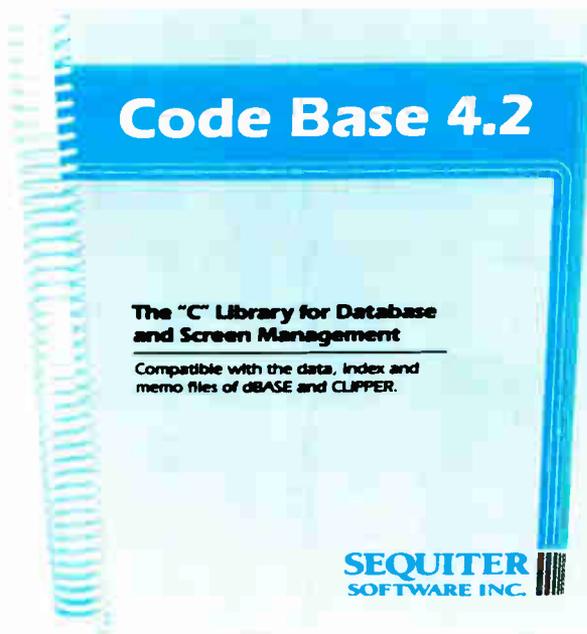
7075 Flying Cloud Drive, Eden Prairie, MN 55344

©Copyright Northgate Computer Systems, Inc. 1990. All rights reserved. Northgate, *OmniKey* and the Big 'N' logo are trademarks of Northgate Computer Systems. Other brand names are trademarks or registered trademarks of their respective owners. Specifications subject to change without notice. Subject to occasional inventory shortages. 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.

Circle 265 on Reader Service Card

World Radio History

# C Speed C Portability C Flexibility



## dBASE Power

*Build a multi-user, dBASE compatible application which is several times faster than dBASE IV, Clipper or Fox Pro. Watch its windows and menus appear instantly on any computer.*

### Portable

Port your application to any environment with a C or C++ compiler. Access megabytes of memory using 386 DOS compilers, OS/2, Unix or Microsoft Windows.

### Compatible

As you directly use the data, index and memo files of dBASE III through IV or Clipper, you can use Code Base 4.2 with any dBASE compatible product.

### Easy

Consult examples in the 280 page user's guide as you interactively execute Code Base 4.2 routines from a learning utility. You will remember the routines which are named like dBASE commands.

### Small

Make stand alone executable files as small as 14K. Code Base 4.2 executables are  $\frac{1}{2}$  to  $\frac{1}{3}$  the size of corresponding Clipper executables.

### Complete

Enjoy the benefits of complete dBASE functionality, including browse, edit, menus, windows, multiple index files per database, dBASE expression evaluation, relations and filters.

### Order Today

Order the DOS-OS/2 version for \$295. Call (403) 448-0313 or fax (403) 448-0315. Discover why Sequiter Software Inc. and most software dealers offer a 60 day money back guarantee. Source is included and there are no royalties!

Sequiter Software Inc. • P.O. Box 5659, Station L, Edmonton, Alberta, Canada T6C 4G1

Circle 313 on Reader Service Card

World Radio History

## REVIEW

# One-Size-Fits-All Code with Lattice C

**N**o one can argue this: Software portability is now more important than ever. The problem for developers, though, is that creating a program that runs under DOS, extended DOS, and OS/2 is no easy task. Often it means collecting a huge library of disjoint programming tools. And if you also consider the increasing importance of Unix, the problem becomes even bigger.

Lattice's newest C compiler package, the 80286 C Development System for DOS and OS/2, addresses much of this concern. It enables developers to create programs that run under DOS, extended DOS, and OS/2. The kicker is that, with Lattice, all three environments can be supported by a *single* executable file. And Lattice includes over 800 functions, many of which mirror Unix calls.

Other development environments exist, of course, that let you use extended memory (i.e., separate third-party DOS extender products, OS/2 itself, and the 386 enhanced mode of Windows 3.0). But Lattice is the first major compiler vendor to *include* a DOS extender with its compiler that gives DOS programs access to 286 or 386 extended memory. There are no fees or royalties when you distribute the Lattice extended DOS facility with your application. And the

users of your application do not necessarily have to upgrade to OS/2 when your software starts running out of RAM.

## The Shootin' Match

The new Lattice development environment includes all the tools and library routines of the regular compiler product (version 6.0). You get a full-screen symbolic debugger, CodeProbe, that runs under both DOS and OS/2. The LASM assembler is mostly compatible with MASM, although it does not handle MASM-style memory-model directives and some assembler macros.

For projects with many source code modules, a make utility (LMK) is supplied that is a superset of the Unix make. EXTRACT and BUILD utilities are also supplied to help you create your make files. Other utilities let you find and optionally change all occurrences of a specified string in your source code files as well as produce source code statistics. Lattice provides its own linker, bind program (for constructing family mode applications), and object file librarian.

The standard library is fully ANSI compliant and incorporates many functions you'd find in a Unix environment. Lattice has added several useful functions of its own to the standard library: The "build string list" and "sort string list" functions are examples of routines that tempt you to forgo strict ANSI coding in your programs. In addition to the standard library of functions, Lattice gives you these application libraries:

- **Communications Library:** supports XMODEM, YMODEM, and Kermit.
- **Database Library:** creates and manipulates dBASE III-compatible files.
- **Graphics Library:** has several drawing routines, but limited font support.
- **Screen Management Library:** text-mode routines very much like Unix curses.

## Installing, Tuning, and the Dongle

The installation of the Lattice 80286 C compiler and its tools is straightforward. Basically, you choose whether you want OS/2 support, and you pick the memory models you want; the installation program then puts the files into the correct

directories. It requires about 5 megabytes of disk space. To take advantage of the features of this compiler, I used my Gateway 2000 386/33 computer as a test bed. It has 4 MB of extended memory, and I regularly use it for both OS/2 and DOS development work.

The installation process is noteworthy in two ways. First, you must let the DOS extender software "learn" about your hardware by running the TUNE utility. TUNE attempts to find the fastest way to enter and leave protected mode on your system, possibly crashing your system in the process. Users of software you produce with Lattice's extender will have to TUNE it, as well.

Second, Lattice decided to copy-protect this compiler product with a hardware device, called a *dongle*, that attaches to your parallel port. The dongle sits transparently between your printer cable and the parallel port. There is no mention on the package about any sort of copy protection. Frankly, I was annoyed by the implications of copy-protecting a professional software development tool.

## Compiling Your Code

To check out the compiler, I created extended DOS versions of the LAN-aware programs that accompany my book *Network Programming in C*. I also compiled the Dhrystone benchmark program. Comparing the size of the resulting executable files with the output of other C compilers proved difficult. The bound family mode version of any program is naturally larger than a pure DOS or pure OS/2 version. Being able to create a single executable file that works correctly under DOS, extended DOS, OS/2, and the DOS compatibility box is an impressive feat.

Performance-wise, the Lattice compiler emits code that is comparable to that of other C compilers. The Dhrystone benchmark ran in 5 seconds no matter which C compiler I used. The results were consistent when I ran the program in DOS mode, in extended DOS mode, and under OS/2.

When you tell the compiler to optimize your code, it invokes a separate step (the global optimizer, LGO) just prior to linking. Because the optimizer gets to see as much of the emitted object file as it wants, the optimizer can make intelligent decisions about what to streamline.

### Lattice 80286 C Development System for DOS and OS/2



#### Company

Lattice, Inc.  
Subsidiary of SAS Institute, Inc.  
2500 South Highland Ave.  
Lombard, IL 60148  
(800) 444-4309

#### Hardware Needed

A 286- or 386-based IBM AT, PS/2, or compatible, 512K bytes of RAM (2.5 megabytes for OS/2), 5 MB of free space on a fixed disk, and parallel port for copy-protect device

#### Software Needed

DOS 2.1 or higher; OS/2 1.0 or higher

#### Price

\$495

#### Inquiry 1225.

**T**he  
*Lattice debugger is a  
 command-line debugger  
 at heart.*

It looks for opportunities to turn functions into in-line code, eliminate dead code assignments, perform peephole optimizations, eliminate common subexpressions, and do other things to make your code faster (or smaller, depending on what you specify).

If you have variables marked volatile, the optimizer won't eliminate references to them. Likewise, if you have a function that calls itself recursively, you can control the depth to which the opti-

mizer "unrolls" the code as it transforms called subroutines into in-line code.

### The Lattice Toolbox

The Lattice debugger, CodeProbe, operates in full-screen mode but is a command-line debugger at heart. Interestingly, when you choose a CodeProbe menu option, the software emits a line of debugger commands to itself. This internal discourse is visible in the debugger's dialog window. CodeProbe works in DOS, extended DOS, and OS/2 modes. It supports conditional breakpoints, data watches, slow-motion execution, and other customary debugger facilities.

The text editor that comes with the Lattice compiler, LSE, is adequate for most programming purposes. It's quick, has an interface to the Lattice compiler, and allows multiple source code files to be edited in multiple windows. Several other tools are provided with the compiler. The linker, LMB, supports both code and data overlays.

The screen management routines that you get with the compiler are a close adaptation of Unix curses. I was able to easily move a small Unix program from an IBM RS/6000 AIX machine to my Gateway computer and compile it for OS/2. I smiled inwardly to see a typical curses user interface appear in an OS/2 session when I ran the program.

Lattice does not supply a hypertext on-line reference with its compiler, although, of course, each part of the development environment has an associated help file that you can access. Speaking of help, the on-line support for the Lattice compiler that has been available for years on BIX has been discontinued by Lattice's parent company, SAS.

The Lattice 80286 C Development System for DOS and OS/2 is a well-documented, high-powered environment. As I put the compiler and tools through their paces, I tried to visualize myself as a developer who has a memory-hungry application. Faced with the decision to shoe-horn my software and stick with DOS or force my customers to upgrade to OS/2, I'd see the Lattice DOS extender as a welcome alternative. And the curses interface might encourage me to port my application to run under Unix so I could take advantage of that marketplace as well. But as good as this compiler is, Lattice may have tied a millstone around its neck with the copy protection. ■

*Barry Nance is the author of Network Programming in C and is the exchange editor for the IBM Exchange on BIX. He can be reached on BIX as "barryn."*

## TURN YOUR PCs INTO X TERMINALS

HCL-eXceed family  
 of X servers for  
 DOS PCs from  
 Hummingbird.

Our  
 Release 11.4  
 implementation  
 of X servers is opti-  
 mized for 286-, 386-  
 and 486-based PCs  
 with EGA, VGA, super  
 VGA, or 8514A compatible  
 graphics controller.

The servers support TCP/IP  
 transports from FTP  
 Software Inc., Excelan,  
 Ungermann-Bass,  
 Hewlett-Packard,  
 Wollongong,  
 3Com, Beame  
 & Whiteside,  
 and Sun.

HCL-eXceed,  
 a real mode server,  
 for PCs with as little as  
 640K of memory.

HCL-eXceed Plus, a protec-  
 ted mode server, makes up to 16MB  
 of memory accessible to X clients.

HCL-eXceed Plus/8514A, a protec-  
 ted mode server supports 8514A  
 hardware compatible display adaptors  
 for high resolution graphics with 256 colors.



**HUMMINGBIRD  
 COMMUNICATIONS LTD.**

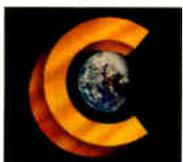
2900 John Street, Unit 4  
 Markham, Ontario, Canada L3R 5G3  
 Telephone: (416)470-1203, Fax: (416)470-1207

# WATCOM C8.0/386

Optimizing C Compiler and Tools  
for 386 Extended DOS

# Unleash 386 Power on Your Microsoft C Code.

- Interactive source-level debugger
- Generates high-performance code for 32-bit protected mode
- Microsoft source and library compatible
- Fast, tight code
- Profiler
- Protected-mode version of compiler
- Graphics library
- 100% ANSI C and SAA compatible
- Run-time compatible with WATCOM FORTRAN 77/386



## Experts Agree on WATCOM C:

"When Novell went looking for a 32-bit compiler for use with the NetWare 386 developer's kit, the company selected WATCOM's...It's clear that Novell chose wisely; this product is a winner."  
*Fred Hommel, BYTE, December 1989*

"WATCOM C/386 is a fantastic new ANSI C compatible compiler for 386-based PC's...If you have written your application in Microsoft C, you will love this compiler."  
*J. Richard Hines, Electronic Test, December 1989*

"Microsoft library- and source- compatibility makes WATCOM C7.0/386 ideal for porting DOS applications to 32-bit native mode. This compiler enables full 386 performance without 640K limitations."  
*Richard M. Smith, President, Phar Lap Software, Inc.*

"WATCOM is definitely the leader in object-level optimizations...For flat-out executable speed...WATCOM C showed shining performance."  
*Computer Language, February 1989*

## WATCOM C8.0/386 Professional

• 100% ANSI C optimizing compiler • Protected-mode version of compiler • 386 run-time library object code • Windowed source level debugger • Profiler • Editor • 386 graphics library • MAKE • Linker • Object-code librarian • Object-code disassembler • Supports Phar Lap and ERGO DOS extenders

## WATCOM F77/386

• 32-bit optimizing FORTRAN compiler based on WATCOM C technology • Full ANSI FORTRAN 77 plus extensions • Includes WATCOM C development tools: Windowed source-level debugger, Profiler, Editor, MAKE, Linker, Object-code librarian and Object-code disassembler • Protected-mode version of compiler • Run-time compatible with WATCOM C8.0/386 • Supports Phar Lap and ERGO DOS extenders

## WATCOM

## 1-800-265-4555

415 Phillip Street, Waterloo, Ontario, Canada N2L 3X2 Tel. (519) 886-3700 Fax (519) 747-4971

WATCOM C is a trademark of WATCOM Systems Inc. Trademarked names are the properties of their respective owners.  
© Copyright 1990 WATCOM Products Inc.



Until now, what appeared to be, was. Until now, there's only been one way to look at data. Now there's **ThinX**<sup>™</sup> software. The revolutionary Windows<sup>®</sup> program that finally links graphic images with databases and spreadsheets and lets you see data in a whole new way. 1-800-688-4469.



World War II History

© Bell Atlantic Windows is a trademark of Microsoft Corporation.

© **Bell Atlantic**  
We're More Than Just Talk.<sup>®</sup>  
Circle 45 on Reader Service Card

Introducing Omnistor™, the first 5¼" optical disk drive subsystem to support both Write-once (WORM) and Eraseable Magneto-Optic (MO) technology in a single multi-function unit. Utilizing ANSI/ISO standard 654MB, sampled-servo 5¼" media, Omnistor provides a turnkey solution for both your intermediate and permanent archival data storage requirements. Omnistor is available for a wide variety of host environments, in both standalone and auto-changer subsystem configurations.

Computer Upgrade Corp., a leader in optical archival storage solutions since 1986, offers



OEM, VAD/VAR, and End-User pricing on both Omnistor and our traditional optical subsystem solutions. At Computer Upgrade the early bird catches more than the WORM, they catch the competitive advantage.

Call today for more information.  
Computer Upgrade Corp.  
2910 E. La Palma Ave.  
Bldg A, Anaheim  
CA 92806  
FAX  
(714) 630-9254



Computer Upgrade®

800/874-8807

# A NEW CONCEPT IN OPTICAL DISK DRIVES.

## REVIEW

# Document Management on Networked PCs

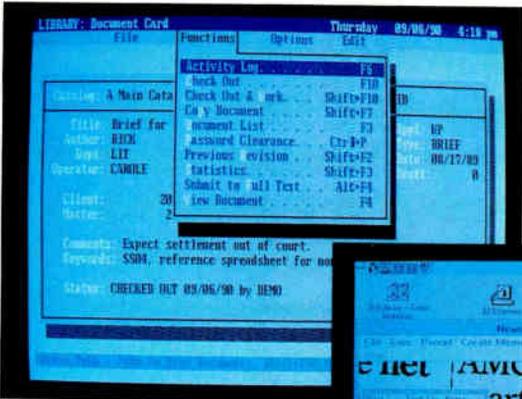
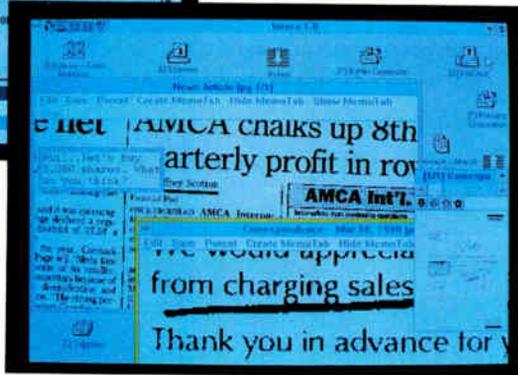


Photo 1: ProFound's card catalog keeps track of several important document statistics and searchable field descriptions.

Photo 2: Imara lets you attach electronic notes called MemoTabs to document images.



As the number of files on a network increases, locating files becomes more difficult, and tracking multiple versions of a document becomes virtually impossible. Time is often wasted by working with out-of-date documents, and file access becomes harder to control. Perhaps most worrisome, frustrated system users may become less disciplined about file backups and may resort to archiving documents instead of simply deleting their obsolete files.

ProFound, from Wang Informatics Legal & Professional Systems, and Imara, from Imara Research, take two different approaches to the problem. ProFound is a character-based DOS application designed to help manage word processing and other live documents on a network; Imara is an OS/2 Presentation Manager-based application that manages graphics and documents that have been stored as image files.

Both Imara and ProFound support distributed (client-server) computing by enabling files on different file servers to be stored and accessed transparently across a network. And both products use the metaphor of a library with a document catalog to control access, storage, and archiving of files that have been checked into their databases.

Imara is aimed at companies moving

toward a paperless office. Imara users scan or import paper documents into Imara's Structured Query Language (SQL) database as compressed Group 4 fax files. Then Imara's image documents are shared among different workgroup members using Imara's built-in E-mail facility (called I-mail).

ProFound provides a more pedestrian solution to document management, relying on the character-based DOS interface and working with files created using word processors, spreadsheets, or other applications. ProFound's mainstream solution contrasts sharply with Imara's attempt to redefine how office workers share information. But while both products provide features that can help you manage your distributed office systems, neither provides a complete solution to the problem of distributed file management.

## ProFound Document Libraries

ProFound helps network administrators manage their users' file requests and document storage requirements by automatically copying, distributing, and backing up their documents across multiple file servers. When you first start ProFound, you can go into one of two areas: the work area or the library.

The work area is where documents and

files are created and edited. A catalog card is automatically created in the work area as each new document is created, and it is updated when any revisions are made.

You can configure ProFound to automatically start the application you will be using after you create your catalog card. After a document is created or revised, ProFound checks it into the library. The library contains one or more catalog files that contain a catalog card for each document. Different workgroups can be assigned to one of 26 different sections in the library. A workgroup can be assigned to its own catalog and section, or many workgroups can be assigned to the same catalog and section.

Each catalog card comprises two screens. The first contains identifying information for the document, including title, author, department, operator, client, matter, comments, and keywords. The second screen contains document statistics such as date created, last access date, last user, number of revisions kept, archive interval, chargeback method and statistics for billing clients (including the actual and charged number of keystrokes), pages printed, and time. Most of the field descriptions can be customized (see photo 1).

Once a catalog card has been created, ProFound can perform searches on 18 different fields, including indexed fields such as author, department, date, client, and matter, and on user-definable keywords. You can use both range and Boolean search parameters to find any documents that have been checked into ProFound. ProFound also does full-text indexing and searching.

Documents that match your search request can be previewed in the library, copied to a new document in your work area, or checked out for modification. You can store document templates in ProFound, but inexperienced users would benefit from having these set up by their system administrator.

ProFound automatically maintains an audit trail of activity for each document, and it can maintain up to 99 revisions of each document. Most users will maintain only a few revisions and will save disk space by archiving their older revisions. You can configure ProFound to automatically back up files to specified directories and to automatically archive files after a predetermined number of days, if the files have not been checked out for that period of time.

Access to documents is controlled through the use of passwords, which can be assigned for each operator, author,

# New!

“The World’s Most Accurate Mouse”



**Sleek, dependable and compatible. The PC Mouse III from Mouse Systems.**

Pin-point digitizer accuracy using patented M5 optics. Supports Microsoft™, MSC, and PS/2 protocols. 100% hardware and software compatibility guarantee. *True lifetime warranty.* Get your hand on the world’s most accurate mouse today!



**Special Introductory Offer**

Buy a PC Mouse III and receive a free copy of Power Panel™ the ultimate DOS utility shell. (PC Magazine Editor's Choice, June 12, 1990.)



47505 Seabridge Drive  
Fremont, CA 94538  
(415) 656-1117

The following are trademarks of their respective companies: PC Mouse III, Power Panel, Mouse Systems Corporation; Microsoft, Microsoft Corporation; PS/2, IBM.



## ProFound

### Company

Wang Informatics Legal & Professional Systems  
2111 East Highland, Suite 400  
Phoenix, AZ 85016  
(602) 224-0855

### Hardware Needed

IBM XT, AT, PS/2, or compatible with 640K bytes of RAM and a hard disk drive with at least 2 MB of storage

### Software Needed

DOS 3.1 or higher and Novell NetWare 2.15 or 386; Banyan VINES 3.1 or higher; or 3Com 3Share network operating system

### Price

First five users: \$995

### Inquiry 1076.

department, or document. Users can be assigned access or modification rights to any or all documents in the system.

ProFound uses a WordPerfect-like interface with pull-down menus, pop-up windows, on-line context-sensitive help, and lots of command keys. ProFound is easy for experienced WordPerfect users to learn and is relatively easy to set up.

The system administrator guide is clearly organized and uses a step-by-step approach. However, the guide does not provide a top-down view of how the program's modules interact. It is best to simply read the system administrator guide cover-to-cover before setting up the program.

As with many database programs, interdependent modules eliminate any hope of shortcuts. Network administrators should plan to spend some time determining the most efficient way to set up ProFound's library and to distribute their workgroup's documents across their network's servers. Once ProFound has been set up, however, its on-screen prompting should enable experienced word processors to master ProFound in an hour or two.

ProFound has been integrated with WordPerfect 5.1 and Jurisoft's CompareRite. If you are using WordPerfect, the ProFound interface takes over when you create, load, or save a document. When you save documents, ProFound's Integrated Document Card Screen is dis-

## Imara

### Company

Imara Research Corp.  
111 Peter St., Suite 804  
Toronto, Ontario  
Canada M5V 2H1  
(416) 581-1740

### Hardware Needed

Intel 386SX-, 386-, or i486-based workstations with 4 MB of RAM and VGA; HP ScanJet; HP LaserJet; GammaLink's GammaFax adapter; 30-MB hard disk drive; network server with 8 MB of RAM and 100-MB hard disk drive or optical disk storage

### Software Needed

OS/2 1.2; OS/2-compatible network operating system; network-based SQL database server

### Price

First two users: \$2995

### Inquiry 1077.

played, enabling you to check your document into ProFound without leaving the WordPerfect interface. If Jurisoft's CompareRite has been installed, past revisions can be red-lined from inside ProFound.

Although ProFound is designed to work with any office workgroup, its most obvious audience is professional offices that do time or project billing. ProFound automatically records keystrokes, time spent in each document, and the number of pages that have been printed. This information is displayed on each document's catalog card and can be printed in a disbursement report. Charges can be accrued on a straight time basis or on a per-document basis. After the clients have been entered into ProFound's client section, ProFound automatically verifies that documents belong to a specific client and generates a disbursement charge report that can be exported into several time-billing programs.

ProFound requires an IBM XT, AT, PS/2, or compatible with 640K bytes of RAM and a hard disk drive with at least 2 MB of storage. The program runs on DOS 3.1 or higher and supports Novell Advanced NetWare 2.15 or higher, NetWare 386, or Banyan VINES 3.1 or higher.

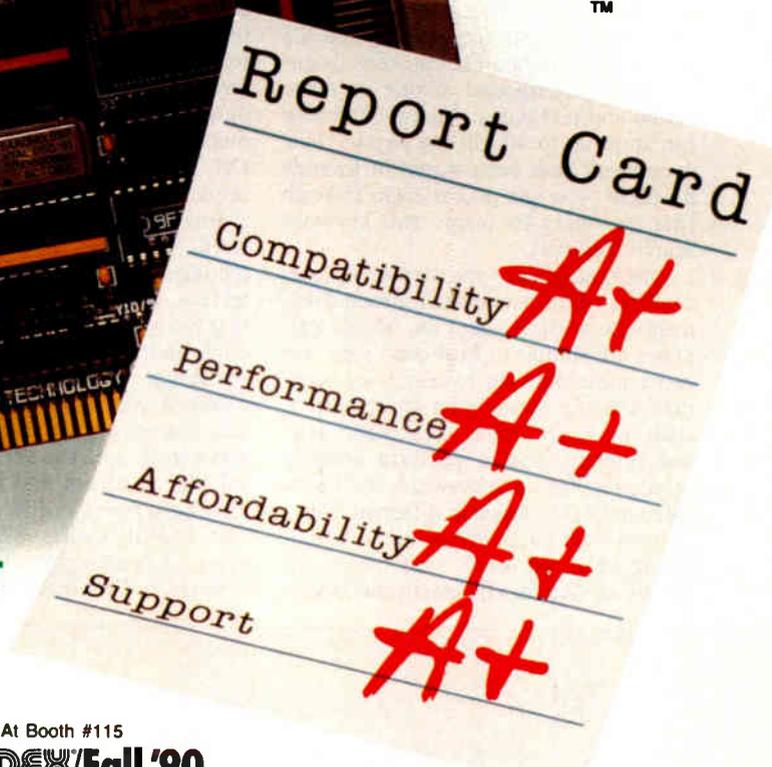
### Imara Imaging

Imara uses a client-server architecture built on Microsoft's OS/2-based SQL Server. Once you have stored documents

Announcing the end of the SCSI compatibility crisis:



TM



The SCSI disk controller from DPT that's so intelligent, it doesn't need special software drivers!

See Us At Booth #115

COMDEX/Fall '90  
November 12-16, 1990  
Las Vegas, Nevada

*Makes the grade without software drivers*

SCSI connectivity hassles are a thing of the past! SmartConnex makes it possible for the first time to run SCSI disk drives without special software drivers or BIOS ROMs that cause compatibility problems. Just plug in SmartConnex and you're all set—exactly as though you were using a standard ST506 drive. And, you'll enjoy optional connectivity to hundreds of other peripherals with appropriate software, including tape and optical drives.

*A Ph.D. in compatibility*

SmartConnex is compatible with all PC ATs and operating systems, and is guaranteed to work with all existing AT applications. So it isn't necessary to buy new programs or make any changes to system software. No matter what operating system or SCSI disk drive you use, you won't have to worry about controller compatibility.

*A 68000 I.Q. on board*

SmartConnex's on-board 68000 processor and custom-designed ASIC chips make it the highest-performance controller on the market. Its unique design pushes the fastest SCSI disk drives to their top performance limits!

*An A+ in affordability*

SmartConnex costs less and performs better than other products—it's that simple. When you consider cost along with SmartConnex's other great advantages, there's no smarter move!

*Backed by the best: DPT*

Distributed Processing Technology was the first to develop caching disk controllers and hardware disk mirroring for micro-computers, and is the recognized leader in the industry. Our products have been at work for over a decade, speeding up minis and mainframes. We offer a 1-year warranty, clear documentation, and outstanding technical support.

*Put SmartConnex to the test!*

Call today and find out more about the end of the SCSI compatibility crisis—with SmartConnex, from DPT.



132 Candace Drive  
Maitland, FL 32751  
Phone: (407) 830-5522  
FAX: (407) 260-5366

Circle 116 on Reader Service Card (RESELLERS: 117)

in Imara as compressed Group 4 fax images, you can share them within a PC-network environment.

Imara uses a five-level hierarchical cataloging system. Users define their image database by creating *sets*, which are analogous to file cabinets; *categories*, which are like file drawers; and *file folders*, which contain *documents*. Documents are composed of one or more image and text *pages*. Imara's database can store up to 40 million pages. Once documents have been stored in Imara's database, you can access them through Imara's query-by-forms and keyword search facilities.

After categories have been set up, you can fill in a form template for each document you wish to check in. These templates are similar to ProFound's catalog cards and enable you to search for documents using structured information, such as owner, topic, action-due-date, and priority, and to perform unstructured searches using keywords that cross-reference information in different files.

Individual pages can be retrieved and displayed at the user's workstation and can be annotated with electronic Memo-

Tabs. MemoTabs are electronic notes that provide a convenient way to share comments about a particular image. They can be either displayed on the image or hidden to facilitate printing.

Users create their filing system by creating new sets, categories, and folders interactively with Imara, or by using Imara's Execution Language (IXL) to create a database script. If you will be moving many documents into Imara, it is much faster to create a database using IXL than to create the database as you import your files.

Imara's script language is straightforward—Imara has done a good job of protecting the user from the SQL Server interface. But the documentation assumes that the system administrator has a thorough understanding of SQL Server and of the networking environment.

When you start Imara, you see four icons: a server, an in box, an out box, and a trash can. The server icon includes all the document and image files that have been stored in different sets, categories, and file folders. The in box lets you scan or fax graphics files and import ASCII text files into the system. The out

box lets you fax, print, export, or I-mail files. The trash can lets you delete or remove files (see photo 2).

When you first click on a page in a document, two windows appear: a page tool and a page window. The page window displays a portion of the image file that you have loaded into the Imara desktop. The page tool's Panview displays a miniature of the entire page, along with a shaded rectangular area called the *lens*. The area in the lens indicates the specific portion of the page. By dragging the lens in the page tool with your mouse, you can view different parts of your image file in the page window. Imara also has a preview feature that lets you view an image without loading and decompressing it.

Imara's I-mail lets you distribute documents by copying or linking them to other folders. I-mail is too limited for general office messaging, however; it only provides a one-line message field.

Much of Imara's power comes from its ability to link documents. Linking documents assigns pointers from a document to different file folders. This helps conserve disk storage and allows users working within different file folders to view

# Harvard Graphics<sup>®</sup> And The HP LaserJet III Invite You To A Very Exciting Presentation.

or modify multiple copies of a document.

Imara's use of Group 4 file compression enables you to store 8½-inch by 11-inch 300-dot-per-inch images, which normally require about 3 MB of storage, in several hundred kilobytes. But Group 4 compression doesn't work well with complex images like photographs; in fact, this type of image may be larger after compression. But the bottom line, according to Imara, is that storage costs using "jukebox" optical drives have come down to about 5 cents per page—provided you make the initial investment in such equipment. This is competitive with microfilm and paper-based document storage systems.

I found that 150-dpi scanned or faxed images are hard to read on a standard 14-inch VGA monitor. Using a 1024- by 768-pixel enhanced VGA display or a 1280- by 960-pixel 19-inch Monitorm display greatly enhances document legibility and obviates the need to print out as many files. Since Imara currently supports only monochrome displays and printers, most users will opt for a large high-resolution monochrome display.

Imara has written its own OS/2 driver

to support the HP ScanJet Plus, and the company recommends GammaLink's GammaFax. (At press time, GammaLink was the only fax-modem supplier shipping an OS/2 driver.)

Imara's ScanJet interface works flawlessly, but I discovered that Hewlett-Packard's interface card conflicts with 16-bit VGA cards. (This can be resolved by plugging 16-bit VGA cards into an 8-bit slot.) Scanning images requires patience; most users will eventually be compelled to invest in an automatic document feeder for their scanner.

All this power takes its toll in the hardware department. Imara workstations require at least a 386SX-based PC with 4 MB of RAM, a 30-MB hard disk drive, a VGA adapter and monitor, a mouse, and a network adapter running OS/2 1.2 or higher.

Imara servers require a 386 processor with at least 8 MB of RAM, a 100-MB hard disk drive, and a network operating system that supports OS/2 1.2 with Microsoft SQL Server 1.1, Oracle Server, or IBM's Database Manager.

Imara recommends using WORM (write once, read many times) optical

disk storage, HP LaserJet printers with at least 2 MB of memory, GammaLink's GammaFax, a LaserMaster LXI printer controller (to enable the LaserJet to print images at a usable speed), and an HP ScanJet Plus.

### Management Decisions

Both Imara and ProFound solve real-world document management problems. But despite their implementation of advanced client-server technologies, neither product lets users manage both text and image files effectively.

Businesses such as law firms and accounting firms that have standardized on particular DOS applications like WordPerfect or Lotus 1-2-3 should give ProFound careful consideration. Businesses such as insurance companies managing many graphics-based documents that include diagrams, hand-written notes, and signatures will find Imara invaluable. ■

*Doug Dayton is the founder of Dayton Associates, a computer-industry marketing and consulting firm in Bellevue, Washington. He can be reached on BIX clo "editors."*

# Yours.

Harvard Graphics 2.3 from Software Publishing Corporation brings new dimensions to presentation graphics. The Hewlett-Packard LaserJet III printer writes a new chapter in printing history.

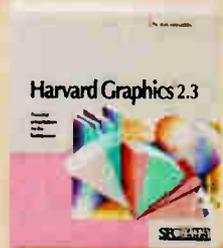
Put them together and your presentation becomes a major event.

Harvard Graphics is packed with easy-to-use new features that will dazzle your audience—like a gallery of pre-designed charts and DrawPartner™, an integrated advanced drawing package.

The HP LaserJet III has raised the standard of printing excellence

with HP's exclusive Resolution Enhancement technology. Your graphics will look unusually sharp—better than ever before.

With Harvard Graphics and the HP LaserJet III, your next presentation is certain to be well attended. And well received.

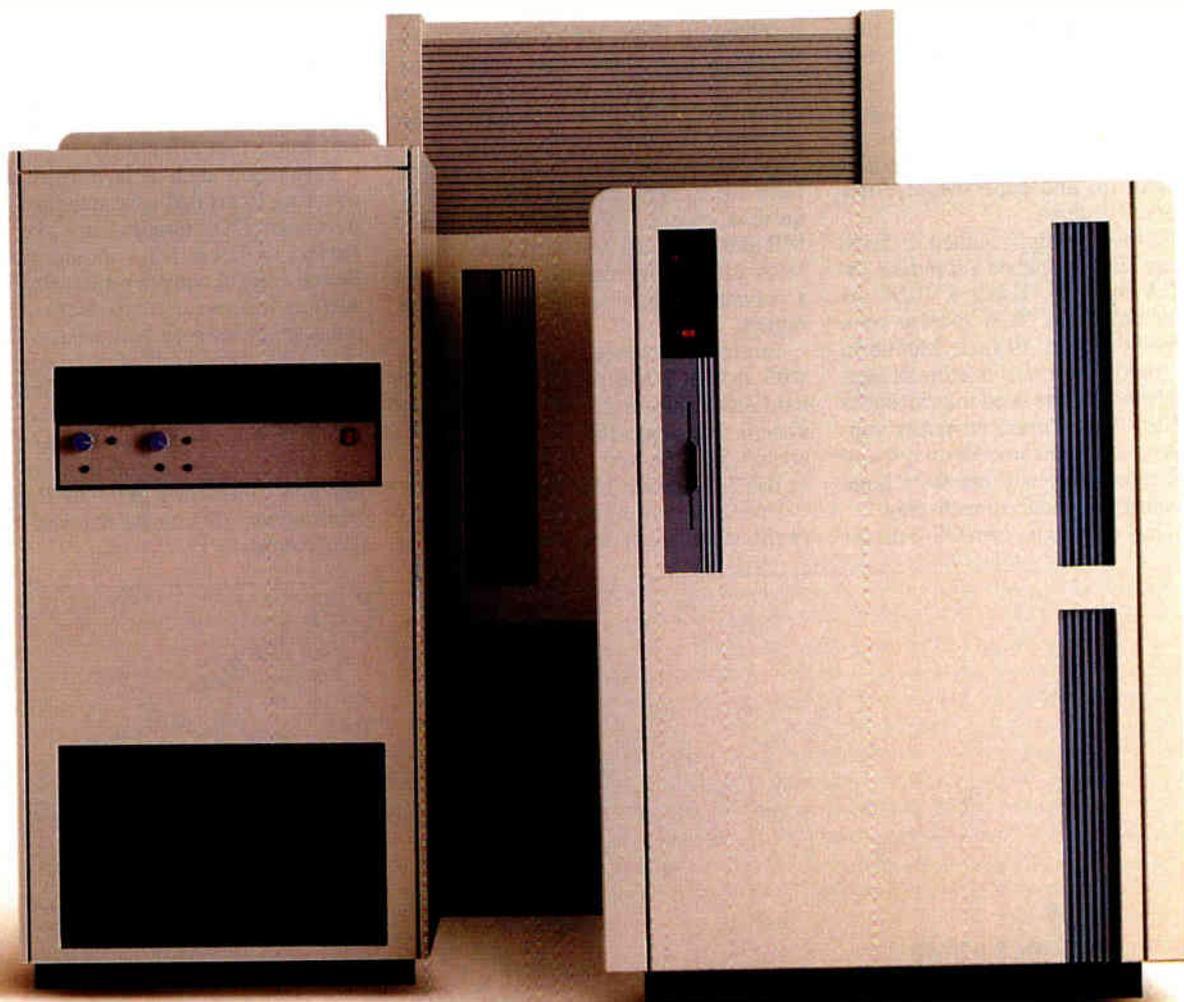


**SPC** SOFTWARE PUBLISHING CORPORATION

Circle 317 on Reader Service Card

Harvard Graphics and DrawPartner are trademarks of Software Publishing Corporation. HP LaserJet III is a product of Hewlett-Packard.  
© 1990 Software Publishing Corporation, 1901 Landings Drive, Mountain View, CA 94039-7210

# The Joneses.



Check out the benchmarks. When it comes to speed, pure and simple, mainframes are no longer the main attraction.

Introducing the Everex STEP 486/33 and STEP 486/25. Along with the STEP 486*is*, they give you desktop performance that was previously unheard of.

There are two reasons. The first, of course, is the 486™ chip. The other is AMMA,™ Everex's proprietary Advanced Memory Management Architecture.

STEP 486/33	34,000 Dhrystones (19.4 MIPS)
CRAY-X-MP/48	17,857 Dhrystones
IBM 3083	16,666 Dhrystones

AMMA uses "write-back" cache technology instead of the "write-through" technologies used in most PC's. The write-back cache was developed for mainframes. Everex was the pioneer in developing it for the PC. And in doing so, opened a whole new dimension in desktop performance.

With AMMA, you can write directly to the STEP 486's cache in nearly all cases. With write-through techniques, on the other hand, you lose most of the performance benefit of the cache.

\*Inquiries from outside the U.S. call 415-498-1111. EVER for EXcellence is a registered trademark and Everex, STEP, STEP 486*is*, AMMA and PDS are trademarks of Everex Systems, Inc. 486 is a trademark of Intel Corp.

# And how to keep up with them.



That's because write-through forces you to write to main memory much more often. And main memory is slower than the cache.

This is especially important in 486 computing, where the CPU performs as many as four times the write operations as in 386. Which makes AMMA's write-back architecture, combined with the 486's embedded cache, a powerful combination indeed.

But the STEP 486 machines give you more than just speed. They come with Programmable Drive Select. If your drive isn't listed on the set-

up table, PDS™ lets you custom-configure the BIOS. It's good for virtually any hard drive.

What's more, all STEP systems come with a one-year extendable warranty and a one year renewable on-site service contract that also covers all Everex peripherals in the system.

To find out more, call 1-800-334-4552\* for the name of your nearest Authorized Everex Reseller—every one a high performance expert.

Then you can let the Joneses try keeping up for a change.



## REVIEW

## Small, Low-Cost UPSes



PC Power's InnerSource 2210 (left) takes a unique approach to backup power by offering a UPS as a replacement for a standard supply. Upsonic's PC Might-25 (right), a single-user UPS, is the smallest, lightest unit BYTE has seen.

**D**ata residing on a single-user system is not any less critical than data stowed on a network file server. But until recently, protecting your single-machine installation from the vagaries of your utility company often meant shelling out the cash for a big, noisy uninterruptible power supply (UPS) with more capacity than you required.

Upsonic and PC Power & Cooling offer two solutions to the problem of supplying reliable power to a single machine. The Upsonic PC Might-25 is a small, quiet, and inexpensive UPS that's suitable for use on a desktop. PC Power

& Cooling's InnerSource Model 2210 is a drop-in replacement for AT power supplies with an internal standby system and AC power for the monitor.

Strictly speaking, both the PC Might-25 and the AC side of the InnerSource are standby power supplies (SPSes). When utility power fails or dips below a critical level, they switch from providing power directly from the line to providing power from a built-in battery. When there is adequate AC power, they use some of the available energy to recharge the battery.

While these two models are functionally similar, their design philosophies

are radically different. The PC Might-25, although small and inexpensive, is more or less a traditional SPS; the InnerSource, on the other hand, avoids many of the problems of providing AC backup by supplying DC power directly to the computer.

**PC Might-25**

At \$195, the PC Might-25 is easily the least expensive SPS I have come across. The price is low enough to attract people who may never have considered buying an SPS in the past. What you get won't shatter any records for holdup time or provide the same type of power your system's power supply is used to, but it will provide adequate power for conducting an orderly shutdown.

The unit is not much bigger than a large modem or a small external disk drive. Installation is simple. The nine-page user's manual is enough to describe user interaction with the system in sufficient detail.

As you might expect from the unit's size, holdup time is limited. The PC Might-25 shuts off before the battery is completely drained, to lengthen battery life and shorten recharge time. I measured holdup time with two loads. The first was a small 286 system running a hard disk drive and a monochrome monitor; this system drew 0.8 amperes of current, so the power requirement was about 40 percent of the PC Might-25's capacity. The second load was a larger 486-with-VGA unit that drew close to twice as much power. The results are shown in figure 1.

When the power goes off, the unit sounds a noticeable but unobtrusive alarm. That's its only communication—since it is meant to back up single systems, the unit has no ports for sending signals over a network or to the protected system for automated shutdown.

Small capacity offers one small advantage: It takes very little time to recharge the unit. Upsonic claims that a full recharge can be completed in 2 to 3 hours.

I had no problems running systems during standby operation. The manufacturer specifies transfer time (the time to switch from normal to backup power) at 4 milliseconds, which should be quick enough to escape the computer's notice. Cut-in and cut-out points are fixed at 102 volts and 108 V, respectively, so if you experience frequent brownouts, the system may go on and off more than you would like.

Backup power has a modified square waveform. Engineers argue over whether

**PC Might-25****Company**

Upsonic Corp.  
One Park Plaza, Suite 600  
Irvine, CA 92714  
(714) 833-7162

**Hardware Needed**

Microcomputer system  
(drawing 250 VA or less)

**Price**

\$195

**Inquiry 1106.**

**InnerSource Model 2210****Company**

PC Power & Cooling, Inc.  
31510 Mountain Way  
Bonsall, CA 92003  
(619) 723-0075

**Hardware Needed**

AT or 386 computer with space for a full-size (8 $\frac{3}{8}$ " × 5 $\frac{9}{16}$ " × 5 $\frac{1}{16}$ "-inch) power supply

**Price**

\$495

**Inquiry 1107.**



# Printer Sharing Solutions



**8 Parallel and 2 Serial Ports  
Now Available With New SL**

**SL 10 Ports from \$495**

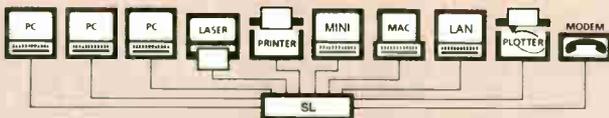
**New Model - SLP™ has 8 parallel and 2 serial ports:** The original SL™ has 4 parallel and 6 serial ports. Both can share any combination of ten printers or PCs; automatic switching, queuing, and serial-to-parallel conversion

**Improved Data Throughput - True 115,200 bps:** use other vendors' file transfer software with serial connected PCs

**Pop-up Menu via Hotkeys:** Keyboard selection of printers

**Simple Installation:** Just plug in your cables and run the menu-driven installation software

**User Upgradable Memory:** From 256KB to 4MB buffer



**Save by Sharing Resources:** The SL enables everyone to share lasers, printers, plotters, and modems. Greater access by more users reduces unproductive idle time and the expense of purchasing additional peripherals. All users can simultaneously send print data and quickly release their PCs to continue working.

**BUFFALO**

45 Day Money Back Guarantee

**CALL TODAY (800) 345-2356**

Fax (503) 585-4505

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

Circle 399 on Reader Service Card



## HWP

5 Ports from \$275

All ports are parallel and user configurable as either 3 inputs to 2 outputs or 2 inputs to 1 output with a pop-up menu, or 1 input to 1 output as a buffered auto-switch; user upgradable memory from 256KB to 16MB buffer

## AS-41

5 Ports \$200

4 parallel inputs to 1 parallel output, automatic switch with no buffer; use the AS-31 for up to 3 inputs to 1 output, \$175

## CE

2 Ports from \$175

Printer interface with 1 parallel input to 1 parallel output, from 256KB to 4MB buffer

## SPPS

Converter \$100

Combination serial-to-parallel, or parallel-to-serial interface converter in a single unit, no power supply needed, serial transfers to 115,200 bps, DIP switch configurable

## RCJ

Toshiba Memory Module

Memory expansion module for the Toshiba T1000SE, T1000XE, or J3100SS laptop (notebook) computer, 1MB - \$299, 2MB - \$549

## Cables & Adapters

High quality, 24 gauge shielded cables, parallel or serial; modular cable adapters

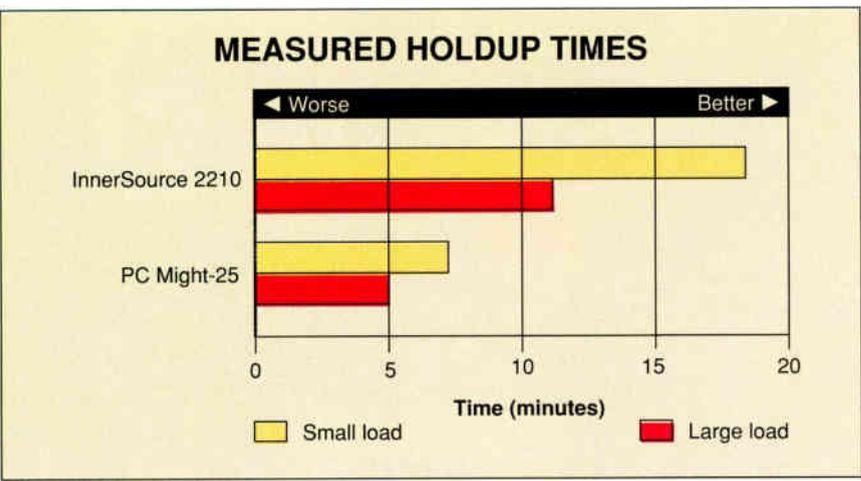


Figure 1: Holdup times for typical small and large loads, in minutes.

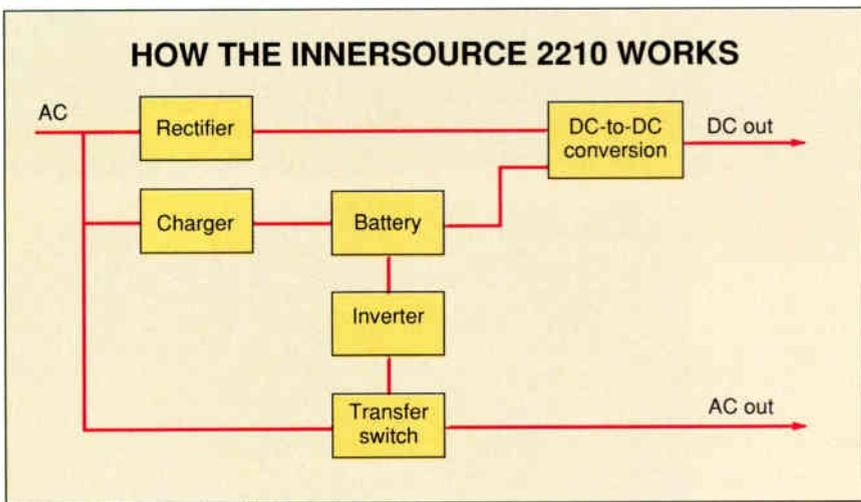


Figure 2: Block diagram of the InnerSource 2210 power supply. The output of the battery is wired to the DC-to-DC converter, which means that no DC switching is required when power fails.

or not square waves make a good input to switching power supplies, but the PC Might-25 provides output filtering to eliminate much of the noise associated with square-wave outputs.

**The InnerSource**

A traditional SPS takes in AC power, converts it to DC power, and stores it in a battery. When a blackout occurs, the unit takes DC power from the battery, transforms it to AC power, and sends it to the power supply in the computer, which transforms it to DC power for use in the system. For those of you keeping score, that's three conversions where only one is required, and each conversion means less efficient use of power.

PC Power & Cooling's InnerSource eliminates most of the extra steps. The

InnerSource looks (and acts, under normal conditions) like a standard, FCC Class B, full-size AT power supply. It replaces the power supply unit in the machine that you intend to protect. When the power fails, the unit supplies DC power from the battery directly to the system board (see figure 2). There is no need for additional conversion.

In addition to having a clean and efficient design, the InnerSource sidesteps debates over which waveform is best and how much noise an AC inverter introduces. Since the battery and rectifier are connected to the same transformer, PC Power & Cooling also claims zero transfer time between standby and normal operation.

If you didn't need to power a monitor during a blackout, this would be the end

of the story. Since you do, the InnerSource provides a standard battery-inverter stage for supplying AC power to the system monitor. This is a typical standby system, with a rated transfer time of 2 ms and a 120-V root mean square modified rectangular-wave output.

Holdup times, shown in figure 1, were good—certainly enough to save work and shut down properly. Like the PC Might-25, the InnerSource sounds an alarm at power failure and shuts down before the battery is completely drained. This unit requires 8 hours for a full recharge, but it recharges constantly as long as the system is plugged in.

Classifying the power output of the InnerSource is not as easy as it is with that of an external SPS. The unit supplies 220 watts of DC power to the system board and 120 volt-amperes of AC power to the monitor. With efficiency and power-factor calculations considered, PC Power & Cooling claims that the InnerSource is equivalent to a 550-VA external UPS; in any case, 220 W is enough to run a heavily stocked AT or 386 system with no problems.

The 120-VA (1-amp) AC source, however, is a little underpowered. Typical VGA monitors require just about all of this; an IBM 8513, for example, requires 0.95 amp. Big-screen monitors can easily require 1.2 amp and may require 1.6 amp; the power draw means you can't use the InnerSource with a typical 19- or 20-inch monitor.

If you want to run a network server off the InnerSource, PC Power & Cooling offers a \$49 module that lets the InnerSource talk to a network.

The InnerSource has a few weak spots, but these have to do with the nature of the device. It requires enough room inside the case for a full-size supply and, of course, will work only with IBM PC-compatible machines. If a power failure should occur, you'll need to replace the entire unit; with an external system, you need replace only the UPS or the internal supply. And at \$495, replacements aren't cheap. Fortunately, PC Power & Cooling has an excellent reputation for reliability.

Between the PC Might-25 and the InnerSource, you should be able to find what you need to back up a single system. Whether you prefer the traditional external device or the drop-in replacement concept, the peace of mind you'll get is worth the small investment. ■

*Steve Apiki is a BYTE Lab testing editor/engineer. He can be reached on BIX as "apiki."*

# The best got better.

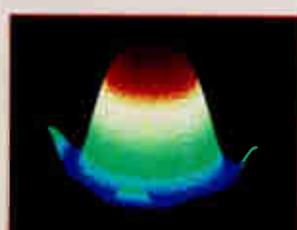
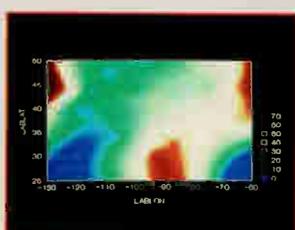
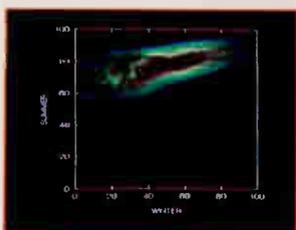
SYSTAT 5.0's new menus make the top-rated statistical program even easier to use.



v 4.1



SYSTAT is the *only* package to receive these three awards.



**New Features** Menus or commands — your choice • Rewritten documentation includes statistics tutorials • Fast, built-in drivers for SYGRAPH • Global mapping and many new plots • Multi way repeated measures • Means model for missing cells designs • Post-hoc tests • Interactive stepwise regression.

**Statistics** Basic statistics, frequencies, *t*-tests, post-hoc tests • Multi way crosstabs with log-linear modeling, association coefficients, PRE statistics, Mantel-Haenszel, asymptotic standard errors • Nonparametric statistics (sign, runs, Wilcoxon, Kruskal-Wallis, Friedman two-way ANOVA, Mann-Whitney U, Kolmogorov-Smirnov, Lilliefors, Kendall coefficient of concordance) • Pairwise/listwise deletion of missing values, Pearson correlation, SSCP, covariance, Spearman, Gamma, Kendall Tau, Euclidean distances, binary similarities • Linear, polynomial, multiple, stepwise, weighted regression with extended diagnostics • Multivariate general linear model includes multi way ANOVA, ANCOVA, MANOVA, repeated measures, canonical correlation • Principal components, factor analysis, rotations, components scores • Multidimensional scaling • Multiple and canonical discriminant analysis, Bayesian classification • Cluster analysis (hierarchical, single, average, complete, median, centroid linkage, k-means, cases, variables) • Time series (smoothers, exponential smoothing, seasonal and nonseasonal ARIMA, ACF, PACF, CCF, transformations, Fourier analysis) • Nonlinear estimation (nonlinear regression, maximum likelihood estimation, and more).

**Graphics** Overlay plots • Drivers for most graphics devices • *Two-dimensional:* Error bars • Scatterplots • Line and vector graphs • Vector, dot, bubble and quantile plots • Bar graphs (single, multiple, stacked, range) • Box plots (single and grouped) • Stem-and-leaf diagrams • Linear, quadratic, step, spline, polynomial, LOWESS, exponential smoothing • Confidence intervals and ellipses (any alpha value) • Smooth mathematical functions • Rectangular or polar coordinates • Log and power scales • ANOVA interaction plots • Histograms (regular, cumulative, fuzzy) • Stripe and jitter plots • Gaussian histogram smoothing • Scatterplot matrices • Voronoi

tessellations • Minimum spanning tree • Maps with geographic projections (U.S. state boundary file included, county and world boundary files available) • Chernoff faces • Star plots • Fourier plots • Pie charts • Contour plots on regularly and irregularly spaced points • Control charts and limits • *Three-dimensional:* Data plots • Smooth function plots • Vector plots • Linear, quadratic, spline, least squares surface smoothing • Typefaces that print in perspective.

**Data Management** Import/export Lotus, dBase, and DIF files • Full screen data editor • Full screen text editor • Unlimited cases • Missing data, arrays, character variables • Capability to process hierarchical, rectangular or triangular files, irregular length records • Character, numeric, and nested sorts • Merge and append large files • Unlimited numeric and character variable transformations • Subgroup processing with SELECT and BY • Value labels and RECODE statements • Macro processor with programming language, screen control, file manipulation, applications generation, and report writing.

SYSTAT operates on IBM PC's® and compatibles, MS-DOS®, VAX®/Microvax and Macintosh®. Site licenses, quantity prices and training seminars available. No fees for technical support.



**SYSTAT. Intelligent software.**

For more information call or write: SYSTAT, Inc. 1800 Sherman Avenue, Evanston, Illinois 60201-3793 Tel: 708.864.5670 Fax: 708.492.3567  
For international representatives call: **Australia** 61.3.4974755, **Canada** 416.424.1700, **Finland** 358.0.6923800, **France** 33.1.40935000,  
**Germany** 49.61.265950, **Italy** 39.587.213640, **Japan** 81.3.5902311, **New Zealand** 64.71.562675, **Norway** 47.3.892240, **Sweden** 46.8.110620,  
**Switzerland** 41.31.416611, **The Netherlands** 31.3402.66336, **UK:** Letchworth 44.462.482822, London 44.81.6926636, London SE 44.0753.841686

Circle 333 on Reader Service Card

## REVIEW

# TravelMate 2000 Lives Up to Its Name



*The Texas Instruments TravelMate 2000 packs AT-class performance into a 4-pound notebook PC.*

There's something about the Texas Instruments (TI) TravelMate 2000 notebook PC that says, "Take me with you." Its size (11 by 8½ by 1½ inches) and weight (4½ pounds with battery) are big factors in creating that impression. So are its 640- by 480-pixel VGA display, internal 20-megabyte hard disk drive, and 12-MHz 80C286 CPU. Together, these features make for what is arguably the most totable AT-class notebook system available.

The TravelMate 2000 has its flaws. The battery life is sub-par: 2 hours at best (an optional battery pack adds 3 hours to the running time, 2½ inches to the length, and about 2 pounds to the unit's weight). A floppy disk drive is available only as an external option. Some people might find the keyboard uncomfortable to use; the keyboard presents no typing angle to speak of, and it's set back about an inch from the front of the unit. And with a price of \$3995, the TravelMate is also expensive.

On the plus side, the TravelMate provides performance, VGA, and convenience. These benefits compensate for the drawbacks if portability is the main issue.

## What You Get

TI sells the standard TravelMate with 1 MB of internal RAM (expandable to 3

MB with two 1-MB RAM cards), a 2½-inch 23-millisecond 20-MB hard disk drive, one serial and one parallel port, the triple supertwist VGA LCD screen with 16 gray levels, and an AC adapter. MS-DOS 4.01, LapLink, and the system utilities reside on 1 MB of ROM. This all fits easily into any briefcase, with room left for other essentials.

When you turn on the TravelMate, you are greeted by Laptop Manager, a DOS shell. Laptop Manager comes set up to run the system utilities from a menu; adding applications to the menu is a simple matter of answering a few prompts. If you get stuck, pressing F1 brings up a help screen.

The system utilities include Traveling Software's ubiquitous LapLink file transfer program (cables are included with the TravelMate) and Battery Watch, which monitors battery drain. Both programs are well-regarded, time-tested utilities.

TI pairs Battery Watch with its BatteryPro power-conservation software. BatteryPro is what TI terms a "power conservation system." Basically, it monitors the notebook's components—hard disk drive, display, and keyboard—and shuts them down when they're not used for a specific amount of time. It puts the whole system in standby mode after a period of inactivity, and it automatically

## TravelMate 2000

### Company

Texas Instruments  
P.O. Box 202230  
Austin, TX 78720  
(800) 527-3500

### Components (as reviewed)

**Processor:** 12-MHz 80C286; socket for 80C287 math coprocessor

**Memory:** 1 MB of RAM; 1 MB of ROM for MS-DOS 4.01 and utilities

**Mass storage:** 2½-inch 23-ms 20-MB Conner Peripherals hard disk drive

**Display:** 10-inch-diagonal 640- by 480-pixel VGA; backlit triple supertwist LCD

**Keyboard:** 79-key IBM Enhanced style

**I/O interfaces:** One parallel port; one serial port; one proprietary external expansion bus

### Size

11 × 8½ × 1½ inches; 4½ pounds (with battery)

### Price

\$3995

### Inquiry 1078.

selects CPU speed for your applications. (The slower you run the CPU, the less drain on the battery.) It also has a RAM-based hard disk cache to minimize accesses. Power utilities of this ilk are becoming common on many notebook PCs.

Despite BatteryPro's energy-saving features, the TravelMate manages only 2 hours of running time on a charge. This is undoubtedly because TI shaved size and capacity from the battery to reach size and weight goals.

File Manager, another Laptop Manager utility, is exactly what its name implies; you can edit, execute, copy, delete, find, and so on. File Manager is simple and does the job, but it's no Norton Commander. For instance, if you want to find a file, you must already be in the directory in which it resides.

## Options You Will Need

If you spend \$4000 for a 4-pound AT-compatible system, you will probably want all the benefits of the 12-MHz processor along with its convenience. Well, you can have them, but at the cost of a few more dollars and a little of that convenience.

For starters, you need a modem (it's about time modems became standard equipment on all notebook PCs) and at least another megabyte of memory to run the latest software. Add \$499 and \$549,



## 486 Engineering Workstation

- 80486-25MHz CPU
- 4MB RAM
- 128K Cache
- 1.2MB 5.25" floppy drive
- 1.44MB 3.5" floppy drive
- 150MB ESDI hard drive
- 16-bit VGA card w/512K
- Super VGA color monitor (1024x768)

- 2 serial, 1 parallel & 1 game ports
- 101 Enhanced keyboard
- MS-DOS 3.3 or 4.01
- Two year warranty\*

**\$4,595**

**45-Day Money-Back Guarantee!**

## 386/33MHz Corporate Workstation

- 80386-33MHz CPU
- 4MB RAM
- 64K Cache
- 1.2MB 5.25" drive
- 1.44MB 3.5" drive
- 100MB IDE hard disk drive
- 16-bit VGA card w/512K
- Super VGA color monitor (1024x768)

- 2 serial, 1 parallel & 1 game ports
- 101 Enhanced keyboard
- MS-DOS 3.3 or 4.01
- Two year warranty\*

**\$2,995**

## 386/25MHz Business System

- 80386-25MHz CPU
- 4MB RAM
- 64K Cache
- 1.2MB 5.25" floppy drive
- 1.44MB 3.5" floppy drive
- 100MB IDE hard drive
- 16-bit VGA card w/512K
- Super VGA color monitor (1024x768)

- 2 serial, 1 parallel & 1 game ports
- 101 Enhanced keyboard
- MS-DOS 3.3 or 4.01
- Two year warranty\*

**\$2,795**

## 386/20MHz Pro-System

- 80386-20MHz CPU
- 4MB RAM
- 1.2MB 5.25" floppy drive
- 1.44MB 3.5" floppy drive
- 65MB hard drive
- 16-bit VGA card w/512K
- Super VGA color monitor (1024x768)

- 2 serial, 1 parallel & 1 game ports
- 101 Enhanced keyboard
- MS-DOS 3.3 or 4.01
- Two year warranty\*

**\$2,395**

## 386SX Executive System

- 80386/SX-16MHz CPU
- 1MB RAM
- 1.2MB 5.25" floppy drive
- 1.44MB 3.5" floppy drive
- 65MB hard drive
- 16-bit VGA card w/512K
- Super VGA color monitor (1024x768)

- 2 serial, 1 parallel & 1 game ports
- 101 Enhanced keyboard
- MS-DOS 3.3 or 4.01
- Two year warranty\*

**\$1,995**

All computers are covered by a "two year labor and one year parts warranty and a 45-Day "Money-Back" guarantee. We accept VISA, MasterCard, American Express, Discover Card, C.O.D., approved P.O.s, and personal checks (allow 7 days to clear). All prices and specifications are subject to change without notice. Call Acma for current specifications, pricing, payment, shipping, warranty, leasing and return policies. \*45-Day Money-Back guarantee covers Acma brand computers only (shipping not included). Software, printers, monitors and shipping are not refundable. Non-Acma brand products are covered by their manufacturers warranty. We are not responsible for errors in typography, photography, or of omission. Acma reserves the right to substitute equivalent parts. Brand names are registered trademarks of their respective companies. 386 and 486 are registered trademarks of Intel Corporation. Acma Computers Inc., 117 Fourier Ave., Fremont, CA 94539 (415) 623-1212 Corp., (415) 623-0818 Fax



## Our Best Starter Package Ever!

- 286/12 computer
- 1MB RAM
- 1.2MB or 1.44MB floppy drive
- 40MB hard drive
- Monochrome monitor
- 101 key keyboard
- Panasonic 1180 printer & cable
- Printer stand
- Ten diskettes
- Computer paper
- MS-DOS 3.3 or 4.01
- Choice of software
- User's guide
- Surge protector

**\$1,495**



"If you're looking to buy a computer by mail order but still want a company that will stand behind what it sells, the ACMA 386/25 is a good bet." \*Among PCs reviewed this issue, our favorite is the ACMA 386/25.\* \*Choose the ACMA 386/20 for better-than-average construction quality.\* (11/28 & 12/26 1989)



good, it's a good

"The Acma 386SX is highly expandable, performs well, and offers a very complete system for an excellent price...Acma offers one of the best service policies in the mail-order business." \*The Acma system not only looks like a good performer...it performed consistently above average.\* (May/June 1990)



"...the machine could reliably handle everything I piled onto it." \*The systems from ACMA Computer, Inc. inspire confidence.\* \*Clearly, ACMA intends to be competitive, not only in terms of system bang for the buck, but also in the realm of intangibles like technical support and product warranty.\* (April & July 1990)

**800-456-8809**

Hearing Impaired TDD 800-456-8901



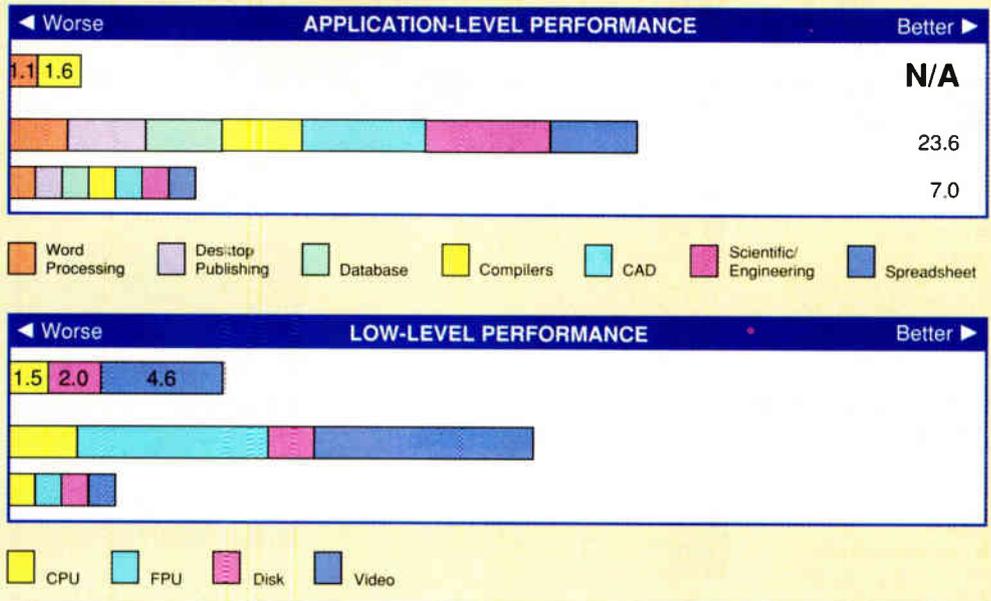
COMPUTERS, INC.  
**Acma**



Ask Us About On-Site Service!



DOS BENCHMARKS



CONVENTIONAL BENCHMARKS

	LINPACK (single) (MFLOPS)	Dhrystones (Dhry./sec.)
TI TravelMate 2000	0.3397	3474.7
Compaq 386/20	0.16970	8449.7
IBM PC AT	0.02105	2317.9

For application and low-level benchmarks, results are indexed and show relative performance; for each individual index, an 8-MHz IBM PC AT running MS-DOS 3.30 = 1

The BYTE low-level benchmark suite identifies performance differences between machines at the hardware level; the application benchmarks evaluate real-world performance by running a standard test suite using commercially available applications. Application indexes include tests using the following programs: Word processing: WordPerfect 5.0; Desktop Publishing: Aldus PageMaker 3.0; Database: Borland Paradox 3.0 and Ashton-Tate dBASE IV; Compilers: Microsoft C 5.1 and Turbo Pascal 5.5; CAD: AutoCAD release 10 and Generic CADD level 3 1.1.5; Scientific/Engineering: Stata release 2, MathCAD 2.5, and PC-Matlab 3.5f; and Spreadsheet: Lotus 1-2-3 release 3.0 and Microsoft Excel 2.1.

The BYTE Lab introduced version 2.0 of the DOS benchmarks in the August issue (see "BYTE's New Benchmarks: New Looks, New Numbers"). Benchmark results for machines reviewed under previous versions aren't directly comparable. To obtain a copy of the benchmarks, join the listings area of the byte.bmarks conference on BIX or contact BYTE directly.

respectively. If you use Windows or another graphical user interface, you will want the full 3 MB. And you will want the second battery pack (\$249), or at least a spare internal battery (\$129). Two hours is barely enough under the best circumstances. I got between 1½ and a little under 2 hours.

These options push your capital investment to over \$5000. You also end up with about 2½ pounds more than the 5 pounds (with AC adapter) that you were already carrying. With the added paraphernalia, you also might have to make more room in your briefcase.

Other Observations

Although I complained about it earlier, I find the TravelMate's keyboard acceptable in light of what TI is trying to accomplish. It felt comfortable, and I had little trouble adjusting to it.

Cradling it in your arm, the TravelMate has a solid feel. It runs quietly; I did not experience the high-pitched whine some LCDs emit. I did notice

something about the construction that troubled me: When you open the screen, the tension from the hinge flexes the plastic above the keyboard more than I'm comfortable with. I don't think this will affect the electronics, but I do worry about stress cracks developing in the case.

On the BYTE benchmarks, the TravelMate turned in scores that, while not startling, were at least respectable—particularly in the disk and video tests. Unfortunately, the BYTE Lab could not get a cumulative application index, as the notebook's memory configuration was inadequate for running some of the software used in that test suite. My evaluation unit was not equipped with a math coprocessor.

The black-on-white VGA screen has good contrast, and the light seems well diffused. A switch lets you reverse the video to white-on-black, and the contrast and brightness controls have adequate range. A pop-up utility lets you adjust the gray scaling.

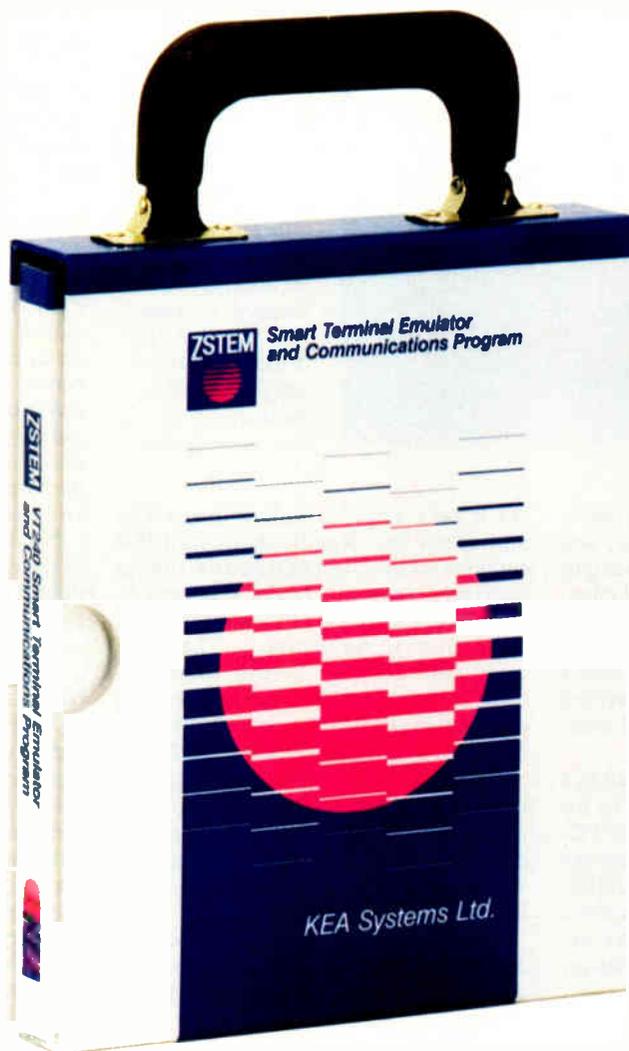
The Verdict

TI has quite an accomplishment in the TravelMate. For many people, it is incomplete in its standard form, but no other computer offers so much in just 4 pounds. (The Sharp 6220 is the same computer with only cosmetic differences and no utility software. TI makes it and similar notebook PCs under OEM arrangements. The TravelMate was actually a joint design project with Sharp.)

The TravelMate is a charmer, warts notwithstanding, and that charm is proportional to the weight of the portable you are currently lugging around. The ultimate portable is one that you don't notice carrying and that performs comparably to your desktop system. The TravelMate is as close as you can get to that ultimate portable. TI sacrificed some functionality to get there, but the trade-offs are reasonable. ■

Michael Nadeau is the managing editor of the BYTE Lab. You can reach him on BIX as "miken."

# Our VT240 terminal emulator has changed the meaning of portability.



## What does VT240 portability mean to you?

- **Portable across operating systems!** Our ZSTEM 240 software runs under both MS-DOS and Unix 386 System V, making your PC look and act like a VT240/340 terminal on either operating system.
- **Portable across machines!** ZSTEM 240 runs on IBM PCs, XTs, ATs, PS/2s and compatibles, from AT&Ts to Zeniths!
- **Portable across portables!** ZSTEM 240 runs on portable PCs, letting you connect to your office systems when you're on the road.
- **Portable across video adapters!** ZSTEM 240 supports all standard video adapters: VGA, EGA, CGA, MCGA, AT&T, Hercules and many extended adapters. No matter what adapter/monitor combination you use, ZSTEM 240 displays double-high/double-wide characters, 132 columns,

and VT340 ReGIS, sixel and Tektronix graphics.

- **Portable across networks!** ZSTEM 240 connects to your favorite networks, including Novell, 3COM, TCP/IP, Ungermann-Bass, Excelan, Wollongong, FTP, Sun and DEC's CTERM and LAT.

Of course, ZSTEM doesn't *really* come with a handle. What it does come with is our top-notch technical support and documentation, plus a solid warranty, so you can be assured of quality products backed by quality people. Call today about our complete line of VT emulation products.

**KEA Systems Ltd.**  
3738 North Fraser Way, Unit 101  
Burnaby, B.C., Canada V5J 5G1  
Telephone: (604) 431-0727  
FAX: (604) 431-0818

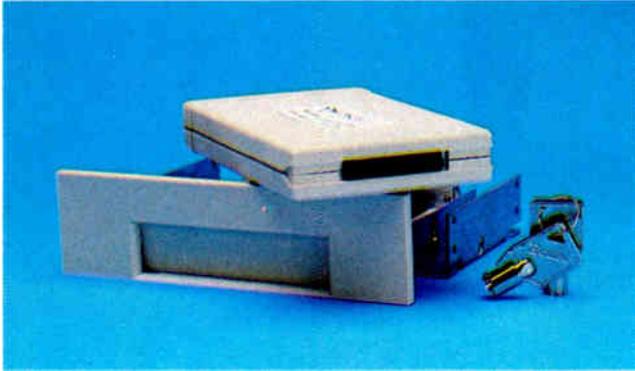
**Toll-Free Order Desk**  
1-800-663-8702



ZSTEM and the KEA and ZSTEM logos are trademarks of KEA Systems Ltd. All other brand and product names are trademarks or registered trademarks of their respective holders.  
©Copyright KEA Systems Ltd., 1989. All rights reserved.

## REVIEW

## Pricey Hard Disk Drive Portability



*The Disctec 20, shown here with its docking bracket, measures just 3.2 by .81 by 5 inches and weighs only 7 ounces.*

**T**he Disctec 20 shows how far we've come from the clunky, noisy, and notoriously short-lived full-height hard disk drives that were the only game in town during the early days of the PC revolution. The Disctec 20 is a 20-mega-byte removable hard disk drive that's packaged in a neat little nylon-covered case measuring just 3.2 by .81 by 5 inches. It weighs a scant 7 ounces.

You might describe the Disctec 20 as a thick floppy disk. It's designed to be interchanged with a wide variety of PC-compatible computer systems by means of a "docking bracket" and a controller. The standard docking bracket requires a half-height bay in your system. (An external docking bracket would be handy,

but it isn't available at this time.) The unit uses a half-length add-in card that contains an Intelligent Drive Electronics interface. Cards are available in both 8- and 16-bit versions for PCs and ATs (and compatibles), respectively. The 8-bit card supports a single Disctec 20; the 16-bit card supports two. If you have an IDE interface in your system, you can buy just the cartridge and the docking bracket.

Disctec also offers a custom combination docking bracket/interface card for the Toshiba T1200's expansion slot. According to the company, more custom versions are in the works for other popular laptop systems.

The case is well sealed and houses one of the new-generation 2½-inch hard disk drives. The company claims it will take a 150-g jolt without damage.

### For Your Eyes Only

The idea of a portable, removable hard disk drive isn't a new one (Tandon did it years ago), but Disctec is the first company to make it truly handy. The disk cartridge itself is small and light enough to toss into your briefcase at the end of the day and bring home to another computer equipped with a docking bracket. Even better is the ability to easily tote your work along on the road with a Disctec 20 in a laptop. And of course, you can't overlook the security aspect. If you lock up your Disctec cartridge or (even better) take it along, your data is absolutely secure from prying eyes. And if you use the Disctec 20 as your boot device, your computer's even more secure.

Installing the Disctec 20 isn't complicated. I installed mine in a 20-MHz 386 system in two different configurations: as the primary (boot) drive and as a secondary hard disk drive. The Disctec con-

troller also has a floppy disk drive interface, so it can be the only disk drive controller in your system. When I installed it as the secondary controller, I had to play with jumpers on the board, disabling the floppy disk drive controller and setting the memory location for the board so it wouldn't conflict with the primary controller.

### Consistent Performer

The Disctec 20 requires special driver software, called from your DOS CONFIG.SYS file. Unfortunately, that precludes its use with alternative operating systems, such as OS/2. The software comes with its own well-designed automatic installation utility. That's where I initially ran into trouble. After installation, the Disctec 20 was flaky, and disk-performance utilities such as Norton Utilities refused to recognize it. A quick call to Disctec got me an updated version of the driver, and I didn't have any additional problems after that.

The installation utility lets you choose among several options, including whether you hear a beep when you change cartridges. And if you're using the Disctec 20 in a laptop, you can choose the time before the drive goes into a "spin-down" mode to conserve battery power. There's also a power-save mode where the disk keeps spinning but the support circuits are powered off. In spin-down mode, it takes about 2 seconds for the drive to get back up to speed. In power-save mode, recovery takes a short 1/10 second. Even without the power-conserving modes, the Disctec 20 pulls just 1 watt of power.

No slouch at performance, the Disctec 20 has an average access time of 23 milliseconds, according to the company. The unit I tested did better, consistently scoring in the 19- to 20-ms range. Data transfer is a respectable 500 megabits per second. There is no performance penalty in using the Disctec 20. In fact, it was considerably faster than my primary drive.

The Disctec 20 is well built and handy. But you'll pay a large premium for convenience. The interface, docking bracket, and a cartridge retail for \$670 to \$695, depending on the system you want to install it in. Additional drive cartridges sell for \$595; additional docking brackets are \$50. For a 20-MB drive, that's expensive. But to be fair, new technology is always initially exorbitant. If you want or need true data portability and security, the Disctec 20 is a logical choice. ■

*Stan Miastkowski is a BYTE senior news editor. He can be contacted on BIX as "stannm."*

### Disctec 20

#### Company

Disctec  
147 West Lyman Ave., Suite 200  
P.O. Box 1750  
Winter Park, FL 32789  
(407) 645-0001

#### Hardware Needed

IBM PC, AT, or compatible or Toshiba T1200

#### Software Needed

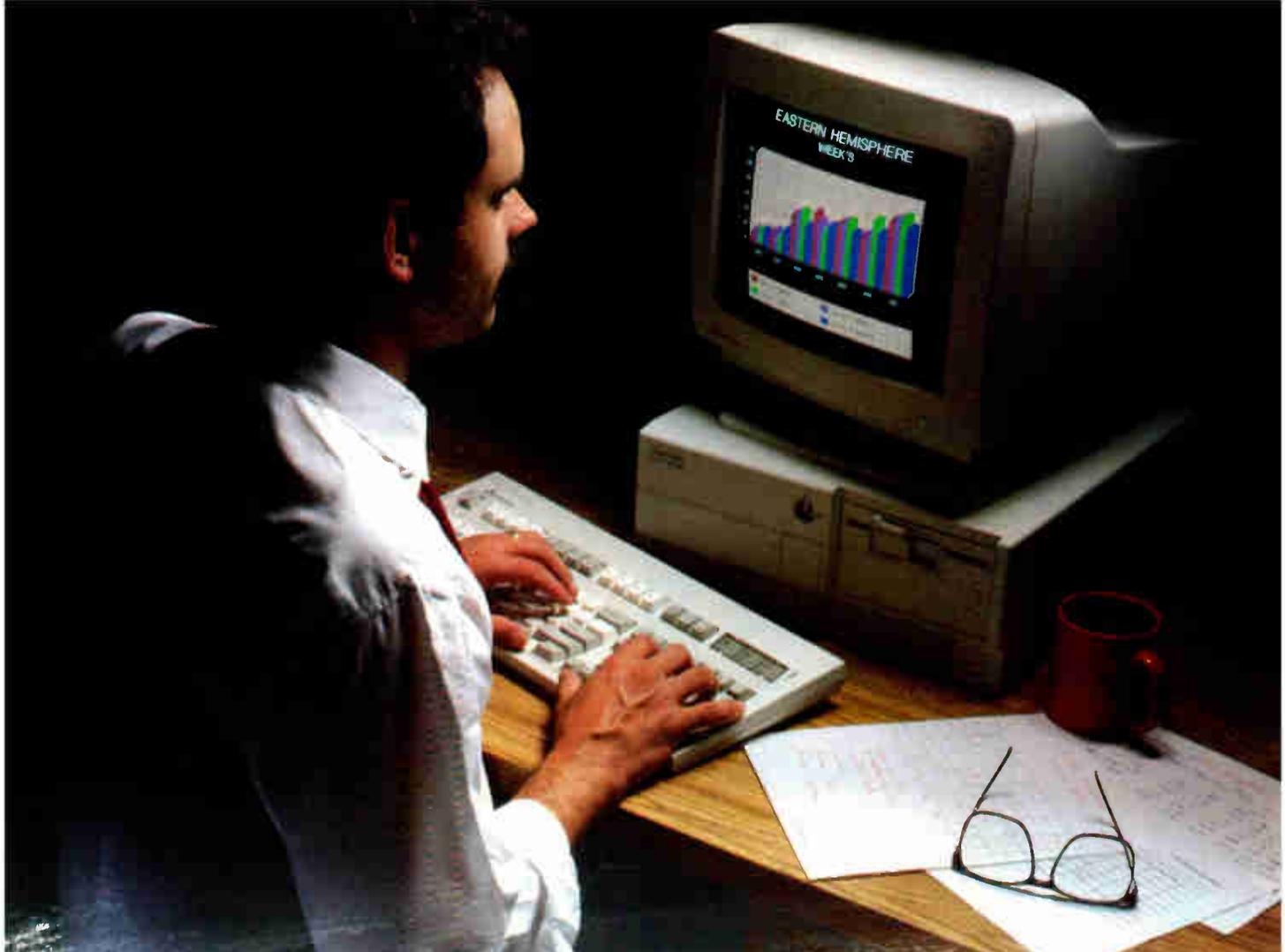
MS-DOS or PC-DOS

#### Price

XT version, \$670; AT version, \$695; drive-only version, \$640; Toshiba T1200 version, \$680; additional cartridge, \$595; additional docking bracket, \$50; additional controller, \$100

#### Inquiry 1060.





# If You're Driven by Success, Make Sure It's a Quality Drive.

To be successful in today's business environment, you need drive, determination and commitment. You also need the right products supporting you—keeping things running smoothly, on track and on schedule. Products that consistently meet operating specifications, and provide the dependability you can rely on. Products such as Mitsubishi disk drives.

Just like you, Mitsubishi Electronics is also driven by success. We manufacture the latest in memory storage technology, and offer one of the broadest ranges of flexible drives in the industry today. Whatever your memory requirements, Mitsubishi has the drive you need—from 720 KB and 1.44 MB 3.5" models to 360 KB and 1.2 MB 5.25" models, with a variety of mounting and bezel configurations.

As one of the largest suppliers of flexible disk drives in the world, Mitsubishi® continues to earn its reputation for product quality and design innovation.

Mitsubishi also manufactures rigid disk drives that have the same incomparable dependability as the flexible drives. Every 5.25" rigid drive supports the high-density mode of the newer (RLL) controllers, with up to 65 MB formatted memory, as well as the standard-density mode of the (MFM) controllers used in today's most popular systems, with up to 42 MB formatted memory.

So when you're looking for reliable, high capacity disk drives, look to Mitsubishi. We'll make sure you get a quality drive.

For the authorized Mitsubishi reseller nearest you, call 1-800-556-1234, ext. 54 in the U.S. and Canada (in California 1-800-441-2345, ext. 54).



 **MITSUBISHI  
ELECTRONICS**

See us at

 **COMDEX/Fall '90**

November 12-16, 1990  
Las Vegas, Nevada  
Booth 1216

Mitsubishi Electronics America, Inc., Information Systems Division, 991 Knox Street, Torrance, CA 90502.

Mitsubishi Electric Sales Canada, Inc., 8885 Woodbine Avenue, Ontario L3R 5G1.

© 1989 Mitsubishi Electronics America, Inc. Mitsubishi is a registered trademark of Mitsubishi Electric Corp., Tokyo. Image courtesy of Software Publishing Corp.

Circle 231 on Reader Service Card (RESELLERS: 232)

World Radio History

Reviewer's Notebook provides new information—including version updates, new test data, long-term usage reports, and reader feedback—on products previously reviewed in BYTE.

## ALR Pumps Up PowerFlex



*ALR has added the PowerFlex 20CSX, a Windows-ready 20-MHz 386SX PC, to its popular PowerFlex line.*

### PowerFlex 20CSX Model 110

#### Company

Advanced Logic Research, Inc.  
9401 Jeronimo  
Irvine, CA 92718  
(714) 581-6770

#### Components (as tested)

**Processor:** 20-MHz 386SX; 20-MHz 80387SX FPU  
**Memory:** 3 MB of 80-ns DRAM, expandable to 5 MB on motherboard and to 16 MB total; 32K-byte static RAM cache  
**Mass storage:** 3½-inch 1.44-MB Teac floppy disk drive; 106-MB 25-ms 3½-inch Toshiba IDE hard disk drive  
**Display:** ALR 800- by 600-pixel Super VGA controller with ALR FlexView 2X Super VGA monitor  
**Keyboard:** 101-key modified IBM Enhanced AT layout  
**I/O interfaces:** One serial, one parallel, and one mouse port; one 8-bit and five 16-bit ISA expansion slots (five open)

**Price**  
\$4008

**Inquiry 1075.**

**R**eviewed in the June issue, the 286-based ALR PowerFlex and its upgradable architecture provides a cost-effective means of keeping your DOS-based system current with the demands of your applications. Advanced Logic Research recently introduced a new PowerFlex model, the 20CSX, which begins life as a 20-MHz 386SX-based PC and is upgradable to a 25-MHz 486. Like the earlier version, the 20CSX is relatively inexpensive and well made. The two systems also share the same 16-bit bus architecture, which forces you to pay a performance penalty when using the 32-bit i486 CPU.

The 20CSX does not replace the earlier PowerFlex. It is a midrange model that ALR is aiming at users of graphical interfaces such as Windows, and its configuration reflects that. The Model 110 that ALR sent to BYTE comes standard with 3 megabytes of RAM, an 800- by 600-pixel Super VGA card, a 25-millisecond 106-MB hard disk drive with an Intelligent Drive Electronics controller, and a

two-button mouse. It also sports a 32K-byte static RAM cache. In all other aspects, the 20CSX is the same machine as the original PowerFlex (see "Two to Grow On," June BYTE).

#### Good Performer

The BYTE Lab benchmarked the PowerFlex 20CSX in its 386SX mode. Benchmark indexes for the 486 version should be similar to those achieved by the original PowerFlex. As the graph shows, the 20CSX performs comparably to the Compaq Deskpro 386s/20 in both the low-level and application suites; the major difference is the ALR's significantly better CPU index: 2.49 versus the Compaq's 1.76.

Windows 3.0 is crisp in both its appearance and its performance on the 20CSX. The Super VGA video with the ALR FlexView 2X Super VGA monitor eliminates the fuzziness sometimes experienced with lesser graphics systems. I experienced no compatibility problems with the ALR system.

Like the original FlexCache system, the 20CSX is ruggedly constructed. The case fits correctly and is easy to remove and replace, and the motherboard is firmly mounted. Installing add-in cards flexes the electronics very little. I found no last-minute engineering modifications in the system.

#### One for the Budget-Conscious

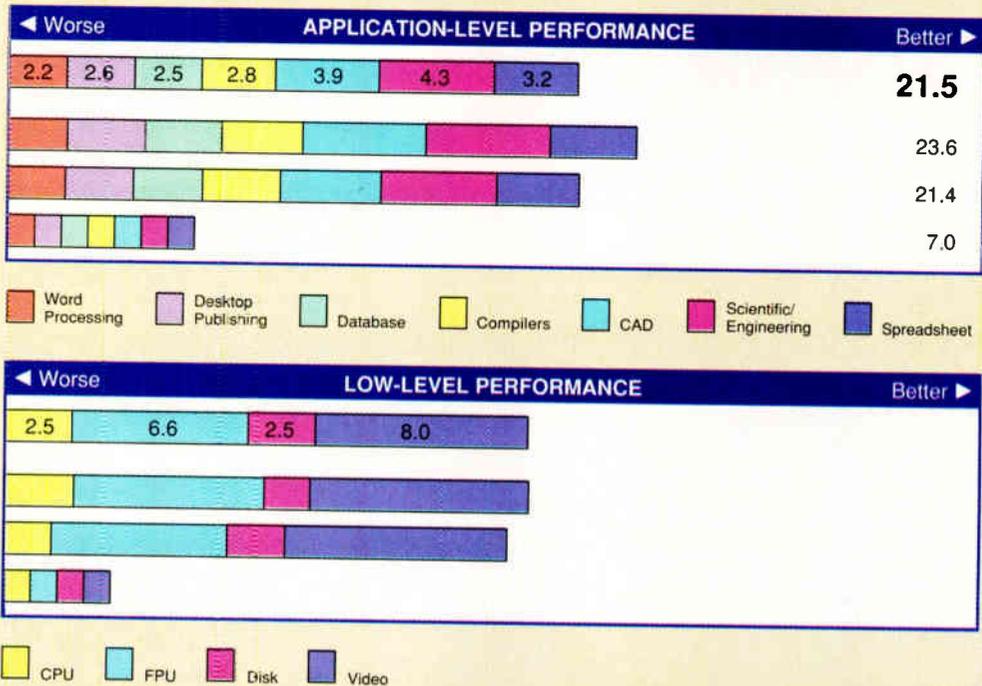
Among all the 20-MHz 386SX systems BYTE has reviewed, the 20CSX is a standout. It is one of the best performers, comes Windows-ready, and provides a means of increasing the horsepower as needed. It's also among the lowest priced at \$3349 (without the math coprocessor).

Its biggest drawback is still its 16-bit bus, which prevents the system from taking full advantage of the i486. As the demands of your applications increase, you just might need all of that i486. Nonetheless, the PowerFlex 20CSX is an attractive starting platform for the business user or professional moving to Windows.

—Michael Nadeau



## DOS BENCHMARKS



For application and low-level benchmarks, results are indexed and show relative performance; for each individual index, an 8-MHz IBM PC AT running MS-DOS 3.30 = 1. For all benchmarks, higher numbers indicate better performance.

The BYTE low-level benchmark suite identifies performance differences between machines at the hardware level; the application benchmarks evaluate real-world performance by running a standard test suite using commercially available applications. Application indexes include tests using the following programs: Word Processing: WordPerfect 5.0; Desktop Publishing: Aldus PageMaker 3.0; Database: Borland Paradox 3.0 and Ashton-

Tate dBASE IV; Compilers: Microsoft C 5.1 and Borland Turbo Pascal 5.5; CAD: AutoCAD release 10 and Generic CADD level 3 1.1.5; Scientific/Engineering: Stata release 2, MathCAD 2.5, and PC-Matlab 3.5f; and Spreadsheet: Lotus 1-2-3 release 3.0 and Microsoft Excel 2.1.

For more information on all the BYTE benchmarks, see "BYTE's New Benchmarks: New Looks, New Numbers" on page 158 in the August issue.

## Hard Disk Confusion at Micro Express

In BYTE's Product Focus on 386SX systems (see "386SX PCs: Heirs to the Low End," August), we recommended Micro Express's ME 386 SX/SL, based in part on its fast (19 millisecond) Quantum ProDrive hard disk drive. Since then, some readers have reported that they had received slower hard disk drives in the systems that they ordered. Readers also reported having problems contacting Micro Express and receiving technical support.

BYTE repeatedly called Micro Express, posing as a customer, and did experience problems getting through to both sales representatives and technical-support personnel. When we asked what hard disk drive was shipped with the system, two salespeople cited a 28-ms Western Digital hard disk drive; another cited a more comparable 23-ms Conner Peripherals hard disk drive. None of the

salespeople mentioned the Quantum ProDrive.

A Micro Express spokesperson said that favorable reviews of the ME 386 SX/SL had caused a rush of orders that overloaded the company's telephone system and created temporary product shortages and support problems. He added that the company is working to correct these problems.

Micro Express confirmed that it no longer sells the 40-MB 19-ms Quantum ProDrive and claimed that it was offering a comparably equipped system with either a 28-ms Western Digital hard disk drive for \$1799 or an 80-MB 19-ms Quantum ProDrive for \$1899. (The system that we tested for the Product Focus, with 2 MB of RAM, a 40-MB hard disk drive, and a color analog monitor, cost \$1945.) In subsequent calls, Micro Express salespersons did offer these alter-

natives, but they quoted \$1999 for the system with the 80-MB Quantum ProDrive and incorrectly stated the average access time for the Western Digital hard disk drive as 23 ms.

Most system vendors "second source" major components to ensure an adequate supply. Usually, these components offer roughly equivalent performance to the components they replace; occasionally, however, they do not. BYTE strongly urges readers to specify the subsystem components that they want when ordering a system. (A description of components in our test systems accompanies every BYTE review.) If a part isn't in stock, most companies will special-order it for you.

As for Micro Express, we are confused about exactly what the company is offering.

—Rob Mitchell



# it's easy to make chocolate moose.

**247 chlorosis / cholinesterase**

**choc'kie-block** (-a bläk') *adj.* [see prec & BLOCK] 1 *Naut.* a) pulled so tight as to have the blocks touching (said of a hoisting tackle) b) hoisted all the way up. ad a signal flag 2 crowded or jammed — *adv.* tightly together

**choc'k-full** (chäk'fool') *adj.* *choke, cheek* + *-ful* as in *choc'k-full*

**cholorosis / cholinesterase**

**block** (-a bläk') *adj.* [see prec. & BLOCK] 1 *Naut.* a) pulled so tight as to have the blocks touching (said of a hoisting tackle) b) hoisted all the way up. as a signal flag 2 crowded or jammed — *adv.* tightly together

**ch'k-full** (chäk'fool') *adj.* [ME *chokkeful, chekefull* < *choke, cheek* + *-ful*. *FUL*: now often assoc. with *chuck, chuck*] as possible; filled to capacity

**choc'late** (chök'ä let, chäk'ä-) *n.* [? via Fr *chocolat* < Sp *chocolate* < Nahuatl *çokolaç*] 1 a paste, powder, or bar made from cacao seeds that have been roasted and made of or coated with chocolate 2 reddish brown — *adj.* 1 made of or flavored with chocolate 2 reddish-brown — *choc'lo* laly or *choc'lo-latey adj.*

**chocolate moose** /c'hak-(e)let/mus/n. pl moose: a large member of the elk family dipped in chocolate.

**choc-co-la-tier** (chö'kä lä tir') *n.* a maker or seller of chocolate candies, esp. fancy or expensive ones

**Choc-taw** (chäk'tö') *n.* [Choctaw *chahta*, a self-designation] 1 *pl.* -*taws* or -*taw*' a member of a North American Indian people who lived in S Mississippi, Alabama, Georgia, and Louisiana and now live in Oklahoma and Mississippi 2 the Muskogean language spoken by this people

**choice** (chois) *n.* [ME & OFr *choisir*, to choose < to taste, test: see choosing]

**chocolate moose 1**

**variable part 5** a variety of an alternative superior

**DE**  
**FG**  
**HI**  
**JK**  
**LN**  
**OP**



text scanning software, AccuScan, simplifies the scanning process by recognizing the layout of even the most complicated material. Including multi-column pages and numerical tables. AccuScan automatically separates text from graphics, making it easy for you to pick and choose the information you want. An optional twenty-page automatic document feeder makes you even more efficient.

The ScanJet Plus gives you a head start. With one-button automatic text scanning. Live preview for instant feedback on image quality. And auto exposure, which works like a point and shoot camera. To make things even easier, it features on-line help.

HP has added all these impressive capabilities to a scanner known for its superior image scanning. The ScanJet Plus reads 256 levels of gray for smooth shading and more realistic graphics.

At only \$2,190\* the ScanJet Plus makes perfect sense for any business interested in being more productive. And more professional. For more information and the name of your nearest authorized HP dealer, call 1-800-752-0900, Ext. 1666. And even if you never make chocolate moose, you'll have a recipe for success.



\*Suggested U.S. list price without document feeder. © 1990 Hewlett-Packard Company PE12036

# Magnetic VS. Optical

**275 State of the Media**  
by David A. Harvey

**Playing Catch-Up**  
by Andrew Reinhardt

**283 Crystal Clear Storage**  
by Tom Parish

**289 Entering a New Phase**  
by Bob Ryan

**301 The Once and Future King**  
by Bob Ryan

**Side by Side**  
by Bill Passavanti

**311 Store Data in a Flash**  
by Walter Lahti and  
Dean McCarron

**323 DAT's a Solution**  
by Karina Lion

**331 Getting Your Byte's Worth**  
by Steven J. Vaughan-Nichols

**338 Masses of Storage**

**M**ass storage is the subject of one of the hottest debates in the computer industry. Will optical media replace magnetic media? Many people think it's only a matter of time. But magnetic media are far from dead. In fact, they outperform optical media by a significant margin.

Perhaps magnetic will withstand the challenge it faces from optical. Perhaps it won't. Or perhaps the two will merge into a hybrid form. In "State of the Media," David A. Harvey looks at the advantages and disadvantages of each and explores the possibilities of hybrid technologies combining the good points of both. And in a related text box, "Playing Catch-Up," Andrew Reinhardt explores the confusion that is the standards' environment for optical storage.

One of the wildest ideas I've heard in a long time is that of storing data in crystals with light. This is no hocus-pocus. In "Crystal Clear Storage," Tom Parish examines holographic data storage, a technology whose capacity dwarfs even that of optical disks, while giving you faster access to your data.

Another new optical storage technology, called *phase change*, uses a whole new method for storing data on an optical disk. In the process, it merges the capacity of magneto-optical storage with a performance better than that of traditional optical storage. It may bridge the gap between magnetic and optical. In "Entering a New Phase," Bob Ryan describes how phase-change technology works and its potential for the future.

The most popular form of magnetic technology is the disk, be it a hard disk or a floppy. If magnetic disk technologies are to remain healthy, they will have to continue to evolve, in speed, in capacity, in densities, and in recording means and materials. In "The Once and Future

King," Bob Ryan looks at new disk technologies, what they are and how they are likely to affect future disk drives. In the text box "Side by Side," Bill Passavanti discusses perpendicular recording, a new way to put more bits onto a disk.

Another new form of "disk" technology is solid-state. Flash-memory ICs, contained on credit-card-size devices, are entering the microcomputer arena. Because of their size, they will probably invade the laptop market first, and take it by storm. In "Store Data in a Flash," Walter Lahti and Dean McCarron explain what flash memory is, what it is likely to be used for, and why.

After disks, the next most popular magnetic medium is tape. You don't tend to think of magnetic tape when you think of microcomputers, but as systems become larger and more complex, backups become more important. When disk-to-disk backups are no longer practical, tape provides an alternative. In "DAT's a Solution," Karina Lion examines the advantages of digital audiotape and explores quarter-inch cartridge and 8-mm options as well.

Whether you use magnetic or optical media, data compression is becoming the rule rather than the exception in an effort to cram more data into existing space. In "Getting Your Byte's Worth," Steven J. Vaughan-Nichols examines hardware-based data compression. It is so transparent and automatic, you'll never know you're using it.

As data continues to proliferate, the optical versus magnetic debate will continue, and new and improved technologies will appear on both sides—and in the middle. So let the opposing factions fight it out. We'll just watch—and collect the spoils.

—Jane Morrill Tazelaar  
Senior Editor, *State of the Art*

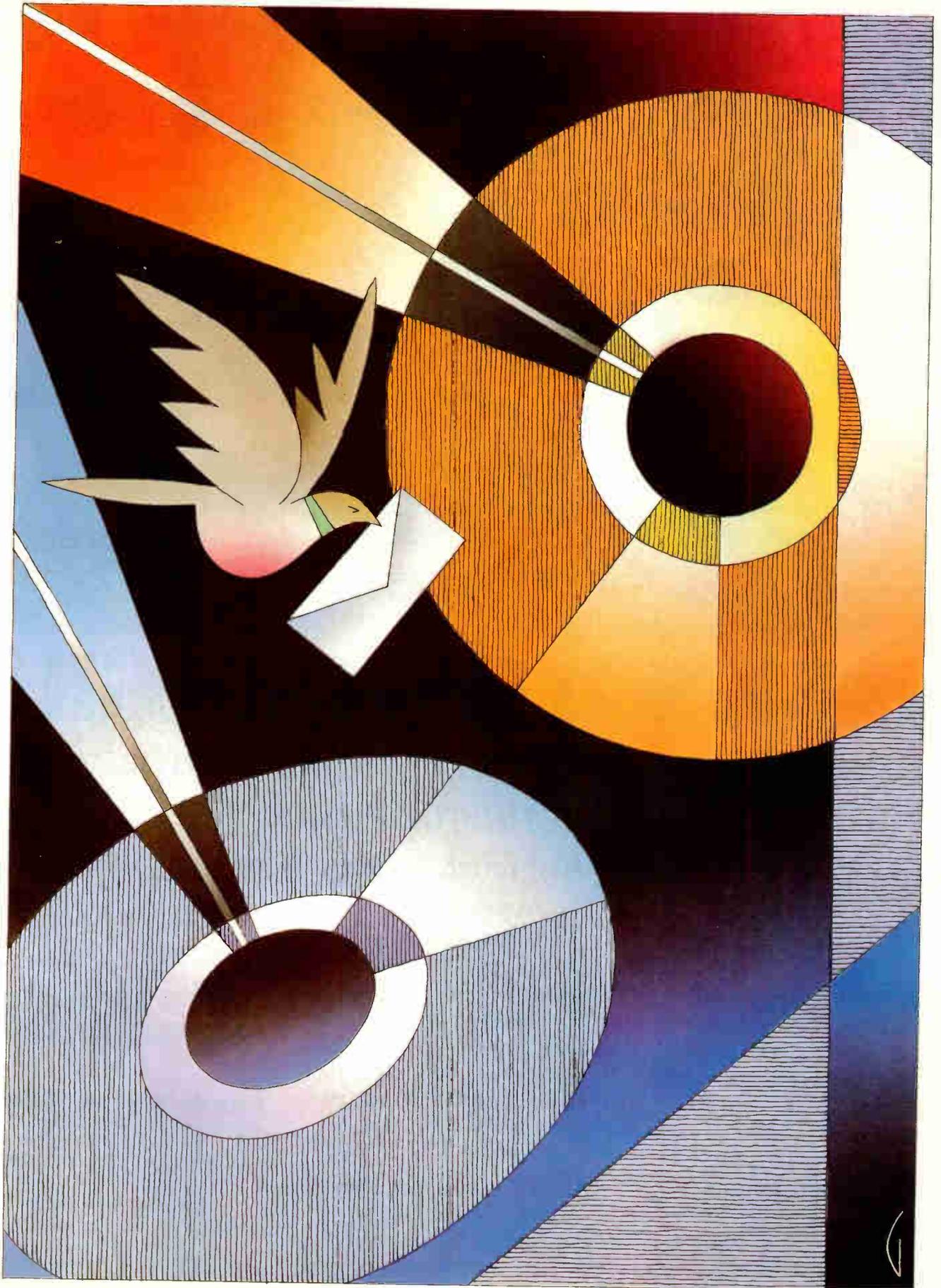
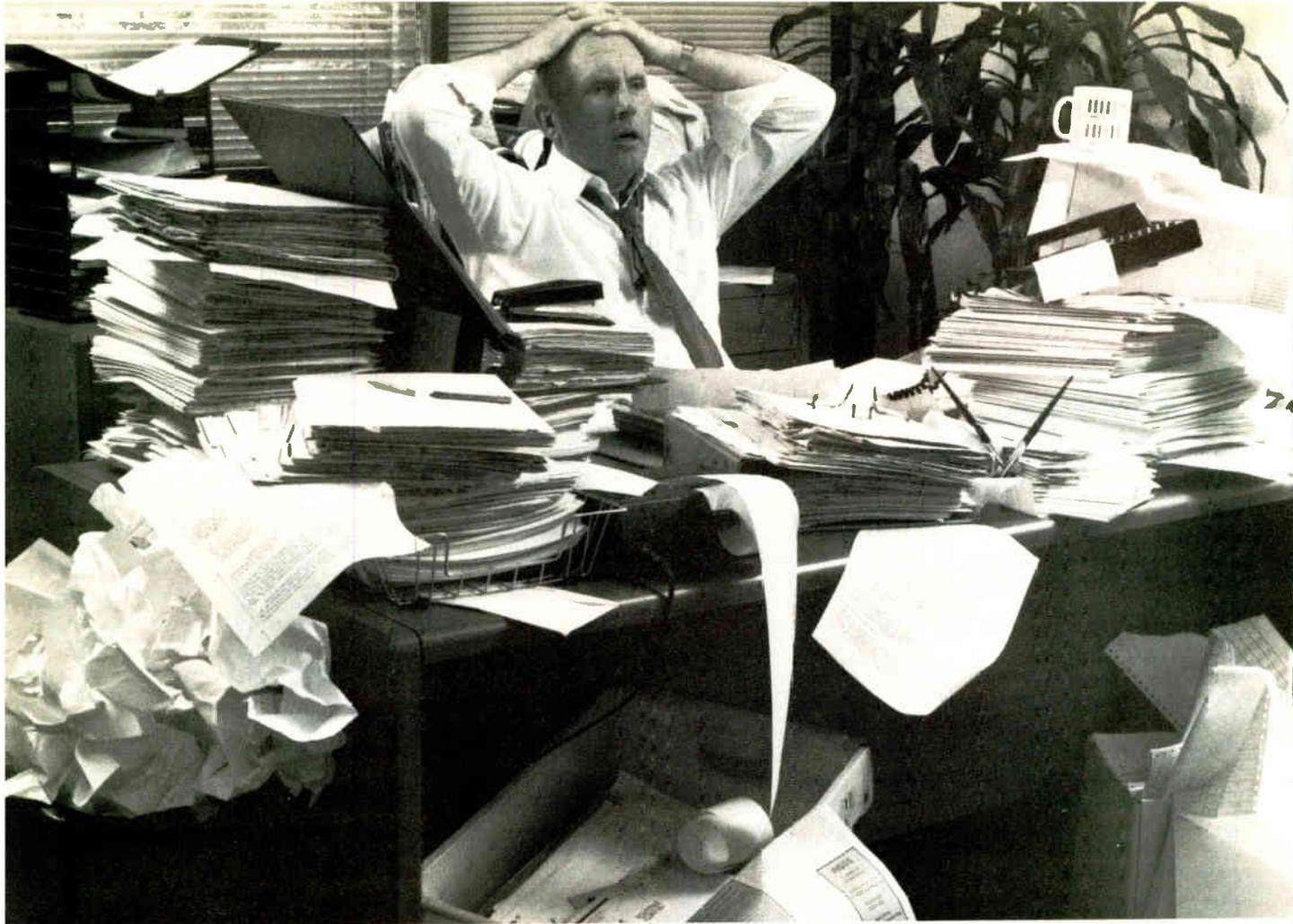


ILLUSTRATION: JOE GAST © 1990



# DESK NOT BIG ENOUGH?

*17 million business documents  
are lost or misfiled each day.*

Announcing a major breakthrough in image storage and retrieval:

**Paper  
Tamer**

*PaperTamer* offers more power and flexibility than other existing document storage and retrieval systems—and *PaperTamer* costs 1/10th of the price.

*PaperTamer* is designed to eliminate the need to run to the file room every time you need information. *PaperTamer* provides immediate access to over a million images, documents, memos and articles.

Flagstaff Engineering offers a complete line of peripheral products to provide complete image storage and retrieval systems including scanners, optical drives and mass storage devices.

No one delivers rock solid solutions like Flagstaff Engineering, the company that continues to help people read a world of information.

**FLAGSTAFF  
ENGINEERING**

**Domestic Sales and Marketing**  
1120 Kaibab Lane  
Flagstaff, AZ 86001  
(602) 779-3341 / FAX (602) 779-5998

**International Sales**  
1930 S. Alma School #C202  
Mesa, AZ 85210  
(602) 831-5100 / FAX (602) 831-0684

GSA APPROVED

Circle 137 on Reader Service Card

World Radio History

# State of the Media

*Magnetic vs. optical: Is it the war of the disk drives or a marriage of convenience?*

*David A. Harvey*

**H**ow far the micro-computer industry has come in a decade or so. It wasn't so long ago that all data was stored on cassette tapes. At that time, the advent of the single-sided floppy disk seemed like a miracle.

Today, with a 150-megabyte hard disk drive, two CD-ROM units, and a 1-gigabyte magneto-optical drive—not to mention double-sided high-density floppy disk drives—serving for storage, thoughts of single-sided disks give me acute claustrophobia. However, the more places you have to put data, the more confusing it can become to decide which device to use.

As much as we'd all like to have the newest and most innovative technologies on our desks, the primary question is, "Which storage option is really appropriate to your needs?" If you listen to all the hype, you're going to hear conflicting reports.

The makers of traditional magnetic drives will tell you that they provide a faster and more tested technology, and that the capacity of hard disk drives is increasing daily. The producers of optical drives are prone to elaborate on how the time has come for optical drives to re-



place all other mass storage devices. And floppy disk drives continue to grow bigger and faster, too.

Ultimately, the industry will probably evolve toward one standard way of storing information. From here, that future looks optical. But for now, the choices you make will affect not only your productivity, but also how you work.

The conflict between traditional mag-

netic mass storage devices and optical technologies includes questions of speed, cost, data migration, archival needs, and the amount of data you need to store. The most important difference between the two technologies lies in how they let you manipulate the data.

## **Magnetic Racing Stripes**

If the data associated with your primary applications is contained in executable and temporary files, in discrete and manageable data files, then you probably want a hard disk drive. The advantages of hard disk drives include their speed, cost, and universality.

No optical device on the market can even come close to matching the speed of a generic Intelligent Drive Electronics drive with a software cache thrown in. And optical drives can't begin to touch an ESDI hard disk drive with 0.5-millisecond access time, throughput greater than 1 megabyte, and a bus-mastered caching controller on an Extended Industry Standard Architecture bus.

If you need your data nearly instantaneously, if a hard disk can contain it, and if you have a good backup system worked out for that data, then you probably have

no reason to go optical. Optical devices are not so slow that they're unusable, however. Some of the newer rewritable devices, both phase-change and magneto-optical, are fast approaching hard disk drive speeds.

Optical drives are slow for a number of reasons. CD-ROMs and some WORM (write once, read many times) drives use constant linear velocity (CLV)—data is organized sequentially in one continuous spiral track, rather than in tracks and sectors (see figure 1). When you want information, the read head must find the temporal position of the data rather than moving to a logical address. The process of finding a specific piece of information is analogous to scanning a compact disk to find a particular passage of music: The read head must move along the entire track until it gets to the data.

Read-write optical drives employ constant angular velocity (CAV)—data is organized into sectors and tracks (see figure 2). The read-write head is heavier than a conventional hard disk drive's, and thus it takes longer to physically move the head to a given location.

Until now, the real degradation in re-

writable optical drive performance was tied to the technology of the magneto-optical drive. On an MO drive, writing a byte of information requires two passes. An erase pass restores the disk to its original state; then a write pass adjusts the

**A** traditional hard disk drive is still the best bet for primary mass storage.

magnetization to reflect the bit pattern of the data. With the advent of phase-change technology, which can do one-pass writes (see "Entering a New Phase" on page 289), the performance of rewritable optical devices will improve tremendously.

Even without phase-change technol-

ogy, however, MO drives are relatively fast. The Storage Dimensions LaserStor on my desk reports an average seek time of about 40 ms. To put that into perspective, it's about as fast as a Seagate ST251 and faster than an ST225.

What all this means is that if you are using disk-intensive programs—animation packages, spreadsheet and database programs, programs that make frequent use of temporary files, or anything that uses the hard disk drive for virtual memory—you're far better off using a traditional hard disk drive to store your information.

### The Magnetic Advantage

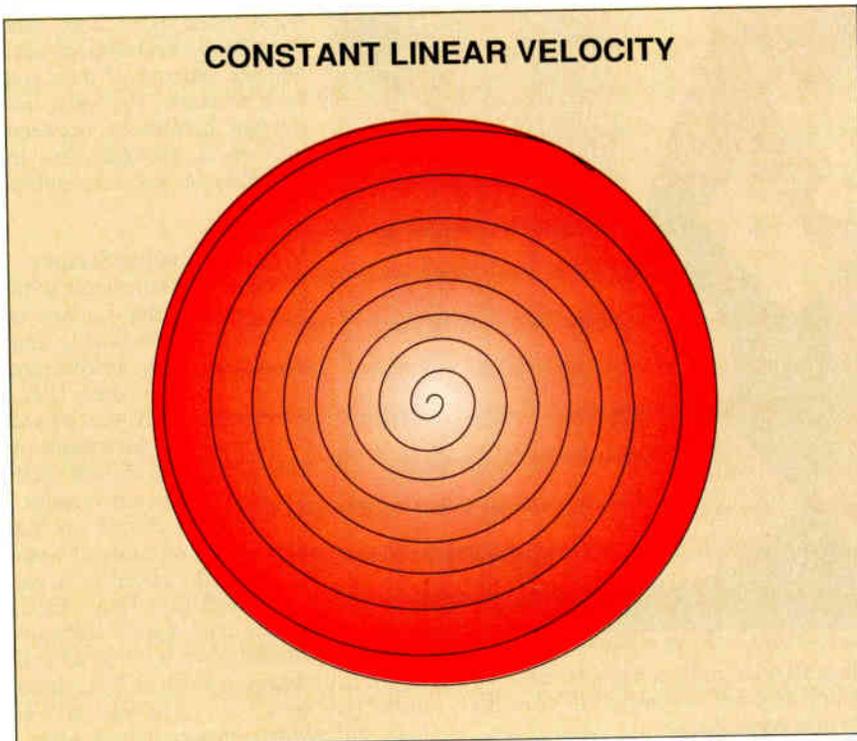
Physical size and power requirements are another advantage of hard disk units. Within the last few years, hard disk drives have become smaller and required less power. It's reached the point where if you look in almost any laptop, you'll find a 2½-inch form-factor drive. The disk in this drive holds between 20 MB and 100 MB of data and can run for hours on battery power.

Optical drives, on the other hand, are bulkier and require more power. With the exception of CD-ROM drives, which come in a 5¼-inch half-height form factor, most optical drives are full-height 5¼-inch models—too large for laptops. (A slew of full-height 3½-inch optical drives are expected to hit the market this year.) More and more manufacturers are making half-height optical drives, but even these are too big and too heavy for a laptop. You'll see them sooner in AC-only transportables and luggage.

As long as you don't continually run out of available storage space, hard disk drives are your most economic solution. This means not only that it's going to cost you less to store your data, but also that you can upgrade or add new drives as you need them. With SCSI drives or a multidrive controller, like PSI's hyperStore, you can easily circumvent DOS's two-drive limitation and add as many drives as you need.

The start-up cost for WORM or rewritable drives is still high. At best, you're going to pay in the neighborhood of \$3500 for an optical drive, a controller, and one piece of media. However, additional disks cost only \$100 to \$200. In the long run, if you're dealing with massive quantities of information, an optical system may be cheaper.

A traditional magnetic hard disk drive is still the best bet for a primary mass storage system. In this role, an optical drive just can't compete with a hard disk drive's price, performance, and overall



**Figure 1:** In constant linear velocity (CLV) recording, data is arranged in a single spiral track with a uniform density of bits. This lets you pack the most information possible onto the disk. The speed of the disk varies between the outer and inner edges—the closer the read head gets to the outer edge, the faster the disk spins. Data is located by its temporal position, measured in minutes and seconds. Each second consists of 2K bytes of data.

functionality. For example, the NeXT Computer came initially with only a rewritable optical drive. However, because this device proved too slow for its virtual memory file swapping, NeXT added a conventional hard disk drive to speed up the operation.

That doesn't mean that there aren't any uses for optical devices. Quite the opposite, in fact. Document storage and retrieval, graphical image databases, medical diagnostic references, and the storage of multiple versions of files are some of the applications best suited to optical storage. And when put to good use, an optical storage system can be an essential part of a computer system.

### The Optical Advantage

The limitations of hard disk drives become apparent when you deal with large volumes of data that in turn require a lot of space for backup. If you're dealing with 1 gigabyte of data, you could opt for mirrored 1-gigabyte hard disk drives. But when the data enters the multigigabyte or even terabyte range, hard disk drive solutions become unmanageable.

Optical drives can store more information in less space than hard disk drives can. Since optical drives use easily removed and inserted cartridges, you can use a single drive to manage unlimited amounts of information. And with jukebox-style changers, in which a robotic arm handles disk changing and selection, you can have terabytes on-line.

The optical storage advantage occurs because the laser is more precise and requires less room to write the same amount of data than the write head of a magnetic hard disk drive does. With WORM drives, which usually encode bytes of information as pits on the surface of the disk, this means both more information in a smaller space, and a more secure store of data—the pits are a relatively permanent form of encryption and are not affected by magnetic fields.

More storage space doesn't just mean cramming more onto a disk, however. It fundamentally changes what you can do with your personal computer. Instead of dealing with only part of a set of data, you can have all the data in one place at one time. If you work with large images, an optical drive not only allows you to store the images in one place, but it makes them easier to manipulate, compare, and analyze.

Optical devices are particularly suited to storing documents. Using software designed for file management, such as N/Hance's TextScan or Lotus's Magellan, you can sort and group documents

contextually. The advantage to this isn't just speed. It allows you to group documents in ways that were impossible when they weren't all accessible for complex word searches.

Another benefit to optical drives is that you can store both a graphical image of the original document and a text copy on the disk. This is useful for performing signature verification or for including diagrams and photographs. The possibilities are endless with this kind of storage.

One real-world example comes from Bill Ford, president of On-Line Computer Systems. Using CD-ROM and the company's retrieval technology, On-Line devised a troubleshooting disk for a telecommunications switch. Technical specifications, the switch's software code, documentation, and diagrams of the switch were linked together by the retrieval engine. Using this tool, it is possible to click on, say, a variable, get its definition, and retrieve every module and procedure that references that particular piece of code.

People have an associative memory and a relatively brief duration of retention in short-term memory. The avail-

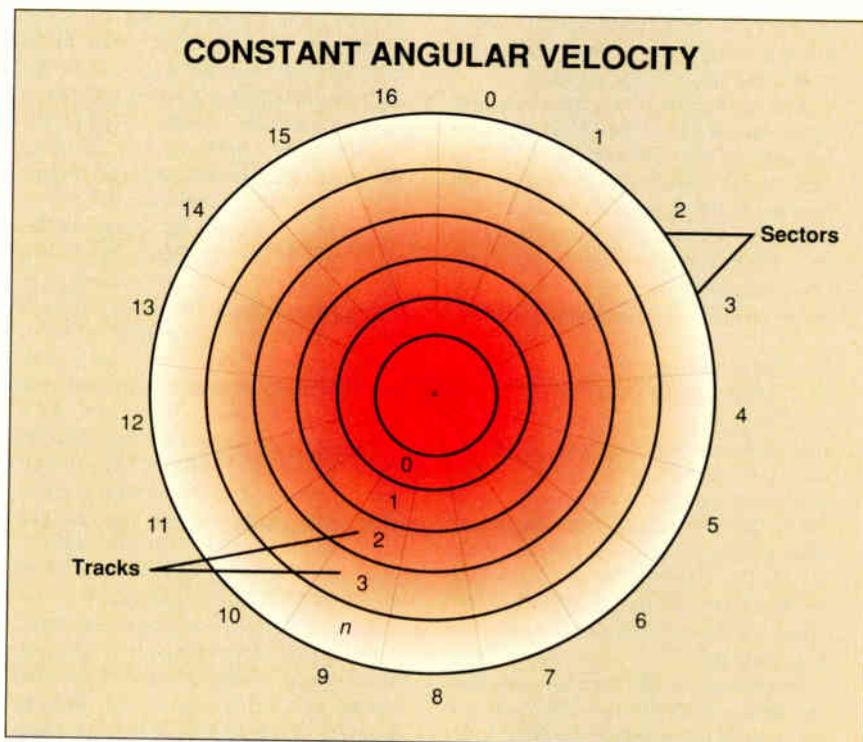
ability of more information organized relative to context rather than to content means that you can draw different conclusions than if you could only access the data in bits and pieces.

### Wanted: Standards for Optical

Optical drives are akin to giant floppy disk drives. Therefore, data exchange between users is as easy as "sneaker" net. Proprietary installable file systems also make data migration between different operating systems possible.

By implementing an installable file system that runs as a TSR program (using interrupt 21 hexadecimal under DOS) or as an IFS driver (for OS/2 and Unix), the only thing you need is to install the appropriate software on each operating system. This approach has also been applied to rewritable drives.

Another benefit of the IFSes used for WORMs or virtual WORMs (rewritable drives using a write-once file system) is archive tracking. When you save a new copy of a file to a WORM device, it doesn't overwrite the old one. Usually when you save a new version of a file, only the changed sectors are written to



**Figure 2:** Constant angular velocity (CAV) is the organization of data into sectors and tracks. Because the number of bits per sector remains constant with CAV, data is packed most tightly in the shorter tracks near the center of the disk. Although this method cannot pack as much data onto a disk as CLV can, the sector/track addressing method makes locating data much faster with CAV than with CLV.

## Playing Catch-Up

Andrew Reinhardt

Hoping to avoid the chaos of incompatibility that has plagued the WORM (write once, read many times) drive market, manufacturers and standards committees tried to get a jump on standards for 5¼-inch rewritable magneto-optical (MO) drives. For a while, it seemed they had succeeded: Except for the Canon drive used in the NeXT Computer, all the MO drives introduced since the fall of 1988 have adhered to the draft ANSI and International Standards Organization (ISO) standards.

But now the situation has grown more complicated. At Spring Comdex last June, Pioneer Communications and Laser Magnetic Storage (LMS) introduced "multifunction" drives that support both WORM and MO media but use a different format than other rewritables. And in August, Hewlett-Packard, Sony, and 12 other companies announced a specification that would allow standard rewritable optical drives to be used in a write-once mode.

The emergence of alternate technologies, on the eve of the ISO's expected approval of a worldwide standard, has thrown the market into confusion and sparked calls to reopen standards discussions. All this wrangling concerns only 5¼-inch media using MO technology; standards for 3½-inch disks and phase-change media are years off.

### The Near Standard

The ANSI's X3B11 committee is now considering only one standard for 5¼-inch rewritable optical disks, using MO media and a formatting scheme called *continuous composite servo*, or CCS. In CCS, the disk is etched at the factory with a spiral of grooves that define the location of data tracks. Two tracking heads read the grooves constantly to position and focus the third head precisely over the data.

In contrast, by the time you read this, the ISO will likely have approved two versions of the standard for MO drives that are identical in all respects except for the servo technique. The standard, called ISO DIS 10089, specifies a Format A, which is CCS, and a Format B, which is *sampled servo*, or SS. The latter does not use grooved tracks or multi-

ple heads; instead, bits that align the single head are mixed in with the data.

An SS disk is stamped at the factory with regions of precisely calibrated pits that tell the head where a data track is located. In the ISO specification, there are 32 sectors per track and 43 servo segments per sector, so in a single rotation of the disk, the head's position is calibrated almost 1400 times; even so, it has to be much more precise than in a CCS mechanism. Besides telling the track location, servo regions are also used to focus the head and provide clock synchronization.

### The Battle of the Servos

CCS traces its roots back to analog-video laser disks. As an older and more mature technology, it is considered a safer bet than SS. CCS-formatted media are easier, though more time-consuming, to manufacture, whereas SS media require more expensive and advanced equipment, but they are faster to make because disks can be stamped. In the end, the manufacturing contest between the two is a draw, because current technology makes both equally feasible; any differences in price are due to production volumes, which favor CCS.

The more germane advantages of SS, according to its proponents, are that it offers superior speed and accuracy, as well as the potential for greater disk capacity. SS drives handle data and servo information separately and sequentially, whereas CCS drives must deal with both simultaneously. Therefore, CCS drives need greater processing capacity to achieve equivalent data throughput. More important, CCS drives can experience cross talk between the data and tracking grooves: Because this interference is absent from SS drives, SS offers a better signal-to-noise ratio.

Since SS drives have only one head, which saves a lot of mass, they can seek tracks faster. And because surface area on the disk is not used up for tracking grooves, SS disks can have many more tracks, although current standards do not specify that. (Because some of each track is used up for servo information, SS disks hold less data per track. In the ISO format, enough additional tracks are added that the net capacity of both

formats is the same.)

Pioneer and LMS developed SS MO drives because they already sell SS WORM drives and wanted to provide an upgrade path for current users. The advantage is that you only need a single drive unit to use both WORM and rewritable media. By contrast, the CCS MO drives, marketed by Sony, Ricoh, and others, can't read from or write to any other optical media. Pioneer and its cohorts asked ANSI to consider adding a specification for SS to its 5¼-inch MO standard, but the membership voted strongly against the request in a May meeting. So, only the ISO will document SS.

### Magneto-Optical Multifunction

The consortium headed by Hewlett-Packard has responded to the Pioneer-type multifunction drives with a proposal to give MO drives an "archival" capability. Such drives would also be multifunctional, but they would use only MO media. However, you would still need to stock separate disks for permanent and temporary storage because each would be coded differently at the factory.

The Hewlett-Packard specification would supplement the current ANSI/ISO specifications, but neither standards organization has plans at this time to incorporate it into published documents. However, with Hewlett-Packard, Sony, Maxoptix, Olympus/Ricoh, Seiko/Epson, Philips-Du Pont Optical, 3M, Fuji, Mitsui, and Asahi backing it, the specification may become a de facto standard even if it is never formally adopted.

In a nutshell, the Hewlett-Packard scheme takes advantage of fields that are defined but unused in the current ISO standard. These fields would be used to set flags indicating that the rewritable medium was to be used only for permanent storage. While bits would not be permanently burned into the medium as with WORMs, Hewlett-Packard contends that with proper firmware the disks would be as secure as WORM storage—and perhaps longer-lived.

Opponents of the proposal say that if you need write-once storage, you won't want to use disks that could theoretical-

ly be erased. Hewlett-Packard responds that somebody bent on destroying data could also alter a WORM; in any case, its write-once MO proposal offers three levels of security. The most prevalent misconception about the method is that an MO disk written with "permanent" data could be accidentally erased if it were inserted into an older-generation MO drive; in fact, says Hewlett-Packard's Bill Boles, the drive would reject the disk or issue an error message.

The three levels of security are as follows: First, the disk contains two tracks whose contents are coded at the factory to indicate whether it is a rewritable or write-once MO. If the codes indicate that the disk is rewritable, the drive can store data; if not, or if the drive can't read the tracks (as would be the case for older generation media), then no writing is allowed. The second and third levels of protection involve setting flags on the disk—one is an indication written during formatting that the medium is write-only, and the other is a code embedded in each sector that indicates it is locked.

What this means, of course, is that disks can be either write-once or rewritable, but not both. What is the benefit of this scheme over Pioneer's if you still have to use different media, especially when WORM disks are cheaper? Hewlett-Packard answers that MO disks will eventually become less expensive than WORMs because of higher volume. More important, some research now indicates that MO disks are more stable in the long run than WORMs, which are subject to decay from humidity trapped in the data pits.

### A Fly in the Ointment

Yet another variant exists for MOs that could further complicate the standards picture. This subset of the CCS format, called *zoned constant angular velocity*, or Z-CAV, is concerned not with pits versus grooves, but only with the arrangement of sectors in tracks. Although neither the ANSI nor the ISO is considering its adoption as a standard right now, a group of vendors, including Maxoptix, Hewlett-Packard, and several media makers, is promoting the speed and capacity benefits of Z-CAV.

All the drives discussed earlier are constant angular velocity (CAV) devices, which means that their motors spin at a constant speed (see figure 2). (By contrast, audio compact disks and CD-ROMs use constant linear velocity, which means that the motor spins at different speeds depending on which track is being read, so that the data passes under the laser at a constant rate. See figure 1.)

CAV disks look like bicycle wheels, with the sectors arranged regularly between the spokes. Z-CAV, on the other hand, takes advantage of the fact that the outer tracks of a disk are longer than the inner tracks. The result is a staggered arrangement of sectors, with an increasing number per track the closer they are to the outer edge. The Tahiti drives from Maxtor can support standard CAV and nonstandard Z-CAV media, and the Z-CAV disks hold 1 gigabyte of data instead of the normal 650 megabytes. Access to data in the outer tracks is also faster than in the CAV arrangement.

### Further in the Future

Two other developments loom on the horizon for optical storage. The first is phase change (see "Entering a New Phase" on page 289). The second is 3½-inch drives and media, for which standards are still evolving.

The ANSI and ISO have promulgated draft standards for 3½-inch MO media and drives, and on that basis, a few companies, including Pinnacle Micro and O.C.E.A.N. Microsystems, have already shipped products based on a Nakamichi mechanism. But you may be taking a risk buying these drives, says Ken Hallam, chairperson of the ANSI subcommittee on 5¼-inch MO standards. Buyers of early Sony and Ricoh 5¼-inch MO drives will be able to meet the final ISO standard with a field PROM upgrade, but changes may yet occur to the 3½-inch specification that would render existing products physically incompatible with the final standard.

Hallam says that an agreement on 3½-inch MO standards is at least a year away at the ISO and even further at ANSI because there are still a lot of arguments between committee members.

The new specification won't be just a scaled-down version of 5¼-inch standards, because manufacturers want to leapfrog today's drive technology. One possible goal—pushed for mainly by IBM—is to allow both rewritable and read-only (stamped) disks to be used in the same drives. IBM apparently believes 3½-inch media will become an important means of distributing software.

Among the most controversial questions still to be decided is whether the whole disk or only parts of it may be read-only. ANSI is leaning toward allowing only a single track to be read-only because this would simplify tracking and eliminate the need to catalog which parts of the disk are rewritable and which are not. But Japanese vendors and other forces in the ISO want read/write status to be fully interchangeable on a sector-by-sector basis, which would complicate tracking and defect management but increase flexibility.

In any case, if 3½-inch drives have to accommodate read-only media, the specifications for tracking and reflectivity will have to be quite different than in the 5¼-inch specification, because, to a laser beam, stamped bits look different from MO spots. If that is not enough to worry buyers of 3½-inch drives, as recently as August ANSI approved minor changes to the disk cartridge specification that could render current 3½-inch media incompatible with future drives.

### A Vicious Cycle

The push and pull between market forces, standards bodies, and what is technically feasible has always been complex, even in the well-planned optical storage area. The problem facing optical drives today is not technology but confusion over standards.

This is a vicious cycle: Uncertainty depresses demand, which keeps volumes low and prices high, which depresses demand, and so on. Until the uncertainty is alleviated, optical drives won't reach their potential.

*Andrew Reinhardt is an associate news editor for BYTE. He can be reached on BIX as "areinhardt."*

disk, and new pointers are added.

Combined with a file system that manages the pointers, this method enables you to recover any version of any file at any time. Such a recovery is possible because the directory structure of a WORM drive is not stored in a file allocation table; it is saved as discrete address pointers located after each sector.

Thus, if you need to keep audit trails of documents, you no longer have to keep multiple floppy disks, directories, or paper copies. This capability makes WORM technology ideal both for backups and, in cases where you always need to have multiple versions available, for primary document storage.

This sounds great, and it would be if you could just install the software, regardless of the drive's manufacturer. Alas, you can't. In the first place, a lot of manufacturers add specialized functions to their bus adapters, and their IFsEs are written to take advantage of unique features and capabilities.

While having devices from different manufacturers is normal in many companies, problems arise when you need a different host adapter for each one. Al-

though I've been pleasantly surprised by the relatively few problems I've had with several different bus adapters coexisting in my computer, I've run out of expansion slots.

Universal support of SCSI would mean that any combination of devices could be daisy chained from one host controller. This would not only solve the slot and I/O address problems generated by multiple adapters, but, in the case of bus-mastered SCSI controllers, would result in significant performance advantages.

One thing that appears to be happening, however, is that a number of vendors are moving to support the SCSI-1 and -2 standards for their drives. Sony drives, for example, can be run off a standard Adaptec SCSI controller.

WORM drives especially are beset by standardization problems. Almost every WORM drive on the market uses a different proprietary file system (the same IFsEs that make portability between operating systems possible). This means that you can't read disks across different manufacturers' drives. But the problem doesn't end with the file system: WORM drives are so proprietary that for some a

pit is a 0 and for others it's a 1.

For MO drives, the situation is slightly better. The International Standards Organization standard was not final when the 5 1/4-inch MO drive came out, which resulted in some incompatibility between different manufacturers' drives. But the move is toward firmware upgrades and the production of new devices that adhere to the standards. For a detailed look at the standards' situation with all kinds of optical disks, see the text box "Playing Catch-Up" on page 278.

Hopefully, optical drives will move increasingly toward standards for dealing with data storage and for bus interfaces. Much of the promise of the technology would be defeated by a scenario in which drives and disks are manufacturer-specific. Rather than going the route of hard disk drives, which, in general, require you to use the adapter card with which they were formatted, optical drive makers need to pull together and work toward common ground.

If you can truly treat optical drives as giant floppy disk drives, the advantages will be limitless. However, if they become entrenched in proprietary inter-

**486 EISA  
NOW SHIPPING**

# WE'RE CERTIFIED...

Novell Labs Tested & Approved

SCO  
THE SANTA CRUZ OPERATION

Quarterdeck

BANYAN

While many computer manufacturers say they are compatible, CSS Laboratories'™ MaxSys™ file servers are certified to work with your network operating system. Our MaxSys 386MT/33, for example, has passed testing by Novell,® Banyan,® SCO® and Quarterdeck.® And our new 486 EISA line offers unsurpassed compatibility, while providing all the power and features to carry your network well into the future.

There are MaxSys systems with up to ten drive bays

and 400 watt power supplies, and all come with our exclusive 12-slot motherboard. If you need a heavy-duty file server, this is it. All of our 286, 386SX, 386 and 486 tower and desktop systems come with a full one-year warranty, a national 800 number for technical support, and optional on-site service. And they are all certified to provide uncompromising performance and reliability.

faces and ways of dealing with media, I fear that many of their advantages will be lost. The situation is reminiscent of the one users faced trying to use 360K-byte floppy disks in the early 1.2-MB drives.

Optical drives are also more suited for use in environments that are not kind to conventional hard disk drives. The recording techniques of optical drives and the durability of the media mean that heat, vibration, and magnetization are less likely to adversely affect them.

Even though the recording heads on WORM and rewritable drives are still very sensitive, using them to read data in adverse circumstances is more successful than using conventional storage devices. Hard disk drives just weren't built for use under extremely stressful conditions. With a magnetically and physically sensitive disk rotating just microns away from a head, hard disk drives are prone to both magnetic and mechanical disruption.

The nature of optical media promises a longer life than that of conventional magnetic media. In the case of WORMs and CD-ROMs, you have the added security of data permanence. Conservative esti-

mates are that a WORM or a CD-ROM disk will last 60 to 100 years and that the data on an MO disk will remain stable for about 10 years.

### A Marriage of Convenience

Traditional magnetic devices and optical storage devices are not mutually exclusive. Rather, they use complementary technologies. The problems arise when you begin to treat them as one and the same. Admittedly, if you don't really need the speed of a fast hard disk drive, you could certainly do very well with a rewritable optical device as your primary storage unit. For most of us, though, faster hard disk drives are essential to getting optimum performance from our applications and our personal computers.

Although data redundancy is a good thing, you don't want to overdo it. When you reach the point where, without any real method or reason, you sometimes use a hard disk drive and sometimes an optical drive as your primary storage device, your productivity will drop in proportion to the number of files that are saved on different devices. It is hard enough to find information on a large

hard disk without having to scan over another gigabyte or so of WORM and rewritable disk space.

If you take a sober look at optical technologies, you'll probably find one that will work for you. Personally, I don't know anyone who wouldn't benefit from CD-ROM. At the same time, don't toss your hard disk drive in the trash. Optical drives bring us the ability to do things that conventional magnetic drives cannot; they don't replace them. Chances are, you'll be using your hard disk to hold programs and store your primary data for some time to come.

"A place for everything, and everything in its place" is a good rule of thumb for managing data. When considering the wonders of optical drives, remember that the power of any new technology lies not in what it can do that's already been done, but in what it can do that has previously been impossible. ■

*David A. Harvey lives in Houston, Texas, where he is finishing an MA degree in literature and creative writing at the University of Houston. You can reach him on BIX as "daharvey."*

# THEY'RE SATISFIED.

"I would like you to know how pleased we are with the CSS Labs equipment installed on our network. Your unique design has allowed us to grow the services to our users beyond what was planned in our budgets." "... the higher performance and reliability has been commented on by the network users." "... Also, please extend my sincere thanks to your technical support staff for their fantastic response in resolving our recent compatibility issue." "... My staff was amazed that the solution was delivered the next day! This type of service is rare in the industry." —Roger Spangler, Network Service Manager, Fujitsu America, Inc.

"... ample provisions for drive and add-on board expansion make this system a fine choice in network or multiuser applications." —PC Magazine

"Our records confirm that over 25,000 CSS boards are in the field now, and judging by the low rate of return, their performance and integration in our systems, is outstanding."

—Bob Ziegler, Purchasing Manager, Datamedia Corporation

"... the combination of large- and small-record test results makes it quite impressive over the full range of data-handling hurdles." "Apparently CSS has found some semi-magical combination of medium technology that will yield sterling performance..."

—PC Magazine

"... a great example of a PC on steroids." "This machine is more than the sum of its parts. Power file server builders should keep an eye on CSS." —LAN Times

Circle 86 on Reader Service Card (RESELLERS: 87)

# CSS

LABORATORIES, INC.

A Solid Investment

See us at  
**COMDEX/Fall '90**

November 12-16, 1990  
Las Vegas, Nevada

**Booth N4256**

DEALERS CALL **(800) 966-CSS1**

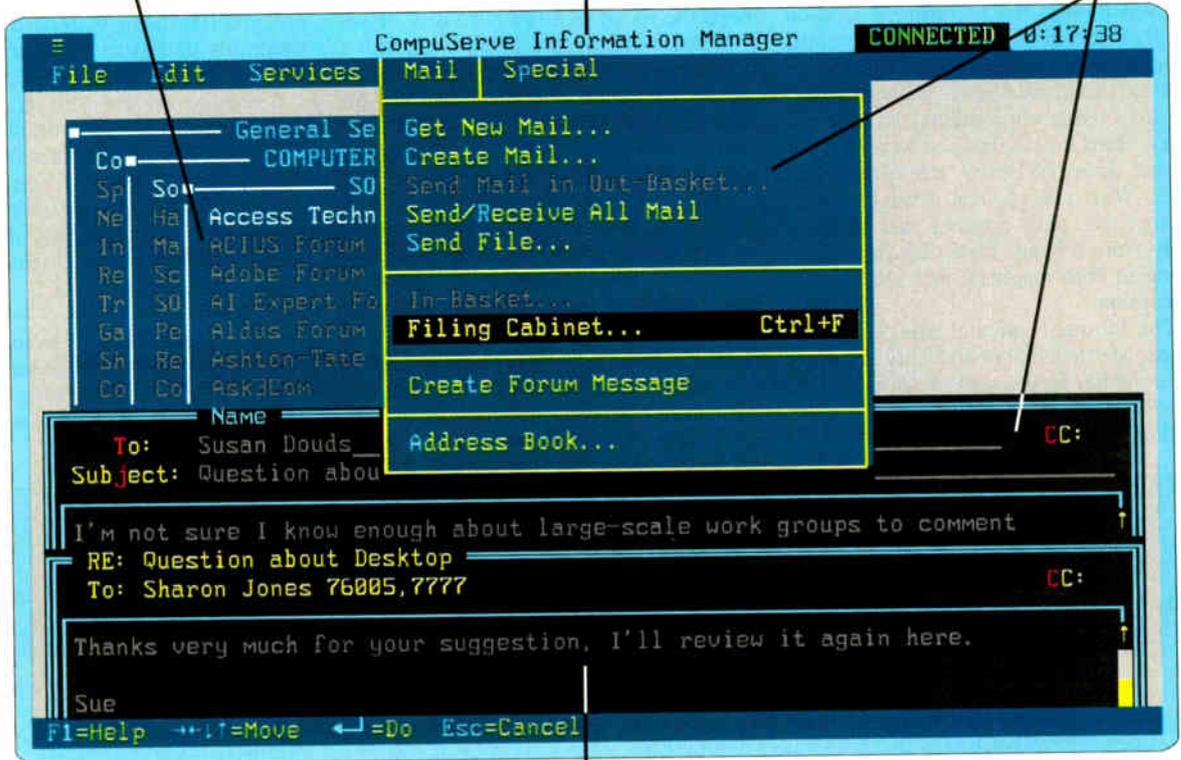
California (714) 852-8161 • New York (212) 605-0290 • Canada (416) 882-0260  
Australia 61-2-808-3666 • Germany 02-51-27-91-17

# Easy does it.

Track where you've been and chart where you're going in a windows-like environment.

Get quick access to multiple information sources.

Save time by using pull-down menus, dialog boxes, and uncomplicated commands.



Save time and money by working offline.

Welcome to the wonderful — and wonderfully easy — new world of CompuServe. Where you can now use the power of your MS-DOS personal computer, while taking advantage of all the online information and communications resources we have to offer.

CompuServe now features CompuServe Information Manager software, making us friendlier and more helpful than ever. Now, you can utilize a windowed PC interface with pull-down menus and dialog boxes. And

you can do more offline — composing letters or reading answers to PC support questions, for instance.

We're offering you this whole new world of CompuServe for only \$39.95\* including software and a \$25.00 usage credit. Usage charges are as low as 10¢ a minute.

So let us show you how CompuServe can put you on easy street. If you're already a member, just type GO ORDER. If not, see your computer dealer, or call us today.

**CompuServe**  
800 848-8199

Requirements for MS-DOS version of CompuServe: Hayes compatible modem and 640K RAM. Hard drive recommended.  
\*Suggested retail price.

Circle 75 on Reader Service Card  
World Radio History

# Crystal Clear Storage

*Holographic data storage promises faster access to lots more data. This is a new age.*

*Tom Parish*

It's no surprise to even the layperson these days to hear about tremendous advances in processor speeds for computers. In the 15 years since the first personal computer was introduced, processors have evolved from 4 bits with CPU speeds in the thousands of instructions per second to 32 bits with speeds of up to 50 million instructions per second.

Processor speeds for supercomputers are moving beyond the billion-instruction-per-second range. With all this performance—and the promise for more—we really need ways to improve data-access times and data transfer rates between primary and secondary memory systems (i.e., RAM and disk).

However, no matter how creative the system architecture is, performance is always limited by how fast you can store (and retrieve) data. The limitations are the result of the seek and latency times that the mechanical nature of all disk drives—magnetic or optical—causes.

The problem is that disk drives are slow in comparison to present-day CPUs, even those used in personal computers. This situation is well known as the I/O



bottleneck. Over the past 10 years, disk drive performance has increased by about a factor of three. In comparison, the CPU performance has increased by about a factor of 1000.

Computers designed with current processor technology require that you invest in sophisticated hardware and software disk-caching schemes to achieve quicker access to large volumes of data. How-

ever, disk caching does not provide significant speed improvements when you need random access to large data sets.

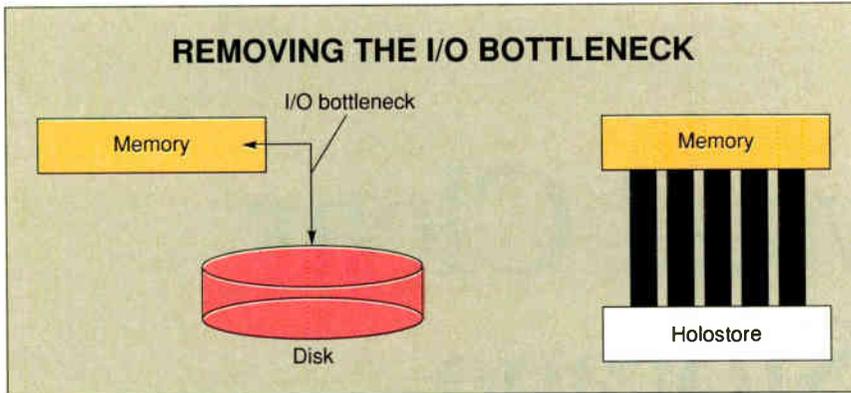
Another idea that was borrowed from the mainframe arena is the use of disk arrays. However, parallel access to eight disk drives only adds an order of magnitude improvement in performance.

Despite fantastic advances in magnetic and optical disk technologies, physical limitations are involved in getting data on and off these rotating devices. A top-of-the-line disk drive today can transfer 3 to 8 megabytes per second.

Enabling full-motion video editing and playback, for example, will require bandwidths greater than 20 MBps with current TV and personal computer standards. Further, high-definition TV requires

four times the resolution of today's video programs and double the frame rate (60 frames per second instead of the current 30 frames per second).

What we need is a memory device that performs like RAM and has the capacity and cost of magnetic and optical media. The Optics Lab at Microelectronics and Computer Technology Corp. (MCC) is developing new techniques for storing



**Figure 1:** The holostore is a new mass storage device that stores digital information as three-dimensional optical holograms. It could eliminate the I/O bottleneck.

**HOLOSTORE STORAGE CHARACTERISTICS**

**Table 1:** The characteristics of the holostore, both in the prototype device and in expected achievable targets, provide an overall view of its capabilities.

Characteristics	Prototype targets	Achievable future targets
Page size	64K bits	1 megabit
Pages per stack	30 to 50	100
Stacks per module	900 to 2500	10,000
Storage module		
Size	3 by 3 by 0.5 cm to 5 by 5 by 0.5 cm	10 by 10 by 0.5 cm
Capacity	200 MB to 2 gigabytes	Over 100 gigabytes
Media	Fixed array of strontium barium niobate (3 cm by 0.5 cm)	Removable module
Average page read time	1 to 10 microseconds	100 nanoseconds
Average page write time	100 microseconds	10 microseconds
Average sustained transfer rate	100 to 800 MB per second	Over 1 terabyte per second
Costs	Prototype costs to be determined	Less than two times magnetic or optical disk cost per bit in 1995
Packaging	5¼-inch peripheral	Hybrid module

digital information as three-dimensional (3-D) optical holograms. The *holostore*, a new mass storage device with super-computer performance, could eliminate the I/O bottleneck (see figure 1).

Storing and retrieving data as two-dimensional patterns of light, or *pages*, in a 3-D volume of light-sensitive crystal provides the basis for the holostore. Organizing the data into pages provides access speeds orders of magnitude faster than the rotating devices of today. For example, the fastest magnetic disk currently available takes over 5 hours to transfer what a holostore device could transfer in 1 second. Here, finally, is a memory device that can handle the de-

mands of computing with images.

This technology is based on photorefractive volume holographic storage (PVHS) techniques; it makes possible extremely fast, nonvolatile, and potentially removable media. Holostore memory would be a good choice for systems that need to provide fast random access for the recording and playback of digital video and high-throughput transaction-processing systems. It could finally enable a secondary memory device to outperform the processor.

**How It Works**

*Holostore* is a name informally adopted for a memory device using holographic

storage techniques that is capable of storing digital information as 3-D holograms in photorefractive crystals. To provide an overall view of the holostore's storage characteristics, table 1 shows its prototype targets and achievable future performance targets.

To optimize the device for a particular system (i.e., to the size of the blocks of data used), you can control page size, pages per crystallite (per stack), stacks per module, and whether modules are fixed or removable. A DOS- or Unix-based operating system would find a 4K-byte or 8K-byte page size easy to handle, since these choices closely map what disk drives provide today as a cluster. A holostore device embedded with custom processors for image processing may work more optimally with images sized to 512 by 512 bits, or 32K bytes. Record-oriented processing systems might perform better with smaller page sizes.

For illustrative purposes, let's assume the storage medium inside the holostore is an array of 2500 tiny crystal rods (50 by 50) tightly packed into a volume of 5 cm by 5 cm by 0.5 cm. This storage medium is small enough to need a special package to carry it. Initial prototypes expected in the next few years will be built to fit in a 5¼-inch form factor. The holostore's size will shrink considerably as solid optoelectronic technology matures, making it possible to integrate holostore technology directly into the processor.

The crystal storage material is strontium barium niobate doped with cerium to accelerate the photoelectronic activity during the write process. For details on the nondestructive read problems being solved for photorefractive crystals and the reason for using an array of crystallites instead of a single monolithic cube of photorefractive material, see the text box "Making PVHS Work" at right.

It has been demonstrated that each crystallite is capable of holding over 30 pages, but recent experiments indicate that 50 or more pages may be possible. One aerospace company demonstrated a prototype with lithium niobate crystals that could store 500 pages of information without signal-to-noise problems.

**Reading and Writing**

The holostore's major components are the laser source, the page composer or spatial light modulator, the crystallite array, the page-selector assembly, and the detector array (see figure 2). The laser light is split into separate beams and steered into the crystallite to write or read a page of data.

The holostore's laser source is a

## Making PVHS Work

**P**hotorefractive volume holographic storage (PVHS) technology has been investigated in the past as a memory-storage mechanism, but with little success. One reason for its failure was the emphasis placed on storage capacity. However, the real advantage of this technology is its random-access speed, which is fundamental and won't erode.

Another reason for early failures was the state of the art of related technologies (e.g., two-dimensional spatial light modulators as page composers, lasers, beam deflectors, photorefractive materials, and detector arrays). Only in the last few years has this technology been mature enough to put a prototype together at a reasonable cost.

One difficulty with PVHS technology has been its destructive readout. The reilluminated reference beam (i.e., the read beam) used to retrieve the recorded information also excites the donor electrons and disturbs the equi-

librium of the space-charge field in a manner that gradually erases the recording. In other words, when you read a page from the crystal many times, eventually you destroy the information. In the past, this has limited the number of times you could read a page before the signal-to-noise ratio became too low.

Previously, bulk photorefractive crystals were usually used with relatively large crystals, usually 1 centimeter by 1 cm in length and 0.5 cm in depth. However, it is difficult to grow high-quality crystals, such as strontium barium niobate, in larger sizes, making scaling to higher capacity difficult. As a consequence, widespread application for bulk photorefractive technology did not occur, despite the initial surge of development in the 1970s.

In 1988, researchers at Microelectronics and Computer Technology Corp. (MCC) and Stanford University patented a nondestructive read tech-

nique and a manufacturing technique for using arrayed crystallites instead of monolithic crystals. The technique for the nondestructive read provides the ability for prolonged readout without degrading the stored image data. Tests have shown that the equivalent of one billion reads can be accomplished without signal-to-noise degradation.

Use of an array of crystallites, instead of a single monolithic crystal, has many advantages for holographic storage. Small-diameter crystals are easier to grow, and you can increase storage capacity by making a larger array. In addition, the reference beam is guided through the crystal rod, increasing the interaction length and thus the dynamic range. Also, these smaller crystals dramatically improve the angular selectivity of pages, allowing a larger number of pages per stack. And finally, they virtually eliminate cross talk between stacks.

## TOTALLY RADICAL...

### The Caching Baby Motherboards A New Concept in PC Design

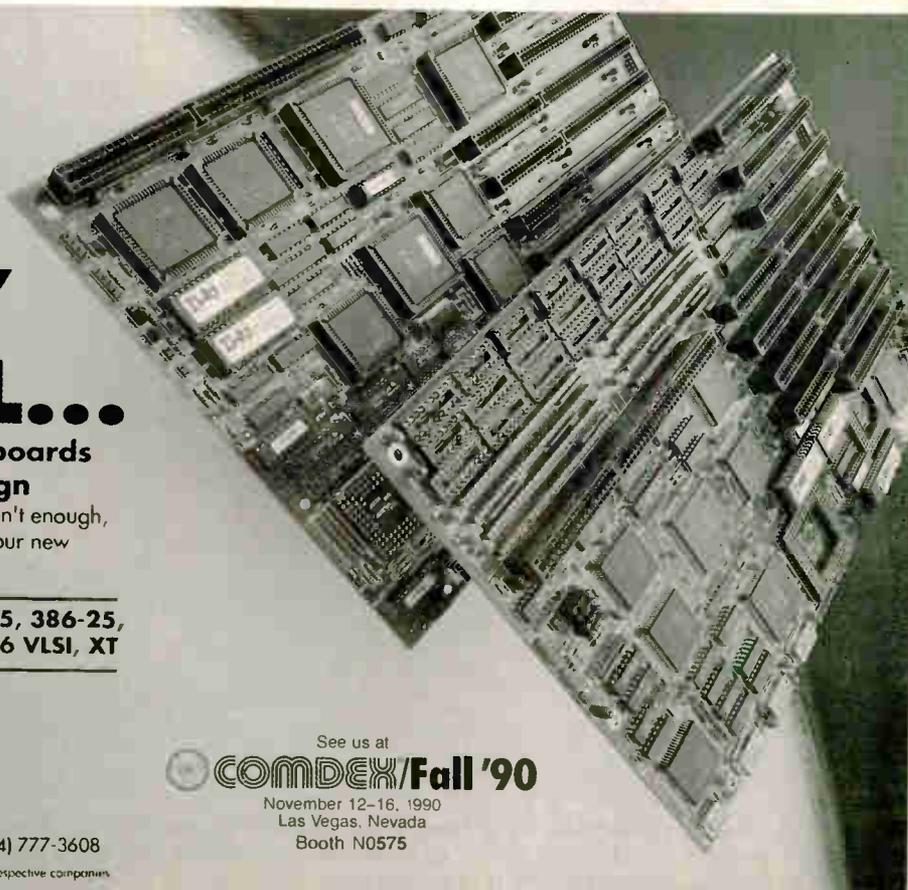
As if being a Caching motherboard weren't enough, we've redefined the state-of-the-art with our new full-functionality Baby Boards.

486, Cache 386-33, Cache 386-25, 386-25,  
386-20, 386SX, Neat 286, AT 286 VLSI, XT

**CACHING**  
(714) 777-2818

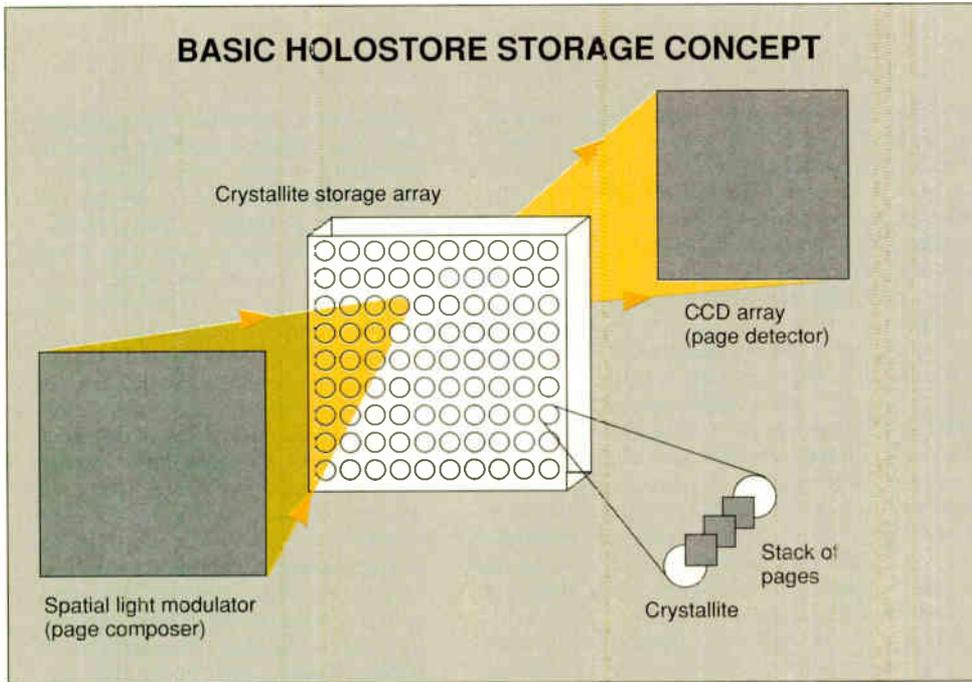
1250 N. Lakeview Ave., #Q  
Anaheim, CA 92807 FAX • (714) 777-3608

All brands and product names are trademarks or registered at their respective companies.

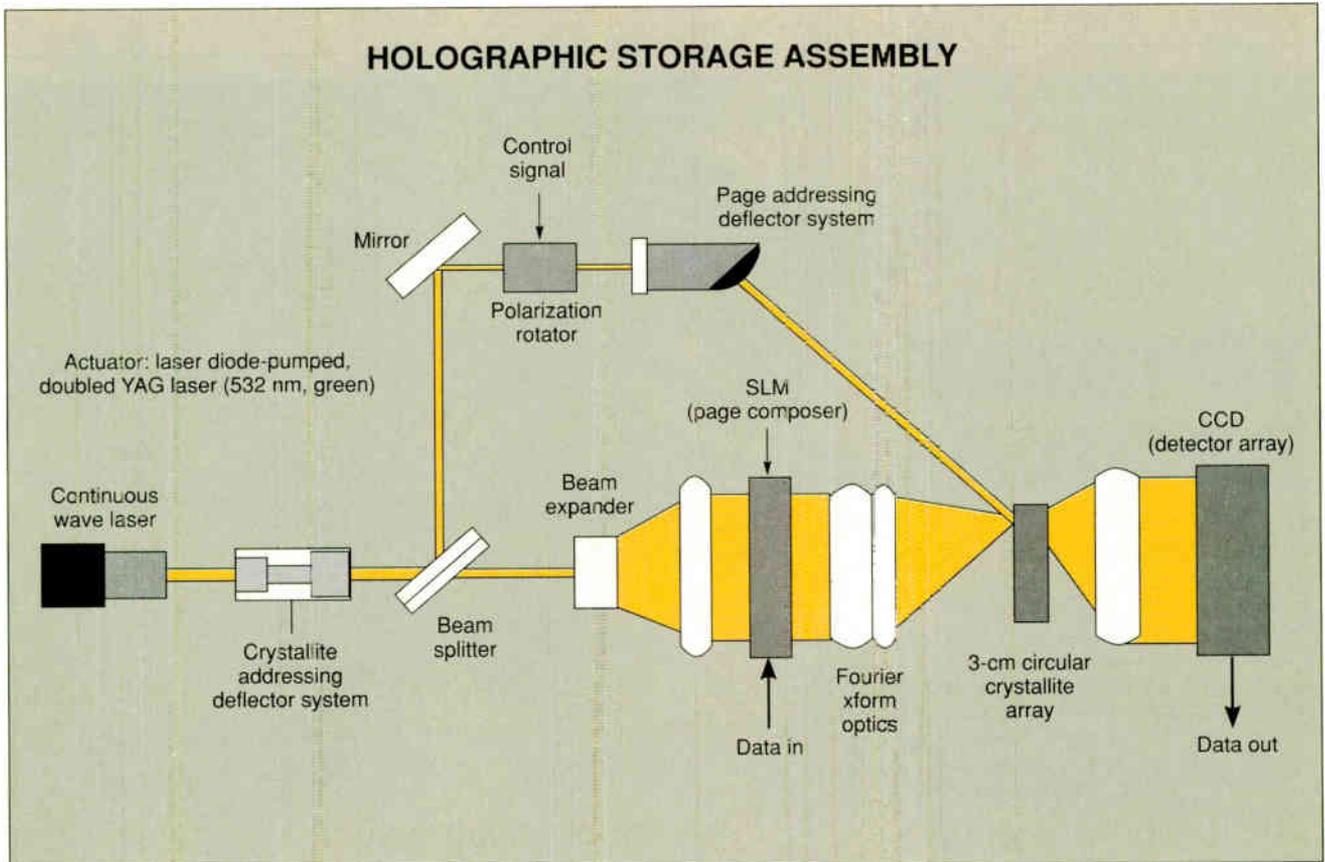


See us at  
**COMDEX/Fall '90**

November 12-16, 1990  
Las Vegas, Nevada  
Booth N0575



**Figure 2:** The holostore superimposes a pattern of light and dark spots based on the digital data onto the data portion of the laser beam. The data is stored as electronic-charge patterns, based on the interference between the data and reference beams, which modify the optical properties of the crystallite. The result is a 3-D holographic image of the bit pattern carried in the data beam.



**Figure 3:** The laser source for the holostore prototype is a compact, doubled, diode-pumped YAG laser with 80-milliwatt output at 532 nanometers. The beam splitter splits the laser into separate data and reference beams and steers them onto the surface of a crystallite to store (or retrieve) a page of data.

compact, doubled, diode-pumped YAG (yttrium aluminum garnet) laser with 80-milliwatt output at 532 nanometers (see figure 3); a 532-nm laser falls within the green range on the visible spectrum (see the photo). Tracing the beam from the laser, it first encounters the stack-selector assembly, which steers it to an individual stack of pages. Next, a beam splitter separates the beam into two parts. The first part is the data beam, and the second is the reference beam.

Starting from the beam splitter, the holostore expands the data beam onto the surface of the page composer, where digital electronic data enters the system. This data is displayed on the surface of the page composer and illuminated by the expanded data beam, creating a bit pattern of light and dark spots. The holostore superimposes this pattern of spots based on the digital data onto the laser beam, where it represents the bits on the page to be stored.

After the page composer, the holostore focuses the data beam through a lens system into and through the crystallite array. As the two beams, data and reference, enter the crystallite together, the reference beam interferes with the data beam, writing an interference grating in the photorefractive material. The holostore converts the grating pattern in the photorefractive material to a stored electronic-charge pattern that modifies the optical properties of the crystallite.

The result is a 3-D holographic image of the bit pattern carried in the data beam. (The interference grating allows the hologram to be recreated when the holostore reads the data.) This is the entire write process.

As an example, a 256- by 256-bit array (8K bytes) should require approximately 100 microseconds to transfer, assuming a theoretical transfer rate of 80 MBps. Currently, the frame rate of the page composer limits the I/O rates. To write another 64K-bit page in the same stack, the holostore shifts the reference beam's angle roughly one-fourth of a degree and loads new data on the page composer.

The read cycle is relatively simple. During a read cycle, the data beam is shut off, so only the reference beam shines through. The holostore selects the location of the reference beam for the specific stack of pages to be read, and the angle then determines the address of the specific page in that stack.

The reference beam illuminates the interference grating stored at this selected angle, resulting in the reconstructed image of the original bit pattern stored there. The holostore then focuses this

pattern as an image on the system's detector array. The detector array is a charge-coupled device that captures the reconstructed light and dark bit patterns of the image and converts them back to digital electronic signals for transfer to the computer.

An average page-access time of 1 microsecond has been demonstrated with the prototype now under development at MCC, which provides a potential transfer rate of 800 MB per second. In the future, even higher speeds should be available as computers are reoriented toward high-performance memory devices.

### Staging the Technology

Getting the holostore into personal computers and workstations will come in stages. Some possible areas of application are disk replacement, disk caching, front-end-processor caching, system-bus interfacing, and direct connection to the CPU. These areas are listed in order of their complexity to implement, as this will have an effect on how soon holostore devices for these functions will appear.

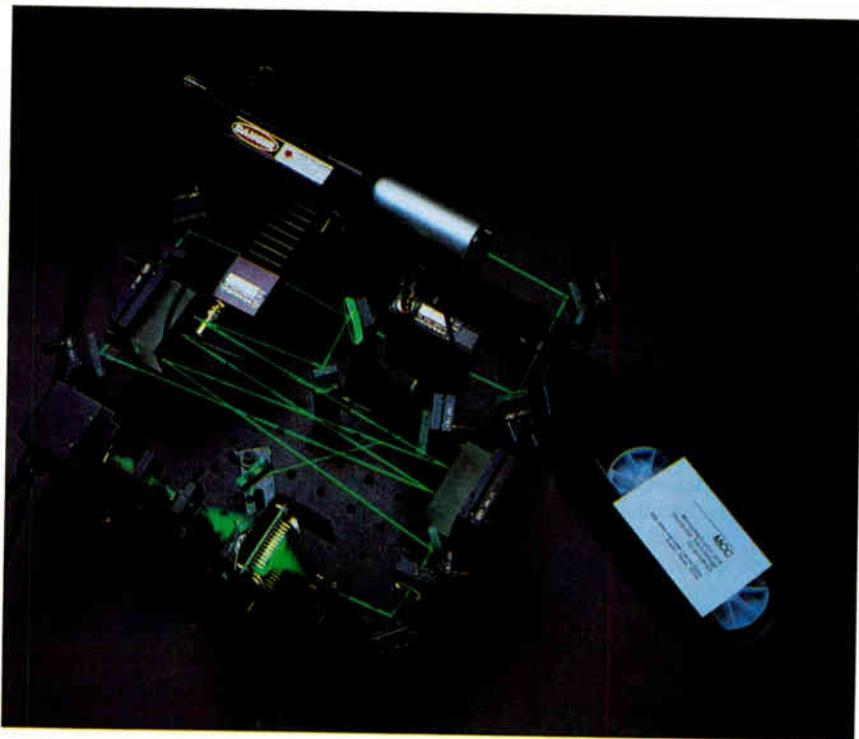
It's easy to affect computer performance by installing a holostore device as an interface to existing ESDI, SCSI, or SMD controllers in installed systems. This would require no changes to bus structure or the operating system, al-

though it might be necessary to modify disk drive controller firmware somewhat. To the controller, the holostore device would look exactly like a disk drive without seek and latency delays. When data is requested, it is available at whatever transfer rate the existing controller can support.

Performance improvements of two to 30 times for workstations are possible because the holostore would greatly reduce seek and latency times. (It would provide 1- to 10-microsecond access time versus approximately a 10-millisecond access time for magnetic or optical disk storage.) The holostore would provide a simple way to boost the performance of installed systems through field upgrades. It could also provide freedom from the vibration and temperature problems that trouble disk drives.

Where a large investment in minicomputer and network-based disk systems exists, you might want to upgrade only the disk-caching component. After all, the processors have the performance you want; it's the disk drives that create the bottleneck.

A new caching disk drive controller with a few hundred megabytes of extremely fast nonvolatile holographic storage would boost the performance of existing drives by holding "hot spots" in



*A prototype holostore device. Since the beam falls within the green range on the visible spectrum, you can trace its progress through the device (see figure 3 for more details).*

**HOLOSTORE APPLICATIONS**

**Table 2:** Many possible applications for the holostore come to mind because of its ability to handle the demands of high bandwidth at a relatively low cost with a nonvolatile memory system.

**Memory-hierarchy element**

- Special virtual memory paging devices
- High-speed write-through cache
- Context swap space
- Plug-compatible disk drive replacement
- "Solid-state disk" for "hot spots" in databases
- "Bulk-store" swapping device for transaction processing and supercomputing
- Removable medium for data backup and high-speed restore

**Image-processing element**

- Diagnostic-medicine image store
- Target-classifier subsystem
- Airborne sensory-data recorder
- Vehicle data-storage system

**Entertainment medium**

- "Crystal jukebox" for music and video
- High-definition TV video recorder
- Read-only movie-playback system

**Data-distribution medium**

- Compact, nonvolatile, random-access replacement for microfiche and CD-ROM

databases, and simplifying recovery and restart issues for transaction-processing systems. This same holostore (disk-caching controller) could provide a port for removable backup and high-speed restore.

Another possibility for improving the throughput in transaction-processing systems is to integrate a multimegabyte, nonvolatile holostore device into a front-end processor or file server. This would allow the front-end processor to run more independently during main-system interruptions, and would vastly simplify recovery and restart.

A holostore device could also be integrated onto the system bus as the primary memory device, which would give you "instant on" support for playing back audio, video, and text files.

Finally, the most fascinating designs with holostore devices will be those integrated directly into the CPU for image-processing applications. The holostore can provide quick random access to extremely large files with no bus delays, an important factor for high-performance graphics workstations and multimedia systems' controllers.

**Interactive Video**

One popular vision for the future includes full interactive-video applications working as smoothly and quickly as text applications do today. To achieve this vi-

sion, you need the ability to record and play back hours of digital video as well as edit the programs in real time. Instant access to video and audio would also decrease the amount of time that professionals currently have to spend to edit and produce video programs.

Current optical and magnetic disk drives aren't built to achieve these visions. You may recall the problems that the budding digital video interactive (DVI) industry has had to overcome to permit CD-ROMs to play back digital video on existing 286/386 systems. Sophisticated compression and decompression algorithms are being designed into special ICs to overcome two problems: insufficient data storage and I/O speeds.

NTSC-standard TV supports a screen resolution of 512 by 480 pixels. You need at least 750K bytes of data to display a single frame. To get the full-motion effect you see on TV, the screen must display 30 frames per second; hence, the bandwidth requirement for playing video is 22.5 MBps. Without precompressing the video into presentation-level video, a CD-ROM of 648 MB would hold less than 30 seconds of video and take more than an hour to show.

Most scenes don't change dramatically from one frame to another. Thus, DVI developers have devised a compression algorithm that digitizes and stores the

first frame of a scene, and then stores only the changes in the scene from frame to frame.

Playing back a video application is made possible by moving the compressed data over the I/O path from the disk drive to special decompression hardware. As the CD-ROM can provide 72 minutes of full-motion video, it will undoubtedly become a common video playback device, much like the audio CD has.

**In the Crystal Ball**

Most of the cost in any computer-related product is the memory component. The cost of RAM, ROM, and disks dominates current products, and with the move to more digital, audio, and video capabilities and the increases in storage that they require, these costs will rise.

The holostore could be the next piece in the hierarchy of memory devices between RAM and disk drives to support the growing demands of high bandwidth, low cost, and, most important, nonvolatile memory systems. Table 2 contains some possible holostore applications.

With the growing emphasis on high-resolution video and graphics merged with high-fidelity audio, the holostore could be a major weapon in the arsenal of high-speed I/O devices—one that can support the high bandwidth that these digital products require. ■

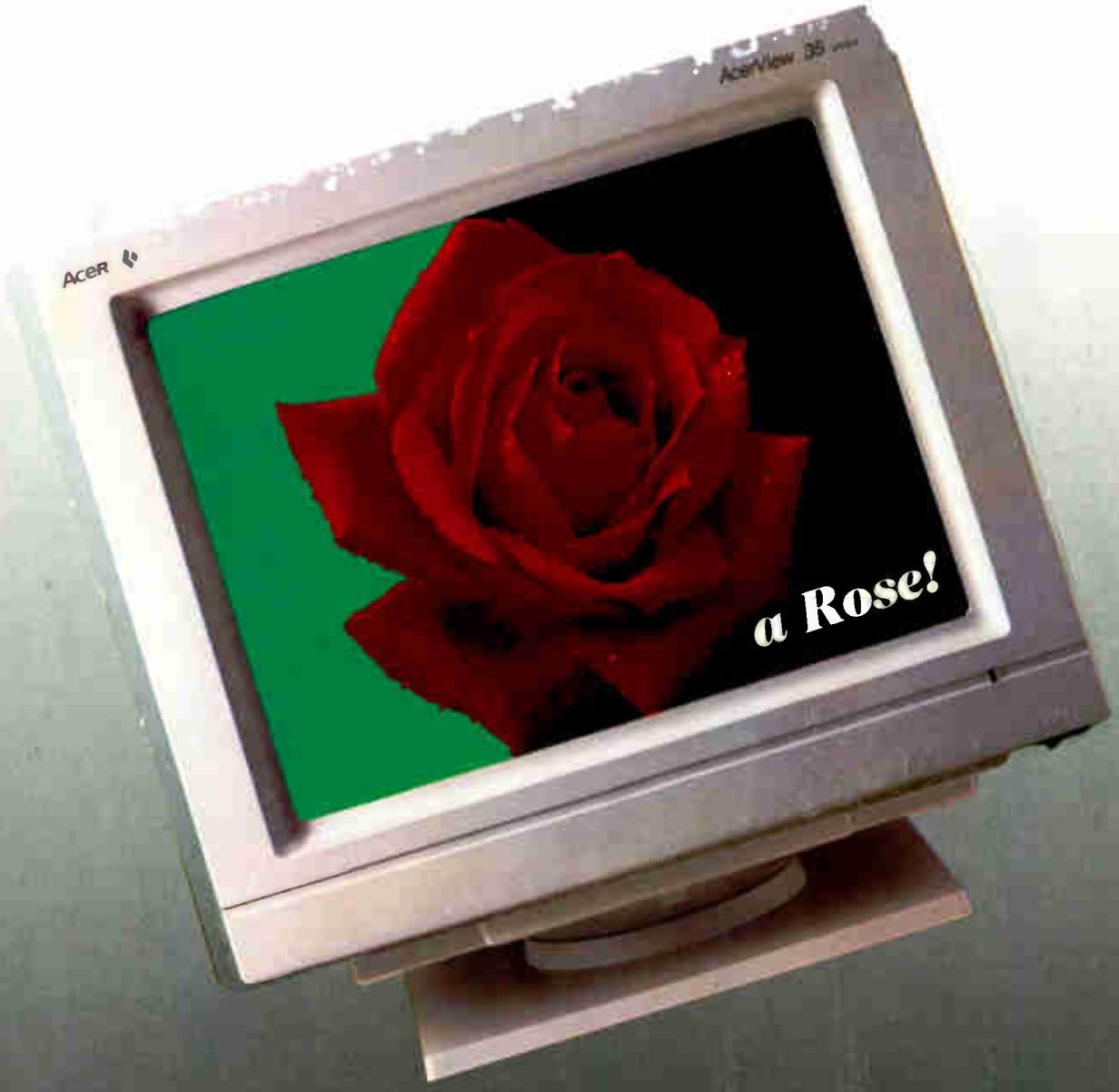
**BIBLIOGRAPHY**

- Chen, Allan. "DVI Technology." *Micro-computer Solutions*, September/October 1989.
- Futuretech*, no. 96, December 26, 1989.
- Parish, Tom. "Bobcat Holographic Storage Project Video." TR # ACT-BOB-219-90, June 1990.
- Redfield, Steve. *Optical Computing Research at MCC*. Microelectronic and Computer Technology Corp., 1990.
- Redfield, Steve, and L. Hesselink. "Enhanced Experiments on Holographic Storage and Retrieval." *Optics Letters*, October 1988.
- Redfield, Steve, and L. Hesselink. "Photorefractive Holographic Recording in Strontium Barium Niobate Fibers." *Optics Letters*, October 1988.

**ACKNOWLEDGMENT**

Special thanks to Ron Riedesel, Steve Redfield, and Jerry Willenbring from the Optics Lab at MCC, and John Pinkston, chief scientist. MCC holds a patent on holostore devices.

Tom Parish is a senior technical advisor for MCC (Austin, TX). You can reach him on BIX c/o "editors."



**Acer** 

# *AcerView: Color So Real, Images Come Alive*



Introducing AcerView color monitors. High-resolution color displays designed for maximum versatility, compatibility and performance, with famous Acer dependability.

	<b>AcerView 31</b>	<b>AcerView 33</b>	<b>AcerView 35</b>	<b>Acer 7015</b>
<b>Resolution</b>	VGA	SuperVGA (800x600), 851 1/4, VGA	1024x768 non-interlaced, SuperVGA, VGA	SuperVGA (800x600), VGA, EGA, CGA, MDA, Hercules
<b>CRT</b>	14" non-glare .28mm dot pitch	14" non-glare .28mm dot pitch	14" Trinitron .26mm screen pitch	14" non-glare .28mm dot pitch
<b>Horizontal Frequency</b>	31.5KHz	31K-38KHz Multiscanning	31K-55KHz Multiscanning	15K-36KHz Multiscanning
<b>Vertical Frequency/ Refresh</b>	50/60/70Hz	45-90Hz	45-90Hz	45-90Hz

For the name of your nearest Acer dealer, call 1-800-SEE-ACER.

**Acer. Now we're all you need to know about peripherals.**



Your Global Partner in Computing

Acer America Corporation, 401 Charcot Avenue, San Jose, CA 95131

Acer and the Acer logo are registered trademarks of Acer, Inc. and Acer America Corp.

# Entering a New Phase

*Phase-change technology combines the capacity of magneto-optical storage with enhanced performance*

*Bob Ryan*

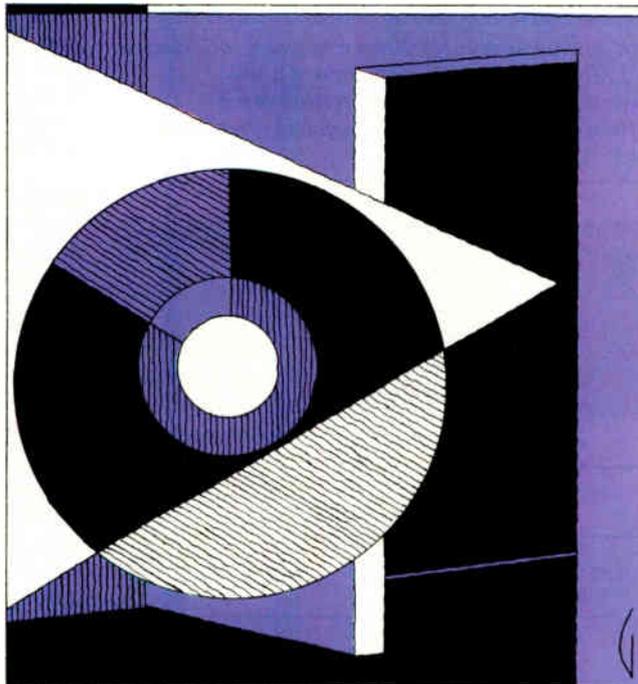
**O**ptical and magnetic storage represent opposite ends of the spectrum. Optical storage is volume storage, while magnetic media offer performance.

With the capacities of individual, replaceable cartridges measured in hundreds of megabytes and gigabytes, optical disks let you store amazing amounts of information in machine-readable form. On the other hand, with access times heading below 10 milliseconds and throughput well over 10 megabits per second, magnetic media remain the only choice for applications where superior disk performance is essential.

Now, by combining the capacity of magneto-optical (MO) storage with enhanced performance, a new optical storage technology—rewritable phase change—promises to make the gap between optical and magnetic storage seem more like a crack in the sidewalk and less like the Grand Canyon.

## **A New Arrival**

Phase-change technology has existed since the 1960s and is used in many commercial WORM (write once, read many times) drives. Up to now, however, tech-



nical concerns about media durability have kept rewritable phase-change storage devices in the research labs and off your dealer's shelves. With the introduction of rewritable phase-change drives in this country and Japan by Matsushita, the technology has made the transition from theory to reality.

Phase-change technology is the first read/write optical storage technology

that allows for the direct overwriting of old data by new. This gives phase change a big advantage over current read/write optical disks, which are based on MO technology.

## **Erasable Optical Today**

As the name implies, magneto-optical disk drives are a combination of magnetic and optical technologies. Unlike purely optical technologies, such as CD-ROM, WORM, and rewritable phase change, MO systems depend on both magnetism and optics to store and retrieve data.

MO drives have made their mark as the first commercially viable erasable optical technology, but limitations in the technology may make it little more than a transition from pure magnetic systems to pure optical ones.

A successful storage technology must be able to create either an "on" or an "off" condition at a particular area—the recording spot—on the recording medium and be able to differentiate between these two conditions. In addition, a read/write technology must be able to change a recording spot from the "on" condition to the "off," and from the "off" to the "on." Like magnetic media, MO systems fulfill all the

requirements of true read/write systems. The problem comes from *how* they fulfill the requirements.

MO disks are built from layers of materials. These layers are built on a glass

or polycarbonate substrate, which carries the grooves and other formatting marks. The active recording layer, consisting of a rare-earth, transition-metal alloy, is normally sandwiched between

two other layers that enhance the effects of the "read" laser beam. The two enhancement layers also protect the active layer from contaminants. Capping off the disk is a transparent surface layer.

The active layer of an MO disk is always magnetized. A magnetic surface affects the polarization of any light that reflects off it by rotating the polarization of the light either clockwise or counterclockwise. This is called the *Kerr effect*. The direction of this rotation depends on the magnetic orientation of the reflective surface.

A recording spot on an MO disk can have one of two magnetic states: positive or negative. These correspond to binary 0s and 1s. The optical head determines whether a spot is a 0 or a 1 by analyzing how the beam of a low-power "read" laser is polarized when it is reflected off the spot. Negative Kerr rotation corresponds to one state; positive rotation to the other. Thus, MO drives fulfill the first criterion of a useful read/write technology: the ability to determine the "on" or "off" state of a particular spot on the recording medium (see figure 1).

The second criterion—changing a spot from a 1 to a 0 or from a 0 to a 1—involves changing the magnetic orientation of a spot. This, in turn, involves the precise synchronization of optical and magnetic technologies.

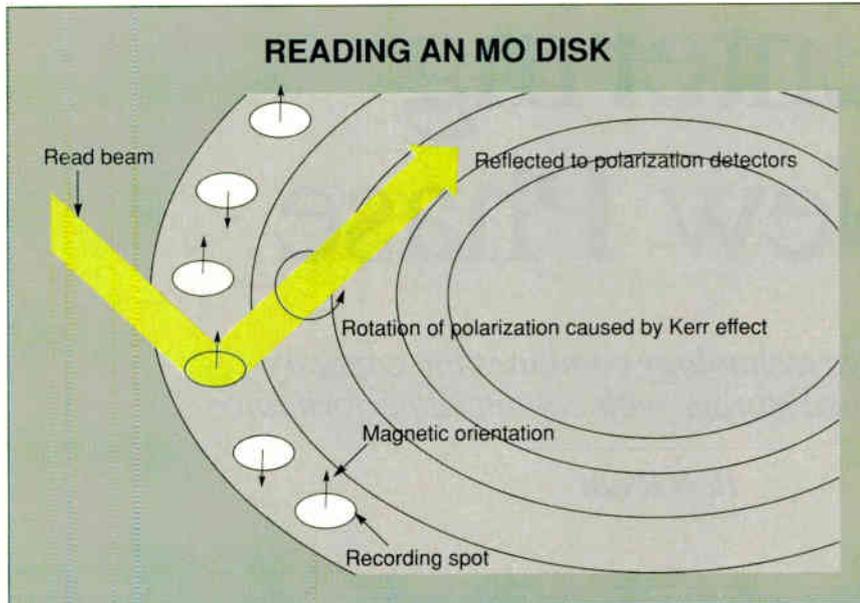
### Magnets and Mirrors

To write to an MO disk, you have to be able to change the magnetic orientation of a spot without affecting the nearby spots. This is the function of the powerful "write" laser.

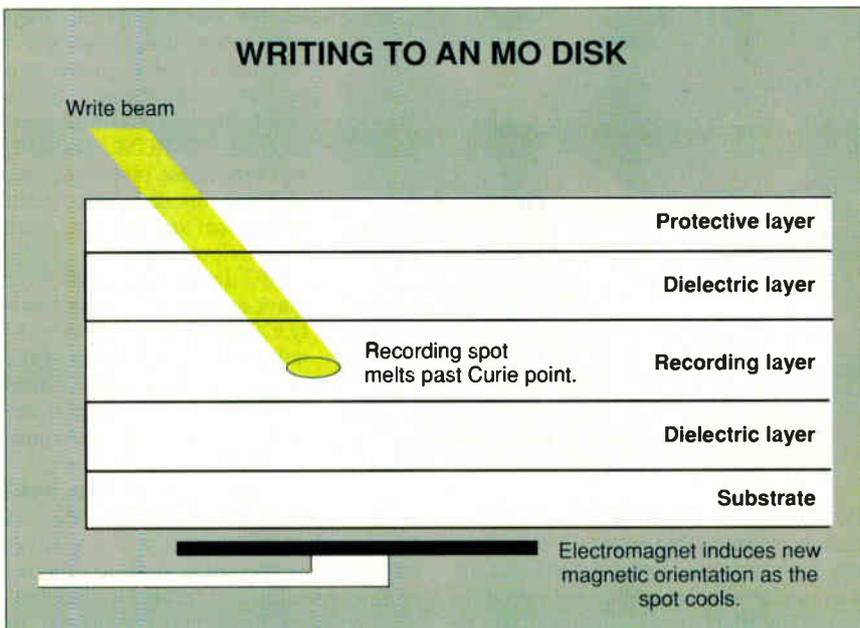
This laser has one purpose: to heat a spot on the recording medium to the Curie point—the temperature at which a magnetized substance loses its magnetic orientation. Once a spot is heated to the Curie point, a small electromagnet on the side of the disk opposite the read/write head generates a magnetic field that reflects the new orientation of the spot. As the spot cools past the Curie point, it assumes the orientation of this magnetic field (see figure 2).

When an MO disk is manufactured, every spot on the recording layer has the same magnetic orientation. This is the default condition of the media. Whenever an MO drive writes to the medium, it assumes that whatever area it writes to is in the default condition. Thus, before writing any data, an MO drive must first erase the area of the disk it wants to write to. Erasing a spot brings its magnetic state back to the default condition.

Having to erase an area before writing



**Figure 1:** Every recording spot on a magneto-optical disk has a magnetic orientation that corresponds to either a 0 or a 1. To determine the orientation of a spot, the read system bounces a low-power laser off the spot. The direction of the polarization rotation put on the reflected beam by the spot's magnetic orientation reveals whether the spot is a 0 or a 1.



**Figure 2:** Writing a bit to a magneto-optical disk means setting the magnetic orientation of a recording spot. The write laser melts the spot, while the underlying magnet produces a field with the new orientation of the spot. As the spot cools, it assumes this new orientation.

**i860 CPU!**

# Parallel Supercomputer Power for your PC/AT/386/486

# 120 MIPS

See us at  
**COMDEX/Fall '90**  
November 12.-16.1990  
Booth Number C611, Caesars Palace



## SPC-860

### Technical Specifications:

- 80 MFLOPS, 40 MIPS, (UP TO 20 GFLOPS)
- 64 bit RISC CPU
- 4/8/16/64 MB RAM
- 2 Dual Ported RAM
- 4 Transputer-Links
- 32 K EPROM for Boot and Self-Test
- Data and Instruction cache on chip (1GB/sec)
- Supports parallel processing of up to 256 SPC-860
- Communication via PC-Bus, Dual-Ported-RAM or Transputer-Links (linear/hyper CUBE)

### Benchmarks

	Dhrystone	Whetstone	100 x 100 Linpack
	Dhry/sec	Double in Kwips	Double-Fortran MFlops
<b>i860 40 MHz (Single Processor)</b>	<b>83400</b>	<b>24000</b>	<b>6.50</b>

### Software (included):

- Native Assembler (running under DOS)
- Loader (including source)
- Debugger (including source)
- Mathgen Formula Compiler
- Math.-Library
- Example programs
- Demonstration program

### Software (optional):

- Intel i860-Macro-Assembler
- Simulator and Debugger
- Math.-Library
- Fortran-Compiler
- C-Compiler<sup>1)</sup>
- Fortran-Vectorizer<sup>1)</sup>
- UNIX V/860 V.4.0

For detailed information please call our California office:

**DSM International**  
**Phone: (408) 946-0655**  
**Fax: (408) 946-0980**

**DSM Digital Service GmbH**  
Landwehrstrasse 37 · 8000 Munich 2, Germany  
Telex: 523 545 dsm d  
Fax: (49 89) 5 51 95-13

# DSM Computer Systeme

1) Under UNIX V/3.2 or OS/2

Circle 119 on Reader Service Card

A Division of DSM Digital Service GmbH

to it effectively doubles the write time of MO drives in relation to other read/write storage technologies. This performance handicap makes it unlikely that MO drives will ever seriously challenge magnetic media as your primary mass storage technology.

Other limitations of MO technology involve the read/write head. Because the magnitude of the Kerr rotation is small—about 1 percent—the head requires relatively large and massive optics to detect the polarization of the reflected “read” beam. A massive head is slower to move across the surface of the disk, resulting in slower access times. Therefore, although MO disks spin as fast as magnetic media, the performance of the drives is two to four times slower than magnetic drives in read/write operations, and as much as six times slower in accessing a particular spot on the disk.

### Direct Write

Phase-change optical storage systems are pure optical technologies. Unlike MO

systems, where the “write” laser merely prepares the recording surface for the data, the “write” laser of a phase-change system actually writes the data to the disk. The laser itself determines whether the spot is a 0 or a 1.

Phase-change technology was first investigated by Energy Conversion Devices (ECD) in the late 1960s. It takes advantage of the property of a particular category of thin films to switch between two stable structural states.

Thin films are a wide-ranging class of semimetal materials that can be deposited onto a substrate in very thin layers. During the deposition process, they are introduced into a vacuum as a vapor. With phase-change thin films, vacuum deposition results in an active layer from 200 to 500 angstroms thick.

The compounds used in phase-change thin films are based on tellurium or selenium. These elements have the property of exhibiting both an amorphous state and a crystalline state. You can switch a spot in the recording layer between these

two states by the judicious application of power from a laser.

### There and Back Again

Initially, phase-change media exist in the amorphous state. Changing a spot to the crystalline state, and changing a crystalline spot back to the amorphous state, requires the manipulation of two important parameters of the recording material: the glass-transition temperature and the melting temperature.

The glass-transition temperature is the point at which an amorphous spot is changed to the crystalline state. The thin films developed by ECD switch to the crystalline state when hit with a short burst of an 8-milliwatt laser.

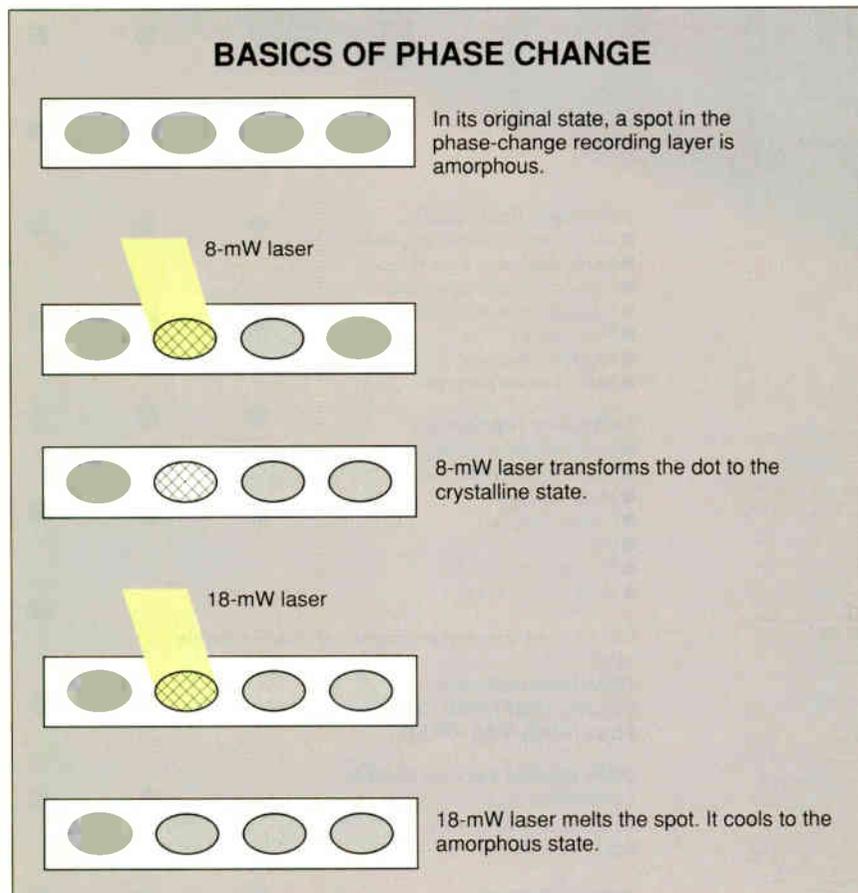
The melting temperature is, of course, the point at which the recording material melts. The melting temperature is higher than the crystalline temperature and requires a more powerful (18-mW) laser. The important feature here is that the recording material doesn't recrystallize as it cools from the melting temperature; rather, it cools into the amorphous state. This process, called *revitrification*, gives the phase-change media the ability to switch directly from amorphous to crystalline and back again. Direct an 8-mW laser at a spot, and it turns the spot crystalline; use an 18-mW laser, and the spot becomes amorphous (see figure 3).

Note that the original condition of the spot is immaterial to the results of the write operation. Say you want to write a 1 to a particular spot, and that the crystalline condition corresponds to a 1. If the spot is amorphous when you hit it with the 8-mW laser, it will change to the crystalline form. If the spot is already crystalline when you hit it with the 8-mW laser, it will remain crystalline, because the laser isn't powerful enough to melt it.

Likewise, when you want to write a 0, the higher-powered laser will always melt the recording material and return it to the amorphous state, regardless of whether it was amorphous or crystalline to begin with.

### Reading Material

The ability to change directly from one state to another is critical to a one-step read/write technology, but equally important is the ability of the system to distinguish between the two states. Luckily, the amorphous and crystalline states differ in a very fundamental optical characteristic—they exhibit different reflectivities. The system determines whether a spot is a 0 or a 1 by examining the intensity with which the spot reflects a low-



**Figure 3:** The remarkable property of phase-change media to change from amorphous to crystalline at one energy level and from crystalline to amorphous at a higher level enables the realization of direct optical overwrite.

# IDEK



## *FLAT is Beautiful ..... and this monitor proves it!*

### IDEK's MULTIFLAT Series of 21-Inch Color Monitors

IDEK's MULTIFLAT Series of 21-inch Color Monitors take full advantage of the remarkable properties of their Flat Square Tubes (FST) to deliver superior resolution and a sharper image that is easier on your eyes. A glimpse at our 21" Color Monitors reveals their matchless over-scan capability that delivers a crisp, distortion-free display across the entire screen.

In addition, Automatic Frequency Scanning realizes outstanding performance for business graphics, CAD/CAM applications as well as desk top publishing on your Mac or IBM compatible system.

As you can see below, whether your requirements are simple or complex, IDEK has the Flat Screen Color Monitor that's just right for you. And priced right, too! See for yourself what a difference a Flat Screen Monitor from IDEK can make

#### MULTIFLAT Series (21" Flat CRT Monitors)

Model	H. Frequency	Dot	Resolution
MF-5J21	15 to 38kHz	0.31	1024 x 768
MF-5121	21 to 50kHz	0.31	1024 x 768
MF-5221	30 to 80kHz	0.31	1280 x 1280
MF-5321 (A.R. Panel)	30 to 80kHz	0.31	1280 x 1280
MF-5121 (A.R. Panel)	30 to 80kHz	0.26	1600 x 1280



IDEK also offers its new Model MF-5117 17" Flat Screen Color Monitor that delivers the same superior resolution and performance as the other members of the IDEK lineup.

# IDEK Iiyama

#### IIYAMA ELECTRIC CO., LTD.

Overseas Division

7th Fl., US Hanzomon Bldg., 2-13, Hayabusa-cho, Chiyoda-ku  
Tokyo 102, Japan

Phone: (81) 03-265-6081 Fax: (81) 03-265-6083

#### IDEK Europe (W. Germany)

Neumannstrasse 38, 6000 Frankfurt a.M. 50, West Germany

Phone: (49) 69-521 922 Fax: (49) 69-521 927

#### IDEK North America

144 Centre Mountain View, CA 94041 U.S.A.

Phone: (1) 415-962-9410 Fax: (1) 415-962-9474

# See Your Data\*



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



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



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

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

\*MapInfo now has "TIGER," the most up-to-date and comprehensive library of street maps available on the PC. Prices vary. MapInfo comes with a map of the world and the U.S. with all ZIP code locations. Runs on IBM PCs or compatibles with 640K RAM, a hard drive, and graphics.

## MapInfo Corp.

Changing The Way The World Looks At Information™

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

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

power "read" laser (see figure 4).

Because the differences in reflectivity between the amorphous and crystalline states of phase-change media can be orders of magnitude greater than the 1 percent change in Kerr rotation detected by MO systems, the read/write heads of phase-change systems don't have to be as sophisticated and sensitive as those of MO drives. Thus, as the technology matures, you should see phase-change read/write heads become less massive than their MO counterparts. The result will be faster seek and access times.

### The Layered Approach

Like an MO disk, a phase-change disk consists of more than a substrate and a recording layer. Further layers are usually added to enhance the contrast between the reflectivity of the two states and to protect the active layer from outside contaminants.

Tellurium, the primary material used in most phase-change media, crystallizes below room temperature in its pure form, making it impossible to use in an everyday office environment. However, the introduction of small quantities of other materials, such as germanium and anti-

mony, raises the glass-transition temperature of the alloy above 100°C.

### Future Phases

After two decades in R&D laboratories, phase-change storage devices are now available from Matsushita in both Japan and the U.S., where they are marketed under the Panasonic brand name (see the text box "Phase Change Is Real" on page 296). As more manufacturers introduce phase-change systems and as researchers make advances in media and optical-head technologies, you will see a steady improvement in media durability and disk access speeds. Given its inherent advantage over MO technology, phase-change storage may be the premier optical storage technology by the middle of the 1990s.

In the future, phase-change technology may also challenge magnetic media in all but the most speed-intensive applications. Advances such as very small integrated optical read/write heads will greatly decrease access times, and more durable media will silence doubts about the reliability of the technology. Given its already large advantage in costs per K byte of storage, phase change may be the

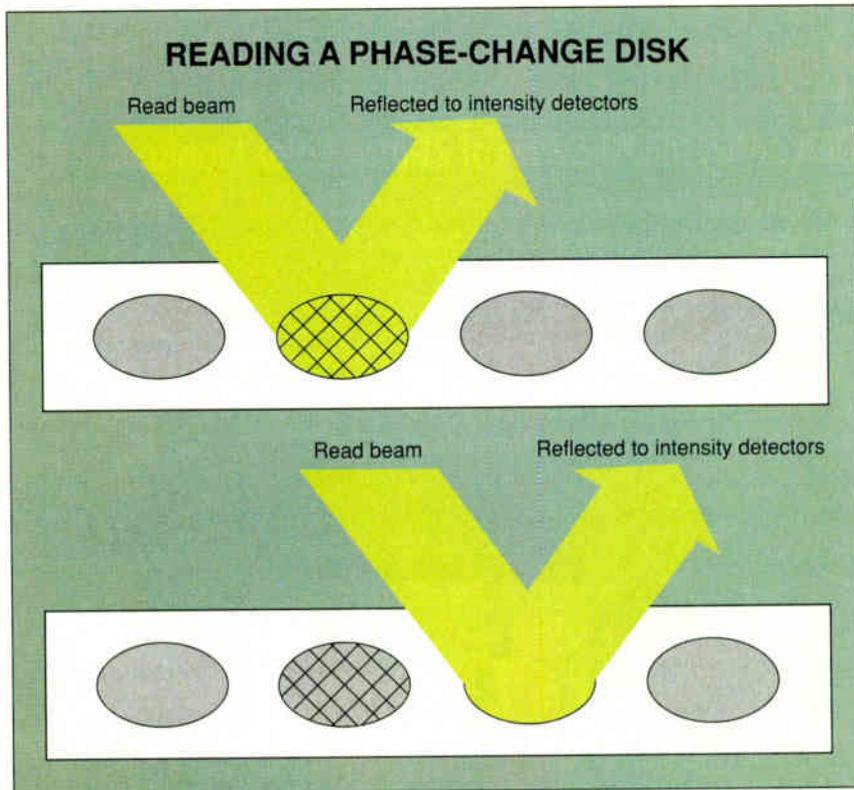


Figure 4: Unlike magneto-optical drives, which must detect small changes in the read beam's polarization, phase-change systems read information by detecting the relatively large differences in the reflectivity of the amorphous and crystalline states.

# WE'D LIKE TO SUGGEST A FEW NEW CRITERIA FOR CHOOSING FORMS SOFTWARE.



To appreciate the benefits of JetForm™ software, we invite you to first examine the subject of business forms themselves. And why every business has so many.

It's because forms are the proven way to gather information. Communicate it. Store it, and process it. Which is precisely the point of view from which JetForm was developed.

Naturally, JetForm gives you complete WYSIWYG graphics and font control, using the industry standard Microsoft® Windows interface.

But we also give you something else. And that's a set of capabilities that turns forms software from a handy way to replace pre-printed forms into a powerful way to run a business.

Which is why you'll find JetForm prints faster on the laser printers that businesses use most.

And connects more effectively to networks. So both forms and the information they contain can be better shared and communicated - across departments, or entire organizations. And not just with IBM® PCs, but with HP®3000s, HP9000s, DEC® VAXs™ and UNIX® machines.



Combined with our optional JetForm-Merge and JetForm-Server software, JetForm makes it possible to completely automate and streamline the entire information management process. From design and forms completion, to printing and integration with your existing dBASE® files.

As years pass, other software makers may discover the true purpose of business forms, and upgrade their products to the capabilities of JetForm. But JetForm has them today. And a new business day starts tomorrow.

Call 800-267-9976 for complete information on the full family of JetForm forms software.



**THEY'RE MORE THAN JUST FORMS. THEY'RE YOUR BUSINESS.**

## SPEED

*Find out how fast it prints on HP LaserJet® printers, and the new IBM LaserPrinter 4019. You'll find JetForm is three times faster than others.*

## RANGE

*How well does it work in a network? Sending forms around the office is one thing. Managing information throughout your organization, across multiple platforms, is quite another.*

## CAPACITY

*Will it handle all your forms needs? Including complex policies and contracts, as well as bar code labels? Will it handle them in the volume you'll need as your forms applications grow?*

## CONTROL

*Just because it "links" to your database doesn't mean it takes full advantage of database links. JetForm verifies data, performs calculations, and fully reads and writes dBASE files.*

## DESIGN

*Make sure you get a full set of flexible, easy to use, WYSIWYG design tools tailored to forms design. After all, this isn't desktop publishing. It's information management.*



MICROSOFT  
WINDOWS  
Version 3.0 Compatible Product

Call (800) 267-9976 (US only) or (613) 594-3026. Indigo Software Ltd., 560 Rochester Street, Suite 400, Ottawa, Canada K1S 5K2  
© 1990 Indigo Software Ltd. JetForm is a trademark of Indigo Software Ltd. All company and product names are trademarks or registered trademarks of their respective owners.

Circle 170 on Reader Service Card

World Radio History

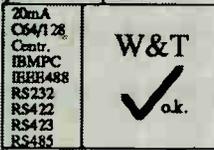
## Don't invest in interfaces!

Don't hassle with another brand-specific interface each time you need one. There is only one W&T interface for each standard (RS232, 422, 20mA, IEEE488 and even your son's C64) and you can connect any standard parallel printer with it! And it is much easier to use than almost any printer-specific interface.

Call or Fax us for a free W&T catalog. Then you can decide whether to order through your dealer (if you like to get everything from the same source), or to order directly from W&T Products. Our products are so easy to use that, if you need any technical support, we can give it to you over the phone.

### Check us out!

You can test any product for 14 days, return it for any reason and pay only a \$6 restocking fee per item.



### System Installation

RS232 lines can go up to about 50feet, Centronics lines up to about 15feet. For further distances you need line drivers. Be sure to use isolated ones to avoid problems with voltage drops and distant lightning. We manufacture drivers and isolators with up to 50,000 volts isolation. No one else does.

#20001, Centronics line driver 1kV 4KByte	\$189
#80001, RS232 line driver 1kV	\$229
#80050, RS232 line driver 50kV	\$319
#88001, RS232 isolator 1kV	\$129
#88050, RS232 isolator 50kV	\$149

### Portable Data Buffers with battery

Instrument readings, drilling templates, programs - you can transport all kinds of data in a small box.

# 22031, Centronics 32K	\$149
# 22127, Centronics 128K	\$319
# 88031, RS232 32K	\$229
# 88127, RS232 128K	\$319

### Computers can run up to 95% faster

Your computer is forced to run with the brakes on because standard printer and plotter buffers are far too small. If you print a lot a printer buffer can accelerate your system by up to 95% and anyone can plug it in within a few seconds.

# 22064, Centronics 64K	\$149
# 22256, Centronics 256K	\$229
# 22102, Centronics 1024K	\$589
# 88128, RS232 128K	\$229
# 88512, RS232 512K	\$319

### The Ideal T-switch is the one you don't notice at all

Now there is a fully electronic automatic T-Switch that lets you share one printer between two or four computers. It does not need any operation and not even a power supply.

# 25210, Centronics, 2 PCs share 1 printer	\$ 99
# 25410, Centronics, 4 PCs share 1 printer	\$189

### Lifestyle. Workstyle?

Remember when you could walk into a place of business and immediately recognize what was being done there? People loved their job and surrounded themselves with professionally-related artistic works. Thanks to W&T, this is again possible. We have commissioned West German artists to design artwork based on the PC-Codetable (order #17750), and part of the MS-DOS command set (order #17760). Computer professionals will find these prints to be both practical, and beautiful to display. Either print (approx. 20" by 28" in size) can be hanging in your office for \$29.00. If you wish to surround yourself, both prints can be purchased together for as little as \$50.00.

To order by mail add \$6 shipping and handling. FL residents add 6% sales tax. MSDOS is a trademark of Microsoft Corp., IBM is a trademark of IBM Corp.

We accept MasterCard and Visa.

A: Basic Merton (022) 9736360 B: Brother Int. (02) 4674211  
 CDN: see USA CH: Weber (01) 9302009 D: Wissmann & Theis (0207) 505077 DK: Jasec (86) 479139 E: Neul 88.62.37.52 IS: Thor (01) 681500 MEX: Telsa 5184500 NL: RamToc (09) 224620 NZ: Cat & Korh (010) 4507696 E: Electronics 1-900848 SE: Movera (91) 626812 SGE: Overseas Trade 2726077 USA: W&T Products 1-800-628-2086

W&T Products Corp.  
 P.O. Box 39559  
 Ft. Lauderdale, FL 33339

Phone: 1-800-628-2086  
 Fax : 1-305-491-5923

**W&T**  
**PRODUCTS**

## STATE OF THE ART ENTERING A NEW PHASE

# Phase Change Is Real

This spring, Panasonic Communication & Systems Co. introduced the LF-7010, the first phase-change optical storage system available in the U.S. The LF-7010 is a multifunction drive, capable of reading and writing Panasonic's current WORM media as well as its own phase-change disks.

The LF-7010 uses 5 1/4-inch media to store 1 gigabyte of information on a single phase-change media cartridge. The drive can also read and write (once) the 5 1/4-inch medium that Panasonic's LF-5010 WORM drive uses. This medium stores 940 megabytes on each cartridge. Panasonic plans to install the LF-7010 into an automatic cartridge changer—a "jukebox"—that will hold up to 50 phase-change and WORM disks for a maximum capacity of 50 gigabytes.

### Pluses and Minuses

This phase-change system features a data transfer rate to and from the disk that can reach 10.3 MB per second. It uses the SCSI-2 interface, making it compatible with an ever-widening range of computer hardware. Panasonic rates it with a mean time between failures of 20,000 hours and a bit-error rate of less than 10<sup>-12</sup>.

To achieve its impressive storage capacity, the LF-7010 varies the amount of data that it stores on each track of the disk. Longer tracks on the outside of the disk contain more data than the shorter tracks on the inside. This provides more room for data on the disk, but the increased complexity of the disk organization slows down access to the data. With an average seek time of 90 millisecond,

the LF-7010 is fast by WORM standards, but 50 percent slower than some magneto-optical (MO) drives and nearly 10 times slower than a high-performance hard disk drive. Obviously, the LF-7010 isn't ready to become your primary mass storage device.

Choosing the appropriate balance between capacity and access speed is a decision every optical-drive manufacturer must make. Panasonic intends the LF-7010 for applications, such as document-image retrieval and archival storage, that put a premium on capacity as opposed to speed. Therefore, it made sense to go with a system that varies the amount of data per track to take advantage of the longer tracks on the outside of the disk. There is nothing to prevent Panasonic from coming out with a faster drive that stores a fixed amount of data per track, although such a system probably wouldn't be compatible with current WORM and phase-change media.

### Battle Joined

Obviously, the LF-7010 can't compete with magnetic media as a primary storage technology. However, MO developers—even those who emphasize access speed over capacity—will have to take note of the LF-7010. Its one-pass write procedure may be enough to offset any advantage small-capacity MO drives enjoy in access speed.

As a new technology, the LF-7010 is a fascinating and welcome development. In the marketplace, though, it won't be judged on the sophistication of its innards but on the job it does for users.

optical technology that finally overtakes magnetic storage. But don't expect that to happen in this century. (By then, you may see electron beams used to write data instead of laser beams, resulting in a significant increase in the storage density of the media.)

Perhaps the most important aspect of phase-change technology is that it uses the same read method used in CD-ROM and WORM systems. This will make it possible to build multifunction optical drives that can read three of the four types of optical storage media—MO is the exception—and write to both WORM and phase-change disks. The benefits of

such a drive would be enormous.

By offering the high capacity and removability of optical media while eliminating the need to erase the media before writing, phase change holds a definite theoretical advantage over MO storage. It remains to be seen whether Matsushita and others can translate this advantage into superior products. However, the next few years will be a banner time for the consumers of optical storage devices as these contending technologies are pushed to their limits. ■

Bob Ryan is a BYTE technical editor. You can reach him on BIX as "b.ryan."

YOU ALWAYS KNEW THERE WAS SOMETHING SPECIAL ABOUT YOUR THUMB.



PC  
MAGAZINE  
EDITORS'  
CHOICE  
August 1990  
TrackMan Stationary Mouse

**Y**ou have a lot of power in your thumb. So we designed TrackMan™ — the world's most popular stationary mouse — to put that power to work. **T**rackMan's brilliant ergonomic design includes a lightweight, thumb-driven ball, three buttons at your fingertips and room to rest your hand. It is far more comfortable than any other stationary mouse. Because the thumb is far more agile and powerful than any finger. **W**ith TrackMan's adjustable resolution,

you command the cursor with exhilarating speed and precision, even in the most confining workspace. **A**nd you get all this for only \$139, including Logitech's™ life-



time hardware warranty. TrackMan works with any application on an IBM® PC (or compatible).

**F**or more information call Logitech's Customer Sales Center: (800) 231-7717 ext. 347. In California: (800) 552-8885; in Canada: (800) 283-7717; in Europe: + + 41- 21-869-9656.

Circle 208 on Reader Service Card  
(RESELLERS: 209)

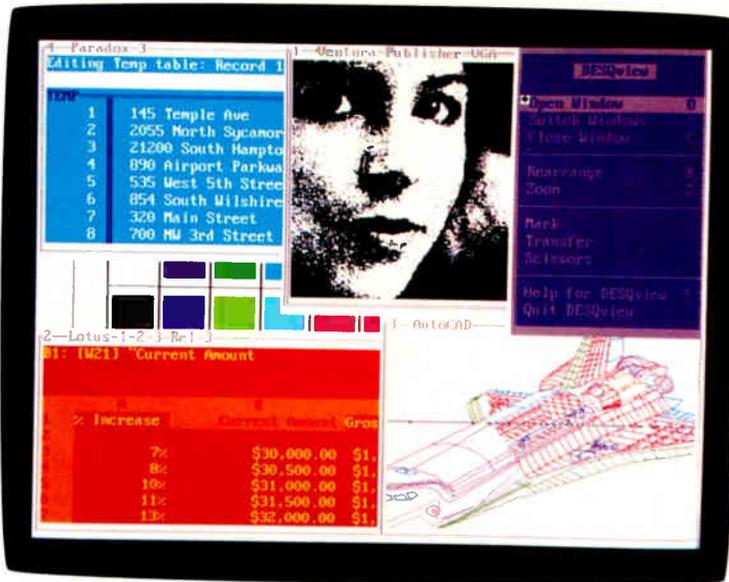
Tools That Power The Desktop.

®/™ trademarks of registered owners



World Radio History

# Multitasking



Aren't you glad Windows and OS/2™ aren't the only way to multitask and window on the PC.

It's all very well to look at screen after screen of colorful graphics and new programs. But the brutal truth is that these environments require extensive, expensive hardware upgrades for 80% of PC users. Not to mention new or upgraded software.

It all adds up to \$1,200 to \$2,500 per PC—and that's for the hardware and software alone. To say nothing about a major investment in the time it will take to learn new ways of working.

If all you want is enhanced productivity from your PC, that's too high a price to pay.

## DESQview does it all. For less.

DESQview runs the programs you know and love in multiple windows, multitasks them and even lets you choose whether or not to use a mouse. And it does it all today. In fact, DESQview's been doing it for over four years now.

People all over the world are using DESQview to manage customized work environments like those shown here. They are using it to cut and paste data between programs running



*DESQview lets you run all these programs in multiple windows and multitask them—all without major modifications to the computer you own now. And without replacing or even upgrading your favorite programs.*

in multiple windows, running sorts and recalculations in the background, and they're operating in text and graphics modes in windows side-by-side.

With no drama, no fireworks and no huge memory or disk space requirements.

In fact, DESQview runs on i486, 80386, 80286 and even 8086 and 8088 PCs. Its low memory overhead means you don't have to buy a faster computer and more RAM to compensate for the demands of a complex, memory-hungry 'graphical' operating system.

And DESQview builds on and extends DOS—the most robust, stable operating system available for your computer.

Plus, you don't give up any flexibility in choosing programs. DESQview runs virtually all DOS and DOS-extended programs and Windows programs as well.

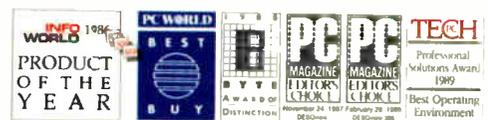
No wonder major corporations all over the world have chosen to standardize on DESQview.

## New DESQview 2.3 gets the most out of DOS. Even in Windows.

For a lot of users, what's exciting about Windows isn't Windows itself, but some of the great new programs that use it. Now you can run those programs in DESQview 2.3, and keep on using the unique DOS multitasking windowing capabilities of DESQview. (On 386 machines, DESQview 386 2.3 runs Windows programs side-by-side with 386

DOS-extended programs such as IBM Interleaf and AutoCAD 386.)

And of course, new DESQview 2.3 gives you all the other great strengths that made it the favorite of knowledgeable PC users. Some of our recently added features: support for mouse menus within windows;



*Some of DESQview's recent awards.*

flexibility for assigning and reassigning special keys within windows, support for 3270 and other terminal emulation, support for a wide range of hardware: CD-ROM, scanners, comm ports, etc. and help in handling troublesome TSRs. DESQview keeps up with software and hardware developments. As new standards develop, you'll find us supporting them.

As long as you're using DOS programs, you need DESQview.

# without tears



Quarterdeck's family of products is designed to enhance the way you work.

At Quarterdeck, our mission has always been to increase your productivity in logical, economical steps—not to reinvent a system that already works for you.

Our best known product, DESQview, has well over a million users.

And hundreds of thousands of people use our QEMM, the expanded memory manager for users of 80386 PCs and IBM PS/2™ models 50 and 60 that makes it easy for your programs to break the 640K memory barrier. (Even within Windows, on 386 machines!)

Our newest products, Quarterdeck Manifest and QRAM help you understand and optimize the critical first megabyte of your PC's memory.

Manifest does for memory what PC Tools Deluxe does for disks. It guides you



The vast majority of programs run in DESQview—even Windows 3.0 programs! And some programs take special advantage of DESQview to enhance their operation. FNN NewsReal and products using Spreadsheet Solutions' @DV 'Hot Links', for example, use windowing, multitasking and interprogram communications.

'under the hood' of your PC, showing how your memory is being used; even which parts of RAM are faster. You'll see where TSRs, utilities, drivers and buffers work, and find all the pockets of idle memory.

QRAM is our memory optimizing

utility that ends 'RAM cram.' It lets you move drivers, TSRs and other utilities out of 'lower' memory and into idle memory locations 'up high,' giving your programs as much as 130K more elbow room. And QRAM makes it easy to optimize your memory—even if you've never used anything beyond 1-2-3 before.

DESQview, QEMM, Manifest and QRAM help you get the most out of the software and hardware you own today.

To find out more about our family of productivity enhancement products, mail in the coupon below with the appropriate boxes checked. Or see your authorized Quarterdeck dealer.

# Quarterdeck

Quarterdeck Office Systems, 150 Pico Blvd., Santa Monica, CA 90405 (213) 392-9851 Fax: (213) 399-3802

**DESQview System Requirements:** IBM Personal Computer and 100% compatibles (with 8086, 8088, 80286, 80386 or i486 processors) with monochrome or color display, IBM Personal System/2 • Memory: 640K recommended; for DESQview itself 0-145K • Expanded Memory (Optional): expanded memory boards compatible with the Intel AboveBoard; enhanced expanded memory boards compatible with the AST RAMPage; EMS 4.0 expanded memory boards • Disk: two diskette drives or one diskette drive and a hard disk • Graphics Card (Optional): Hercules, IBM Color/Graphics (CGA), IBM Enhanced Graphics (EGA), IBM PS/2 Advanced Graphics (VGA) • Mouse (Optional): Mouse Systems, Microsoft and compatibles • Modem for Auto-Dialer (Optional): Hayes or compatible • Operating System: PC-DOS 2.0-4.0; MS-DOS 2.0-4.0 • Software: Most PC-DOS and MS-DOS application programs, programs specific to Microsoft Windows 1.03-3.0, GEM 1.1-3.0, IBM TopView 1.1 • Media: DESQview is available on either 5-1/4" or 3-1/2" floppy diskette.

Trademarks are property of their respective holders: IBM, OS/2, PS/2, Interleaf, TopView, Lotus, 1-2-3, Metro, Freelance, AutoCAD, Ventura Professional Publisher, PC Tools Deluxe, Intel, 80386, i486, Above Board, AST, RAMPage, Hercules, Mouse Systems, Hayes, Microsoft Windows, Microsoft Word, GEM, FNN NewsReal, Spreadsheet Solutions.

**YES!** I need increased productivity now!

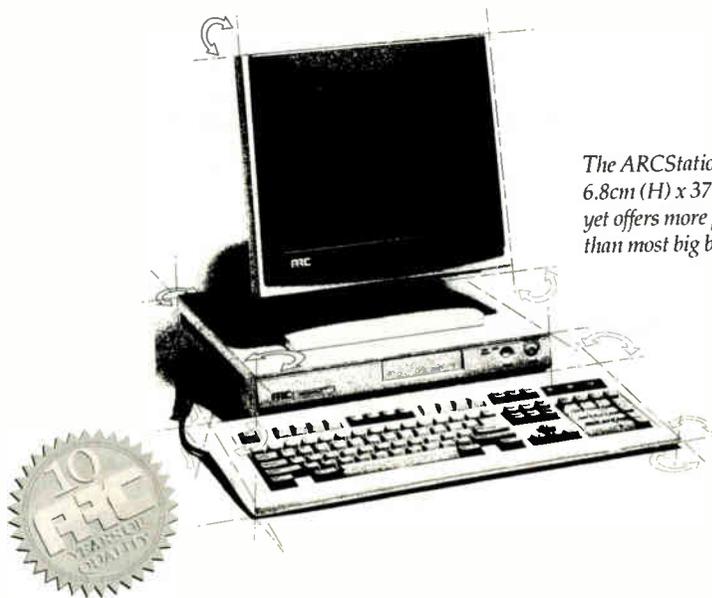
Qty	Product	Send Info	5-1/4	3-1/2	Price Each	Totals
	DESQview 386 v2.3 Multitasking windowing environment	<input type="checkbox"/>			\$219.95	
	DESQview v2.3 Multitasking windowing environment	<input type="checkbox"/>			\$129.95	
	QEMM-386 version 5.1	<input type="checkbox"/>			\$99.95	
	QEMM-50/60 version 5.0	<input type="checkbox"/>			\$99.95	
	QRAM Memory optimizing utility	<input type="checkbox"/>			\$79.95	
	Quarterdeck Manifest Memory analyzer	<input type="checkbox"/>			\$59.95	

Payment  Visa  MasterCard Expires \_\_\_/\_\_\_/\_\_\_ Shipping & Handling \$5 in USA / varies outside USA  
 Acct # \_\_\_\_\_ California Residents add 6.75%  
 Name \_\_\_\_\_ Title \_\_\_\_\_ Grand Total \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Circle 295 on Reader Service Card

Call for upgrade information ©1990 Quarterdeck Office Systems

# One little ARCStation offers lots of angles on performance.



The ARCStation SX is just 6.8cm (H) x 37cm (W) x 38.7cm (D) yet offers more performance angles than most big boxes.

Among an otherwise bland assortment of network nodes from which to choose, the ARCStation SX is unique. It's the best mix of an inexpensive LAN workstation and a powerful personal computer.

As a LAN workstation it's small, thus ideal for data entry and production in areas where desktop real estate is at a premium.

Despite its size, it's fast. The ARCStation has an 80386 SX CPU running at 16MHz,

0 wait state. So, it aids LAN performance. And, perhaps most importantly, it's inexpensive.

The ARCStation's greatest feature is... its great features. Users that require more than typical LAN nodes offer can have it in a platform consistent with the rest of the network.

The ARCStation has enhanced and standard I/O interfaces already in place. Any ARCStation SX can be

decked out with up to 8MB of RAM, an 80387-SX math coprocessor, 800X600 VGA, a mouse, and one parallel and two serial peripheral devices. Then, if you want, add two 3.5" half-height disk drives. A 16-bit IDE hard disk controller and a floppy disk controller are built-in.

So if you're building a new LAN or maintaining an old one, you can standardize with one workstation platform throughout and still

span the range of user needs. From the simple, diskless node to the all-out performance workstation, ARCStation SX offers lots of angles.

Ask your ARC dealer about the ARCStation SX20 and ARCStation 286 as well.

**ARC**  
AMERICAN  
RESEARCH  
CORPORATION

Argentina 1-402-447  
Austria 222-934212  
Bahrain 973-531-447  
Bangladesh 2-257-851  
Belgium 2-241-8784  
Denmark 31-304-500  
Finland 52-609100  
France 1-470-93636  
Greece 1-361-3500  
Hungary 1-667688

Indonesia  
Iran  
Italy  
Kenya  
Kuwait  
Malaysia  
Norway  
Pakistan  
Papua New Guinea  
Peru

21-380-4169  
1-828-248  
1-176-7719  
2-746-044  
242-1823  
5-530-030  
42-12560  
21-521-529  
257-477  
14-419860

Philippines  
Philippines  
Portugal  
Spain  
South Africa  
Spain  
Sri Lanka  
Sweden  
Switzerland  
Taiwan

2-817-4567  
2-817-1882  
1-562-459  
1-416-9412  
11-805-3163  
1-416-9412  
1-574980  
31-658-551  
22-785-1000  
2-917-5269

Thailand 2-498-4552  
Turkey 1-169-0230  
United Arab Emirates 4-224261  
United Kingdom 1-6844144  
USA California: 213-265-0835  
Elsewhere: 800-423-3877  
West Germany 40-660051  
Yemen Arab Republic 2-207721

Circle 25 on Reader Service Card (RESELLERS: 26)

# The Once and Future King

*Hard disk technology: Reports of its death have been greatly exaggerated*

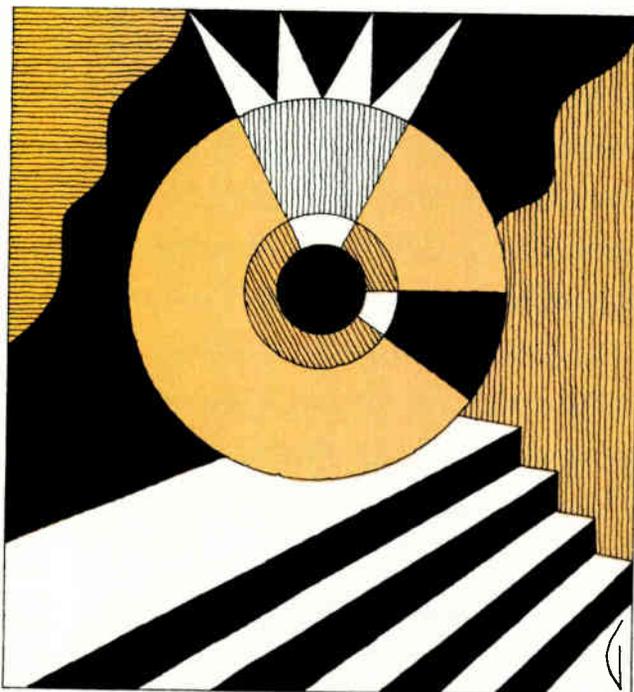
*Bob Ryan*

**I**n Greek mythology, Odysseus had to sail a fine line between Charibdis and Scylla. Today, the same can be said about hard disk technology, as it tries to maintain a viable position between solid-state and optical technologies. A safe course depends on the continued evolution of materials, recording methods, and storage subsystems.

Solid-state storage has a speed advantage over hard disk drives, and optical disks are capable of storing more data. With the continued improvement in speed, capacity, and price/performance ratio, hard disk drives can still remain the preferred direct-access storage devices. The challenges, however, are formidable.

## The Contenders

The idea of using memory chips for direct-access storage is not a new one. Dedicating a portion of memory to a RAM disk is a well-known way to increase system performance for disk-intensive activities. In fact, some companies in the early to mid-1980s were quite successful selling RAM disk expansion boards for IBM PCs and Apple IIs. These products were not meant to replace



magnetic storage; you always had to copy the data they contained to a magnetic disk before you powered down your computer.

Newer forms of semiconductor mass storage *are* intended to replace disk storage. As DRAM densities climb to the 4-megabit and 16-Mb levels and as the cost per bit drops, it becomes practical to construct mass storage units that are pri-

marily semiconductor-based. Such solid-state storage units have been in use in the mainframe world for almost a decade, so don't be surprised to see them migrate to network servers, workstations, and even desktop personal computers. While they do include a magnetic disk for backup in the event of power loss, solid-state disks are permanent storage devices.

Another class of semiconductor devices that is being used for mass storage is the flash EPROM. While not as fast as DRAM, flash EPROMs hold their data when you power down (see "Store Data in a Flash" on page 311). They thus combine some of the speed of semiconductor devices with the permanence of magnetic media.

## The Optical Path

The biggest challenge to magnetic mass storage comes from optical technologies such as CD-ROM, WORM (write once, read many times), and erasable optical disks. Optical storage is slower than magnetic primarily because of the greater mass of optical read/write heads, but it offers greater capacity. And because optical-media cartridges are removable, you can store far more data than the

capacity of the disk would indicate. Disk changers even alleviate the need to manually swap cartridges.

With semiconductor memory possessing a speed advantage and optical storage having greater capacity, magnetic disk storage is being squeezed on both ends. But advances in all aspects of hard disk technology, from basic materials to disk subsystems, ensure that the newcomers will be shooting at a moving target.

#### Magnetic Basics

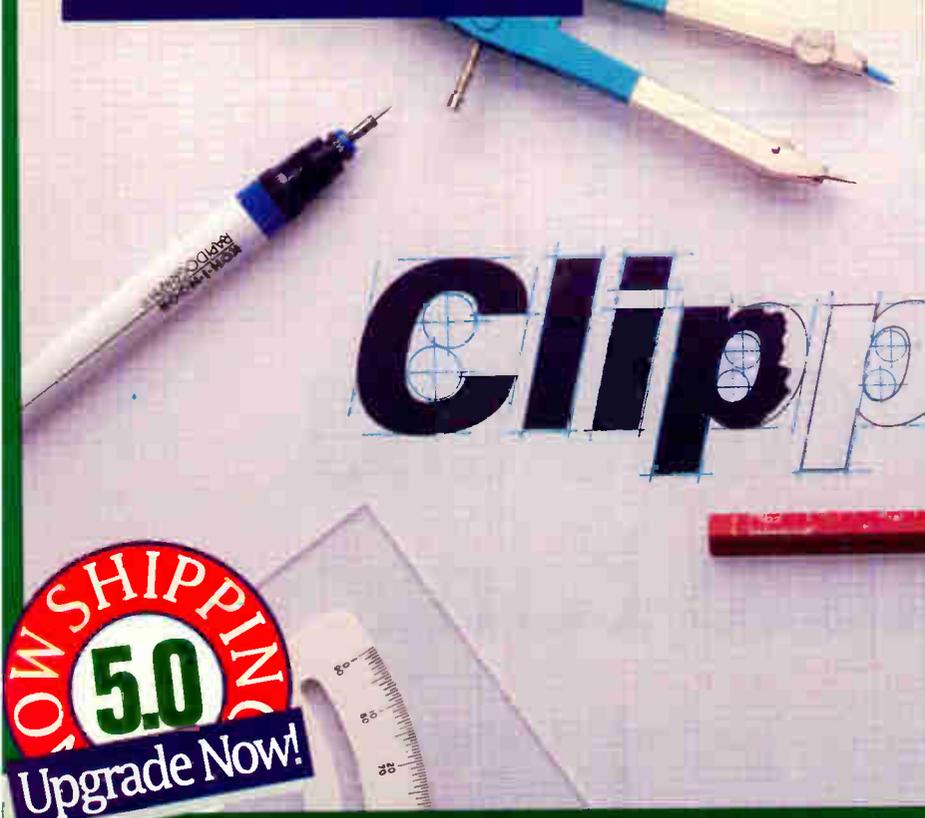
A hard disk drive stores data by magnetizing areas on the surface of the disk. "On" and "off" bits are represented by areas magnetized in opposite directions. The read/write head is an electromagnet that writes a bit by magnetizing an area with the proper orientation. The head determines whether an area represents a 0 or a 1 by the current induced in the head by the magnetized area.

Hard disk drives store bits on concentric tracks on a disk that spins at 3600 revolutions per minute. To increase the capacity of a hard disk, you have to increase the number of tracks per inch. To increase the performance of a drive, you need to increase the number of bits per track, which permits more bits to pass under the head per unit of time. Squeezing more tracks into the same area and more bits into a track requires both advanced recording media and high-performance read/write heads.

#### Media Messages

Until a few years ago, the recording surface of a hard disk was a plastic binder sprinkled with slivers of gamma ferric oxide ( $Fe_2O_3$  with a particular crystalline structure). Given the monolithic ferrite heads used at the time, this material gave very good performance. The problem with ferric oxide is that it is not coercive enough to let you pack bits and tracks closely together. Coercivity is a measure of the field required to reverse the direction of magnetization of a bit on the magnetic medium. As you pack bits closer together, you need very high coercivity materials to ensure that a bit won't be demagnetized or have its magnetization reversed by neighboring bits.

Coating the gamma ferric oxide splinters with cobalt doubles their coercivity, but even this isn't good enough to ensure a recording density that can compare with optical densities. Today, most hard disks are coated with a continuous thin film that is sputtered or plated onto an aluminum disk. These films consist of pure magnetic material, resulting in a much higher coercivity and a reduction



LOW SHIPPING  
5.0  
Upgrade Now!

## Your Left Brain Needs Clipper.

Organization is everything in business. The left side of your brain knows this. It wants order. Economy. Precision. All reasons your left brain appreciates Clipper 5.0, the premier application development system for PCs.

An open architecture programming system, Clipper provides a flexible environment for developing precisely the application you need, not a messy approximation. Its user-definable commands and functions let you configure the Clipper language for your exact requirements. Its compiler generates .EXE files for rapid execution and cost-free distribution. Its new linker even lets you build and run applications larger than available memory! And its elegant network support yields high performance on even the largest systems.

So, if you're charged with coaxing order out of chaos for your business, put Clipper in your programming arsenal today. It has exactly the programming power you need!

### Clipper 5.0

The Application Development Standard

213/390-7923

Ask For Department-A

 nantucket

Circle 238 on Reader Service Card

in signal noise over ferric oxide coatings.

The most popular materials for magnetic thin films are cobalt-nickel alloys. Unlike ferric oxide, these films contain no nonmagnetic oxygen. Because the signal a bit induces in the head is proportional to the media's magnetization, pure magnetic media will produce better signal-to-noise ratios than media containing nonmagnetic material. This is important when you're packing so many bits together in a small area.

Another advantage to cobalt is that it is highly *anisotropic*: It responds much more strongly to magnetic fields oriented along a certain axis. Aligned properly, cobalt bits are thus highly susceptible to magnetization from the read/write head but relatively impervious to magnetization from nearby bits. This is one of the reasons for cobalt's high coercivity.

One problem with thin films is that they are susceptible to corrosion. Today, however, hard carbon coatings protect the recording media from contaminants and from damage from the read/write head, which touches the surface of the disk during starting and stopping.

Metallic thin films are the medium of choice for today's high-capacity disks and will remain so for the foreseeable future. In fact, it is no longer the medium that limits the capacity of magnetic storage. The limiting factor is the read/write head.

### Closing the Gap

As today's thin-film media let you pack more bits per unit area, the bits themselves become smaller and, even with pure magnetic materials, produce smaller signals. To read a bit on this scale requires a head that has a very small gap between the poles of the electromagnet; otherwise, the fields from adjacent bits would interfere with the signal. It must also be sensitive enough to detect the weaker signals from the smaller bits.

Even before thin films were used on recording media, they were the materials of choice for read/write heads. Their anisotropic properties help ensure that the signal they read is from the target bit only. The ability of drive manufacturers to construct heads that fly as little as 100 nanometers above the disk is also critical, because a closer head also has a better chance to read the weaker signals from smaller, higher-density bits.

### Beyond Induction

Despite the advantages of thin-film heads over the older ferrite heads, the limiting factor that keeps the bit density of magnetic disks below that of optical



## Your Right Brain Wants It!

While your left brain duly notes the benefits of Clipper programming, the right half is wild about how you get them! Imagine a programming environment with no limits! The language can be easily extended with your own routines and you can even integrate code from other languages, like C and Assembler. You're always free to configure Clipper to suit your own programming style.

Hey, let's say you want to read and write data in some format other than the .dbf structure Clipper already supports. It's no problem since Clipper 5.0 sports a replaceable database driver, even allowing multiple drivers to be used concurrently in the same application! There's no end to the possibilities you can pursue with Clipper!

Clipper's open architecture system will fire your imagination with unparalleled freedom. It's spray paint for a developer's mind. So, if you want your imagination to inspire your applications, indulge yourself with Clipper 5.0. It has everything you need and anything you'd want.

## Clipper 5.0

The Application Development Standard

213/390-7923

Ask For Department-A

 Nantucket®

Circle 239 on Reader Service Card

disks is the difficulty in reading closely packed magnetic bits. Heads that read by induction have a harder time reading smaller bits, because the intensity of the signals induced by such bits drops linearly with the size of the bits.

Last year, the IBM Magnetic Recording Institute (San Jose, CA) demonstrated a noninductive magnetic head capable of reading bit densities as great as 1.8 million bits per square millimeter. This is almost triple the data density of most popular magneto-optical drives.

The demonstration drive used a magneto-resistive head to read the tightly packed bits. This head uses a thin-film element containing a single magnetic domain strung between two electrical leads. The resistance of the element changes as the angle of its magnetization does. The angle, in turn, changes as the element passes over the different bits in the recording layer. Because different polarities in the bits produce different angles of magnetization, which in turn produce different resistances across the element, the head reads the data by monitoring a current passed through the element.

Although no production drive uses magneto-resistive read heads, this demonstration proves that magnetic media have a lot of life left. The density advantages of optical drives may not be as great in upcoming years.

Other technologies that may affect the density of magnetic media in the years to come include the metal-in-gap heads, first popularized in Sony 8-mm videotape decks, and perpendicular recording, which produces vertically oriented magnetic domains on the media. See the text box "Side by Side" for more on perpendicular recording.

### System Advances

While advances in basic technology continue to contribute to the speed and capacity of hard disk drives, advances in other areas of hard disk systems also contribute to the vitality of the media.

Perhaps the most common way to speed up hard disk access is to couple a hard disk drive with a cache of fast semiconductor memory. Recently, controllers with caches of 1 MB, 2 MB, and even 4 MB have become common on workstations and high-end personal computers. These controllers combine many advantages of semiconductor memory with the safety and permanence of hard disk storage.

Beyond simple caching, many companies are producing hard disk systems for personal computers that rival those in

## Side by Side

Bill Passavanti

**R**ecent technology advances have brought about a new generation of higher-capacity floppy disk drives. Among these, perpendicular recording, a technology developed by Toshiba, uses a new material—barium ferrite—on the recording media. Unlike conventional oxide media in which particles are magnetized horizontally, or parallel to the recording surface of the disk, barium ferrite particles are magnetized vertically, or perpendicular to the recording surface (see figure A).

With the particles in the recording media arranged more closely together, you can store more bits in the same linear space, thus increasing data capacity. Data particles take less room when you line them up side by side instead of end to end. Bit density increases from the 17,434 bits per inch you get on a conventional 2-megabyte floppy disk to 34,768 bpi, resulting in a 4-MB storage capacity and a fast 1-megabit-per-second data transfer rate.

In addition to increasing data storage capacity, perpendicular recording also improves data integrity. Since the particles are magnetized vertically, there is a sharp magnetic transition between the particles. Even high densities maintain this transition to clearly define each data bit. This orientation minimizes peak shift and reduces coercivity (see figure B). With conventional floppy disk recording, increasing the bit density crowds the particles, thereby reducing the magnetic-transition space, blurring bit transitions, and increasing peak shift.

The barium ferrite that is used in perpendicular recording also improves data integrity. Since barium ferrite particles are flat platelets, they provide a relatively flat data surface. Consequently, a strong, continuous read signal is induced in the read/write head when you read the data (see figure C). Conversely, conventional floppy disks exhibit a read signal that fluctuates between strong and weak because of the magnetization and shape characteristics of the media particles.

To accommodate perpendicular recording, the drive is engineered using some conventional drive components

combined with new and modified elements. Changes to the perpendicular-recording drive include a narrower gap on an otherwise conventional ferrite-ring read/write head; modified read/write electronics to accommodate the higher data rate; and a full-track-width erase head that provides the full, deep erasure required in a perpendicular-recording system.

While offering both performance and storage capacity improvements over conventional floppy disk technology, perpendicular recording promises to continue the tradition of cost-effective storage that has made present-day floppy disk drive technology so popular. The use of conventional and readily available drive components, combined with the ability to manufacture the barium ferrite media in high quantities with the use of existing coating facilities, has kept the cost of perpendicular recording low compared to other new floppy disk technologies.

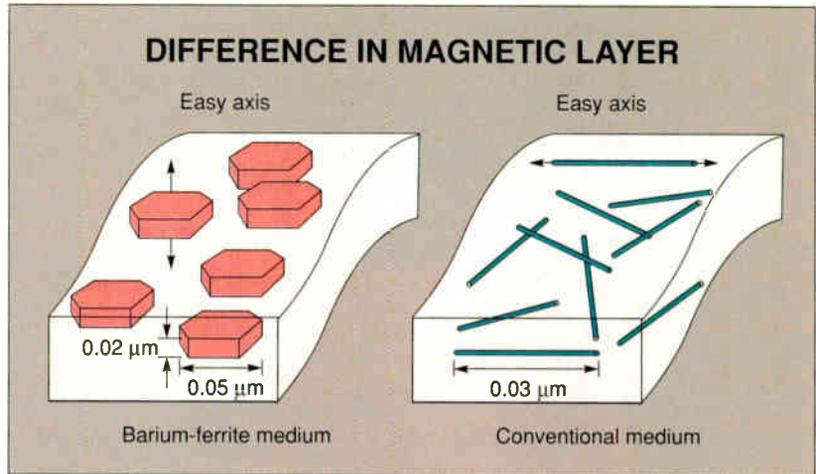
Another element that makes perpendicular recording cost-effective is downward compatibility. Perpendicular-recording floppy disk drives will allow you to read and write data using disks formatted by conventional 1-MB and 2-MB drives. Therefore, you can upgrade your system without rendering your existing floppy disks obsolete: Your data remains accessible while you gain in performance and storage capacity.

Future changes in servo technology that will allow for more precise positioning of the read/write head will bring about capacity increases in perpendicular-recording systems of up to 32 MB in the next couple of years. Ultimately, barium ferrite technology will store as much as 64 MB of data on a single floppy disk, providing higher storage capacity along with the cost-effective, volume-manufacturing characteristics that are required of floppy disk drives.

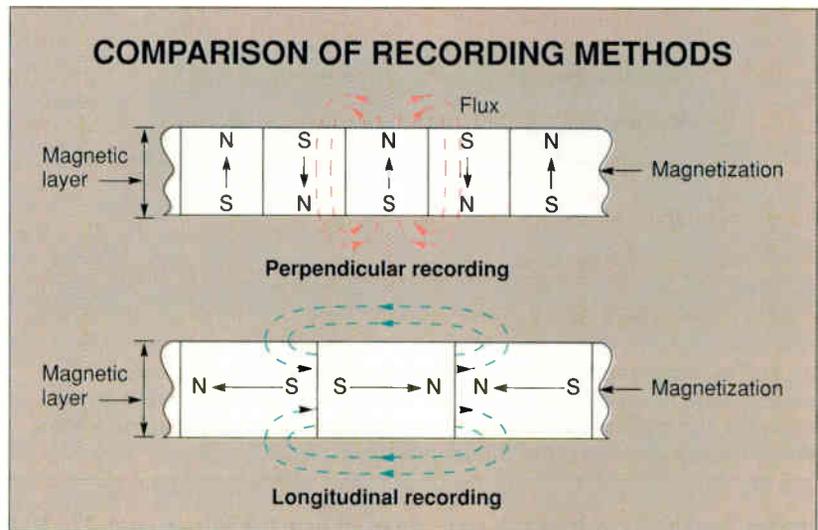
---

*Bill Passavanti is vice president of marketing for floppy disk drives with the Disk Products Division of Toshiba America Information Systems (Irvine, CA). He can be reached on BIX c/o "editors."*

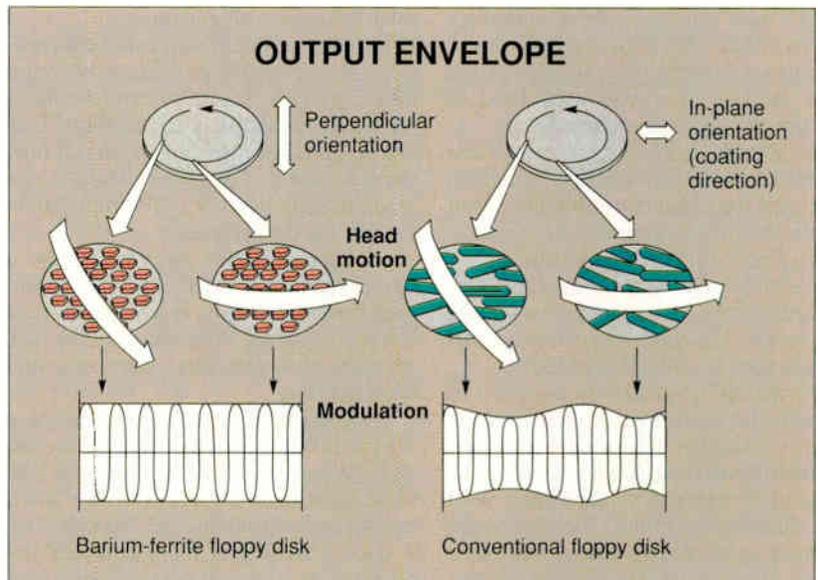
**Figure A:** In the barium ferrite medium (left), particles are magnetized vertically—perpendicular to the recording surface. In the conventional oxide medium (right), particles are magnetized horizontally, which takes more room.

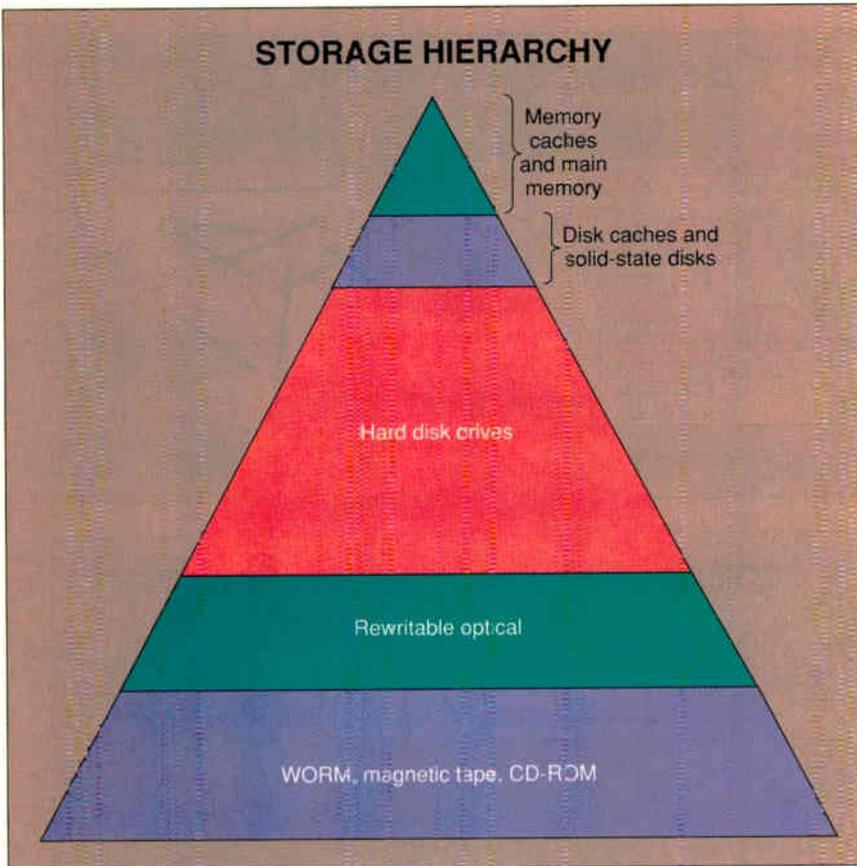


**Figure B:** Since the barium ferrite particles (top) are magnetized vertically, there is a sharp magnetic transition between the particles, even at high densities. This is in contrast to the conventional oxide particles (bottom).



**Figure C:** Barium ferrite particles are flat platelets and provide a relatively flat data surface and a strong, continuous read signal (left). However, the media particles of conventional floppy disks exhibit different magnetization and shape characteristics and a fluctuating read signal (right).





**Figure 1:** The relationship between access speed and capacity: The fastest technologies have the smallest capacity; the slowest technologies have the largest capacity. The pyramid makes a rough correlation between the height of each block and the percentage of each type of storage present in a typical system.

mainframe systems for complexity and storage. Earlier this year, Zenith introduced a new hard disk drive controller with its Z-386/33E. This controller is designed to minimize the amount of time spent waiting for a read/write head to seek the proper track and sector.

The Zenith controller can detect the current location of a read/write head and determine the distance between the head and the data it has to access. In a single-drive system, this isn't very helpful, but in a multiple-drive system, the controller can determine which head is closest to its destination. The controller can then initiate data transfer from that head first.

The Zenith controller is designed to increase the performance of multidrive systems. Another advanced controller, the Intelligent Disk Array found in the Compaq Systempro, is designed with fault tolerance in mind. The Systempro supports up to four pairs of hard disk drives. Each drive has its own control cable, and each pair shares a data cable. The controller is thus able to read data

from all four disk pairs at once. The IDA maximizes the benefits of this arrangement by using sector striping.

In sector striping, sequential data sectors are not arranged contiguously on a disk. Instead, the sectors are spread across the eight disks in the system. This is a big plus because the system can read multiple disks at one time. Thus, it can read different parts of a file from different disks at the same time.

Of course, sector striping can be a curse if one of the drives on the system goes down. Suddenly, every file on your system is missing some sectors. The IDA provides two solutions: mirroring and data guarding.

With mirroring, the system keeps a mirror image of each disk on a second disk. When one drive goes down, the backup kicks in. This is effective, but it eats up half of your storage capacity.

Data guarding is more complex but takes up less space. It takes 25 percent of your disk space to store a combined image of the disks in the system. Every

time you write a byte to a disk, the corresponding byte on the other disks is read. The system combines the bytes with an exclusive-OR and writes them to a special area. If a drive fails, you simply read the bytes from the other disks and perform an XOR on them to recover the missing data. The IDA can perform this data recovery in the background.

### The Storage Hierarchy

Advances in recording materials, heads, and controller subsystems will ensure that magnetic-disk storage keeps up with its solid-state and optical cousins. However, these alternative technologies will find a place on an increasing number of desktops, not as replacements for magnetic disk storage, but as adjuncts.

The different types of direct-access computer storage, from main memory to WORM drives, fall into a pyramidal hierarchy (see figure 1). At the top are memory caches and main memory. As you go down the pyramid, you encounter storage technologies that offer increased capacities but slower access times.

Until recently, hard disk technology was unchallenged in the field of permanent direct-access storage. For most people, it continues to be their only form of permanent storage (other than floppy disks). However, as personal computer systems increase in size and complexity, optical and solid-state storage will see their share of the pyramid increase. Rather than being the only show in town, magnetic media will share storage duties with other technologies better suited to certain applications.

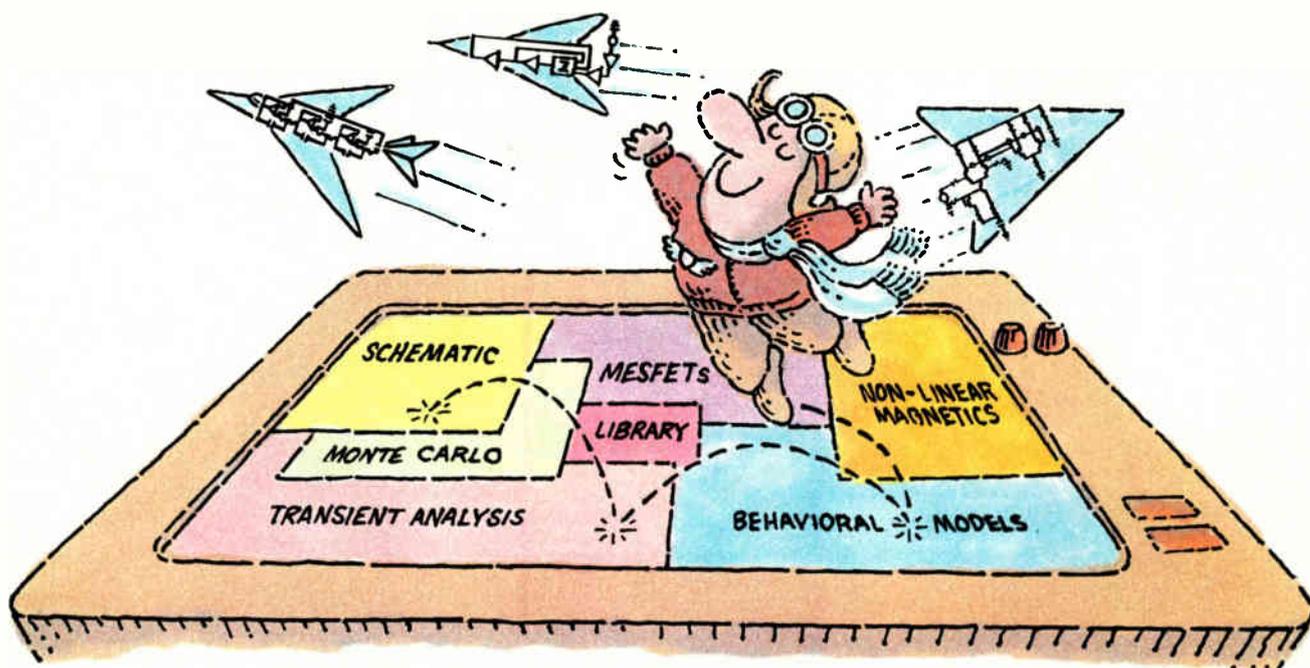
One of those applications is archival storage. Hard disk drives are simply too expensive to waste on archival storage. Why should you pay for sub-10-millisecond access to data you retrieve once a month, if that often? Archival storage demands capacity, not speed, so it is an ideal domain for erasable optical disks, WORM disks, and magnetic tape.

### The Main Squeeze

The future of magnetic media is not in doubt; it will remain your most important form of permanent storage. But you will increasingly see it augmented by other forms of storage (e.g., solid-state for very fast storage, and optical for high-capacity archival storage).

Magnetic media will be squeezed on both ends by these alternate technologies, but it's doubtful that it will ever be squeezed out of the storage pyramid. ■

*Bob Ryan is a BYTE technical editor. You can reach him on BIX as "b.ryan."*



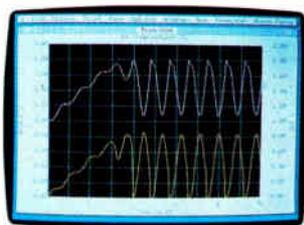
# THE NEW MICRO-CAP III. SO YOU CAN TEST-FLY EVEN MORE MODELS.

It wasn't easy. But we did it. Made the long-time best-selling IBM® PC-based interactive CAE tool even better.

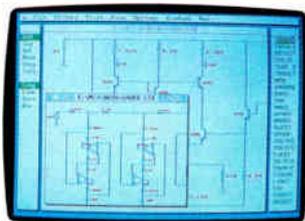
Take modeling power. We've significantly expanded math expression capabilities to permit comprehensive analog behavioral modeling. And, beyond Gummel Poon BJT and Level 3 MOS, you're now ready for nonlinear magnetics modeling. Even MESFET modeling.

Analysis and simulation is faster, too. Because the program's now in "C" and assembly language. That also means more capacity — for simulating even larger circuits.

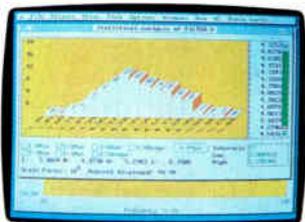
As always, count on fast circuit creation, thanks to window-based operation and a schematic editor. Rapid, right-from-schematics analysis — AC, DC, Fourier and transient — via SPICE-like routines. The ability to combine digital/analog circuit simulations using integrated switch



*Transient analysis*



*Schematic editor*



*Monte Carlo analysis*

models and parameterized macros. And stepped component values that streamline multiple-plot generation.

And don't forget MICRO-CAP III's extended routine list — from impedance, Nyquist diagrams and BH plots to Monte Carlo for statistical analysis of production yield. The algebraic formula parsers for plotting virtually any function. The support for Hercules, CGA, MCGA, EGA and VGA displays. Output for plotters and laser printers.

Cost? Still only \$1495. Evaluation versions still only \$150. Brochure and demo disk still free for the asking. Call or write for yours today. And see how easily you can get ideas up and flying.

**spectrum**

1021 S. Wolfe Road  
Sunnyvale, CA 94086  
(408) 738-4387

Circle 319 on Reader Service Card



# The joy of C-scape

*Elegant graphics and text*

**The C-scape™ Interface Management System is a flexible library of C functions for data entry and validation, menus, text editing, context-sensitive help, and windowing. C-scape's powerful Look & Feel™ Screen Designer lets you create full-featured screens and automatically generates complete C source code.**

C-scape includes easily modifiable high-level functions as well as primitives to construct new functions. Its object-oriented design helps you build more functional, more flexible, more portable, and more unique applications—and you'll have more fun doing it.

**The industry standout.** Many thousands of software developers worldwide have turned to the pleasure of C-scape. The press agrees: "C-scape is by far the best. . . . A joy to use," wrote IEEE *Computer*. Major companies have selected C-scape as a standard for software development.

C-scape's open architecture lets you use it with data base, graphics, or other C and C++ libraries. C-scape runs in text or graphics mode, so you can display text and graphics simultaneously. To port from DOS or OS/2 to UNIX, AIX, QNX, or VMS, just recompile. C-scape also

**Graphics.** Run in color in text or graphics mode. Read images from PCX files.

**Object-oriented architecture.** Add custom features and create reusable code modules. C++ compatible.

**Mouse support.** Fully-integrated mouse support for menu selections, data entry fields, and to move and resize windows.

**Portability.** Hardware independent code. Supports DOS, OS/2, UNIX, AIX, VMS, others. Autodetects Hercules, CGA, EGA, VGA. Supports Phar Lap and Rational DOS extenders.

**Text editing.** Text editors with word wrap, block commands, and search and replace.

**Field flexibility.** Masked, protected, marked, required, no-echo, and named fields with complete data validation. Time, date, money, pop-up list, and many more higher-level functions; create your own.

**Windows.** Pop-up, tiled, bordered and exploding windows; size and numbers limited only by RAM.

**Menus.** Pop-up, pull-down, 123-style, or slug menus; create your own.

**Context-sensitive help.** Link help messages to individual screens or fields. Cross reference messages to create hypertext-like help.

**Code generation.** Build any type of screen or form with the Look & Feel™ Screen Designer, test it, then automatically convert it to C code.

**Screen flexibility.** Call screens from files at run time or link them in. Automatic vertical/horizontal scrolling.

**International support.** Offices in Berlin, Germany, with an international network of technical companies providing local training, support and consulting.

supports Phar Lap and Rational DOS extenders.

**Trial with a smile.** C-scape is powerful, flexible, portable, and easy to try. Test C-scape for 30 days. It offers a thorough manual and function reference, sample programs with source code, and an optional screen designer and source code generator. Oakland provides access to a 24-hour BBS, telephone services, and an international network of companies providing in-country support. No royalties, runtime licenses, runtime modules. After you register, you get complete library source code at no extra cost.



**Call 800-233-3733** (617-491-7311 in Massachusetts, 206-746-8767 in Washington; see below for International). After the joy of C-scape, programming will never be the same.

DOS, OS/2 (Borland and Microsoft support): with Look & Feel, \$499; library only, \$399; UNIX, etc. start at \$999; prices include library source. Training in Cambridge and Seattle each month. Mastercard and Visa accepted.

**OAKLAND**

BY1190

**Oakland Group, Inc.** 675 Massachusetts Ave., Cambridge, MA 02139 USA. FAX: 617-868-4440. **Oakland Group, GmbH.** Alt Moabit 91-B, D-1000 Berlin 21, F.R.G. (830) 391 5045, FAX: (030) 393 4398. **Oakland International Technical Network** (training, support, consulting): Australia Noble Systems (02) 564-1200; Benelux TM Data (02159) 46814; Denmark Ravenholm (042) 887249; Austria-Germany-Switzerland ESM 07137/5244; Norway Ravenholm (02) 448855; Sweden Linsoft (013) 111588; U.K. Systemstar (0992) 500919. Photo by Jessica A. Boyatt; Kanji by Kaji Aso. Picture shows a C-scape program combining data entry with video images loaded from PCX files. C-scape and Look & Feel are trademarks of Oakland Group, Inc.; other trademarks belong to their respective companies. Copyright © 1990, by Oakland Group, Inc. Features, prices, and terms subject to change.

Circle 267 on Reader Service Card

World Radio History

# Store Data in a Flash

*Flash-memory ICs offer new options  
for personal computer storage*

*Walter Lahti and Dean McCarron*

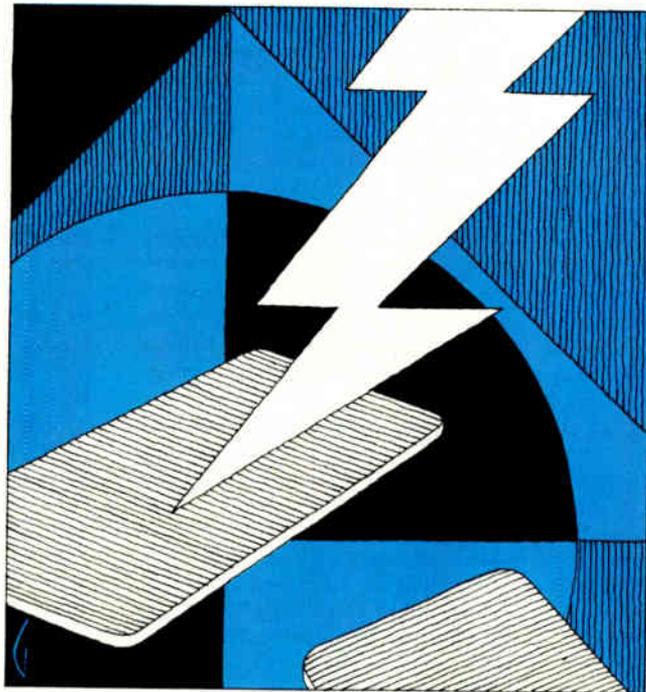
**N**ormally, you'd think of a flash flood as a natural disaster, something that could pick you up and carry you away. But the flood of flash memory that is about to reach the personal computer world will be a positive event. It will carry the power to expand the reaches of personal computing.

Flash memory is a nonvolatile memory IC. Born of the blending of EPROM and EEPROM, the flash IC is functionally and technologically the offspring of these parents (see the text box "Do You Remember?" on page 312). It is reportedly named for the speed with which it can be reprogrammed.

While flash and EPROM memory cells usually contain a single transistor, a DRAM cell typically contains a transistor and a capacitor, an EEPROM cell two transistors, and a static RAM (SRAM) cell four or six transistors. Obviously, the more cells, the more real estate (silicon) a memory requires. And real estate is always expensive.

## **Advantages of Flash**

Flash's two significant attributes, nonvolatility and DRAM-like speed, are



ideal for solid-state "disk" drives. Flash-based disks are very fast compared to most available disk drives (see figure 1). In 120 nanoseconds, you can access data stored in flash memory, while it takes 15 to 30 milliseconds to access data stored on today's typical hard disk. In some implementations, such as in portable computers, the speed advantage of flash over disk drives is even greater.

Today, a personal computer's hard disk drive is one of its most power-hungry components. When you use a desktop machine, you may not notice this power consumption. But the power a battery-operated portable can supply is limited—and hard disk drives use up that power quickly. Most portables today require fairly sophisticated power management facilities to extend the amount of time the machine can be used.

A portable's power management facility often turns off the hard disk drive if it isn't being used. While this is great for extending a portable's limited battery life, it is terrible for performance. When the power comes back on, the disk drive's motor can take several seconds to bring it up to speed before disk I/O can begin. A flash-based disk needs no warm-up. When you turn on the power, the data is immediately available. With no waiting, you experience no loss in performance.

In addition to achieving power savings from an "instant-on" flash disk, you also realize savings from not having to operate power-hungry motors and servos. A 1-megabyte flash disk requires a maximum of only 1.2 watts while operating.

## Do You Remember?

There are two kinds of memory: volatile and nonvolatile. Memory such as DRAM is called volatile if it forgets what it had stored when you turn off your computer's power. Memory such as ROM is called nonvolatile if it retains its data whether or not your computer's power is on. As all users who have ever turned off their computers before saving files to disk can tell you, the DRAM used in your personal computer to store programs and data cannot retain information without power.

DRAM, however, is reprogrammable; the information it contains can be changed. When you load a new file, the new information replaces the old. ROM, though, is not reprogrammable—the programs and data in ROM are permanent, and you can't change them.

In the early 1970s, the only semiconductor memory available was DRAM, its cousin static RAM—which is also volatile—and ROM. The choices open to computer designers were using memory that was reprogrammable but lost information without power, and using memory that always retained information but could never be changed. What designers really needed was memory that could be reprogrammed in the system and that also retained its contents when the power was off.

A few years after DRAM became available, a new kind of memory known as electrically programmable read-only memory, or EPROM, was introduced. EPROM is reprogrammable and nonvolatile. But it has one drawback. In order to reprogram EPROM chips, you have to remove them, expose them to high-intensity ultraviolet light for as long as 20 minutes, reprogram them, and then replace them in your computer. Thus, EPROM fell short of being the ideal memory. Today, because vendors find them easier to program, EPROM chips are largely used as replacements for your personal computer's ROM.

Electrically erasable programmable read-only memory, or EEPROM, was introduced in the late 1970s. EEPROM



*Psion uses four Intel 1-Mb flash-memory ICs in its credit-card-size solid-state disk.*

(like EPROM) is reprogrammable and nonvolatile, and it can also be easily reprogrammed within the computer.

Still, there are drawbacks. EEPROM is slow and expensive and doesn't hold very much data. Today, you can store 1 megabit of data in an ordinary DRAM chip. You can access the data in 80 nanoseconds, and it costs \$5. In contrast, it takes 150 ns to access a 1-Mb EEPROM, which costs \$265.

In the mid-1980s, Toshiba Semiconductor invented flash memory. About the same time, Intel and Seeq Semiconductor were also working on flash memory. While each manufacturer built its flash memory differently, they operate similarly.

Like both EPROMs and EEPROMs, flash memory is nonvolatile and reprogrammable. But it has none of the faults of these other types of memory. Unlike EEPROM, it is inexpensive: Today, a 1-Mb flash memory costs about \$15. Unlike EPROM, flash memory can be reprogrammed electrically while it is embedded in the system—either by you or via system software.

Still, one drawback remains. With DRAM, you can change a single bit at a time, but with flash memory, you can change only a sector (consisting of mul-

multiple bytes) at a time. While constraints of sector-level reprogrammability prevent it from replacing your computer's DRAM, flash memory is well suited to other applications.

The type of storage that hard and floppy disk drives provide resembles that of flash memory. Disks are nonvolatile—they hold onto data with or without power. And disks are reprogrammable—you can change the files whenever you want to. The similarities between flash memory and disk storage led to the building of "disks" based on the concept of flash memory.

A flash disk isn't a disk drive at all; there are no disks or moving parts. A flash disk is a set of flash-memory parts mounted in a credit-card-size package that acts as a hard disk. This same set of parts could be mounted on a board inside a machine. The difference between the two is that one is removable storage and one is fixed storage. A flash disk emulates a disk drive.

A flash disk is built from one or more flash-memory ICs and some controlling logic devices. For example, to build a 512K-byte flash disk, you could connect four 1-Mb flash-memory ICs and place them on a small card. Psion has used this principle with its flash disk (see the photo).

Flash disks operate fairly simply. At the hardware level, the computer simply sends digital read or write signals to the disk with the address of the information. If it is a read signal, the disk responds with the requested information. If it is a write signal, the disk takes information from the computer and stores it.

In addition to flash-disk hardware, you also need software to manage the files on a flash disk. This file-system software handles creating and deleting files, changing the file sizes, and formatting the flash disk. Microsoft has worked with Intel to create the Microsoft flash file system, a standard MS-DOS-compatible flash-disk interface that makes it much easier for vendors to use flash disks in their computers.

The lowest-power hard disk drives today require about 3 W.

The fact that flash-based disks have no moving parts carries with it yet another advantage—reliability. While hard disk

drives have become remarkably tough, on occasion they still do crash.

Flash-based storage is very reliable because a flash disk is as tough as the rest of the electronic hardware in a personal

computer. It takes a lot for a flash disk to fail: The flash memory must be damaged physically, through destruction of the device package, or electrically, by an extreme electric shock or a power spike.

### Disadvantages of Flash

Flash memory's extremely high speed, low power, and high reliability would seem to make it the ideal storage technology. Unfortunately, there are two significant drawbacks to flash disks. The most severe limitation is its cost. A conventional 40-MB hard disk drive costs about \$320, or \$8 per megabyte. Today, a 1-megabit flash IC costs \$15. Eight flash ICs are needed per megabyte of flash disk, making a flash disk cost about \$120 per megabyte.

Thus, you would have to pay about \$4800 for a 40-MB flash disk, or about 15 times what an ordinary hard disk drive would cost. Because of this present inequality, the first mass-produced flash-based disks probably will store less than 40 MB. In the future, flash-based disk prices will certainly decline, making large amounts of flash-disk storage more affordable. In a few years, you should only have to pay about \$600 for a 40-MB flash disk.

The other problem with flash disks is that they can't compare with hard disks in density. The highest-density flash memory available today stores 2 Mb per IC—you would need 160 of these ICs to produce a 40-MB disk. Like all memories, flash memory is expected to grow in density, so eventually far fewer ICs will be needed.

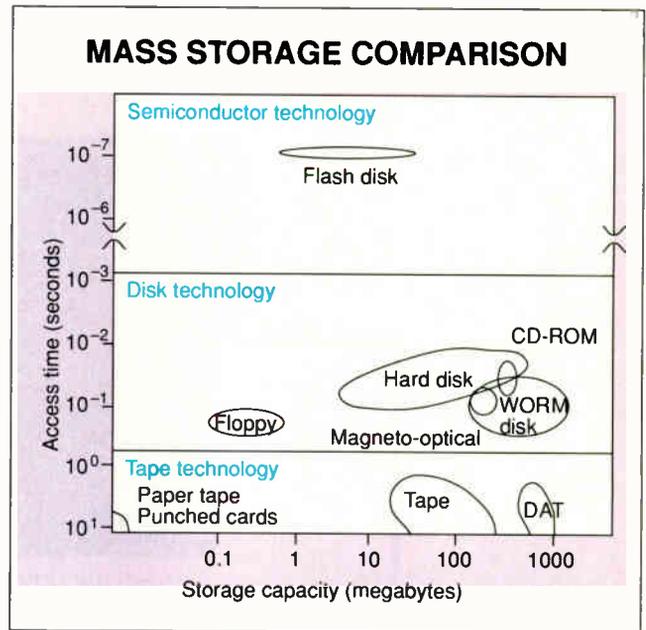
### Two Flavors

Manufacturers currently offer flash devices in two programming flavors: those that require a 5-volt power supply, and those that require a 12-V supply. With both erasure and programmability possible at 5 V, only one power supply is required at the system level. The benefits of this feature are reduced system-component cost and space savings. Thus, flash is ideal for portable-computing applications.

The 5-V flash cell is generally a modified two-transistor (or split-gate) derivative of EEPROM and is packaged with a different pin-out than the 12-V varieties. Five-volt programming lets a system interface with the device in much the same way it would with SRAM. Therefore, for some applications, a flash device can replace SRAM, particularly in systems that use SRAM with battery backup.

While both 12-V and 5-V flash memory can be used as an SRAM replacement, the 5-V feature becomes more desirable for portable equipment where no external 12-V power is available and the addition of a 12-V power supply is not feasible.

**Figure 1:** Flash disks are 125,000 to 250,000 times faster than today's hard disk drives. However, they are limited to up to 40 MB in capacity, whereas hard disk drives can store from 5 MB to 1 gigabyte.



### Ideal for Laptops and Palmtops

Laptop and notebook computers are the ideal applications for flash disks. With current hard disk drives, you must carry

around heavy batteries, deal with short amounts of work time, or suffer from hard disk drives operating at floppy disk drive speeds. Flash disks will answer all

# Microsoft makes sure you fly realistically. It's up to you to fly responsibly.



So you get an urge to buzz the Golden Gate Bridge. Okay. You can ignore the FAA—but not the crosswinds. Because in the world of Microsoft® Flight Simulator® 4.0, everything that happens is true to life.

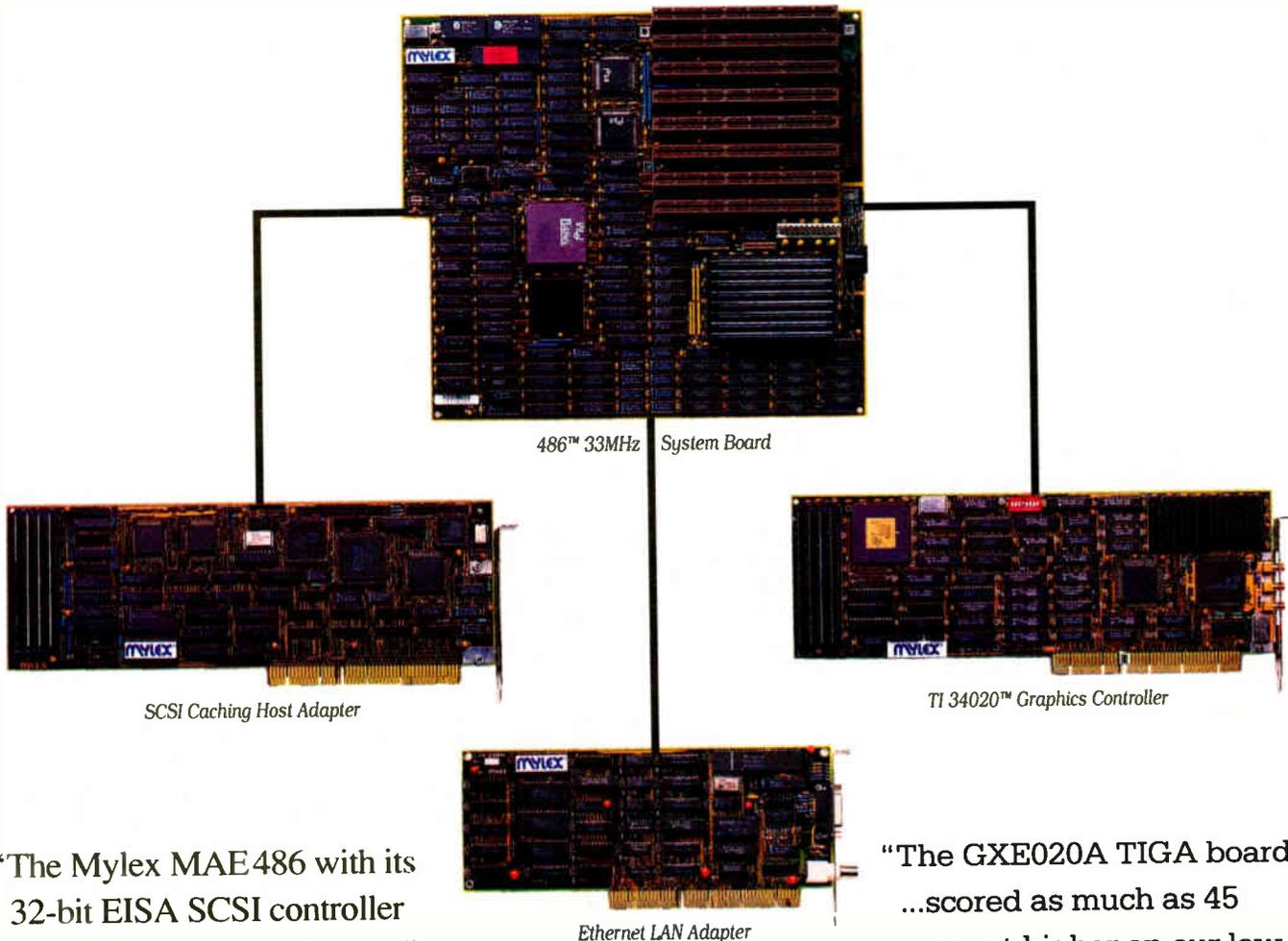
Banking, climbing or dodging thunderheads, your plane responds with perfect realism to your every move. Plus, you have 100,000,000 square miles of land to fly over. And four planes to choose from: a Cessna, a Lear Jet, a sailplane, or a dogfighter's dream—the Sopwith Camel.

Ask your Microsoft dealer about PC Flight Simulator. Take it into the air. And find out what they really mean by "the wild blue yonder."

**Microsoft**  
Making it all make sense

For more information, call (800) 541-1261, Dept. M51. Customers in Canada, call (416) 673-7638. Outside North America, call (206) 882-8661. © 1990 Microsoft Corporation. All rights reserved. Microsoft and the Microsoft logo are registered trademarks and Making it all make sense is a trademark of Microsoft Corporation. Flight Simulator is a registered trademark of SubLOGIC Corporation, used under license by Microsoft Corporation.

# Mylex has the best EISA solution. At least that's what people tell us.



486™ 33MHz System Board

SCSI Caching Host Adapter

TI 34020™ Graphics Controller

Ethernet LAN Adapter

“The Mylex MAE486 with its 32-bit EISA SCSI controller kills the competition for reading large sequential files in the IOBench 2 tests under UNIX.” *Personal Workstation*, June 1990

**“If I wanted to replace my entire system for optimum all-around performance, I’d build it from Mylex EISA-based boards.”**

*Personal Workstation*, June 1990

“The GXE020A TIGA board ...scored as much as 45 percent higher on our low-level benchmark tests than any other TIGA board evaluated.” *BYTE*, April 1990

*“Mylex has done a lot of work with EISA, and we plan to use its motherboard and adapters in a LAN Labs ‘super-AT’ server.”*

*PC Magazine*, May 1990

Visit us at COMDEX/Fall  
Las Vegas Hilton  
Booth #H7368

Of course, we've tested our EISA peripherals for compatibility with major EISA systems. To see what our high-performance EISA solutions can do for your system, call us at 1-800-446-9539, or fax us at 1-415-683-4662.

**MYLEX**

your critical needs for laptop and notebook computers by providing speed, rugged construction, and low power consumption.

You can also benefit from flash memory in other implementations. Flash will let you update your laptop's ROM with the latest versions of DOS, or any other operating system, whenever you want to. Laptops save space on disks and in RAM by placing the operating system in ROM. The problem with this is that you can't update the operating system without replacing the entire ROM—an expensive proposition. Thus, laptops often use old but reliable versions of DOS. Using an old version of DOS may mean that your computer won't need a ROM replacement in the near future, but it may not run recently written programs, either.

One thing lacking in palmtop computers, such as the Poqet PC and Atari Portfolio, is small, convenient mass storage. Without any optional peripherals, their storage is limited to programs on ROM cards and memory-expansion cards that lose their contents when they are removed. With flash-based memory cards, you can put your own programs and data onto the card, modify them at will, and not worry about losing the information when you remove the card. These features make flash-memory cards the logical choice for the palmtop's missing "floppy disk drive."

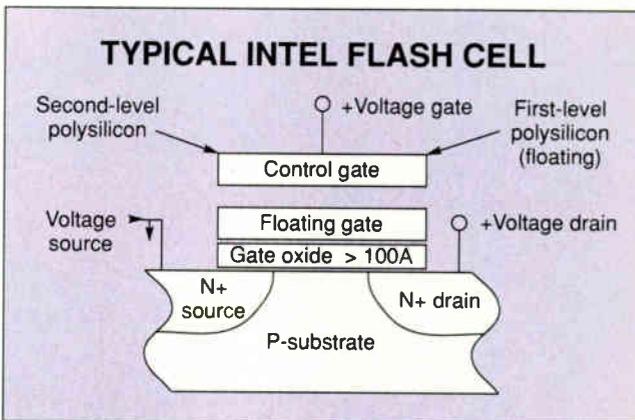
#### Laser Printers

If you use a laser printer, you can benefit significantly by using flash memory instead of ROM. In laser printers, ROM stores programs and fonts. ROM replacements are expensive because printer-control language programs have become large and are subject to frequent upgrades and improvements. Using a laser printer equipped with flash memory instead of ROM to store control-language programs, you can reprogram your printer's control language yourself at no cost and without replacing any ROM.

Currently, laser-printer font-storage options leave much to be desired. You have three choices. You can download a font to the printer each time it is needed, wasting your time and the laser printer's memory. You can place a font in a ROM cartridge and plug it into the printer, but you are limited to a selection of only a few fonts out of the hundreds available. Or you can store a font on a dedicated hard disk connected to the printer.

But when you use flash memory inside your printer, you only have to download a font once and it remains in your printer until you choose to delete it from the

**Figure 2:** A flash-memory cell is basically one memory bit (on or off). An array of up to 4 million flash-memory cells can be connected to form a flash IC.



printer's memory. Because you decide which fonts are stored in the printer's memory, you can really personalize them according to your preferences. You no longer have to buy cartridges that come with a half-dozen fonts just to get the one font you need.

#### Fabrication Techniques

Flash devices are manufactured using designs and processes similar to those used for EPROM and EEPROM, so the tech-

nology is evolutionary rather than revolutionary. Because manufacturers have dealt with similar products, they will be able to climb the learning curve much more rapidly than if the technology were completely new. Thus, vendors planning to produce flash memory should be able to attain manufacturing costs close to, but perhaps not equal to, those enjoyed by EPROM.

However, flash devices are a bit more complex and more silicon-hungry than

# How to land a 747 in an area no bigger than your desk.



What do you need to bring in a 400-ton, five-story jetliner? Nerves. Skill. And the new Microsoft Flight Simulator Aircraft & Scenery Designer.

Add it to our Flight Simulator 4.0, and you're off on the most realistic flight experience this side of a PC. You get a Boeing 747-400, complete with computerized flight display. You can also try out a Piper Archer, a Beechcraft Starship or a seaplane. Fly them stock, or push the envelope and modify them to your own specs.

See a Microsoft dealer. Because now it's possible to buy excitement. In the jumbo size.

**Microsoft**  
Making it all make sense

For more information, call (800) 541-1261. Dept. M51. Customers in Canada, call (416) 673-7638. Outside North America, call (206) 882-8661. © 1990 Microsoft Corporation. All rights reserved. Microsoft and the Microsoft logo are registered trademarks and Making it all make sense is a trademark of Microsoft Corporation. Flight Simulator is a registered trademark of SubLOGIC Corporation, used under license by Microsoft Corporation.

NOW WITH  
**V.42bis**



**BLINDING SPEED**  
**COMPLETE COMPATIBILITY**



## Introducing the high speed modems from U.S. Robotics Now with V.42bis

Until now, high speed modem users had the best of one world. They either had speed or compatibility. U.S. Robotics just changed all that.

### THE BEST OF ALL WORLDS...

With the new line of high speed modems from U.S. Robotics – the Courier HST, the Courier HST Dual Standard and the Courier V.32 – you can now have both the highest speeds and the most compatibility.

**For speed** – it's the Courier HST which delivers throughput up to 35,500 bits per second with MNP® level 1-5 error control and V.42bis. And it still costs less than \$1,000.

**For Compatibility** – the Courier V.32 provides CCITT standard modulations from 300 bps to 9600 bps for under \$995. And with MNP levels 1-5 and V.42bis you will get complete data integrity plus throughputs approaching 24,000 bps.

**For the best of all worlds** – it's the Courier HST Dual Standard, combining the blinding speed of the Courier HST with the compatibility of the V.32. At \$1,295, it costs less than some featureless V.32-only modems.

### U.S. ROBOTICS – THE EXPERT'S CHOICE

You would expect the broadest high speed modem line from U.S. Robotics. We manufactured our first HST in 1987, and it quickly became the standard on over 8,000 bulletin boards and for over 40,000 users. Rated #1 by *Data Communications* magazine, it confirmed what our customers knew all along – U.S. Robotics delivers the best modem value. And we've been doing that for 13 years – for over 1,000,000 customers.

When you look for high speed modems, don't settle for half a solution. Look to U.S. Robotics. Call today for details on the high speed modems that give you the best of all worlds.

**Call 1-800-Dial USR. (1-800-342-5877)**

# U.S. Robotics®

The Intelligent Choice in Data Communications

8100 North McCormick Boulevard, Skokie, Illinois 60076  
U.S. Robotics, Courier and HST are trademarks of U.S. Robotics, Inc. Other computer and software names identified by ® or ™ are trademarks of their respective manufacturers. Prices are suggested retail prices in U.S. Dollars.  
For sales in the United Kingdom, please call Miracom, Ltd., Ipswich, England.  
Telephone: 0473 233888, For Canadian sales, call 1-800-553-3560.

EPROM devices. The most common flash chip is an array of single-transistor memory cells and looks much like an EPROM (see figure 2). It is slightly larger than an EPROM of equal density to allow for the command port and peripheral circuitry that supports the in-system rewrite function and provides an on-chip processor interface.

The typical EEPROM chip is made of an array of two-transistor cells to enable bit-level erase/reprogram. For any given density, it requires much more silicon than either the EPROM or flash cell. Because a major cost determinant in any IC is the silicon required, the EEPROM is a more expensive part.

### Erasing and Reprogramming

In terms of reprogrammability, the flash IC falls somewhere between the traditional EPROM and EEPROM (see figure 3). A major difference between flash memory and EPROM is that flash does not require ultraviolet light for erasure, as does the traditional EPROM. While flash resides in your system, you can electrically erase it in much the same way as you would an EEPROM.

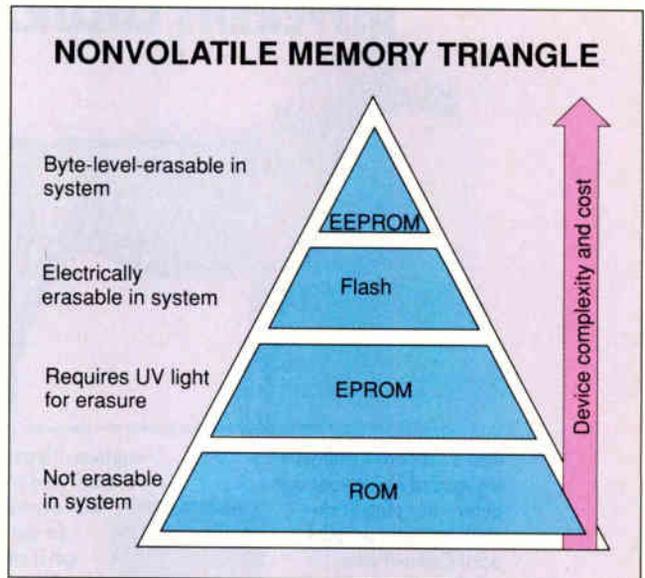
The energy needed to discharge or erase the gate in a typical EPROM is derived from UV light, a requirement that makes it difficult and time-consuming to erase an EPROM. In a typical flash IC or EEPROM, energy resident in the system can be used to erase a group of memory cells or the entire chip. This feature makes it easy and fast to erase a flash IC in the system.

You generally cannot erase a flash IC on a byte-level basis as you can with the EEPROM, but some flash ICs can be erased on a sector-level basis. Flash ICs are usually reprogrammable by hot electron injection, a solid-state physics process that uses the energy in the system. It is possible to program on a byte level, but because it is not possible to erase on a byte basis, reprogramming is limited to sector or the entire chip.

Because the flash device does not require UV light for erasure, the chip does not need to be housed in an expensive ceramic window package such as that required for an EPROM. Therefore, flash is also an excellent candidate for surface-mount technology.

The advantage of surface mount is that there is less distance between the device and the board. This reduction can lead to improved reliability, better system performance, and higher board density, as well as reduced cost. Also, the flash device can readily be packaged in memory-card configuration and handled as if it

**Figure 3:** *Technology trade-offs for semiconductor nonvolatile memories. As programming flexibility increases, so do device complexity and cost.*

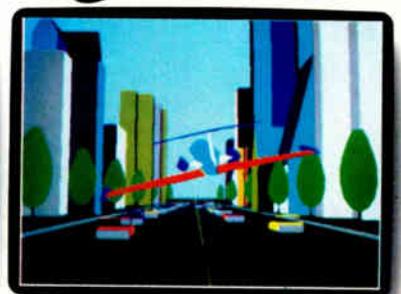


were a floppy disk, which is important to the portable computer world.

The total cost of using flash memory can be considerably lower than that for EEPROM and, with some applications, close to that for EPROM—about \$6.50

for a 1-Mb EPROM versus over \$250 for a similar-size EEPROM. On a comparable device-density basis, flash memory's \$15 average selling price is much lower than the EEPROM's and greater than the EPROM's. With flash, application solu-

# Create a scene in your living room.



Make mountains. Build bridges. Give rise to rivers and runways. When you add Microsoft Flight Simulator Aircraft & Scenery Designer to Flight Simulator 4.0, the world is literally yours.

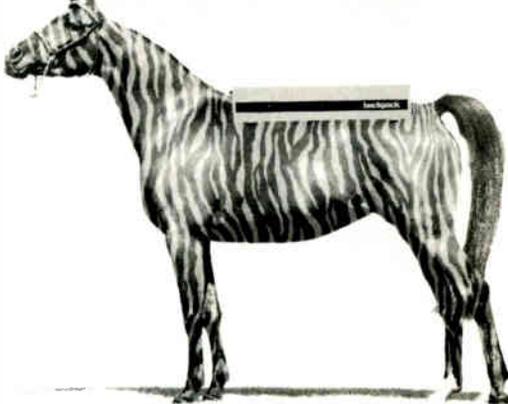
Because now you can choose from 34 different objects—natural or man-made—and change their size, shape, color and even location to your liking. Ask your Microsoft dealer about it.

You'll get the biggest kicks in the air. While you're having the most fun on earth.

**Microsoft**  
Making it all make sense

For more information, call (800) 541-1261, Dept. M51. Customers in Canada, call (416) 673-7638. Outside North America, call (206) 882-4661. ©1990 Microsoft Corporation. All rights reserved. Microsoft and the Microsoft logo are registered trademarks and Making it all make sense is a trademark of Microsoft Corporation. Flight Simulator is a registered trademark of SubLOGIC Corporation, used under license by Microsoft Corporation.

# BACKPACK. IT'S A DRIVE OF A DIFFERENT COLOR.



Add a disk drive without horsing around inside your computer – just plug Backpack into your parallel port! Connect your printer to the Backpack drive. No tools. No hassles. No interface cards. Backpack works with IBM and compatibles including PCs, XT's, AT's, PS/2's, PS/1's, and



laptops. It's available in 5.25" and 3.5" and comes complete with everything you need. So see your dealer or get it straight from the horse's mouth and call us about Backpack today!

**MicroSolutions**  
Computer Products  
132 W. Lincoln Hwy., DeKalb, IL 60115  
815-756-3411 Fax: 756-2928

## STATE OF THE ART STORE DATA IN A FLASH

**L**aptop and notebook computers are the ideal applications for flash disks.

tions are possible that would be impractical with either the UV-light erasure EPROM or the pricey EEPROM.

The law of the semiconductor jungle is that over time, all device types see improved performance and reach greater density levels. At the same time that silicon real estate is minimized, costs are significantly reduced. By 1994, the cost of a megabyte of flash memory is expected to move from its current level of about \$120 to about \$15.

### Flash in the Pan?

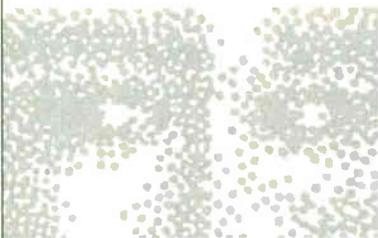
Unless developers are able to overcome the current limitations of flash disks, you will probably continue to use hard disk drives on your desktop computer for mass storage. Hard disk drives are inexpensive and fairly reliable, and they can store plenty of data. Although single-user personal computers will probably continue to include hard disk drives, eventually network servers will probably offer both hard disk drives and flash disks on-board.

On many servers, you frequently access files, such as programs, that are rarely changed. Flash disks are ideally suited to perform this service. You can store seldom-changed program files on flash disks, relieving the burden on the server. By doing so, the server's response to program load requests will be far faster than if the files were stored on a hard disk.

Flash memory combines the advantages of an EPROM's low cost with an EEPROM's ease of reprogramming. These advantages will allow flash memory to make significant contributions to personal computers. Portable computers will be the first to benefit from this new technology, as flash-based disks increase their speed, operating time, and ruggedness. ■

*Walter Lahti and Dean McCarron are vice presidents of In-Stat (Scottsdale, AZ), a company that provides market research for the electronics industry. They can be reached on BIX c/o "editors."*

# Video In.



Truly affordable video imaging for IBM PC and Macintosh computers. ComputerEyes includes everything you need to capture 8- or 24-bit color (or 8-bit gray scale) images from any composite or S-Video source.

Captured images can be used with all popular paint, animation, database, presentation, and publishing programs.

Call today for more information and free demo disk.

Digital Vision, Inc.  
270 Bridge St., Dedham, MA 02026  
(617) 329-5400  
To order call (800) 346-0090

*Professional  
Series*

*Color Video*

*Digitizers*

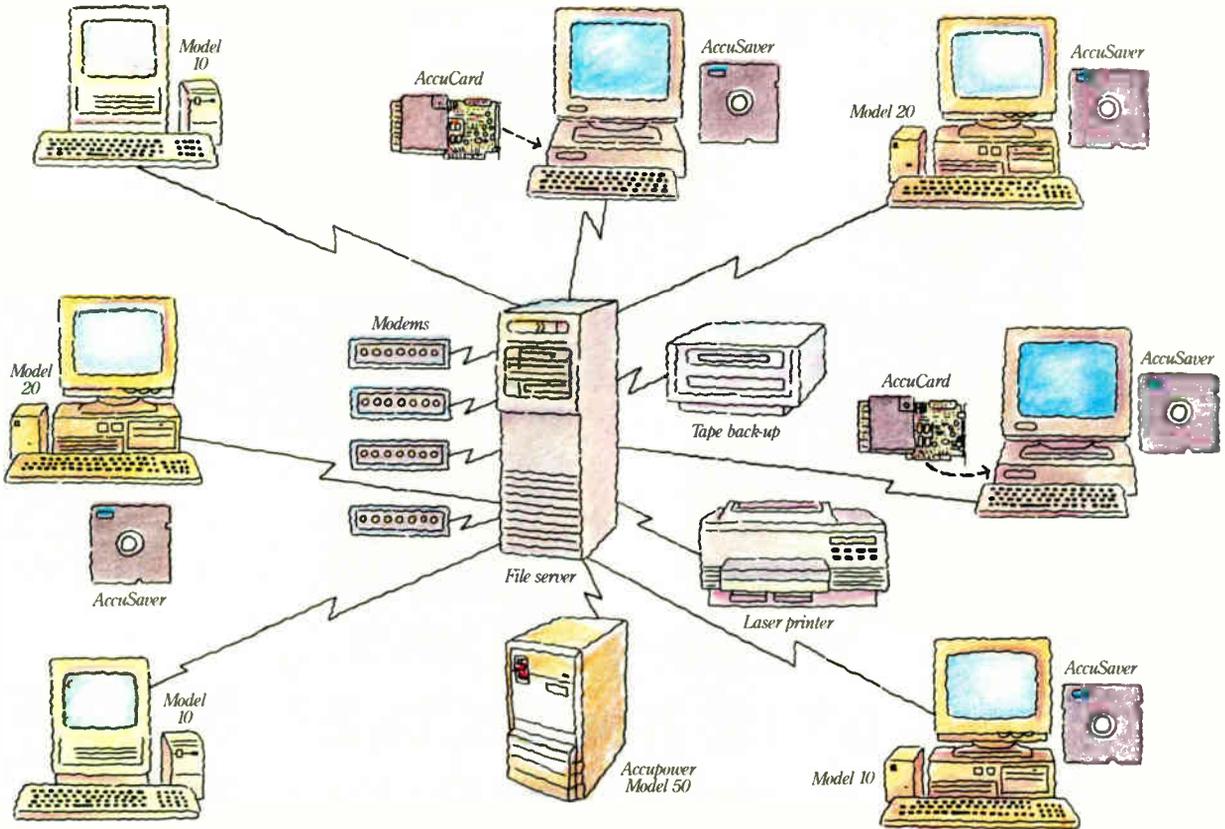
*For Under*

*\$ 450.*

*Digital Vision*

**C O M P U T E R E Y E S <sup>TM</sup>**

# Introducing The Total LAN Plan.<sup>™</sup> Only Emerson UPS has it.



Novell  
Banyan  
3Com  
LAN Manager  
UNIX

It's the first systems approach to network power protection.

*Total* network protection.

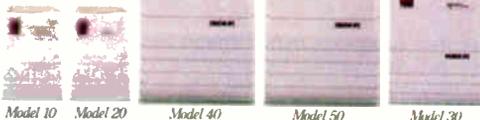
With the price breakthroughs we've achieved on our Accupower<sup>®</sup> line, you can now protect a file server and five to six PC nodes. All for what you'd expect to pay just for file server protection.

And Emerson UPS has the broadest range of LAN interface cables and software in the industry. From Novell's Netware to the new IBM RS/6000 AIX.

But that's just the first of many unique solutions that only Emerson offers.

**A UPS that fits in a slot.**

There's our unique AccuCard,<sup>™</sup> for instance.



A low-cost UPS-on-a-card that fits right into an unused slot in your PC. It features complete data save and restore, self-diagnostics and unattended operation on your nodes.

And cable adapters make AccuCard compatible with virtually all desktop computer brands.

**Plus there's our proprietary AccuSaver software.**

AccuSaver software is activated by any data-threatening power problems. While the battery backup capability of the Emerson UPS supplies emergency power to the system, our AccuSaver software orchestrates a controlled shutdown on all your PC nodes.

Then, when power is restored, you can either manually or automatically restore your workstation.

**And you get our money back guarantee.**

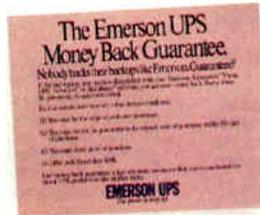
We're so confident in the absolute reliability of our network protection systems, we'll refund your money if, for any reason, you're not satisfied with your UPS system.\*

Think about it. Absolute reliability. More power protection solutions than any other company offers.

And a money-back guarantee. All at truly affordable prices.

The Total LAN Plan.

For more information or the name of the distributor nearest you, just call 1-800-BACK-UPS.

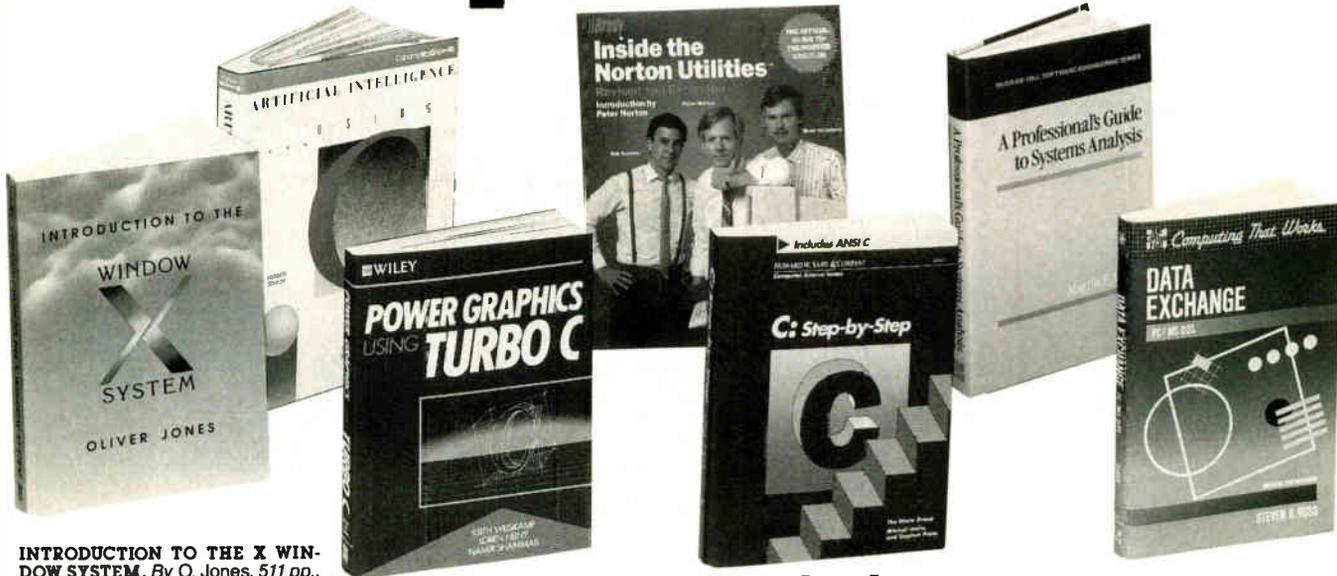


**EMERSON UPS**  
*The power to keep up.*

Accupower is a registered trademark and AccuCard, AccuSaver and the Total LAN Plan are trademarks of Emerson Computer Power, a division of Emerson Electric. PC is a registered trademark of International Business Machines Corporation. LAN Manager is a registered trademark of Microsoft Corporation. Novell and Netware are registered trademarks of Novell, Inc. UNIX is a registered trademark of AT&T Bell Labs. Banyan and 3Com are registered trademarks of those respective companies. Some restrictions apply. See your reseller for details or call Emerson UPS direct. Offer ends December 1991. ©1990 Emerson Computer Power, a division of Emerson Electric Co.

Circle 125 on Reader Service Card (RESELLERS: 126)

# Take any 3 books for only \$1<sup>00</sup> each



## when you join BYTE Book Club<sup>®</sup> VALUES UP TO \$142.85!

- Your one source for computer books from over 100 different publishers
- the latest and best information in your field
- discounts of up to 40% off publishers' list prices

**INTRODUCTION TO THE X WINDOW SYSTEM.** By O. Jones. 511 pp., illus., softbound. Here's the new portable software standard for workstations, presented in a complete, detailed tutorial. This book will help you harness the system, cut down on redundant workstation events, exploit private/shared color cells, and map strategies.  
585109-1 Pub. Pr., \$32.00

**INTRODUCING PC-DOS & MS-DOS, Second Ed.** By T. Sheldon. 403 pp., illus., softbound. This Second Edition covers all releases through 4.0, as well as Microsoft Windows and DOS-SHELL. Features the same hands-on tutorial format of the First Edition, with expanded coverage of batch file techniques that can dramatically increase your computing speed.  
565/651 Pub. Pr., \$29.95

**LOCAL AREA NETWORKS: Architectures and Implementations.** By J. Martin, with K. K. Chapman. 353 pp., illus. An indispensable reference for all who buy, install, maintain, or manage LAN services. Provides complete coverage of the concepts, architectures, and implementations of LAN technology.  
584900-3 Pub. Pr., \$44.00

**A PROFESSIONAL'S GUIDE TO SYSTEMS ANALYSIS.** By M.E. Modell. 307 pp., illus. Detailed coverage of what you need to know—what questions to ask, how to conduct a cost-benefit analysis, how to document and validate your findings—to design the best systems for your user's needs.  
426/325 Pub. Pr., \$37.95

**DATA EXCHANGE: PC/MS-DOS.** By S. Ross. 426 pp., illus., softbound. Now you can convert files quickly and painlessly from word processing programs to spreadsheets... from spreadsheets to databases... or from databases to word processing programs. Packed with simple, step-by-step instructions that will save you headaches and money.  
539/235 Pub. Pr., \$24.95

**C: Step-by-Step.** By M. Waite and S. Prata. 629 pp., illus., softbound. Mastering C has never been easier! This updated version of the classic *C Primer Plus* includes ANSI C, pointers, structures, bitwise operators, and much more... all in a format that makes learning it faster and easier than ever.  
585146-6 Pub. Pr., \$29.95

**INSIDE THE NORTON UTILITIES: Revised and Expanded.** By R. Krumm. 559 pp., illus., softbound. The "official guide" now covers all the latest upgrades and shows you how to get the most from the Standard and Advanced Editions, the Norton Commander, Editor, Disk Doctor, and the On-Line Guides.  
585444-9 Pub. Pr., \$24.95

**MVS PERFORMANCE MANAGEMENT.** By S. L. Samson. 400 pp., illus. This unique work demystifies MVS and provides strategies for solving performance problems. Extensive coverage of control mechanisms ranges from measurement and modeling to application tuning and workload management.  
545/286 Pub. Pr., \$39.95

**DESIGN OF COMPUTER DATA FILES, Second Ed.** By O. Hanson. 419 pp., illus. This comprehensive book contains lucid descriptions of the latest techniques and storage devices to help you design files for maximum performance at minimum cost. Easy to read, with scores of examples, tables, and illustrations.  
585143-1 Pub. Pr., \$37.95

**HOW TO BE A SUCCESSFUL COMPUTER CONSULTANT, Second Ed.** By A. R. Simon. 280 pp., illus. This new edition of a best-seller is updated to steer your career toward the emerging opportunities of the '90s, including security, microcomputer networking, systems integration, and much more.  
575/541 Pub. Pr., \$29.95

**POWER GRAPHICS USING TURBO C.** By K. Weiskamp, L. Heiny, and N. Shamma. 367 pp., illus., softbound. This easy-to-follow manual is packed with practical examples of actual code, guidelines for programming 2D and 3D graphics using animation, customizing GAD/CAM, the capabilities of the Borland Graphics interface, and more.  
585091-5 Pub. Pr., \$22.95

**ARTIFICIAL INTELLIGENCE USING C: The C Programmer's Guide to AI Techniques.** By H. Schildt. 412 pp., 37 illus., softbound. This hands-on guide shows you how to create your own AI applications and systems using C. After an introductory overview it provides coverage of expert systems, logic, natural language processing, machine learning, pattern recognition, and more, with ready-to-run programs illustrating each topic.  
881255-0 Pub. Pr., \$21.95

**PROGRAMMING USING THE C LANGUAGE.** By R.C. Hutchison and S.B. Just. 519 pp., illus. Whether you want to understand programs in C written by others, or write better C programs of your own, this practical, authoritative book gives you the tools and guidance you need. Coverage includes program organization, sorting algorithms, recursion, linked lists, and more — with many sample programs.  
315/418 Pub. Pr., \$29.95

**DATA PROCESSING IN UNIX.** By R. S. Tare. 438 pp., illus. The only guide you'll ever need to harness the full power of UNIX for database management. It sets out system selection criteria... examines such applications as INFORMIX, INGRES, and UNIFY... and explores flat file systems in UNIX.  
628/858 Pub. Pr., \$39.95

**CIARCIA'S CIRCUIT CELLAR, Vol VII.** By S. Ciarcia. 256 pp., illus., softbound. The latest volume in this best-selling series provides schematics operating explanations, and step-by-step building instructions for a wide range of projects—from video digitizing to multitasking process control.  
109/699 Pub. Pr., \$19.95



**TURBO PASCAL EXPRESS**, Revised  
ed. By R. Jourdain.  
84963-1 Pub. Pr., \$39.95

**COBOL II: Programming Techniques; Efficiency Considerations; Debugging Techniques Includes Release 3.1.** By H. Bookman.  
165/330 Pub. Pr., \$39.95

**ADVANCED MS-DOS BATCH FILE PROGRAMMING.** By D. Gookin.  
85018-4 Pub. Pr., \$24.95

**ARTIFICIAL INTELLIGENCE & TURBO C.** By C. F. Chabris.  
85052-4 Pub. Pr., \$24.95

**LOWER GRAPHICS PROGRAMMING.** By M. Abrash.  
85443-0 Pub. Pr., \$24.95

**12-BIT MICROPROCESSORS.** Edited by H. J. Mitchell.  
25/85X Pub. Pr., \$49.95

**ADVANCED 80386 PROGRAMMING TECHNIQUES.** By J. L. Turley.  
81342-5 Pub. Pr., \$22.95

**NETWORKING SOFTWARE.** By J. B. Ungaro.  
06969-9 Pub. Pr., \$44.95

**80386: A Programming and Design Handbook, 2nd Ed.** By P. Brumm and D. Brumm.  
85077-X Pub. Pr., \$24.95

**PRINCIPLES OF ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS DEVELOPMENT.** By D.W. Rolston.  
136/147 Pub. Pr., \$47.95

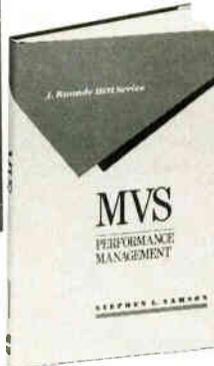
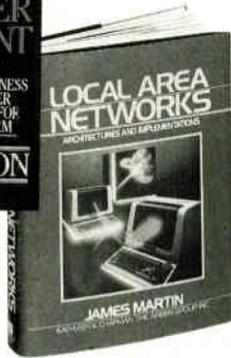
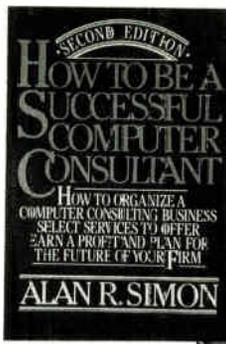
**IBM PERFORMANCE MANAGEMENT.** By T. Eddolls.  
89/668 Pub. Pr., \$39.95

**DB2/SQL: A Professional Programmer's Guide.** By T. Martyn and J. Hartley.  
106/669 Pub. Pr., \$39.95

**DATA COMMUNICATIONS: A User's Guide, 3rd Ed.** By K. Sherman.  
85384-1 Pub. Pr., \$34.00

**OPERATING SYSTEMS.** By M. Milenkovic.  
119/205 Pub. Pr., \$44.95

**IBM PS/2: A Reference Guide.** By J. Byers.  
95/272 Pub. Pr., \$39.95



**Any 3 books for \$1.00 each... if you join now and agree to purchase two more books—at handsome discounts—during your first year of membership.**

**ADVANCED GRAPHICS IN C: Programming and Techniques.** By N. Johnson.  
881257-7 Pub. Pr., \$22.95

**THE PAUL MACE GUIDE TO DATA RECOVERY.** By P. Mace.  
584926-7 Pub. Pr., \$21.95

**STRUCTURED WALKTHROUGHS, 4th Ed.** By E. Yourdon.  
585016-8 Pub. Pr., \$28.50

**C CHEST AND OTHER C TREATURES FROM DR. DOBB'S JOURNAL.** Edited by A. Holub.  
584807-4 Pub. Pr., \$24.95

**EGA/VGA: A Programmer's Reference Guide.** By B. D. Klierer.  
350/892 Pub. Pr., \$32.95

**FILE ORGANIZATION FOR DATABASE DESIGN.** By G. Wiederhold.  
701/334 Pub. Pr., \$44.95

**STRETCHING TURBO C.** By K. Porter.  
584967-4 Pub. Pr., \$24.95

**1-2-3 RELEASE 3: The Complete Reference.** By M. Campbell.  
881318-2 Pub. Pr., \$28.95

**GRAPHICS DESIGN AND ANIMATION ON THE IBM MICROCOMPUTERS.** By J. Sanchez.  
585375-2 Pub. Pr., \$28.00

**MASTERING ORACLE: Featuring Oracle's SQL Standard.** By D. J. Cronin.  
585034-6 Pub. Pr., \$24.95

**SECURITY IN COMPUTING.** By C.P. Pfeiffer.  
584941-0 Pub. Pr., \$44.00

**VS COBOL II FOR COBOL PROGRAMMERS.** By P. Kavanagh.  
335/710 Pub. Pr., \$39.95

**C: The Complete Reference, 2nd Ed.** By H. Schildt.  
881538-X Pub. Pr., \$28.95

**INTRODUCTION TO SNA NETWORKING: A Guide for Using VTAM/NCP.** By J. Ranade and G.C. Sackett.  
511/446 Pub. Pr., \$39.95

**ONLINE COMMUNICATIONS SOFTWARE.** By R. Ashley, J. Fernandez, and P. Ashley.  
024/634 Pub. Pr., \$27.95

Clip & Mail

**BYTE BOOK CLUB®**

P.O. Box 582

Hightstown, NJ 08520-9959

Please enroll me as a member and send me the three choices I have listed below. Bill me only \$3.00, plus local tax, postage and handling. I agree to purchase a minimum of two additional books during my first year as outlined under the Club plan described in this ad. Membership in the club is cancellable by me any time after the two book purchase requirement has been fulfilled. A shipping and handling charge is added to all shipments.

Indicate in the boxes the code numbers of the books you want.

Signature \_\_\_\_\_

Name \_\_\_\_\_

Address / Apt. # \_\_\_\_\_

City / State / Zip \_\_\_\_\_

This order subject to acceptance by McGraw-Hill. All prices subject to change without notice. Offer good only to new members. Foreign member acceptance subject to special conditions.

BYCA-031

**Here's how BYTE Book Club® works to serve you:**

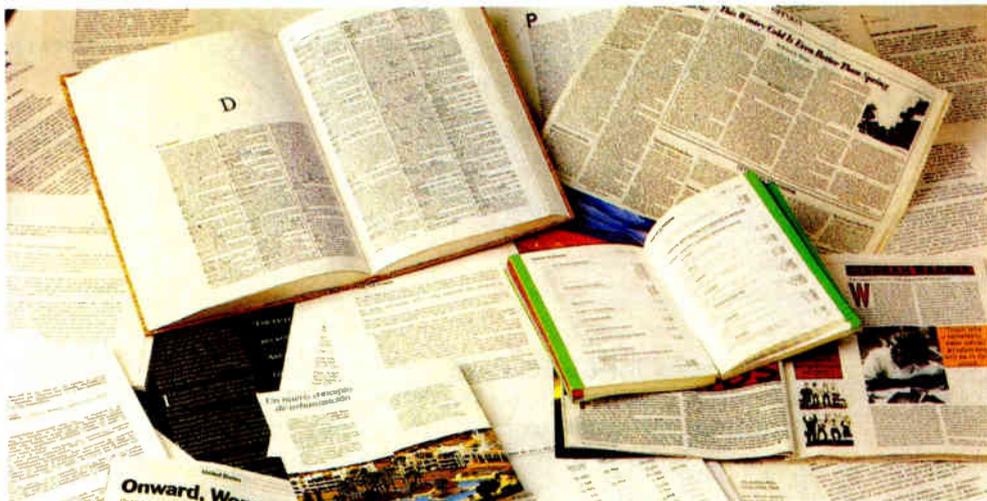
- Important information . . . we make it easy to get!** Today, professionals who perform best are those who are best informed. For reliable, hands-on information, turn to the Byte Book Club. Every 3 or 4 weeks (12-15 times a year), members receive the Club Bulletin offering more than 30 books – the best, newest, most important books from all publishers.
- Dependable service . . . we're here to help!** Whether you want information about a book or have a question about your membership, just call us toll-free or drop us a line. To get only the books you want, make your choice on the Reply Card and return it by the date specified. If you want the Main Selection, do nothing – it will be sent to you automatically. (A small shipping and handling charge is added to each shipment.)
- Club convenience . . . we do the work!** You get a wide choice of books that

- simply cannot be matched by any bookstore. And all your books are conveniently delivered right to your door. You also get 10 full days to decide whether you want the Main Selection. (If the Club Bulletin ever comes late and you receive a Main Selection you don't want, return it for credit at our expense.)
- Substantial savings . . . and a bonus program too!** You enjoy substantial discounts—up to 40%!—on every book you buy. Plus, you're automatically eligible for our Bonus Book Plan which allows you savings up to 70% on a wide selection of books.
- Easy membership terms . . . it's worthwhile to belong!** Your only obligation is to purchase 2 more books – at handsome discounts – during the next 12 months, after which you enjoy the benefits of membership with no further obligation. You or the Club may cancel membership anytime thereafter.

**Fill out the card and mail today! If the card is missing, write to:**

**BYTE Book Club®, P.O. Box 582, Hightstown, New Jersey 08520-9959**

# Need to enter all this into your PC?



**TextPert™ Windows\* does it in 3 easy steps.**

**SCAN/READ**

**EDIT**

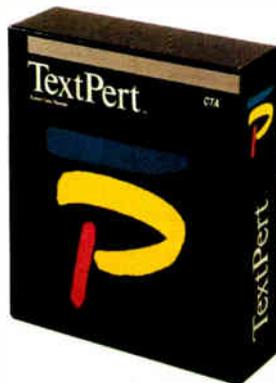
**SAVE TEXT**

Transfer essential data from paper form to computer format...

Data essential to the productivity of your office. Financial tables, mailing lists, internal reports and daily correspondence are instantly stored as text files, spreadsheets, databases. Live editable information as opposed to dead weight.

TextPert™ Windows increases your company's productivity by breaking the data entry bottleneck, without breaking your budget.

TextPert™ ICR  
(Intelligent Character  
Recognition).



In United Kingdom:



**S.S.  
STEVENSON  
& PARTNERS LTD**  
Stevenson House: Wey Hill: Haslemere  
Surrey: GU27 1BX  
Telephones: 0428-51500 & 51671  
Fax: 0428-53356  
Telex: 858145 RMP G

**Call us at 1-800-252-1442**



CTA  
747 Third Ave., 3rd floor  
New York, NY 10017  
Tel: 212-935 2280  
Fax: 212-9352272  
Roger de Lúria, 50 entlo.  
08009 Barcelona (Spain)  
Tel: 343-318 4737  
Fax: 343-302 5110

**Programs for the future**

\* Windows is a registered trademark of Microsoft Corporation

Circle 90 on Reader Service Card  
World Radio History

# DAT's a Solution

*Reliable multigigabyte backup storage  
with digital audiotape*

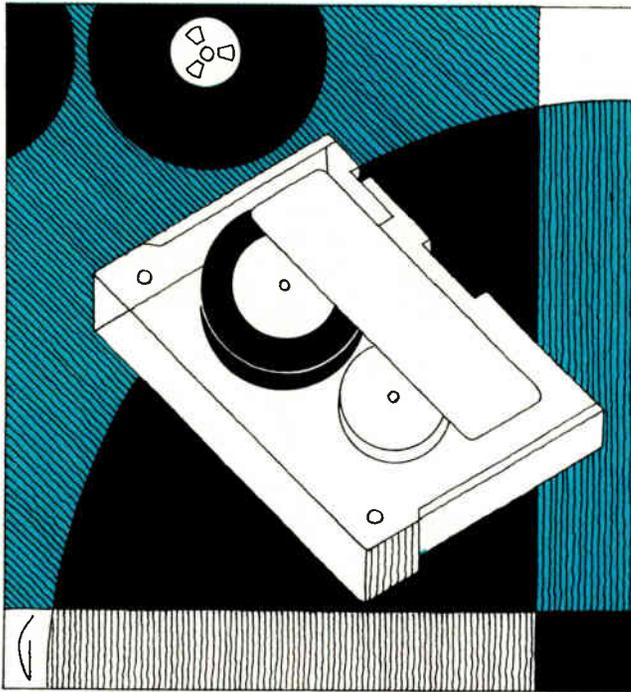
*Karina Lion*

**T**ape backup has been around for a long time. In the early days of computing, mainframe shops developed half-inch reel-to-reel tape drives. (Such drives remain popular in centralized computing environments today.)

Then, with the advent of personal computers, came quarter-inch tape drives. Quarter-inch cartridge tape, developed originally to store 5 megabytes of data, soon became a popular backup solution for the stand-alone PC.

Next came the 8-mm tape format. This storage medium, developed in the 1950s for the video industry, uses the standard VHS recording method, *helical scan*. The primary benefit to early users of 8-mm tape was its ability to store over 2 gigabytes of data on a VHS cassette. Like its quarter-inch and half-inch cousins, 8-mm tape employs analog recording methods.

To date, just one company manufactures 8-mm tape drives: Exabyte Corp. Nonetheless, 8-mm tape backup products have proliferated into many operating environments. Prior to the advent of 4-mm digital audiotape (DAT) in the microcomputer arena, the Exabyte 8-mm



tape was the only high-capacity tape-backup solution available.

Now comes DAT data storage, which uses digital recording technology developed for DAT devices in the music industry. In 1988, GigaTrend introduced the first DAT drive for computer data. Numerous companies have since announced DAT products, including JVC, Hitachi, WangDAT, Archive, Wangtek, Hewlett-

Packard, Mitsumi, Sony, and Teac.

No mystery surrounds the popularity of DAT. The demand for multigigabyte storage is rapidly becoming commonplace. The backup and archival requirements of PC LAN users, for example, have grown exponentially in the last five years. Users of high-end workstations and mini-computers also need multigigabyte backup solutions.

DAT shares with 8-mm tape the ability to store gigabytes of data on a small tape cartridge. But although the two technologies are able to store comparable quantities of data, DAT drives are cheaper to manufacture. What about optical storage? CD-ROM/WORM (write once, read many times) technology provides quick random access to files. But optical disks cost

more than 4-mm and 8-mm tapes, and they hold less (only 600 to 700 MB), so you pay for the privilege of instant access to files. If that's what your application requires, go with a CD-ROM or WORM drive.

DAT systems, like conventional and 8-mm tape drives, can of course locate individual files, but there's a delay. For most backup applications, however, tape

remains the medium of choice. And, per megabyte, DAT is cheaper than 8-mm tape storage.

### Making the Connection

DAT drives, like the conventional tape drives and hard disk drives, come in two flavors: internal and external. The internal DAT systems are available in full-height and half-height models. On a LAN, you can attach a DAT system to a

file server or to a network node.

DAT systems support various interfaces. SCSI has become the de facto standard for DAT drives. Older tape drive interfaces such as QIC-02, used with quarter-inch and half-inch tape systems, cannot achieve the high throughput levels of SCSI. If your system already has a QIC-02 interface, your existing tape-backup software could be able to communicate with a DAT drive. You can even

buy a DAT drive with a Pertec interface to modernize a nine-track tape system.

### Advantages of Helical Scan

The stationary-head technology used in quarter-inch tape drives puts a great deal of stress on a tape. In order to achieve a backup rate of 5 MB per minute, a half-inch or quarter-inch tape has to move at speeds of 90 to 120 inches per second past the stationary head. (See the table for a more complete comparison of quarter-inch and DAT technologies.) That causes significant wear and tear on the tape.

As a result, 150-MB tape cartridges are rated for only about 200 passes; 60-MB cartridges are rated for 400 passes. The newer 300- to 500-MB quarter-inch systems yield only about 100 passes per cartridge. By contrast, a 4-mm DAT can sustain over 1000 passes. Why? With a DAT system's helical-scan technique, tracks are laid down in an angular format, 6 degrees from the physical edge of tape. In a single pass, a DAT system can record a gigabyte of data. Quarter-inch tape technology requires 24 passes to record 150 MB.

In addition to wear and tear, the speed at which tape moves in conventional quarter-inch systems creates other problems. As the tape passes rapidly over the stationary heads, friction causes heat, which can distort the tape's metal-oxide coating. Such distortion can compromise the integrity of data. That's why every quarter-inch tape drive incorporates a tape-tensioning mechanism that the drive must monitor continuously to ensure accurate performance.

DAT systems employ a rotating drum. Because the heads on the rotating drum do most of the work, the tape doesn't need to travel so fast. DAT moves at a mere one-third of an inch per second. The tape heads record the data in a herring-bone pattern. Unlike with the linear recording method of quarter-inch tape, with a DAT drive each head can read only its own track. Tracks can overlap, which prevents gaps on the tape and cuts down on wear and tear. All this enables the tape to travel more slowly, and therefore to last longer.

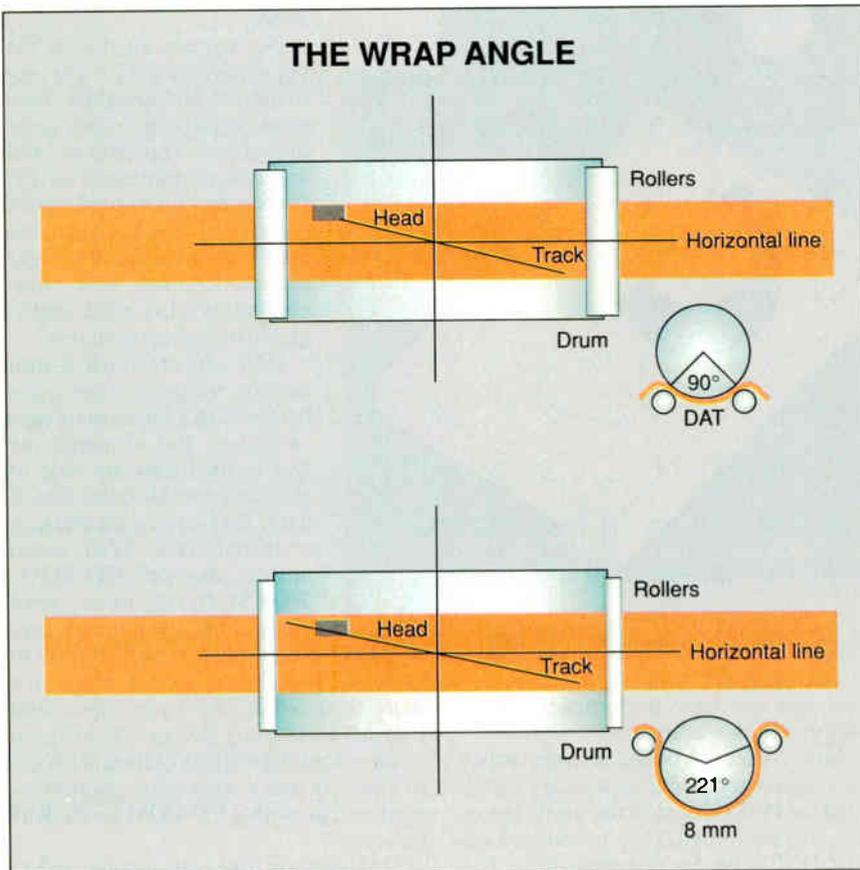
Both 8-mm systems and 4-mm DAT systems employ helical-scan technology. One key difference is the degree to which the tape wraps around the rotating drum. In the Exabyte 8-mm system, the angle of wrap is 221 degrees; with a 4-mm DAT system, it's only 90 degrees (see figure 1). The smaller 90-degree wrap angle reduces friction and requires fewer moving parts.

### DAT VS. QUARTER-INCH TAPE SYSTEMS

*A DAT system stores more, faster, for fewer dollars per megabyte.*

	Quarter-inch	DAT
Capacity in production	60-500 MB	2.5 gigabytes
Next capacity level	1 gigabyte	5 gigabytes
Recording density	12,500 bits/inch	61,000 bits/inch
Maximum data transfer rate	90K bytes/sec.	207K bytes/sec.
Head technology	Stationary	Rotating drum
Recording method	Serpentine	Helical scan
Tape movement (wear/tear)	90 inches/sec.	0.32 inches/sec.
Data storage method	Analog	Digital
Media cost/100 MB (avg.)	\$25	\$1.20

### THE WRAP ANGLE



**Figure 1:** A DAT system's smaller wrap angle reduces friction during normal operation and prevents stretching of the tape during high-speed searches.

# One Word About Your Hard Disk Controller

# SLOW

# One Word About the PSI hyperSTORE Controllers

# FAST

## *Intelligent Mass Storage Controllers*

Virtually all applications are disk bound. Today's PCs have over 60 times the power of their ancestors of just ten years ago, while hard disk performance has only just tripled. This makes mass storage the PC's worst bottleneck. PSI has eliminated this bottleneck with the hyperSTORE Caching Disk Controller, a sort of mass storage co-processor. The hyperSTORE

does for disk-intensive programs what a math co-processor does for number-crunching software. Databases, file servers, multiuser systems, and other disk-hungry applications start screaming . . . frustrated users stop screaming! Call (800)486-FAST now to find out more about PSI's line of intelligent controllers. All you have to gain is time.

### **hyperSTORE FEATURE HIGHLIGHTS**

- Data access in 0.28ms or less at 3-4MB/sec
- Works in any 286, 386, or i486 system
- Simultaneously control any drive interface: *MFM, RLL, ESDI, SCSI, or AT/IDE*
- Controls up to 28 physical disk drives
- 0KB to 20MB of SIMM-based cache memory
- Supports all PC-based operating systems: *DOS, Windows, UNIX/Xenix, Netware, etc.*
- Data mirroring option for fault tolerance
- *NO DEVICE DRIVERS REQUIRED*

# PSI

**Perceptive Solutions, Inc.**

2700 Flora Street · Dallas, Texas 75201  
800-486-FAST · 214-954-1774 · Fax: 953-1774  
European Inquiries: 415-284-9505

"Normally, it's a bit hard to pick the most impressive item at Comdex [Spring 1990], . . . This time it was easy, . . . the hyperSTORE/1600."  
-Jerry Pournelle, *Byte Magazine*, September 1990

"PSI has created the power user's ultimate Lego set for disk controllers: the hyperSTORE/1600"  
-Alfred Poor, *PC Magazine*, June 12, 1990

"The real-world result will be blazing record handling from within a data file as well as unstopably fast program loads."  
-Bill O'Brien, *PC Magazine*, February 13, 1990

See PSI at COMDEX

©1990 by PSI. All rights reserved. hyperSTORE and the PSI logo are trademarks of Perceptive Solutions, Inc. Other brand and product names are trademarks or registered trademarks of their respective companies. Specifications are subject to change. · Ad Code: BY1090.

**RapidFACTS™ 1-900-776-3344 · Doc# 8101**  
Detailed specifications faxed directly to you 24 hours/day · \$4.95 billed to your phone

Circle 280 on Reader Service Card (RESELLERS: 281)

World Radio History



## REAL-TIME MULTITASKING KERNEL

8086/88, 80x86/88 80386  
Z80, 64180, 8080/85 68000/10/20

- Fast, reliable operation
- Compact and ROMable
- PC peripheral support
- DOS file access
- C language support
- Preemptive scheduler
- Time slicing available
- Configuration Builder
- Complete documentation
- Intertask messages
- Message exchanges
- Dynamic operations
  - task create/delete
  - task priorities
  - memory allocation
- Event Manager
- Semaphore Manager
- List Manager
- InSight™ Debugging Tool

### THE BEST

Join over 600 developers such as IBM®, Xerox, Hewlett Packard, Hayes, Hughes Aircraft and NASA.

### CHOOSE AMX

The best low-cost, high-performance real-time multitasking system available today.

**No Royalties**  
**Source Code Included**

Demo Disk \$25 US  
Manual only \$75 US  
AMX 86 \$3000 US  
(Shipping/handling extra)

Call for prices for other processors.

IBM is a registered trademark of IBM Corp.  
Z80 is a trademark of Zilog, Inc.  
AMX, AMX 86, InSight are trademarks of KADAK Products Ltd.

### KADAK Products Ltd.

206-1847 West Broadway  
Vancouver, B.C., Canada  
V6J 1Y5

Telephone: (604) 734-2796  
Fax: (604) 734-8114

The DAT system's narrower wrap angle confers another advantage over 4-mm tape systems: It prevents stretching of the tape during high-speed tape motion. That means file access can occur at 200 times the nominal read/write speed.

To obtain high-speed reads of the tape's file marks, DAT manufacturers now use a digital strobe at the beginning and end of each track. The technique is called *logical file marking*. This differs from the 8-mm system's file-marking method—an erased length of tape followed by a series of tracks. These *physical file marks* use up a lot of tape. In some cases, file marks can consume as much as 2 MB, so a 2.3-gigabyte 8-mm tape can end up with only about 1.8 gigabytes of data.

The 8-mm systems and 4-mm DAT systems also use different head arrangements (see figure 2): 8-mm drives have separate servo (positioning), read, and write heads. With 4-mm DAT drives, the servo heads are integral with the read and write heads. The latter scheme, which does not depend on mechanical alignment of servo and data heads, can better follow distorted tracks.

### DAT Standards

Two DAT recording methods now await ANSI approval. DDS (digital data storage) is a streaming method similar in operation to half-inch and quarter-inch tape drives that support the QIC command set. The other method is called DATA/DAT. Its features include fast sequential storage and high-speed file search with indexing. DATA/DAT also has a random-write mode that supports multiple (up to 254) partitions on a tape.

DDS does random reads, but not random writes. It's a bit faster than DATA/DAT, but it isn't designed for updating files in place. DATA/DAT, which supports block- or sector-oriented operations, does support partial updates.

### Forward Error Correction

Recording vast amounts of data on a tape of such large capacity requires superior error-detection methods. With a 1.2-gigabyte tape, the conventional error detection of one error in  $10^8$ , the usual with traditional drives, is unacceptable. Using read-after-write in conjunction with cyclic redundancy checks does not prevent the types of errors that only show up

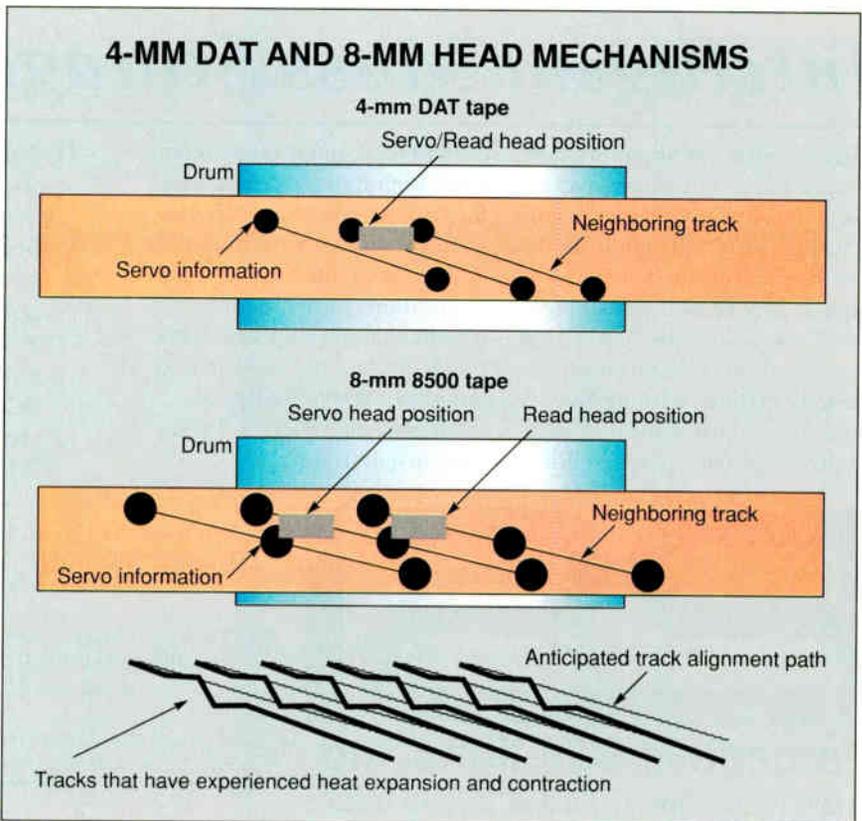


Figure 2: An 8-mm tape drive's separate servo and data heads can have trouble following distorted tracks. The 4-mm DAT drive's integrated servo and data heads track more faithfully.

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

## Announcing MathCAD 2.5: The Dawn of a New Age.

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

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

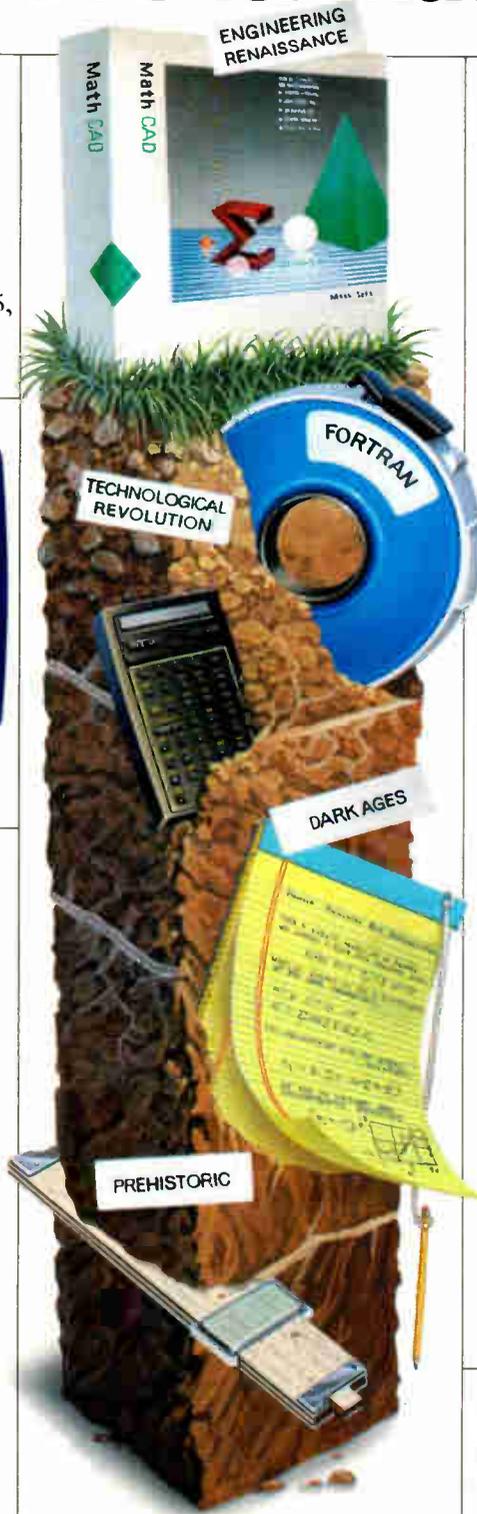


MathCAD 2.5 includes 3-D plotting, HPGL sketch import, and PostScript output.

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

And now there's MathCAD 2.5, a dramatically improved version that includes three-dimensional plotting, enhanced numerical analysis, PostScript® printer support, and HPGL file import from popular CAD programs like AutoCAD®.

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



analysis in presentation-quality documents.

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

No matter what kind of math you do, MathCAD 2.5 has a solution for you. In fact, it's used by over 90,000 engineers and scientists, including electrical, industrial, and mechanical engineers, physicists, biologists and economists.

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

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

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

Available for IBM® compatibles and Macintosh computers. Call for UNIX platform availability.

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

**UNIX  
version now  
available.**



March 14, 1989 issue.  
Best of '88  
Best of '87

# MathCAD®

MathSoft, Inc. 201 Broadway, Cambridge, MA 02139

when a tape is being read later, such as those produced by capstan flutter. Forward error correction (FEC), used only in DAT drives, reduces the error rate to one in  $10^{15}$  bits. To put it another way, there is only one error per 1,000,000 tapes.

The drive's electronics implement error correction using information from two correction layers on the tape. FEC can correct up to 640 consecutive bytes in a 4K-byte block. Older tape-recording methods, such as quarter-inch, cannot ensure this level of accuracy.

Both DDS and DATA/DAT use a technique that segments the data-recording track into two areas of the tape. Approximately 60 percent of each track is allocated to user data and error-correction coding. The remainder stores the automatic track-finding information used to keep the tape head centered on the track, along with saveset marks and file marks.

### Interleaving

Both DAT formats support interleaving, which prevents the stop/start phenomenon that occurs when a tape drive must stop its streaming operation because it must wait for the host to catch up. A DAT system supports interleaving by buffering data and by writing only complete groups of data while the tape is in continuous motion. This provides an economical way to use an entire tape from beginning to end without wasting start/stop time. Sophisticated DAT drives now contain "adaptive interleaving" that shortens the tape-repositioning time even more.

Although DDS and DATA/DAT have been introduced as separate standards, they will probably continue to coexist. Backup applications that don't require a quick file-restore feature can use the slightly faster DDS format. Applications requiring quick access to file marks and fast restore will use DATA/DAT.

### Modes of Access

DAT systems support three modes of access: streaming, random, and update-in-place. With streaming access, you append data onto a tape. To change a file, you write a complete new version; all previous versions of the file remain on the tape. The partition, or tape, does not require preformatting, and no spare groups are provided.

With random file access, you can locate any file on a 1- or 2-gigabyte tape in less than 60 seconds. A DAT system, uniquely, does this in a way that emulates a standard block device, such as a floppy or hard disk drive. A tape, or a subportion of a tape called a partition, must be preformatted. The formatted tape (or partition), now called a data group, can be overwritten, or refreshed, without the need to change other sections of the tape. Note that 4-mm DAT storage devices can do random reads (as opposed to random writes) in all three modes of access.

The update-in-place mode is the most advanced form of the random-access technology. In this mode, data access is a combination of both the random- and sequential-access methods. Append and overwrite capabilities are both provided,

but no preformatting is required. Instead, formatting is done "on the fly" by allocating spare groups at set intervals. This method of dynamically formatting and altering files increases data transfer rates with random writes, while simultaneously maintaining areas of the tape with streaming compactness, where needed.

### DAT's Bright Future

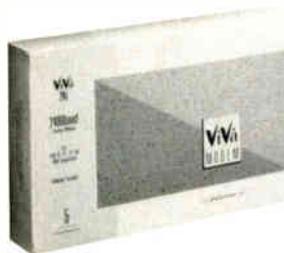
With primary disk storage growing at a precipitous rate, DAT technology offers a fast, reliable way to keep those big disks safely backed up. It can be useful in other ways, too. With a DAT system's random-access and update-in-place capability, you might want to keep primary storage uncongested by off-loading certain files (e.g., images) to tape. That scenario would require more sophisticated application software than is available for DAT systems today, but it's entirely feasible.

A DAT system offers a higher level of reliability and data integrity than its analog predecessors. Already more than 15,000 DAT drives are installed in Europe and the U.S. The technology requires little training. If you're responsible for large quantities of data, you'll probably soon be saving that data on a DAT. ■

*Karina Lion is executive director of public relations and corporate communications for GigaTrend. She holds a B.B.A. degree from George Washington University. She can be reached on BIX c/o "editors."*

# ViVa 2400 baud Modems

**FAX It - Compress It - Send It with ViVa!**



The ViVa 24, 24fx and 24m external modems expand your world with standard 2400 baud transmission rate, built-in FAX capability, or MNP 5 data compression.

All ViVa internal and external modems are 100% Hayes compatible and support the Hayes "AT" Command Set.

ViVa modems fit easily into your IBM PC, XT, AT, PS/2, 386, 486 and IBM compatibles and each is backed by a FIVE YEAR WARRANTY. **1-800-854-7600**

**COMPUTER PERIPHERALS, INC.**

667 Rancho Conejo Blvd. • Newbury Park,  
California 91320 • 805-499-5751

Circle 77 on Reader Service Card



# A Complete 386™-33 MHz Cache System For Under \$2,000.



Finally, you can afford to put the fastest 386™ computer at your fingertips to enjoy the performance that once only belonged to the ranks of File Servers, Multi-user host Computers and CAD/CAM/CAE Workstations.

Other manufacturers with their simple-minded direct-mapped Cache architectures were obsessed with churning out the best benchmark numbers. We, however, were not convinced DOS and Power Meter 1.3 is any example of a typical real life application (registering at 8.003 MIPS, we are not too shabby either). With Two-Way Set Associative Cache capability, our 386™ is also more attuned to run the emerging multi-tasking operating systems like OS/2® and UNIX™, where modular code

sizes (of less than 32K) and frequent code-switching are norms. Worrying about compatibility? Both IBM® and COMPAQ® endorsed the same INTEL® 82385 Cache Controller. Furthermore, we enhanced it with page-mode and interleaved memory in the event of a cache miss. It is the closest to a true 0-wait-state implementation on the market.

**Nobody does it better, Nobody!**

## MIS 386™-33MHz STANDARD

- 1MB 80NS RAM
- 32K 25NS SRAM CACHE
- INTEL®/WEITEK® MATH CO-PROCESSOR SOCKET
- TEAC® 5.25" 1.2MB FLOPPY DRIVE
- TEAC® 3.5" 1.44MB FLOPPY DRIVE
- 43MB 28MS AT HARD DISK DRIVE
- 2 SERIAL, 1 PARALLEL AND 1 GAME PORTS
- MGP ADAPTER
- SAMSUNG® 12" AMBER MONITOR
- MICROSOFT® COMPATIBLE SERIAL MOUSE
- NMB® 101-KEY ENHANCED KEYBOARD
- DESKTOP CASE WITH FIVE DRIVE BAYS
- 220W POWER SUPPLY
- ONE YEAR PARTS AND LABOR WARRANTY
- 30-DAY MONEY BACK GUARANTEE

**\$1,995**

386-25MHz STANDARD System w/ 32K Cache	\$1,845
386-25MHz STANDARD System (Non-Cache)	\$1,595
386SX-16MHz STANDARD System	\$1,145
286-12MHz STANDARD System	\$ 945
486-25MHz STANDARD System w/ 64K Ext. Cache	\$3,795

VGA (640x480) Upgrade	Add	\$ 360
P-VGA (1024x768) Upgrade	Add	\$ 500
80MB/212MB Hard Drive Upgrade	Add	\$250/750
4MB RAM Upgrade	Add	\$ 300
64K Cache Upgrade (386-25/33 MHz)	Add	\$ 120
Vertical Case	Add	\$ 150
Mini Vertical Case	Add	\$ 75
CALL FOR ADDITIONAL UPGRADE OPTIONS		

## MIS Computer Systems

P.O. Box 70897 Sunnyvale, CA 94086-0897

**Order Now**

**1-800-733-9188**

Office Hours: M-F 9:00 am-6:00 pm Pacific Time



Prices and terms are subject to change without notice. 30 days money back does not include shipping charge. CA residents add appropriate sales tax. No surcharge on credit card purchases. Personal and company checks require 2 wks clearance. All names mentioned are registered trademarks of their respective companies.

Circle 229 on Reader Service Card (RESELLERS: 230)

World Radio History

# 1,000 Words On Quality.



See the picture of quality for yourself. Discover the unsurpassed picture crispness, brilliance, and infinite range of color of the CTX monitors.

Compare the superlative quality with the rest. Then check the affordable prices.

1,000 words won't do it justice.

Available from CTX is a full range of powerful 14" color monitors: from the top-of-the-line Multiscan to a Super VGA and Deluxe and Standard VGAs as well as EGAs and CGAs.

	Multiscan	Super VGA	Deluxe VGA	Standard VGA
Model	3436	5468	5432	5439
Resolution	1024x768	1024x768	640x480	640x480
Horiz. Freq.	15.75-38 KHz	30-38 KHz	31.5 KHz	31.5 KHz
CRT Dot Pitch	.28 mm	.28 mm	.29 mm	.39 mm

Add to all these features complete IBM and Macintosh compatibility, handy up-front controls, non-glare direct etch screens, detachable tilt/swivel bases, and reliable nationwide servicing, and you will agree that the CTX monitors are the best deal available on the market.



WHERE MONITORS ARE CTXELLENT



- Technological Excellence.
- Unbeatable Performance.
- Exceptional Pricing.

For a real picture of quality, see your local CTX dealer or contact:

**CTX INTERNATIONAL, INC.**  
161 Commerce Way, Walnut, CA 91789  
714/595-6146, FAX 714/595-6293

**CTX SOUTH, INC.**  
6090-F Northbelt Parkway, Norcross, GA 30071  
404/729-8909, Fax 404/729-8805

Factory:  
**CHUNTEX ELECTRONIC CO., LTD.**  
6F, No. 2, Alley 6, Lane 235, Pao Chiao Rd.  
Hsin Tien, 23115 Taipei Hsien, Taiwan, R.O.C.  
886-2-9175055, Fax 886-2-9172736

Watch for CTX's new 17" and 21" Large Screen Displays coming soon.

IBM is a registered trade mark of International Business Machines. Macintosh is a registered trade mark of Apple Computer, Inc.

Circle 91 on Reader Service Card (RESELLERS: 92)

# Getting Your Byte's Worth

*Hardware-based data compression is transparent and automatically compresses everything you store*

*Steven J. Vaughan-Nichols*

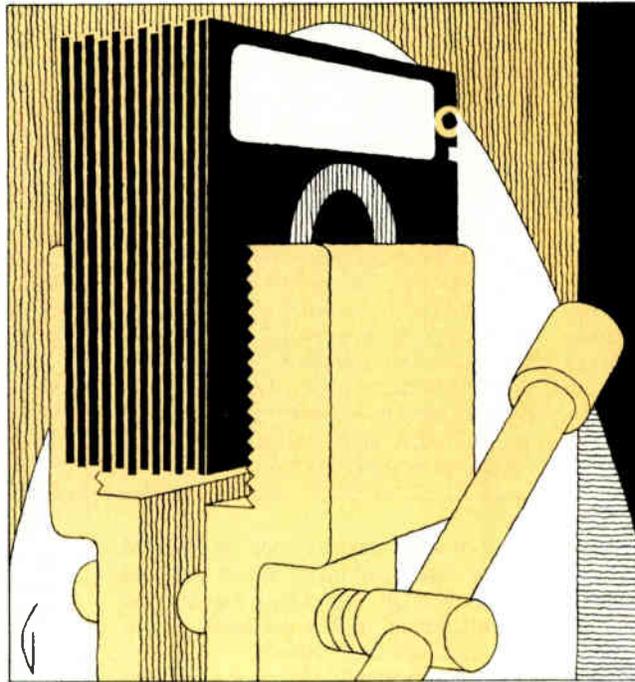
**S**ixty megabytes of files on a 40-MB disk! And 120 MB of data packed onto an 80-MB tape, with faster access time to boot. You can squeeze more data onto a disk or tape than you might think.

More than ever, mass storage devices are bursting at the seams. Hard disk drives routinely come in sizes of over 100 MB, and some tapes can hold over a gigabyte of information. Even so, the number and size of files continue to outstrip storage capacities.

Data compression is one solution. You may think of that as a software solution (see the text box "Software Solutions" on page 332), involving the selective compression of individual data files. However, hardware solutions also exist. Hardware data compression is transparent and automatically compresses everything you store. Often, these techniques are embedded in hard disk and tape drive controllers.

## **A Gigabyte for QIC**

The most notable successes for hardware data compression have come in the realm of quarter-inch tape drives. For several years, the popular quarter-inch cartridge (QIC) format could hold no more than



320 MB of storage. Recent advances in data-compression and tape-length technology, however, have made it possible for these cartridges to hold over a gigabyte of information.

With this boost in capacity, QIC technology is emerging as a serious choice for *any* backup job. Within the next year, gigabyte-plus QIC drives will begin appearing. Then, QIC can be considered

not just for single-user systems, but also for LAN backups and even mainframe and minicomputer backups.

In the forefront of this technology is Stac Electronics. Its product, the StacPack 9703 data-compression chip, has become a market leader in this developing field. Indeed, the QIC Standards Committee has declared Stac's hardware-compression algorithm a standard: QIC-122.

But there are standards, and then there are standards. Many tape backup firms have hesitated to use the Stac chip. They are, understandably, concerned about backing the wrong horse in what is turning into a four-way race of competing data-compression chips.

Advanced Hardware Architectures, InfoChip Systems, and Hewlett-Packard

have also thrown their hats into the ring. Unfortunately, their chips are completely incompatible with each other. Isn't that just what you need—another compatibility question to worry about? However, it hasn't stopped some companies from leaping into the fray.

Colorado Memory Systems, a leading supplier of QIC tape drives, adopted Stac's data-compression algorithm

## Software Solutions

There's more than one way to compress data. Currently, the most popular method is to use a shareware or public domain file-compression program. You have several choices if you decide to go this route (see "Saving Space" in the March BYTE).

Now, as then, PKzip from PKware is your best choice. The program, now up to version 1.10, continues to stand out in both speed and efficiency. In addition, you can now view zipped files and manipulate them with popular commercial programs, such as Lotus's Magellan.

The popular LHarc 1.13 excels at data compression, but you can feel yourself growing gray as you wait for it to complete a job. There have been rumors that a turbocharged LHarc is in the offing, but so far I haven't seen any sign of it. The other popular programs, PAK, ARC, and Zoo, remain unchanged.

### Software Pluses . . .

There are several advantages to using file-compression software. Foremost among them is that you have much more control over which files will be compressed. If you only want to slim down data files, like databases and spreadsheets, you can arrange to do that. You can leave executable files untouched.

Another point in favor of this software is that you can use most compression formats on a range of operating systems. Zoo 2.01, its source code freely available, has been ported to every modern operating system. Unofficial, but effective, compression programs allow you to use LHarc's LZH, PKzip's Zip, and SEA's ARC files on Unix,

VAX/VMS, AmigaDOS, and Macintosh systems.

Hiding behind this advantage is another one. Data that has been squeezed down by a chip must be expanded by the same kind of chip. This can make transferring information from one system to another impossible. That may be exactly what you want for security reasons. On the other hand, it could be a major obstacle if your office uses several different tape-backup systems. Software data compression avoids all this.

There is one other factor that you should not overlook: money. None of these programs costs more than \$100, and Zoo is free. If you're willing to take the time to manage your burgeoning file collection, you can't beat the price.

### . . . and Minuses

That's the good news. The bad news is that, compared to hardware compression, these programs are as slow as mud. They all normally use a disk as a scratchpad for their temporary files. This performance shackle ensures that they will always lag behind pure hardware data-compression implementations.

There's more. Compression routines that do their work in hardware are invisible. You may never even know that your files are being reduced in size. But you'd never make that mistake using data-compression software. One thing they all have in common is their painful command-line interfaces. The only way to make them palatable to many people is to use a shell program like California Software Design's Shez 5.6.

before it had even made the move from software to silicon. In 1989, the company adopted Stac's algorithm in its software for the Jumbo tape line.

This option enables you to increase the backup capacity of the QICs by approximately 50 percent. This increase, in turn, drops media costs to well under 50 cents a megabyte for the frequently used DC-2000 40-MB QIC drive. In addition, increased production has continued to force the price of QIC drives down.

Even with the additional price of the Turbo-Compression data-compression board, these reductions push system prices per megabyte to well under \$10. Coupled with the increased capacity of

mass storage devices such as WORM (write once, read many times) and hard disk drives, QIC drives have thus become affordable and highly desirable options on even single-user systems.

Data throughput, always a sore point when making backups, has also improved. The 9703 chip can, in theory, slim down input data at a rate of 750K bytes per second. More impressively, the chip can expand data to full size at up to 5 MB per second.

In practice, mechanical and data-path size considerations drop the overall system performance considerably. Even so, there's an impressive increase in speed when you use a QIC-40-compatible tape

## Advertisement AUTOMATING ON A SHOESTRING

By Julie R. Caruso



Automating an office on a budget is a common challenge businesses face. The project can be particularly difficult when the company doesn't have the money to replace a diverse base of equipment and software that

has been purchased randomly throughout its history, and needs to incorporate these resources into an integrated, smoothly functioning network.

A case in point is the automation of the Fulton County Planning and Economic Development Department in Atlanta, GA. Faced with a limited budget, an odd assortment of computer brands and models, a need to connect four individual departments with 30 users located in two buildings, and a growth plan that demanded a doubling of the initial network solution within a one year period, the County set to work finding the best solution.

"Our major concern was to be able to link all the existing, yet different, types of personal computers, future add-on personal computers, and dumb terminals into a cost-effective system," said Dr. June Woodward, who, as Director of the Georgia Systems Development and Technical Systems Department, oversaw the project.

Woodward turned to National A. I. Lab, Inc., an Atlanta-based national distributor of network solutions, for help. After carefully assessing the County's needs, Jim Williamson, president of National A. I. Lab, recommended a "hybrid" system that combined both shared and distributed processing using PC-MOS and LANLink 5X, both products from The Software Link.

"By combining both types of technology using products that are compatible with the broad base of hardware and software that the county already had in place, we gave them a solution that didn't cost a lot of money and allows the expansion they require," said Williamson.

In fact, the system cost more than \$200,000 less than other alternatives the county considered. In three years the network has grown from supporting 30 users to serving more than 104 users through a combination of PC-MOS, LANLink and Novell's NetWare.

"In addition to saving us money, our network has dramatically increased our productivity," said Dr. Woodward. Our word processing capacity has increased by more than 200 percent, and we're doing much more of our work by computer because the network is accessible to everyone who needs it."

Julie Caruso is Managing Director and Director of Sales and Marketing for The Software Link, Inc.

# PC-MOS

## The Multi-User Solution For The Multi-Dimensional Company

Odds are, you're part of a multi-faceted organization, one that's involved in many different projects and activities. Every day you juggle dozens of tasks. So why are your PCs still doing one thing at a time — for one person at a time?

Today's 286 and 386-based PCs provide the power to do much more. PC-MOS is the multi-user, multi-tasking software that unleashes that power, making your PCs as multi-dimensional as your business.

### Minicomputer Power For The Cost Of A PC!

PC-MOS lets several users simultaneously run different programs on a single, high-performance PC. One user can run a spreadsheet, while another uses the word processor and several others access a database — all at the same time! So instead of replicating expensive PCs, each user has an inexpensive monitor or terminal. The benefits are lower cost, more control, better security and consistency across applications. And at \$595 for a 5-user version, you can afford to get started today!

### DOS Compatibility, NetWare Connectivity

PC-MOS lets users run the popular DOS programs they use now — even Microsoft® Windows 286. Our gateway to NetWare lets you expand your Novell

network inexpensively and easily. And PC-MOS requires no expensive wiring, and no network management headaches.

### Proven Reliable With 100,000+ Users

Because PC-MOS was the first DOS-compatible multi-user operating system, it offers broad compatibility and the reliability of time-tested software. More than 100,000 satisfied users trust their work to PC-MOS each day. Our latest version features an easy-to-use install program, lets you re-boot individual workstations, and supports high-resolution, bit-mapped color graphics.

Call us today. We'll show you how to add multiple dimensions to your PC.



**THE SOFTWARE LINK**

3577 Parkway Lane, Norcross, GA 30092

1-800-451-LINK, (404) 448-5465

FAX: (404) 263-6474 TELEX: 4996147 SWLINK

Circle 346 on Reader Service Card (RESELLERS: 347)

**VARs and RESELLERS:**  
Ask about our Sales Support Program

GSA Schedule/GSOOK 89 AGS6448

PC-MOS is a trademark of The Software Link. All other products referenced are trademarks of their respective companies. Prices and policies subject to change without notice.



## A One-Sweep Approach

A typical example of the marriage of data compression and primary storage technology can be seen in Hewlett-Packard's half-inch reel-to-reel streaming 7980XC tape drive. When using the 6250 GCR tape format, this drive uses a real-time data-compression engine and a "superblocking" packing process to achieve data-compression ratios that average better than 2 to 1.

The 7980XC accomplishes this by allying two different components. The first is the integrated circuitry that contains the data-compression engine. This subsystem catches data as it goes back and forth from the disk interface and the tape-cache buffers. Having captured the data, it then compresses and decompresses it on the fly.

The algorithm that actually does the work appears to be based on a public-domain version of the Lempel-Ziv algorithm. That isn't surprising. Most data-compression schemes owe a debt to this algorithm and its close relative, Lempel-Ziv-Welch. Hewlett-Packard's enhancement to the basic theory was to modify the contents of the data dictionary. This makes an algorithm that gives good compression results, no matter how many data types it tackles in a single session.

### Removing Redundancy

As with all compression algorithms, the key to success is the removal of data redundancy. That's more easily said than done. The Hewlett-Packard program encodes patterns that are found in the input stream. When a unique data string

comes along, it's placed in a dictionary. The string can be any kind of data, from ASCII to imaging data.

The dictionary contains records with two elements. The first field contains a unique string, and the second holds a code word that represents the string. This dictionary is made up of 4096 record positions and must be initialized before data compression begins.

The first eight locations in the dictionary are reserved for control flags. The next 256 positions are assigned a value range from 0 to 255. These represent the familiar ASCII characters. The remaining 3832 entries are set aside to hold unique strings. As the program fills these entries, it link-lists the other entries in the dictionary to them. The records always end with a pointer to the records that contain the ASCII values.

The program searches the dictionary for matching strings as data is input. If it can't find a match, it enters the data string into the dictionary and assigns it a code word. These code words are output to the mass storage device, where they make up the building blocks of the compressed file. They are 9 to 12 bits long, depending on the record's position in the dictionary. If the record already exists, the program replaces the data string with the code word of the corresponding record. The program gives unique strings 12-bit-long code words after it fills all 4096 slots of the dictionary.

At the beginning of the compression cycle, the program doesn't compress data. In fact, the data stream actually

increases in size at first, because the first few 8-bit words are replaced by 9-bit codes. As the dictionary fills with multicharacter sequences, the 9- to 12-bit-long code words begin to represent character strings that are at least 16 bits long. An example should make this process clearer.

The word *cat* is input as part of a data stream. The program searches for the first byte, *c*, in the dictionary. It's found in the ASCII character set. Since a match has occurred, the next byte, *a*, is added to the string. Then the program searches for the string *ca*. If it doesn't find *ca*, it makes a new entry in the dictionary for the unique string. The program sends out the code word for the longest string that was matched before the new dictionary entry was made. In this case, the 9-bit code word for *c* is output.

Then, the program drops the first byte from the search string, and the hunt begins for the character *a*. It's also found among the ASCII characters. The program adds the next input byte and looks for the string *at*. If it finds *at* in the dictionary, it adds the next byte, and then the entire search procedure begins again.

In the event that the new search string isn't found, the program makes a new dictionary entry and exports the code word for the longest string that was previously found, *at*, to the tape drive. In this case, a 9-bit code word now resides in the place of the 16-bit string *at*. Data compression has begun.

The program doesn't attempt to scan

in a Jumbo Plus system. Backup times are cut almost in half as the throughput increases from 2.3 MB per minute to 4.5 MB per minute. Colorado Memory Systems claims even better gains when using the drive with higher-capacity tapes.

These performance improvements haven't been lost on other vendors in the field. Tandberg Data A/S is planning to add the Stac chip to its line of tape drive controllers. Archive, the largest QIC drive vendor, has also jumped on the Stac bandwagon. Its product, expected by the end of this year, is named the Viper 2650. This drive will use QIC-525 tapes to store up to a gigabyte of data with an effective throughput of 500K bytes per second.

### DAT: Gigabytes for Gigabucks

It's clear that by 1991 every important QIC drive will sport data-compression technology. That doesn't mean that QIC will rule the personal computer backup world, though. Digital-audiotape (DAT) drives that use hardware data compression to good effect are also on their way.

The first DAT competitor to see the light of day will be a 2.5-gigabyte 4-mm DAT drive, the TurboDAT, from GigaTrend. Stac's ubiquitous 9703 chip powers this SCSI device as well, but it's more than just another platform. The engineers of GigaTape GmbH, the German parent company of GigaTrend, have added several features to the drive.

One of the most important of these

features is the use of logical file marks, which lets you store more data on a DAT than older file-storage schemes allowed. This and other enhancements have brought random-file-access speeds down to 60 seconds or less.

Archive has joined forces with Hewlett-Packard to work on producing a compression-capable DAT drive. This device is still in the development stage. It will be based on a variation of HP's DCLZ algorithm. HP already successfully uses this algorithm in its half-inch reel-to-reel 7980XC tape drive compression coprocessor. (See the text box "A One-Sweep Approach" above.)

Peripheral Vision, a data-storage newcomer, is introducing the 4Sight series of

the data before building the dictionary to determine which strings occur more frequently than others. The statistics of data redundancy indicate that you can achieve good compression performance even with a 4K-byte dictionary. A larger dictionary or a sophisticated data-analysis scan could increase data-compression efficiency, but it would slow down the operation. This one-sweep approach is at the heart of today's speedy hardware data compression.

Clearly, what would prove a good compression dictionary for one kind of file would not serve as well for another. To ensure maximum performance, the engineers at Hewlett-Packard have programmed the chip to reset the dictionary frequently.

This approach has two points in its favor. The most important is that it forces the dictionary to adapt to changes in the current data stream. The second is that the code-word length for the most recent repeating patterns will be set to 9 bits.

In other words, the algorithm is always trying to get the highest possible theoretical compression without wasting the time involved in analyzing the data and then operating on it. But the method isn't perfect. By resetting the dictionary every time  $x$  number of kilobytes have been processed, performance suffers when the nature of the data stream doesn't change.

### Three Systems on a Chip

Originally, Hewlett-Packard coded the algorithm and proved it successful in Pascal. From there, it was ported to a proprietary integrated chip. The company then made several changes to ensure that the implemented algorithm

could deal with the high-speed throughput required of a tape drive controller.

In the hardware version of the program, the dictionary is created in a 23-bit-wide static RAM bank. While it might seem that the dictionary could get by on only 4K bytes of RAM, it really needs more. This extra space handles data collisions that occur while building the dictionary. Still, the Hewlett-Packard algorithm requires far less space than many other schemes.

A single VLSI chip contains all the necessary programs and work space. This chip does both the compression and decompression processes, but it can only do one at a time. Hewlett-Packard heightened the chip's efficiency by dividing it into three semi-autonomous systems: the input/output converter, the compression and decompression converter, and the microprocessor interface. Each section operates independently of the others for the most part. Thus, the chip can maintain a high performance level even with changes in the throughput speed.

Compression and decompression are closely bonded in this algorithm. Unlike such algorithms as Huffman coding, the data dictionary is an integral part of the compressed data. As such, the program must re-create it every time it needs to decompress a data set.

While this process yields additional space savings, it also means that decompression can start at only a few specific points in the data. It would be almost impossible, for instance, to translate a fragment of a compressed file into its original form. In practical terms, this means that data can be decompressed only when it is presented in proper order to the decompression hardware.

4-mm DAT drives. These drives are supposed to raise the capacity of a 1.3-gigabyte cartridge by almost 300 percent, to 5 gigabytes. The company says that data throughput also increases by almost the same measure, from about 180K bytes per second to 700K bytes per second.

The 4Sight 4-mm drive is not directly connected to the computer. Instead, the compression device serves as a bridge between the tape system and the host. The compression system, which has its own housing, is connected to the drive and the computer by a SCSI. From the viewpoint of the host, the 4Sight DAT drive is just another SCSI tape drive. Several VLSI chips, controlled by an integral microprocessor, manipulate the data once it

arrives at the device.

The actual data compression (or decompression) occurs in a 128K-byte static RAM buffer. The data is then passed on, via a second SCSI, to the drive itself. If you wish, you can switch data compression off so that other devices can read its tapes. I expect this to become a standard option on all these systems. Versatility demands it. If this option isn't available, you may want to think twice before buying such a device.

DAT drives have several obstacles to overcome, however, before they appear on every desktop. The chief obstacle is a lack of consensus on DAT formats. GigaTrend and several other major companies support the Data/DAT format. Others,

including Hewlett-Packard, back the DDS (digital data storage) format.

While Data/DAT is technically superior—it enables both random reads and writes while DDS permits only random reads—that doesn't mean it will be the winner. If you consider the number of Beta VCRs sold last year versus the number of VHS VCRs, it's obvious that technical superiority is not the only criterion.

And DAT drives are far more expensive than QIC devices. In fact, the pocketbook blues may slow down DAT market penetration more than anything else and thus put the brakes on any DAT standardization efforts.

### Spare Room on Your Hard Disk

Data compression on backup devices is all well and good, but what you really want is something that will give you more room on your hard disk. Several products have tried to meet this demand, and, sad to say, without exception, they've all crashed and burned.

Contrary to popular opinion, data-compression and error-correction issues were not the culprits. The devices that have come and gone have floundered on the rocks of system integration. Every operating system has its own way of addressing random-access devices. Fitting compression and decompression routines between such structures as the DOS file allocation tables (FATs) and the system BIOS is a difficult task. For instance, a file compressor could allow a logical drive to contain more than the 32 MB of files MS-DOS 3.x can recognize. New hardware systems may finally manage to fly past these hurdles.

InfoChip Systems' Disk Expander is a half-length card that offers transparent compression and decompression under DOS 3.x. While its proven IC-105 compression coprocessor can work with any mass storage device, the Disk Expander board has been optimized for disk drives.

Part of this optimization involves the use of what InfoChip calls "lossless" or "noiseless" data compression. This recording methodology uses proprietary algorithms to ensure that no errors creep in during the compression (or decompression) cycle. That may sound like wishful thinking, but it's not.

InfoChip's error-free processing is based solidly on the pioneering work of information theorist and computer scientist Claude Shannon. Information loss, often feared in data compression, is actually extremely rare due to successful implementations of the Reed-Solomon error-correction algorithm. InfoChip has taken a different road from that of

other companies, one that should lead to even more reliable data compression.

A software driver bridges the gap between the operating system and the hardware interface. It maps compressed files to the DOS FAT and intercepts all operating-system and applications calls to the drive. This software bridge is necessary because the minimal storage unit under InfoChip is the cluster.

True random block read and write operations will go much more easily than

when you try to work with a file-based system. This means that an unaugmented DOS will be unable to use a disk partition under the Disk Expander. However, this may not be a major objection.

InfoChip's president, Dr. Kai P. Yiu, has stated that his company's aim is to produce a bootable drive that any normal DOS application can run on. If you don't want to put all your eggs in one basket, Disk Expander lets you have both compressed and uncompressed partitions.

You will need a separate driver for every operating system you use (and their major variants). First to be released will be the MS-DOS 3.x driver. The beta version takes up about 27K bytes of conventional memory. It will work with most conventional interfaces—ST506, ESDI, and SCSI—with one exception: It won't work on Micro Channel PCs. Other drivers for DOS 4.x and Micro Channel systems are under development.

Stac Electronics is also working on a card to bring in-line data compression to hard disks. This product is intended to compete directly with the InfoChip board. Stac is taking its time with this project, and no release date has been set.

Stac also plans to use the device driver approach, but the company has bigger things in mind than drivers. Stac's method includes a restructuring of the MS-DOS FAT and other low-level data organization structures. The driver will not cover the ground between the FAT and the compressed files, but rather the territory between the file organization and the operating system and applications.

It's a tall order, but Stac seems up to the challenge. To quote Gary Clow, president of the company, "We're being very cautious and spending a lot of time and effort in the quality-assurance area and compatibly testing before even announcing the product." Stac plans for its driver to be compatible with DOS 3.x and 4.x and the Windows 3.0 environment.

### Cutting Its Teeth

The promise of data-compression firmware and hardware is bright. Graphical user interfaces demand data-storage and transmission rates that challenge even the biggest and fastest products of conventional data storage. Multimedia has data requirements that dwarf anything ever attempted on a microcomputer.

The first generation of transparent data-compression devices has arrived in the nick of time. It may have teething problems, but there will be integral data-compression chips, on either a board or a drive, working in microcomputers within the next year. High-end-computer users won't be able to live without them. LAN managers and Unix administrators in the microcomputer world would kill for data-compression benefits now. Hardware data compression can't come a moment too soon. ■

*Steven J. Vaughan-Nichols is a programmer/analyst for Bendix Field Engineering Corp. (Seabrook, MD) supporting NASA communications. He can be reached on BIX as "sjvn."*

## QIC 'n Easy Access to all your Data Everytime

AS/400  
Sys 36/38  
Apollo  
Everex  
Sun  
Sytos  
UNIX



Lotus 123  
DBASE  
Mail Merge  
Secure Data  
Duplication  
XENIX  
UNIX

The QICPAK family provides unique facilities to access 1/4" (QIC) data cartridges created on a wide range of Micros, Minis and Mid-Range Systems using your PC. This gives you a secure, low cost, fast and high capacity alternative.

QICPAK's facilities cover all aspects of cartridge processing, including:

- Extracting data directly from the cartridge into packages such as Lotus 123 or DBASE or for use in Mail Merge applications.
- Data files can be extracted by QICPAK from cartridges recorded on many systems, including: IBM System 36/38, IBM AS/400, IBM PC-RT, Apollo, Everex, Maynard, Mountain, Sun, Sytos, UNIX and XENIX systems etc.
- QICPAK's High Speed Cartridge Duplication gives complete in-house control.
- QICPAK's Backup & Restore facilities are UNIX tar compatible
- Custom applications, eg recorded information may be protected from unwanted access providing secure interchange of your confidential information.
- Source in Microsoft & Turbo C, Turbo Pascal and BASIC is provided.

We provide both QICPAK Kits for use with existing 1/4" cartridge drives and also complete internal & external solutions. Support is by the developers.

Access & Visa Accepted

# VOGON

VOGON ENTERPRISES LIMITED

94 Easthampstead Road, Wokingham,  
Berkshire RG11 2JD

Tel: (0734) 784511/890042 Fax: (0734) 890040



# Technology that stands the test of time

See us at  
**COMDEX/Fall '90**  
November 12-16, 1990  
Las Vegas, Nevada



For over 40 years now Sankyo have been supplying the world with motors (currently 150 million a year in fact), magnetic heads, card readers and industrial robots of outstanding technical excellence.

It's true we've been around a long time. But in all that time we've never once rested on our laurels.

Instead we've always aimed to push the boundaries of technology and design still further.

Something that's especially true of our approach to the tape drive market.



Sankyo tape drives offer state-of-the-art design and unrivalled reliability.

Each drive is fully enclosed, has a direct drive motor, a door for media

protection and modern design head mechanism.

And as well as the Sankyo 150Mb and 525Mb tape drives, we also provide sub-systems for PC applications.

Indeed, what is true of our tape drives is true of Sankyo.

Technology that stands the test of time, backed by service of a quality to match.

To find out more, contact Roger Kirkland, Telephone: (44) 628 810260 or Fax: (44) 628 819435



**Sankyo**  
Tape Drive Products

PERFECTION THAT ONLY COMES WITH TIME

Circle 306 on Reader Service Card

## Masses of Storage

*For more information on the products and companies mentioned in this State of the Art section, contact the companies and organizations listed below.*

**Archive Corp.**  
1650 Sunflower Ave.  
Costa Mesa, CA 92626  
(714) 641-1230  
**Inquiry 1226.**

**California Software Design**  
P.O. Box 15248  
Santa Rosa, CA 95402  
(no phone listed)  
**Inquiry 1227.**

**Canon U.S.A., Inc.**  
One Canon Plaza  
Lake Success, NY  
11042  
(516) 488-6700  
**Inquiry 1228.**

**Carlisle Memory Products Group, Inc.**  
6625 Industrial Park Blvd.  
North Richland Hills, TX 76180  
(800) 334-8273  
(817) 281-9450  
**Inquiry 1229.**

**Cipher Data Products, Inc.**  
10101 Old Grove Rd.  
San Diego, CA 92131  
(800) 424-7437  
(619) 578-9100  
**Inquiry 1230.**

**Colorado Memory Systems, Inc.**  
800 South Taft Ave.  
Loveland, CO 80537  
(800) 432-5858  
(303) 669-8000  
**Inquiry 1231.**

**Compaq Computer Corp.**  
P.O. Box 692000  
Houston, TX 77269  
(800) 231-0900  
**Inquiry 1232.**

**Energy Conversion Devices, Inc.**  
1675 West Maple Rd.  
Troy, MI 48084  
(313) 280-1900  
**Inquiry 1233.**

**Exabyte Corp.**  
1685 38th St.  
Boulder, CO 80301  
(303) 442-4333  
**Inquiry 1234.**

**Fujitsu America, Inc.**  
3055 Orchard Ave.  
San Jose, CA 95134  
(408) 432-1300  
**Inquiry 1235.**

**Gigatek, Inc.**  
1989 Palomar Oaks Way,  
Suite A  
La Costa, CA 92009  
(619) 438-9010  
**Inquiry 1236.**

**GigaTrend, Inc.**  
2234 Rutherford Rd.  
Carlsbad, CA 92008  
(619) 931-9122  
**Inquiry 1237.**

**Hewlett-Packard Co.**  
3000 Hanover St.  
Palo Alto, CA 94304  
(415) 857-1501  
**Inquiry 1238.**

**Hitachi America, Ltd.**  
50 Prospect Ave.  
Tarrytown, NY 10591  
(914) 332-5800  
**Inquiry 1239.**

**IBM**  
Old Orchard Road  
Armonk, NY 10504  
(914) 765-1900  
**Inquiry 1240.**

**InfoChip Systems, Inc.**  
2840 San Tomas Expy.,  
Suite 200  
Santa Clara, CA 95051  
(408) 727-0514  
**Inquiry 1241.**

**Intel Corp.**  
3065 Bowers Ave.  
Santa Clara, CA 95051  
(408) 765-8080  
**Inquiry 1242.**

**JVC Information Products Co. of America**  
2903 Bunker Hill Lane  
Santa Clara, CA 95054  
(408) 988-7506  
**Inquiry 1243.**

**Laser Magnetic Storage International Co.**  
4425 Arrowswest Dr.  
Colorado Springs, CO  
80907  
(719) 593-7900  
**Inquiry 1244.**

**Maxoptix Corp.**  
2520 Junction Ave.  
San Jose, CA 95134  
(408) 954-9700  
**Inquiry 1245.**

**Maxtor Corp.**  
211 River Oaks Pkwy.  
San Jose, CA 95134  
(408) 432-1700  
**Inquiry 1246.**

**MCC**  
3500 West Balcones  
Center Dr.  
Austin, TX 78759  
(512) 343-0978  
**Inquiry 1247.**

**Microsoft Corp.**  
1 Microsoft Way  
Redmond, WA 98052  
(800) 426-9400  
(206) 882-8080  
**Inquiry 1248.**

**Mitsui Petrochemical Industries**  
LightStore Co.  
1825 South Grant St.,  
Suite 550  
San Mateo, CA 94402  
(415) 572-2333  
**Inquiry 1249.**

**Mitsumi Electronics Corp.**  
35 Pinelawn Rd.  
Melville, NY 11747  
(516) 752-7730  
**Inquiry 1250.**

**Mountain Computer, Inc.**  
240 Hacienda Ave.  
Campbell, CA 95008  
(408) 379-4300  
**Inquiry 1251.**

**Nakamichi**  
c/o Mass Optical  
Storage Technology  
(MOST), Inc.  
11205 Knott Ave.  
Cypress, CA 90630  
(714) 898-9400  
**Inquiry 1252.**

**NeXT, Inc.**  
900 Chesapeake Dr.  
Redwood City, CA  
94063  
(415) 366-0900  
**Inquiry 1253.**

**NoGate Consulting**  
P.O. Box 88115  
Grand Rapids, MI  
49518  
(616) 455-6270  
**Inquiry 1254.**

**O.C.E.A.N.  
Microsystems**  
246 East Hacienda Ave.  
Campbell, CA 95008  
(800) 262-3261  
(408) 374-8300  
**Inquiry 1255.**

**Panasonic  
Communications  
& Systems Co.**  
Two Panasonic Way  
Secaucus, NJ 07094  
(800) 742-8086  
(201) 348-7000  
**Inquiry 1256.**

**Peripheral Vision**  
7712 Paseo del Rey  
Playa del Rey, CA 90293  
(213) 574-1144  
**Inquiry 1257.**

**Philips-Du Pont  
Optical Co.**  
1409 Foulk Rd.,  
Suite 200  
Wilmington, DE 19803  
(302) 479-2500  
**Inquiry 1258.**

**Pinnacle Micro, Inc.**  
15265 Alton Pkwy.  
Irvine, CA 92718  
(800) 553-7070  
(714) 727-3300  
**Inquiry 1259.**

**Pioneer  
Communications**  
Sherbrooke Plaza  
600 East Crescent Ave.  
Upper Saddle River, NJ  
07458  
(201) 327-6400  
**Inquiry 1260.**

**PKWare, Inc.**  
7545 North Port  
Washington Rd.  
Glendale, WI 53217  
(414) 352-3670  
**Inquiry 1261.**

**Psion, Inc.**  
(subsidiary of Psion Plc.)  
118 Echo Lake Rd.  
Watertown, CT 06795  
(203) 274-7521  
**Inquiry 1262.**

**Quarter-Inch  
Cartridge Drive  
Standards, Inc.**  
311 East Carrillo St.  
Santa Barbara, CA  
93101  
(805) 963-3853  
*Members: Archive  
Corp., Carlisle Memory  
Products, Cipher Data  
Products, Colorado  
Memory Systems,  
Gigatek, Laser Magnetic  
Storage International  
Co., Mountain Computer,  
Sony Corp., Tandberg  
Data A/S, 3M, Wangtek*  
**Inquiry 1263.**

**Ricoh Corp.**  
5 Dedrick Place  
West Caldwell, NJ  
07006  
(201) 882-2000  
**Inquiry 1264.**

**Seagate Technology**  
920 Disc Dr.  
Scotts Valley, CA 95067  
(800) 468-3472  
(408) 438-6550  
**Inquiry 1265.**

**SEEQ Technology,  
Inc.**  
1849 Fortune Dr.  
San Jose, CA 95131  
(408) 432-7400  
**Inquiry 1266.**

**Seiko Instruments  
U.S.A., Inc.**  
PC Products Division  
1144 Ringwood Court  
San Jose, CA 95131  
(800) 888-0817  
(408) 922-5800  
**Inquiry 1267.**

**Sony Corporation  
of America**  
9 West 57th St.  
New York, NY 10019  
(212) 371-5800  
**Inquiry 1268.**

**Stac Electronics**  
5993 Avenida Encinas  
Carlsbad, CA 92008  
(619) 431-7474  
**Inquiry 1269.**

**System Enhancement  
Associates, Inc.**  
925 Clifton Ave.  
Clifton, NJ 07013  
(201) 694-4710  
**Inquiry 1270.**

**Tandberg Data A/S**  
KJELSASUN 161  
N-0808 Oslo 8  
Norway  
**Inquiry 1271.**

**Teac America, Inc.**  
Data Storage  
Products Division  
7733 Telegraph Rd.  
Montebello, CA 90640  
(213) 726-0303  
**Inquiry 1272.**

**3M**  
3M Center  
St. Paul, MN 55144  
(612) 733-1110  
**Inquiry 1273.**

**Toshiba America  
Information Systems,  
Inc.**  
Disk Products Division  
9740 Irvine Blvd.  
Irvine, CA 92718  
(714) 583-3108  
**Inquiry 1274.**

**Toshiba  
Semiconductor**  
9775 Toledo Way  
Irvine, CA 92718  
(714) 455-2000  
**Inquiry 1275.**

**WangDAT**  
151 Kalmus Dr.,  
Suite K3  
Costa Mesa, CA 92626  
(714) 241-9613  
**Inquiry 1276.**

**Wangtek, Inc.**  
41 Moreland Rd.  
Simi Valley, CA 93065  
(805) 583-5255  
**Inquiry 1277.**

**Zenith Data Systems**  
1000 Milwaukee Ave.  
Glenview, IL 60025  
(312) 391-8860  
**Inquiry 1278.**

*This resource guide lists information sources for the concepts and products listed in this section. Inclusion in the resource guide should not be taken as a BYTE endorsement or recommendation. Likewise, omission from the guide should not be taken negatively. The information here was believed to be accurate at the time of writing, but BYTE cannot be responsible for omissions, errors, or changes that occur after compilation of the guide.*

# We'll Build It

## ASSEMBLE YOUR OWN COMPUTER KIT!

- Building your own computer provides you with a better understanding of components and their functions
- Upgrading becomes a snap
- In-depth assembly instructions included
- Have your new computer assembled and running in three hours, using common tools
- Software included
- Purchase computer kits configured by Jameco or design your own

## Jameco 16MHz 80386SX Desktop Computer Kit

Includes:

- 80386SX Motherboard with 2MB RAM (expandable to 8MB)
- 101-key enhanced keyboard
- Multi I/O Card
- Toshiba 1.44MB, 3.5" DSHD floppy disk drive
- Baby sized desktop case
- 200 Watt power supply
- DR DOS by Digital Research and Diagsoft's QAPlus diagnostic software

**\$1199.95**  
JE3816 monitor extra

## Jameco 33MHz 80386 Vertical Computer Kit

Includes:

- 80386 33MHz Motherboard with 32KB cache, 4MB RAM (expandable to 16MB)
- 101-key enhanced keyboard
- Multi I/O Card
- Toshiba 1.44MB, 3.5" DSHD floppy disk drive
- Vertical enclosure with 7 half-height drive bays
- 300 Watt power supply
- DR DOS by Digital Research and Diagsoft's QAPlus diagnostic software

**\$2599.95**  
JE3833 monitor extra

## UPGRADE YOUR COMPUTER!

- Today's new software requires power; you may be able to upgrade your current system
- Call us for information on upgrading today

## LOOK TO JAMECO.....

- Inexpensive entry to computing
- Powerful office computer
- Upgrading your current system

*Let us show you what we have to offer;  
call or write for the latest Jameco Catalog!*

**(415) 592-8097**

**JAMECO**  
COMPUTER PRODUCTS

1355 Shoreway Rd., Belmont, CA 94002

Terms: Prices are subject to change without notice. Items subject to availability and prior sale. Complete list of terms/warranties is available upon request.  
All trade names are registered trademarks of their respective companies.

**Circle 190 on Reader Service Card**

World Radio History

# if You Put it Together.



# CHIPS FOR THE NINETIES AND BEYOND

*Chips that speak, reason, and identify smells  
offer more than just MIPS*

*Janet J. Barron*

**C**hips aren't just plain chips anymore. And they aren't just faster, smaller, and smarter than they used to be. Nowadays researchers and developers are creating microprocessors that will do things that were only theoretically possible a few years ago—like speak, identify smells, train themselves, and form conclusions with less than hard-and-fast facts.

Here's a look at some of the more interesting new chips. For the purpose of this article, I'll discuss only stand-alone microprocessors (versus chip sets or modules). All are programmable, meaning that they can be "taught" to perform a number of tasks within the particular class of applications they address.

Many of these microprocessors don't fall into the category of "conventional" chips, and some purists won't consider them true microprocessors. But I have included them because they are noteworthy or have unique features or technologies that will probably affect the way you compute both in the near term and in the long run.

Some of the microprocessors in this chip medley are still in the conceptual or architectural stages. Some are in the process of being produced, and some are already helping businesses use their devices more efficiently.

## Dealing with Logic That's Fuzzy

Currently, many of the most dynamic R&D efforts involve chaos, fuzzy logic, and neural networks. These techniques deal with ways of understanding and coming to conclusions about phenomena that are nonlinear in nature or aren't clear-cut enough for conventional computers to handle efficiently.

For example, the FC110 from Togai InfraLogic (see photo 1) is a digital fuzzy processor capable of performing generic microprocessor tasks. However, in a couple of ways (i.e., its instruction set and its chip specifications) this processor is geared to handle fuzzy logic information.

This chip's FZAND and FZOR instructions were designed to perform fuzzy AND and fuzzy OR operations. (For more information on fuzzy logic, see "When Facts Get Fuzzy,"

April 1988 BYTE). The following is an example of a rule that uses two premises. It is one of several rules used to demonstrate the balancing of an inverted pendulum.

```
Rule 1: ;Clear the Alpha Register
        LOAD    #FF,ALPHA
        ;if(Theta == PM && dTheta == Z0)
        LHS    ALPHA, #2
              Theta
              Theta.PM
              dTheta
              dTheta.Z0
        ;Velocity = PM
        RHSC   ALPHA, CONCL
              Velocity.PM
```

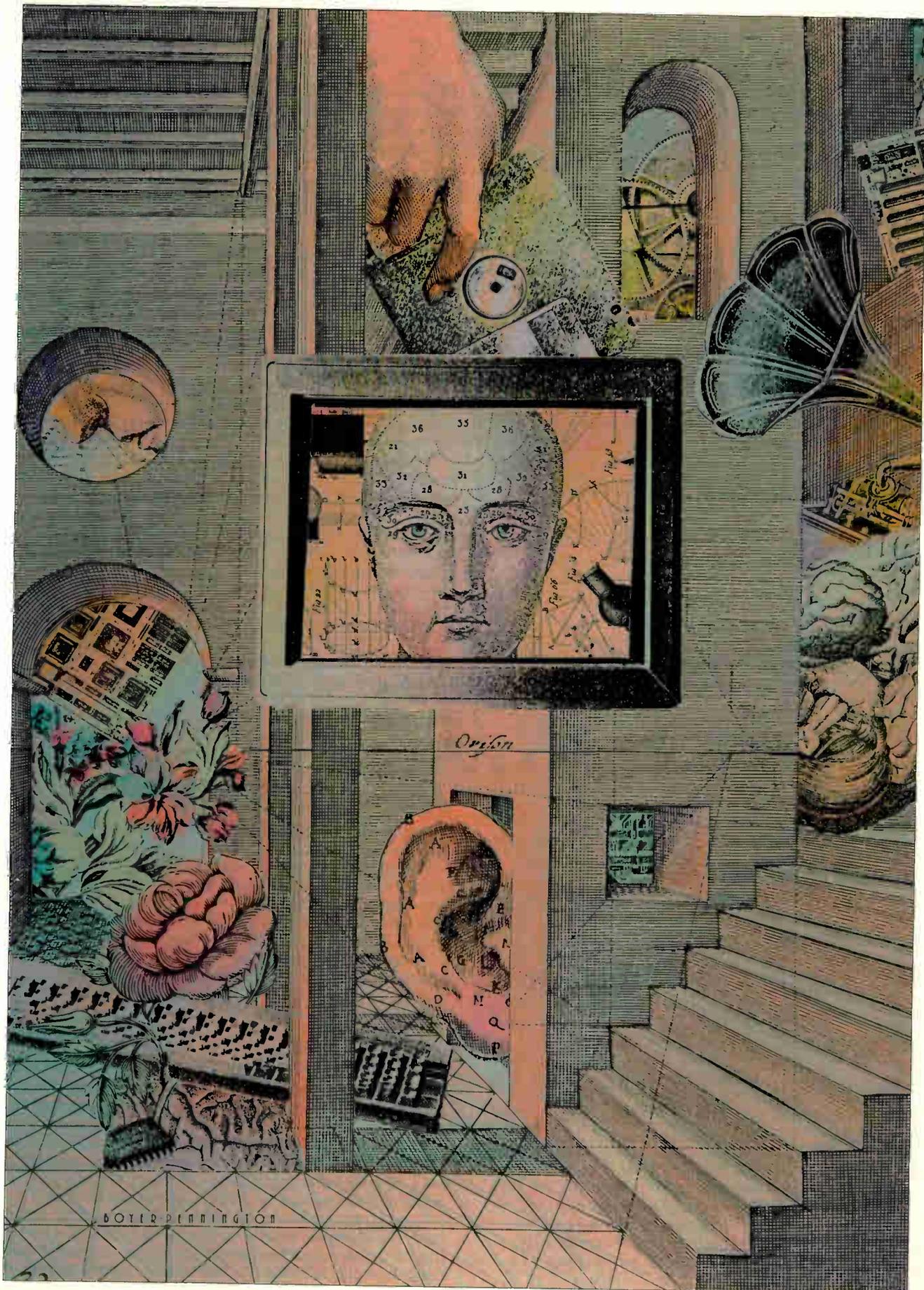
The FC110 is one of the few chips that has an instruction that evaluates the entire left side (IF condition) of such a rule. A single LHS (left-hand-side) instruction on the Togai processor handles up to 255 fuzzy membership tests (versus several instructions per test on chips not specifically developed for fuzzy-logic applications). The RHSC (right-hand-side by centroid) instruction evaluates the right side of the rule.

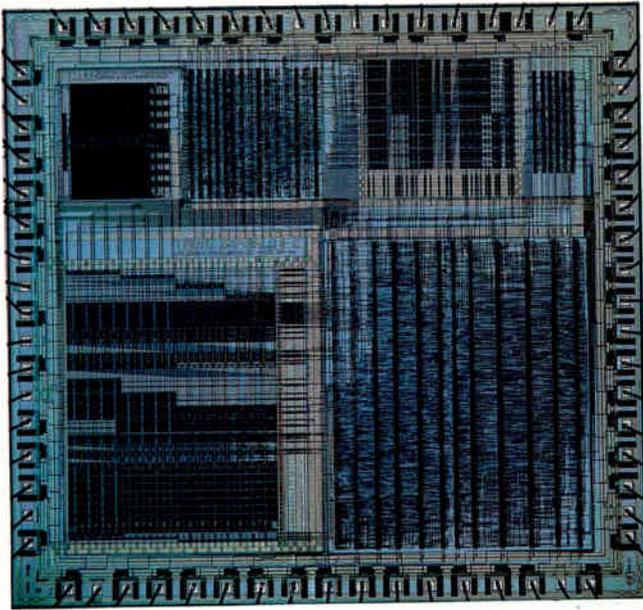
The data processing portion of the FC110 was also designed and sized to handle fuzzy-logic tasks. The processor runs at 10 million instructions per second (MIPS) and, although mainly an 8-bit chip, can perform 16-, 24-, and 32-bit (as well as some other) operations especially suited for fuzzy-logic problems.

Because of these features, Togai's processor is suited for applications requiring real-time performance, such as robotic joint/trajectory control, sensory fusion (combining the input from a variety of sensors), pattern recognition, and analytical and medical-instrument reading interpretations.

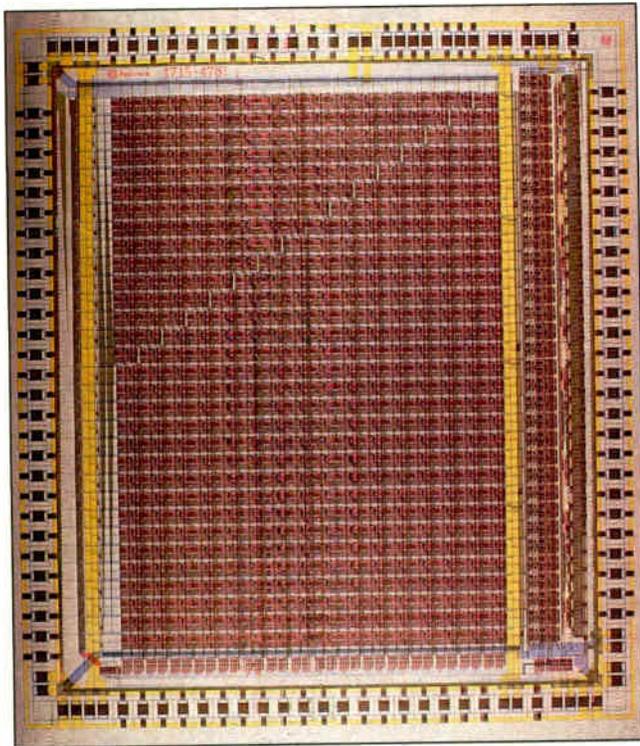
## Cloning the Brain

Researchers have high hopes for neural networks as a potentially valuable processing technology. These artificial systems





**Photo 1:** The FC110. On the bottom left of the die, the ALU path is set up so it will do 8-, 16-, or 32-bit operations. The large block at the lower right contains the hardware to implement the special instruction set that performs fuzzy-logic operations.



**Photo 2:** This is a rendering of the Bellcore chip that contains three major functional areas: the noise generator (extreme right), the neurons (just to the left of the noise generator), and the synapse array (to the left of the neurons). Most of the chip is occupied by the learning synapse array.

simulate how it is believed the human brain works, learning by example rather than having to be programmed. (For more information on neural networks, see the State of the Art section in the August 1989 BYTE.)

As of this writing, at least a dozen organizations claim to have produced working neural-network chips. In the last quarter of 1988, using VLSI technology, scientists at Bellcore (the research arm of the seven regional Bell holding companies) developed an analog neural-network chip. The purpose of this processor (developed for research purposes only) is to perform high-speed on-chip learning in parallel.

Recently, Bellcore's researchers enhanced the learning algorithm and produced a new version of the chip that can learn as well as evaluate information at the rate of about 100,000 patterns per second. There are 160,000 transistors and 496 bidirectional synapses (electrical connections between neurons) on the new chip (a 7- by 8-mm die). Each of these synapses has 5 bits of dynamic range and 32 neurons with variable gain. (A neuron is the nerve-cell body and all its processes.) The learning synapse array covers most of the chip (see photo 2).

This second-generation learning chip can perform  $10^8$  connections per second, as well as the same number of connection updates per second. Bellcore calls its neural-network processor a "cascadable" learning chip: It can be cascaded (arranged so that the output of one feeds directly into the input of another) for larger systems with no degradation in performance. A neural-network chip with this type of processing power and self-learning features can tackle hard-to-handle applications such as visual pattern recognition, speech synthesis and recognition, and network optimization and control.

#### Alternative Neural Network Approaches

It should come as no surprise that Intel has thrown its hat into the neural-network ring in a big way. The company has already produced one neural-network chip and is in the process of letting another company use some of its technology to produce a second chip. Intel also has a neural-network workstation in the prototype stage.

Intel used CMOS-III EEPROM technology and a 208-pin PGA (pin grid array) package to create its first neural-network device, dubbed an electronically trainable analog neural network, or ETANN (see photo 3). ETANN contains 64 analog processing elements and 10,240 trainable weights. It is currently being provided to system developers as an experimental chip for prototyping and research.

Because of its highly parallel architecture, the chip achieves a blazingly fast computation rate—roughly 2 billion multiply accumulates (interconnections) per second. Another feature of ETANN is that it uses floating gate storage (versus digital RAM elements or analog DRAM storage) for its weights.

Since it was Intel's first entry into the neural-network field, the company took a conservative approach by not adding a learning capability to the chip. Thus, you need some support tools to train ETANN. A PC-based simulation and training program from California Scientific Software (developer of the BrainMaker neural-network simulator) provides the learning capability.

ETANN's speed and parallelism make it good at mapping and character- and pattern-recognition. But because the chip has a memory limitation of about 10K bytes, it is not good at performing recognition tasks that require a large database.

This past spring, Nestor was awarded a \$1.2 million contract from the Defense Advanced Research Projects Agency (DARPA) to develop a neural-network chip in conjunction with Intel. According to Nestor, the N1000 device will be capable of

processing 150 billion synapse interconnects per second and will function as a true learning device and parallel processor.

The inherently fault-tolerant N1000 will incorporate Intel's proprietary flash memory technology (see "Store Data in a Flash" on page 311). The N1000 will use an estimated 250,000 flash memory cells to implement a nonvolatile storage capability that is expected to provide 10-year data retention. Portions of the data path are parallel, and portions are multiplexed. One of the noteworthy features of the N1000 is that learning can be performed on-chip (as opposed to in software).

A chip as fast as the N1000 is ideally suited for applications such as speech, handwritten character and pattern recognition, machine vision, signal processing, on-board automotive diagnosis, and industrial process control.

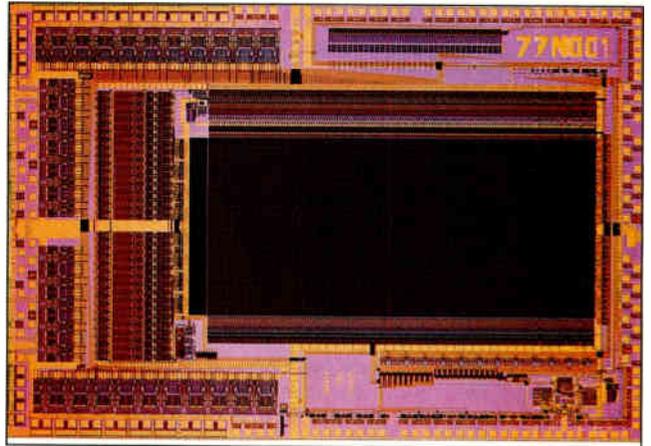
### Sniff Chip Coming

If the collaboration between the University of California at Irvine (UCI) and Adaptive Solutions is successful, a new chip will be born that can identify, discriminate between, and store odors.

The olfactory system was the evolutionary precursor to the rest of the brain's cortex. If Adaptive Solutions is able to translate a simulation of the olfactory cortex onto a chip, researchers may begin to understand other kinds of primary perception, such as vision, hearing, and touch. Understanding the olfactory system would be one of the first steps toward figuring out how the neocortical brain functions really work (the neocortex comprises 80 percent to 90 percent of the brain).

UCI scientists Richard Granger and Gary Lynch performed the research that resulted in programming a computer to duplicate the wiring of neurons in the olfactory cortex. "Identifying smells is a tentative first step toward circuit designs that may emulate those in our heads," says Granger. As the simulation receives the computer equivalent of smells, it stores memories by creating a hierarchy of categories and sorting the sensory information into finer classifications with each "sniff."

Currently in architectural form, this neural-network processor will learn with on-chip hardware. You will be able to tweak the chip to work with any neural-network learning model by



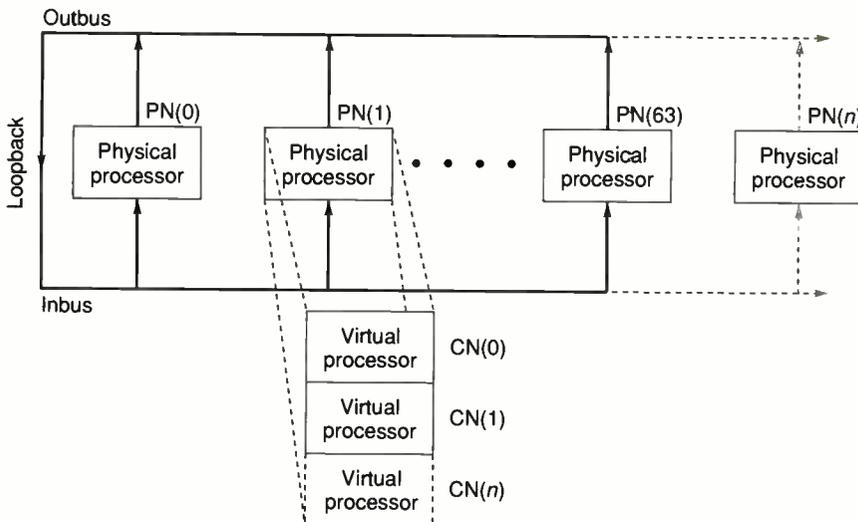
**Photo 3:** Intel's nonvolatile ETANN chip provides permanent true analog weight storage without refresh or battery backup. Its 10,000 multipliers and 20,000 analog EEPROM cells take up the bulk of the dye area.

reconfiguring its microcode. Tasks will be distributed among an array of parallel processors that can process up to 300 million connection updates per second during learning. The chip will hold a single layer of processing nodes, which are time-shared among all the virtual connection nodes in a network (see figure 1). (A virtual node concept uses time-division multiplexing to simulate all the layers in a particular network, one at a time.)

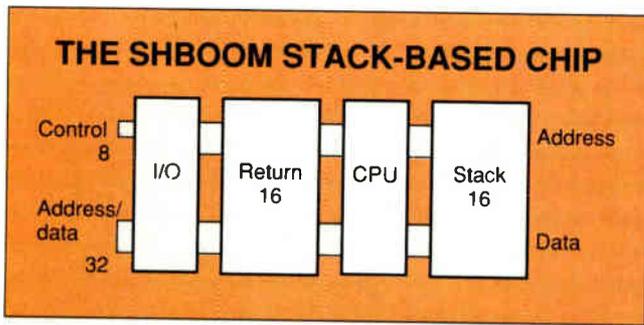
### Help for Your Shrinking Desktop

Are you getting the feeling that space on your desktop is shrinking in direct proportion to the number of imaging devices becoming available? Wouldn't it be nice to be able to replace all

## MASSIVELY PARALLEL AND EXTENDABLE ARCHITECTURE



**Figure 1:** Adaptive Solutions' architecture can be extended in two directions. Each chip has 64 processor nodes, and additional chips can be added to provide arrays of hundreds of processors. Virtual processors, called connection nodes, are mapped to each physical processor, creating thousands of neural-network nodes. Loopback techniques and broadcast from any processor allow arbitrary interconnection of all nodes.



**Figure 2:** *ShBoom* has separate 32-bit internal buses for address and data. Both access the CPU, its two stacks, and the I/O processor. These buses are multiplexed into a single 32-bit external bus with DRAM and I/O control signals.

the clutter with a single box that (with the addition of special software) would let you scan, copy, and print documents; desktop publish; communicate via fax, voice, and E-mail; transmit data; and be networked to your entire workgroup?

A sophisticated chip from National Semiconductor can perform all these imaging functions. Tagged the NS32GX320, the chip was designed for computation-intensive, embedded-control applications. Concurrent processing, digital signal processing (DSP) instructions, and a two-channel DMA controller are features of this new member of National Semiconductor's family of embedded system processors.

The 32-bit chip's internal organization allows a high degree of parallelism in executing instructions, on-chip BitBlit instruction primitives and logic, stack instruction syntax tuned for PostScript execution, and a two-way set-associative data cache for character generation. The NS32GX320 integrates more than 390,000 transistors that are fabricated in submicron, double-metal CMOS technology and, according to National Semiconductor, achieves a peak performance of 15 MIPS.

This microprocessor was designed for applications such as embedded control of high-performance laser printers, intelligent terminals, and solid-state phone answering. It can also act as a controller for fax machines (including Group 4 ISDN), scanners, or multifunctional combinations of both.

### Stack 'Em Up and Go Forth

A stack-based processor has an architecture that is optimized for real-time control with specific capabilities and features that make that type of operation its best application area. Among the companies that are preparing stack-based chips for commercial production are Harris Semiconductor and Computer Cowboys.

One of the newest chips from Harris Semiconductor is the RTX 2010. This enhancement of the company's RTX 2000 chip will be able to run floating-point and DSP operations. The 2010 was not designed as a 32-bit chip, but as a high-performance 16-bit microprocessor. It has a built-in 48-bit multiply-accumulator that provides its DSP capabilities. In working silicon now, Harris's 2010 is due out at the end of this year.

Why do a stack processor? According to Phil Koopman, one of Harris's leading experts on stack-based microprocessors, it fills the need for low-cost, low-performance processing. Why a stack-based processor for the embedded controller market? Again according to Koopman, "Outside the highest-volume product, DRAMs, the next largest market is microcontrollers."

Because they are stack machines, both the Harris and Cow-

boy Computer chips run Forth well. Why Forth? A characteristic of high-level machines is that they were optimized for a particular language to the exclusion of being able to run other languages. Forth makes a natural assembly language for a stack machine, but, if you wish, you can also work in C instead of an assembly language. Both companies offer an ANSI C.

Although both chips are stack-based, Chuck Moore (computer pioneer, software innovator, and creator of Forth) went down a different trail with his ShBoom chip. He designed it to be a 32-bit chip with two processors—each with its own instruction stream, sharing memory. An I/O processor directs time-synchronous data transfers while the CPU asynchronously runs the ALU. A low-power (100 milliampere) CMOS microprocessor, Moore's chip was designed for an inexpensive, fast (1-megabyte, 200-MIPS peak speed) computer. It has 8-bit instructions so that each 32-bit word is a 4-instruction cache.

Figure 2 shows the chip's external 32-bit address and data bus interfaced to its internal 32-bit address and data buses. These buses link the stack caches, the CPU with its registers, and the ALU with the I/O processor and its registers. At power-up, the I/O processor writes 32-bit data into DRAM after four reads from 8-bit ROM. With this bootstrap, additional data can be loaded from ROM, disk, or serial line.

This type of chip may be used in areas such as storage and transfer of data as well as communications. Stack-based micro-

**T**his prototype may show that digital GaAs is ready for ultralarge-scale ICs and that it is possible to build GaAs logic circuits that will operate over a wide temperature environment.

processors such as these may be used as network controllers in high-performance LANs. They may also find applications as controllers for fiber-optic concentrators with multiple incoming fiber-optic lines handling packets of information that need to be switched. This type of chip responds to external events (e.g., catching a packet off a LAN) quickly.

### TRON Offspring

Suppose you want to economically produce a microprocessor that provides 32-bit addressing and upward compatibility with future 48- and 64-bit addressing modes. To make things even more challenging, say you want the end result to combine the high-speed simplicity of RISC and the programming ease of CISC. How do you develop a chip in record time with these features plus the ability to include very high-level instructions useful for a compiler or operating system?

Today's answer: Develop a chip based on TRON specifications. Anyone can adopt them; they are free of charge; and they give companies an all-encompassing global computing solution (see "The TRON Project," April 1989 BYTE).

# Discover Parallel Processing

## Quadputer™

The Microway Quadputer is the world's most popular PC Transputer development environment. It can be purchased with two to four Transputers and one to four megabytes of RAM per processor. The Quadputer runs all the popular Transputer development software, all of which is available from Microway. It is compatible with our Monoputer™ which provides 1 to 16 megabytes of RAM and a single T800, our Videoputer™ which comes in VGA and higher resolution versions and is powered by a memory mapped pair (T800 and 34010), and our Linkputer™ whose cross bar switching network can dynamically link up to 32 Transputers. Finally, all Microway Transputer products can be used with our Number Smasher-860 to provide out-of-this-world numeric performance!

For more information, please call 508-746-7341.

# Microway

The World Leader in PC Numerics

Corporate Headquarters, Research Park, Box 79, Kingston, MA 02364  
TEL 508-746-7341 • FAX 508-746-4678  
U.K. - 32 High St., Kingston-Upon-Thames, 081-541-5466 • Italy 02-74.90.749  
Holland 40 836455 • Germany 069-75-2023 • Japan 81 3 222 0544

World Radio History

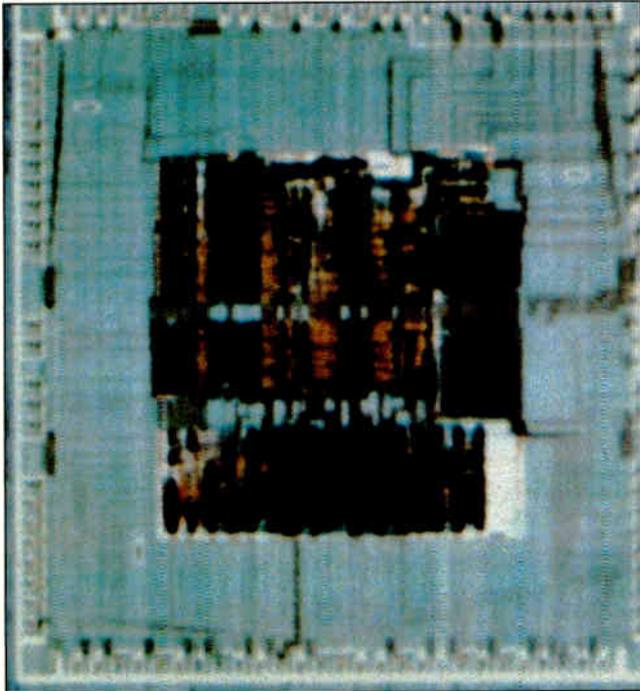
## Number Smasher® 860

The highest performance coprocessor card to ever run in a PC, Number Smasher-860 delivers up to 80 million single precision floating point operations per second at 40 MHz and produces over 10 Linkpack megaflops. The board comes standard with an ISA interface, two Transputer Link Adaptors that allow it to interface with a Microway Quadputer or Videoputer, your choice of our NDP Fortran, C or Pascal for the 80860, plus 8 megabytes of high speed memory.

## NDP Fortran-860, C-860 and C++-860

Microway NDP 860 Compilers make it easy to recompile your favorite mainframe, 80386 or PC application for the 80860. The resulting code runs on our XTEND-860™ environment under DOS, UNIX or XENIX.





**Photo 4:** The first 32-bit GaAs RISC microprocessor. Demonstrated in September 1988, the chip had 13,000 TTL gates. Improvements have led to 10-times-faster gates and yields to support 30,000 gates.

TRON (for The Real-Time Operating System Nucleus) is a standardization effort consisting of an open architecture, a family of VLSI chips, and system software. Although it is a recently implemented concept developed by Ken Sakamura of the University of Tokyo, several companies have already based processors on its specifications. Mitsubishi is one such company, with its new family of M32 embedded controller microprocessors.

One of Mitsubishi's TRON-based chips, the M32/100, has been optimized for any control application requiring general performance rates between 8 and 12.5 MIPS at 25-MHz clock rates. Due to its instructions for bit-mapping operations, this chip is a suitable 32-bit CPU for applications with graphics requirements. The M32/100 shines in areas such as laser printers, X Window System terminals, and telecommunications.

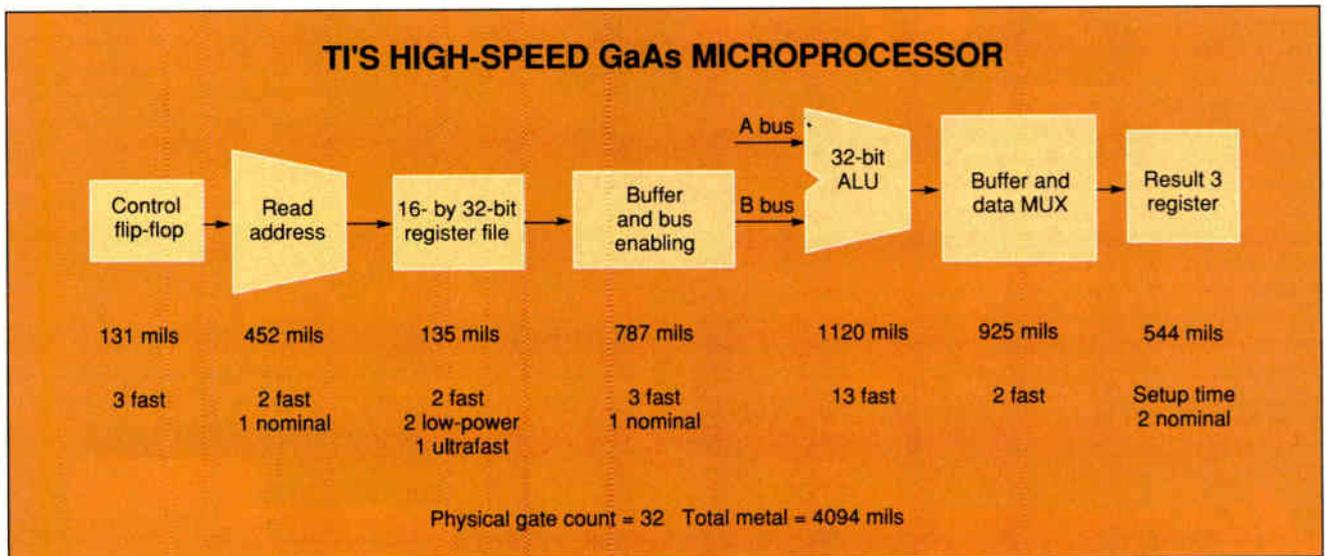
Although currently produced with 1.0-micron technology, by the end of this year this chip is due to be fabricated with 0.8-micron process techniques. Because of its TRON heritage, the M32/100 provides a good application-specific IC core so that, with the addition of application-specific hardware, users can achieve an economical system-specific solution.

**First of the GaAs Chips**

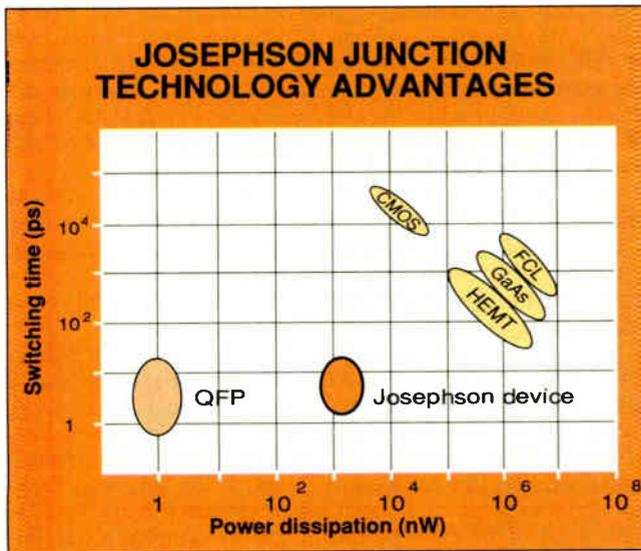
Coming soon will be microprocessors fabricated from gallium arsenide (GaAs) instead of silicon, and possibly hybrid chips that are a combination of these and other materials.

Texas Instruments (TI), one of the major innovators in the microprocessor industry, has in the prototype stage a DARPA-funded GaAs chip that has demonstrated some very impressive potential capabilities. At a DARPA symposium held last year, this chip was touted as being the world's fastest 32-bit CPU (see figure 3).

TI's speedy 150-MHz pipeline RISC processor, with six pipeline stages, uses heterojunction-based bipolar technology, which is faster but more complex and expensive than conventional MESFET (metallic Schottky field effect transistor) technology (see photo 4). According to company officials, this chip's nearest competitors are 80-MHz, 20-watt microproces-



**Figure 3:** This critical path analysis shows the trade-offs made in TI's chip between speed and power requirements (which are directly proportional in GaAs technology). Propagation delay due to metal interconnects is significant, increasing the critical path delay by 25 percent. Note that the design concentrates 13 fast gates at the ALU, where a 1120-mil interconnect would otherwise slow processing significantly.



**Figure 4:** A comparison of switching time and heat-generation between several kinds of circuit elements. Note the orders of magnitude difference between those that use Josephson Junction technology and those that don't.

sors. TI's prototype is a 13,000-gate microprocessor (equivalent to a CMOS chip with 50,000 transistors).

TI has built and tested this 16,000-gate-equivalent logic gate device; emitter coupled logic usually runs in the 15,000-gate to 20,000-gate range. The processor contains a 32-gate-delay critical path with 200-picosecond-per-gate delays. More typically, high-speed processors contain a 20-gate-delay critical path with 650 ps-per-gate delays. This 20-gate-delay path length in GaAs would have required memories in the 1.5-nanosecond range, which is considered too demanding for current memory technology.

Some of the first applications for this high-speed processor will be in military guidance systems where there is space for only one processor and it must do the work of six less-powerful chips. The TI GaAs offering will also lend itself to DSP and other very high data rate applications.

This prototype chip offers many advantages, such as its small size and light weight. It has also been shown to be highly reliable and to offer reproducible performance. And, for logic and processing tasks, GaAs is faster than silicon.

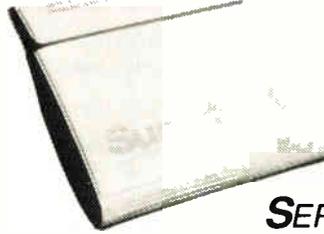
However, since TI's chip hasn't yet been commercialized, with the resultant optimization of its good features, it still has some disadvantages, as well. Although it will perform three times as fast as silicon chips, it will also cost three times as much. Another disadvantage is that, at this point, the processor does not contain much memory. GaAs is an intrinsically poor technology choice for microprocessor memory, compared to BiCMOS.

Nevertheless, hopes are high for this high-speed, high-performance microprocessor. This prototype may show that digital GaAs is ready for ultralarge-scale ICs and that it is possible to build GaAs logic circuits that will operate over a wide temperature environment.

**Toward Smaller and Faster Machines**

If, as some people believe, silicon- and GaAs-based devices will ultimately reach their size and speed scaling limits, significant opportunities will open up for microprocessors using

*Want to save Time, Money, & Headaches?*



**GET SUPERSOFT'S SERVICE DIAGNOSTICS**

All the software, alignment diskettes, parallel/serial wrap-around plugs, ROM POSTs and extensive, professional documentation to provide the most comprehensive testing available for IBM PCs, XTs, ATs and all compatibles under DOS or Stand Alone. No other diagnostics offers such in-depth testing on as many different types of equipment by isolating problems to the board and chip level.

**NEW:** SuperSoft's ROM POST performs the most advanced Power-on-Self-Test available for system boards that are compatible with the IBM ROM BIOS. It works even in circumstances when the Service Diagnostics diskette cannot be loaded.

**NEW:** 386 diagnostics for hybrids and PS/2s!

For over nine years, major manufacturers have been relying on SuperSoft's diagnostics software to help them and their customers repair microcomputers. End users have been relying on SuperSoft's Diagnostics II for the most thorough hardware error isolation available. Now versions of Service Diagnostics are available to save everyone (including every serious repair technician) time, money, and headaches in fixing their computers, even non-IBM equipment.

- All CPUs & Numeric Co-processors
- System Expansion & Extended Memory
- Floppy, Fixed & Non-standard Disk Drives
- Standard & Non-standard Printers
- System Board: DMA, Timers, Interrupt, Real-time Clock & CMOS config. RAM
- All Color Graphics & Monochrome Monitors
- Parallel & Serial Ports
- Mono, CGA, Hercules & EGA Adapters
- All Keyboards & the 8042 Controller

**"EDITOR'S CHOICE" — PC MAGAZINE August 1990**

Service Diagnostics for PC, PC/XT, and compatibles only	\$169
Alignment Diskette for PC, PC/XT and compatibles (48 tpi drives)	\$ 60
Wrap-around Plug for PC, PC/XT and compatibles (parallel and serial)	\$ 30
Service Diagnostics for AT and compatibles only	\$169
Alignment Diskette for AT and compatibles (96 tpi drives)	\$ 60
Wrap-around Plug for AT (serial)	\$ 15
ROM POST for PC, PC/XT and compatibles only	\$245
ROM POST for AT and compatibles only	\$245
<b>Service Diagnostics: The KIT (includes all of the above—save \$502)</b>	<b>\$495</b>
Service Diagnostics for PS/2 models 25/30 50/60 or 70/80 and compatibles (please specify)	\$195
Service Diagnostics for 386 or V2, V30, or Harris, etc. (please specify)	\$195
Diagnostics II is the solution to the service problems of users of all CP/M-80, CP/M-86 and MS-DOS computers	\$125
Alignment Diskette for PS/2 and compatibles (3.5 inch)	\$ 60

To order, call 800-678-3600 or 408-745-0234  
FAX 408-745-0231, or write SuperSoft.

*your microcomputer repair solution*  
**SuperSoft**

FIRST IN SOFTWARE TECHNOLOGY P.O. Box 4178, Mountain View, CA 94040-0178  
(408) 745-0234 Telex 270365

SUPERSOFT is a registered trademark of SuperSoft, Inc.; CDC of Control Data Corp.; IBM PC, AT & XT of International Business Machines Corp.; MS-DOS of MicroSoft Corp.; NEC of NEC Information Systems, Inc.; PRIME of PRIME INC.; Sony of Sony Corp.

## COMPANY INFORMATION

*Operational data on the chips discussed in this article was provided by the manufacturers. For more information, contact the companies listed below.*

**Adaptive Solutions, Inc.**  
1400 Northwest Compton  
Dr., Suite 340  
Beaverton, OR 97006  
(503) 690-1236  
**Inquiry 1003.**

**Bellcore**  
290 West Mount Pleasant  
Ave.  
Room 1B-147  
Livingston, NJ 07039  
(201) 740-4324  
**Inquiry 1004.**

**California Scientific  
Software**  
10141 Evening Star Dr.,  
Suite 6  
Grass Valley, CA 95945  
(916) 477-7481  
**Inquiry 1005.**

**Computer Cowboys**  
410 Star Hill Rd.  
Woodside CA 94062  
(415) 851-4362  
**Inquiry 1006.**

**Harris Semiconductor**  
P.O. Box 883  
MS 62A-021  
Melbourne, FL 32902  
(800) 442-7747  
**Inquiry 1007.**

**Intel Corp.**  
2250 Mission College  
Blvd.  
Mail Stop SC9-40  
Santa Clara, CA 95052  
(408) 765-9235  
**Inquiry 1008.**

**Mitsubishi Electronics**  
1050 East Arques Ave.  
Sunnyvale, CA 94086  
(408) 730-5900  
**Inquiry 1009.**

**National Semiconductor**  
2900 Semiconductor Dr.  
P.O. Box 58090  
Santa Clara, CA 95052  
(408) 721-5000  
**Inquiry 1010.**

**Nestor, Inc.**  
1 Richmond Sq.  
Providence, RI 02906  
(401) 331-9640  
**Inquiry 1011.**

**Texas Instruments**  
Defense Systems and  
Electronics Group  
P.O. Box 650311  
MS 3926  
Dallas, TX 75265  
(214) 917-7698  
**Inquiry 1012.**

**Togai InfraLogic, Inc.**  
30 Corporate Park,  
Suite 107  
Irvine, CA 92714  
(714) 975-8522  
**Inquiry 1013.**

**University of California  
at Irvine**  
600 Administration  
Irvine, CA 92717  
(714) 856-6922  
**Inquiry 1014.**

alternative technologies. Processors developed using Josephson junction (Jj) superconducting technology stand a good chance of being serious contenders.

Jj technology is based on the use of tunnel junctions (a kind of quantum-mechanical switch) made with a thin layer of insulating material. This insulator is sandwiched between layers of a superconducting material cooled to an extremely low temperature. Liquid helium is the coolant that is currently used. Jjs can switch voltages extremely quickly while consuming only a small fraction of the energy that conventional devices need (see figure 4).

On the road to developing smaller and faster computers that feature high switching rates and very low power consumption,

many U.S. universities, as well as companies like AT&T, TRW, Westinghouse, duPont, Conductus, and Hypres, are working with superconducting technology. But superconducting ventures undertaken by dozens of Japanese companies and organizations are eclipsing U.S. endeavors in this field. These efforts have already resulted in prototype chips and other elements based on Jj technology.

In 1983, IBM abandoned its attempts to develop Jj products because it decided that commercialization of the technology would take too much time and cost too much money. About that time, as part of its fifth-generation computing effort, the Japanese government beefed up its interest in, and sponsorship of, Jj technology.

Several Japanese governmental agencies, such as the Ministry of International Trade and Industry, the Japanese Research Development Corp., and the Electrotechnical Laboratory, launched serious endeavors focused on developing Jj products. A couple of these undertakings, including that by ETL and one called ERATO (for Exploratory Research for Advanced Technology)—an offshoot of JRDC—have paid off in Jj chips. So have some of the many private efforts by companies like Fujitsu, NEC, and Hitachi.

ETL has reportedly developed a 1-kilobit Josephson memory chip in which 90 percent of the cells can be accessed by the peripheral circuit. ETL has also announced completion of a four-chip, Jj-based RISC microcomputer that processes most instructions in 1 ns and consumes only about 6.2 milliwatts (mW) of power.

ERATO is taking a new look at a device called the quantum flux parametron, developed about 30 years ago, that uses the Josephson junction. QFP researchers are exploring the possibility of producing an ultrafast computer using this technology.

Fujitsu has demonstrated a single-chip, 4-bit Jj microprocessor with roughly 3000 gates and approximately 12 instructions stored in an on-chip ROM module. Its maximum clock frequency is said to be 1.1 gigahertz, with a minuscule energy consumption of only 6.1 mW. Hitachi has also reported having developed a microprocessor similar to Fujitsu's in complexity and performance.

This past spring, NEC scientists announced development of a 4-kilobit Josephson memory with a memory read-out time of 580 ps (0.58 ns). Comprising about 25,000 Josephson elements, the NEC chip measures 5 mm square, with a cell size of 55 microns square.

### A Ticket to Tomorrow

With the advent of new superconductive materials that can be used with higher-temperature coolants (liquid nitrogen, for instance), a number of experimental Jj processors, switches, A/D converters, and even computers are arriving on the scene. At the moment, niobium and niobium nitride are the most promising superconductors of choice, while aluminum oxide, niobium oxide, and manganese oxide are the three most commonly used insulators.

Many difficult material problems (as well as a lack of progress in related memory technology) remain to be solved. But scientists may produce the next generation of chips and computers using Jj, SQUID (for superconducting quantum interference device), and QFP superconducting techniques. Circuits using these technologies may run faster, use less power, occupy less space, and in other ways outperform their conventional electronic counterparts. ■

*Janet J. Barron is a technical editor for BYTE. She can be reached on BIX as "neural."*

# Bugs are expensive. Can you afford them?

**R**ichard Fink, President of RainTree Computer Systems, writes, "...What it [Periscope] offers is probably the most comprehensive debugging capability on the market today. And for you and me, that means getting to market sooner. Getting to market with a cleaner product. That's an objective we all know about."

**Periscope handles the level of debugging you need.**

Whether you're developing applications written in a high-level language, doing low-level system development, or something in between, Periscope can help you find the bugs. Randy Brukaradt, a developer of the Janus Ada compiler, writes, "I couldn't imagine using anything else...It is just as useful debugging my Ada code at the source level as it is for finding bugs in assembler code, even TSRs and device drivers."

**There's just not much you can't debug with Periscope.**

For example, you can debug device drivers and TSRs, child processes, and software interrupts.

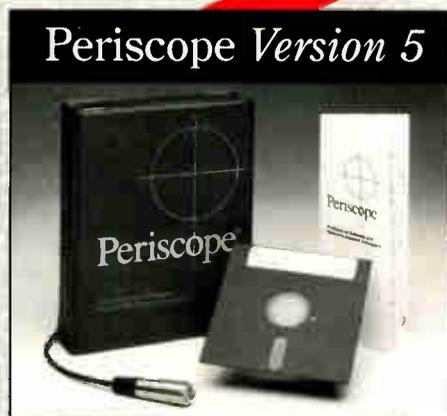
You can trace DOS and debug foreground and background programs in the same session. Large programs are no problem. Periscope supports Plink and .RTLink overlays, and Windows

3.0 programs in real mode. You can monitor software running on another system. And you can debug the boot process, hardware interrupts, and real-time code. The Periscope software runs on 8088 through 80486 machines, supports 80386/80486 debug registers, and runs with 386 control programs in the system.

**There's a Periscope model for every budget.**

Prices start at \$195 for software-only Model II-X. Model II with

its handy break-out switch is \$225. Model I with 512K of write-protected RAM is \$595 for PCs and \$695 for PS/2s. Model IV with its real-time hardware trace buffer and breakpoints is \$1895 to \$2395, depending on your processor and its speed. We'll be happy to help you decide which model you need.



*Periscope Model II includes a break-out switch and the new Version 5 software. The new software, included with all models, features a menu system that makes Periscope easier than ever to learn and use.*

**Start saving money today. Call Toll-Free: 800-722-7006**

Overseas, call: UK - Roundhill Computer Systems, 0672 84 535; Germany - H+B EDV, 07542 6353; ComFood, 02534 7093; Sweden - LinSoft, 013 124780; Denmark - Ravenholm Computing, 02 88 72 49; Australia - BJE Enterprises, 02 858 5611.

**The Periscope Company, Inc.**

1197 Peachtree St., Atlanta, GA 30361, USA • 404/875-8080  
FAX 404/872-1973

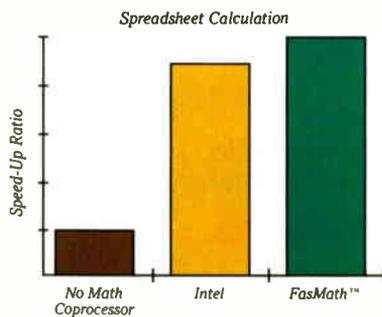
Circle 342 on Reader Service Card (RESELLERS: 343)

# Get the FasMath™ Advantage.

Cyrix FasMath math coprocessors provide real advantages for all 386™ computer users.

## SUPERIOR PERFORMANCE IS OUR MAIN ADVANTAGE.

Performance is why you buy a math coprocessor. And, the entire line of Cyrix FasMath processors were developed with superior performance in mind. Cyrix engineers have designed FasMath utilizing new technology. The result — FasMath processors are the fastest, most accurate and consume the least amount of energy when compared to all other math coprocessors on the market today.



## THE ADVANTAGES OF SPEED, ACCURACY AND LOW POWER.

A math coprocessor offloads the complicated math functions from your computer's main processor, providing actual time savings. Depending on your application, FasMath can deliver up to three times the application performance of the Intel 80387. No other math coprocessor provides greater time-saving advantages than a Cyrix FasMath processor. In addition, FasMath computes results to 20 decimal digits of accuracy in the same time other coprocessors compute 7 digits. With FasMath, accuracy is never sacrificed for the sake of speed. Another FasMath advantage is that the FasMath processor runs cooler and uses less power than all other math coprocessors — a feature that is especially important to laptop users who can take advantage of extended battery life by using FasMath.

FasMath provides faster performance on many popular software programs.



## THE FASMATH ADVANTAGE WORKS WITH YOUR FAVORITE PROGRAMS.

If you thought that only scientists, engineers and programmers performing high-level mathematical calculations could benefit from the performance advantages that FasMath delivers, think again. FasMath helps hundreds of leading software programs work faster. These include spreadsheets, databases, accounting packages, and of course scientific, engineering and graphics applications. FasMath is easy to install in any 80386 or 80386SX system, is fully compatible with IBM® PC based software and socket standards, and is backed by a 5-year limited warranty and toll-free support hotline.



An unprecedented combination of performance and value. Cyrix FasMath is setting the standards for the 90's!

## THE ADVANTAGES OF FASMATH ADD UP TO EXTRAORDINARY VALUE AND DEPENDABILITY.

The entire line of Cyrix FasMath numerics processors offers the value-conscious buyer distinct advantages — faster performance, improved accuracy and low power dissipation, all at competitive prices. What's more, there are tens of thousands already in use today, attesting to the product's superior dependability.

So when it's time to choose a math coprocessor, get the one with *all the advantages* — FasMath by Cyrix. The world's most advanced numerics processors.

The Cyrix FasMath Processor  
High Performance Math CoProcessor For Use In All 80386 Systems

# FasMath™



Cyrix manufactures a full-line of advanced processors for 386 systems at various clock speeds. For more information or where you can buy FasMath in the U.S.A. or Canada call 1-800-FASMATH (1-800-327-6284)

# Cyrix™

Advancing the Standards™

© 1990 Cyrix Corporation. All rights reserved.  
FasMath is a trademark of Cyrix Corporation. All other products referenced are trademarks of their respective companies.

# MODEM BUSINESS

*A close look at the Bell and CCITT standards  
for modem communications*

*Steven E. Turner*

S

ending and receiving files over modem connections is a routine procedure for most personal computer users. It's not unusual, however, to find modems that can't communicate effectively because of compatibility problems—they don't all follow the same standards.

For users, just *understanding* modem standards can be a problem. The maze of modem standards grows constantly. Look at modem advertisements and you'll see a long list—Bell 103J, Bell 212A, V.22, V.22bis, V.32—not to mention proprietary technology and protocols that are licensed by individual companies.

These standards cover a variety of transmission speeds and such features as error correction and data compression. The modem standards in use today come primarily from three sources: Bell Standards, CCITT Recommendations, or EIA/TIA Standards. (For definitions and an explanation of how modem standards are established, see the text box "Where Modem Standards Come From" on page 354.) Table 1 shows the most common modem standards for data rates of from 300 bps to 14,400 bps, over leased-line and dial-up telephone lines.

## Low-Speed Standards

The most common low-speed standards in use are the Bell 103J standard for 300-bps transmission and the Bell 212A standard for 1200-bps transmission. Almost every modem sold in the U.S. supports these standards, either as the primary rate or as secondary *fallback* rates. Fallback rates are used when the modem is unable to connect at higher rates, usually because the telephone channel is too noisy to provide error-free communication at that rate. For example, if a modem attempts to connect at 2400 bps but determines that the line will not support that rate, the modem may try to connect at 1200 bps or 300 bps instead.

The Bell 103J and 212A standards are two-wire, full-duplex standards. This means that modems that support those standards use ordinary telephone lines, and they transmit and re-

ceive data in both directions simultaneously. Even at 1200 bps (212A), the data rate is low enough that the data channel for both directions of transmission can fit comfortably within the 3000-Hz-wide voiceband telephone channel.

Because the CCITT was developing international standards during the 1960s (while Bell was defining U.S. standards), most 1200-bps modems in the rest of the world operate using a standard known as V.22. This is similar to the Bell 212A standard, but the carrier frequencies at which the data channels are modulated are different. Thus, V.22 modems and 212A modems are not compatible, unless special design changes are incorporated.

For 2400-bps transmission, most personal computer modems in use today implement V.22bis. The Bell Standard for 2400-bps data was never completely accepted, because at the time the telephone company's monopoly was dissolved, 2400-bps transmission wasn't yet perfected. As a result, there is almost universal compatibility among 2400-bps modems based on V.22bis.

Like the lower-speed standards, V.22bis is a two-wire (dial-up line), full-duplex standard. To fit two 2400-bps data channels in the 3000-Hz-wide voiceband telephone channel, the data bits are encoded into 4-bit bytes before transmission. Each data signal is then transmitted at 600 baud, and the two modem channels can again fit comfortably within the telephone-line channel.

## High-Speed Standards Grow

Prior to 1984, modem transmission at speeds above 2400 bps was possible only by transferring the data over expensive four-wire (leased) telephone lines. Special standards, such as Bell 208 for 4800 bps, V.29 for 9600 bps, and V.33 for 14,400 bps, were available for use with these leased lines. However, only users needing to transfer very large amounts of data could justify the cost of leasing the telephone lines and buying the more expensive modems.

In 1984, the CCITT approved V.32 for use with standard

## Where Modem Standards Come From

To grasp the conglomeration of modem standards, some understanding of where they come from and how they are made is important. The modem standards in use today come primarily from three sources. The modulation and coding standards are normally Bell Standards or CCITT Recommendations. The interface standards are either CCITT Recommendations or Electronic Industry Association/Telecommunications Industry Association (EIA/TIA) Standards.

The Bell Standards are holdovers from the 1960s when all domestic modem standards were set exclusively by the telephone company. In those days, the telephone company had a monopoly on anything connected to its lines, and, by law, it was the only one allowed to sell modems. As a result, it set its own design standards.

The 1968 Carterphone court decision opened the door for other manufacturers to begin making modems, and the method of standards-making

changed. Since modems used in other countries at that time generally followed international standards, U.S. manufacturers became involved in helping develop those standards instead of creating a new set of standards specifically for the U.S.

Today, most new modem standards are created by the CCITT, based in Geneva, Switzerland, and affect modem users worldwide. In the U.S., modem experts participate in national standards development groups, such as the TIA, to create those standards needed solely for U.S. interests. They also generate technical papers and proposals for the international CCITT organization and join technical experts from other countries in attending CCITT meetings.

Together, these groups work out the fine details of new international modem standards. However, when it comes time to vote on the new standards, each member country is granted only one vote. An official of the U.S. Department of State (the formal representative

to the CCITT) casts the U.S. vote.

Many standards efforts never make it to a vote because of technical problems or political snags along the way. As a result, those that do reach approval are usually well-tested and proven techniques that can be applied around the globe. Once a standard is adopted by the CCITT, modem makers begin implementing it in their products.

One interesting feature of CCITT "standards" is that they are called *Recommendations*. The CCITT cannot force modem manufacturers to comply with its procedures; rather, it recommends an approach. However, in many countries where the telephone network is operated exclusively by the government, CCITT Recommendations have the full force of telecommunications law. In such cases, all modems connected to the network must comply explicitly with the appropriate CCITT Recommendations. In practice, worldwide adherence to CCITT Recommendations is the norm.

dial-up telephone lines. V.32 leapfrogged from 2400 bps to 9600 bps, representing a 4-to-1 increase in throughput over modems using V.22bis. Using advanced technology to provide 9600-bps transmission over ordinary telephone lines, V.32 put the everyday personal computer user in the high-speed data business for the first time by opening new doors to sharing files and programs rapidly over modem connections.

### V.32 Specifics

The technology required to implement V.32 modems did not come easily. The level of technical expertise needed in devel-

oping V.32 modems has been conservatively estimated to be 100 times greater than for V.22bis modems. As a result, fully functional V.32 modems did not become widely available until late 1986—two years after V.32 was adopted.

To send 9600-bps data, V.32 modems group the data into 4-bit bytes and transmit them at 2400 baud. Since there is room for only one 2400-baud data channel within the 3000-Hz-wide telephone channel, V.32 calls for both modems to transmit over the same channel at the same time. Each modem must then sort out its own transmitted signal from the signal it is receiving from the other modem. To do this, V.32 modems use *echo cancelers*. Figure 1 shows a typical modem connection, with the echo cancelers included in the modems at each end.

Hybrid circuits inside all modems are designed to match the characteristics of the modem to the telephone line. Since the nature of the telephone network changes constantly, this match is never ideal. This results in part of a modem's transmitted signal being reflected through the hybrid and back into the modem's receiver.

In addition, echoes of the transmitted signal from the hybrid circuits out in the telephone network bounce back into the modem's receiver. To get a good strong received signal, these reflected echoes must be removed before the modem receiver processes its input.

The echo canceler, which is driven by the known transmitted signal, models the echoes produced by hybrid circuits in the modem and the network. The output of the echo canceler is subtracted from the received signal before it goes into the modem receiver for processing, thus eliminating the effects of the echoes. This is not a simple task. The precision that is required in the echo canceler to remove the echoes is substantial. Since the transmit signal is constantly fluctuating with changes in the data, the echo canceler must continuously adapt to those

### MODEM STANDARDS

**Table 1:** Many standards and recommendations govern how modems are designed. These standards allow modems from many different manufacturers to communicate with one another. An asterisk indicates "with echo cancellation."

Data rate (bps)	Standard	Line	Duplex
300	Bell 103J	Dial-up	Full
	Bell 212A	Dial-up	Full
	Bell 202	Dial-up	Half
	Bell 202	Leased	Full
2400	CCITT V.22	Dial-up	Full
	CCITT V.22bis	Dial-up	Full
	CCITT V.26ter	Dial-up	Full*
4800	Bell 208	Leased	Full
9600	CCITT V.29	Leased	Full
	CCITT V.32	Dial-up	Full*
14,400	CCITT V.33	Leased	Full

**Hayes  
ESP™**

When your high-speed error-control modem outruns your PC system, you stand to lose more than a few characters. You could lose valuable time, not to mention your company's money.

The problem is that today's error-control modems often send data at speeds faster than even the best PC systems can handle.

This problem can be easily solved, however, with the new dual serial port from Hayes. When used with such high-performance software as Smartcom Exec™ or Smartcom III,\* this remarkable communications coprocessor ensures data integrity at the highest speeds.

In fact, Hayes ESP is the only coprocessing serial card that can be used with standard communications software to prevent serial port

errors and provide error-free data transfer at speeds up to 57.6k bps. Even with such advanced operating systems as OS/2\* and Windows.\*

Of course, Hayes ESP also provides all the basic functions you want from a serial card, including two serial port connections for your printers, modems, or other equipment. And it works with all IBM\* and fully compatible PCs.

What's more, Hayes ESP is backed not only by one of the best customer service staffs in the industry, but by a two-year performance warranty as well.

For more information about Hayes ESP, call us at 1-800-635-1225.

There's just no way you can go wrong with it.

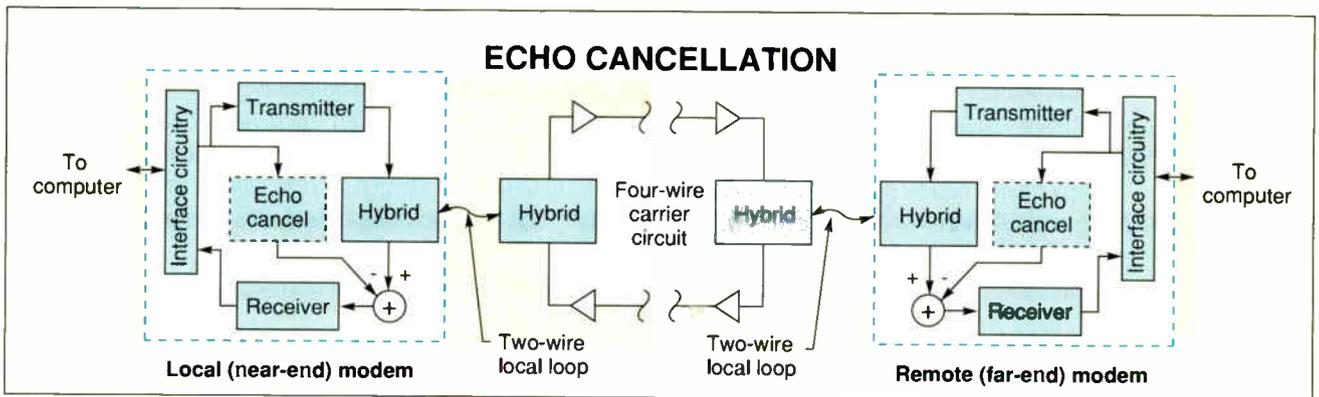
**Hayes.** Our technology has the computer world talking. More than ever.

Circle 158 on Reader Service Card

# If you're not using Hayes ESP, you could be making a big mistake.



All trademarks referenced are the trademarks or registered trademarks of their respective manufacturers.  
©1990 Hayes Microcomputer Products, Inc. P.O. Box 105203, Atlanta, GA 30318



**Figure 1:** In all modem connections, the computer output signal is sent directly to the modem for transmission over the telephone line. A typical dial-up telephone-line modem connection requires the modem signal to pass through two-wire local-loop channels to the telephone company's nearby central office. From there, it travels over a four-wire circuit to the other end of the connection. The signal then passes through the distant modem's receiver to the computer at the other end. Hybrid circuits connect the two-wire/four-wire links and isolate the transmit and receive signals in the modems. In high-speed modems, such as V.32 modems, an echo canceler is used to further isolate the transmit and receive signals and improve signal reception.

changes as it mimics the transmitted signal's echo.

Since at any given moment a V.32 modem is transmitting more data than a lower-speed modem, the individual V.32 data signals are much weaker and harder to detect. For this reason, V.32 incorporates advanced coding techniques such as *trellis encoding*. Trellis encoding allows the modem to examine several consecutive received signals and look for known patterns before deciding the value of the signal.

This memory effect can produce dramatic reductions in the error rate. The end result is that well-made V.32 modems produce very low error rates and provide reliable, high-speed data transfer between modems. This allows personal computer users to trade programs and download files at rates unimagined in the early 1980s.

In an attempt to push technology barriers even further, the CCITT began, in 1989, to study the idea of extending V.32 up to a 14,400-bps rate. This standard was named V.32bis, since it represented an outgrowth of V.32 rather than a new idea. V.32bis requires even better echo cancelers than does V.32. It also requires an overall improvement in receiver quality. Testing has shown, however, that 14,400-bps transmission over standard telephone lines is quite feasible with proper modem design.

V.32bis is expected to be formally approved by the CCITT by mid-1991. Once adopted, V.32bis will open the door even wider for very fast data transfer between personal computers. A summary of new and evolving modem standards and their status is detailed in table 2.

### Data-Manipulation Standards

With the basic modulation rates approaching the theoretical limits of telephone-line channels, modem makers and the CCITT have turned to new ways of improving performance and increasing the data rates. The two most important steps in this direction are V.42 for error correction, and its companion, V.42bis, for data compression.

The error-correction and data-compression functions are applied to the data before modulation and stripped off before the modem receiver decodes the data at the other end. An expanded view of these functions inside the modem is depicted in figure 2.

At high speeds, modems are prone to making more errors,

not only because of the reduced power in high-speed modem signals, but also because they use the edges of the bandwidth (which tend to be noisier) to carry data. V.42, formally approved in 1988, provides error correction using the automatic repeat request (ARQ) principle.

Under ARQ, data is grouped into blocks at the transmitter, and an advanced cyclic redundancy check is applied across each block. This is the same CRC concept already used to ensure the integrity of file transfers in techniques such as XMODEM. The main difference is that V.42 provides error-corrected operation for all information exchanges, not just file transfers using specific computer software programs. Since the technique for checking the received data and retransmitting flawed blocks is contained directly in the modem itself, it is completely transparent to the user and speeds up the transfer process.

The main drawback of V.42, as with any error-correction technique, is that when numerous errors are detected, the throughput rate suffers as blocks of data are retransmitted. However, this only comes into play when errors are actually present, and even then the slowdown in the transfer rate is a small price to pay for the capability to identify and correct those errors.

Modems equipped with V.42 were originally introduced in late 1988 in V.22bis products. It is now widely available in V.32 modems as well.

### Data Compression with V.42bis

Approved in late 1989, V.42bis provides the first "official" method for compressing and decompressing data in modems. (Several proprietary compression techniques have been available for some time, the most notable being Microcom's MNP level 5 technique.)

As with V.42, the CCITT adopted a technique similar to those already in use in the computer industry when it selected a method for V.42bis. This method is a variant of the Lempel-Ziv compression algorithm, the same type of compression used in the familiar .ARC and .ZIP techniques.

However, instead of applying only to files compressed in advance, V.42bis performs automatic, real-time compression and decompression on all the data flowing between the modems. This can bring about dramatic reductions in the amount of time



# Finally, DAT for Computers. <sup>Fall</sup> SEE US AT COMDEX BOOTH #1025

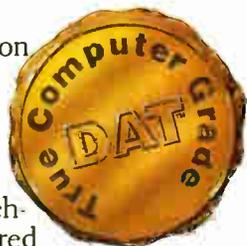
Looking for the ultimate backup for Local Area Networks? Here's a new generation DAT product you can finally rely on: MaynStream® 1300DAT, True Computer Grade DAT™ from Maynard™ Electronics.

## DAT for Performance.

Other DAT products use adapted audio mechanisms. MaynStream 1300DAT was engineered from the ground up for the rigors of computer use. It features advanced electronics and silent operation. Plus an 11 megabyte-per-minute transfer rate and 5 megabyte-per-second burst mode.

## DAT for Networks.

Depend on MaynStream 1300DAT for peer-to-peer networking. Novell®-certified MaynStream 3.0 software backs up your entire network, including file servers and workstations. On-disk tape cataloging provides quick restore of backup data to any network location.



Also, it's the perfect backup for popular NetWare® 286 and NetWare 386.

## DAT for Capacity.

Finally, MaynStream 1300DAT stores 1,300 megabytes of data on one compact 4mm computer grade DDS standard DAT cassette. All from the leader in tape backup—Maynard Electronics. For more information: call 1-800-821-8782 or 1-407-263-3500; write Maynard Electronics, Marketing Communications, 460 E. Semoran Blvd., Casselberry, FL 32707.

**Maynard Electronics**  
An Archive Company

**We're backing you one-hundred percent.**

Maynard is a trademark and MaynStream is a registered trademark of Maynard Electronics, Inc. True Computer Grade DAT is a trademark and Archive is a registered trademark of Archive Corporation. NetWare and Novell are registered trademarks of Novell, Inc.

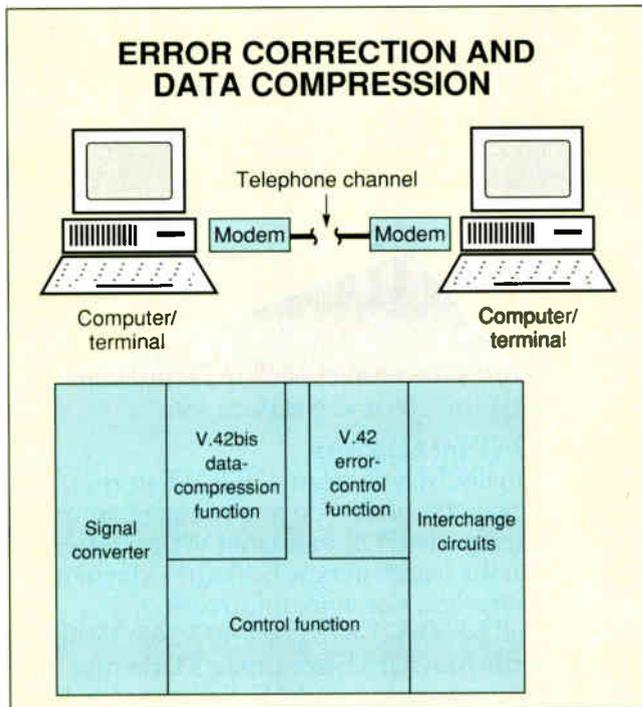
Circle 217 on Reader Service Card (RESELLERS: 218)

World Radio History

**NEW AND EVOLVING STANDARDS AND RECOMMENDATIONS**

**Table 2:** The U.S. TIA and international CCITT committees continue to develop new modem recommendations. Here is a list of recent recommendations and important ones currently under development. The V.32bis Recommendation will likely be approved in mid-1991; it will provide for 14,400-bps file and data transfer over standard telephone lines.

Standard	Purpose	Status
CCITT V.32bis Fallback Procedure	Provides a standardized way of negotiating fallback data rates from 14,400 bps down to 2400 bps.	Technically agreed upon but not yet formally adopted.
U.S./TIA Fallback Procedure	Provides a standardized way of negotiating fallback data rates from 14,400 bps down to 300 bps, including the Bell 103J standard.	Under study by the U.S. TIA TR-30.1 Committee.
CCITT V.32bis Recommendation	Provides standardized dial-up modems at rates of up to 14,400 bps; an extension of V.32.	Under study by the CCITT Study Group XVII Committee. Possible approval by mid-1991.
CCITT V.42 Recommendation	Provides standardized error correction in modems via either MNP Level 4 or LAPM (Link Access Procedure for Modems) protocol.	Approved, April 1988.
CCITT V.42bis Recommendation	Provides standardized data compression in modems via a version of the Lempel-Ziv data-compression algorithm.	Approved, September 1989.
CCITT 19.2K-bps Dial-Up Modem Recommendation	Provides standardized dial-up modem communications at rates of up to 19,200 bps.	Under study by the CCITT Study Group XVII Committee.



**Figure 2:** Many new modems now use the CCITT V.42 error-correction and V.42bis data-compression Recommendations. In the modem, these functions are located in the overall control processor and are applied to the signal between the computer and the signal converter (modulator/demodulator). Modems at both ends of the connection must have V.42 and V.42bis capability for these features to be used.

needed to send and receive data. For example, it is possible to achieve up to 4-to-1 compression ratios with V.42bis. That could mean effective rates of up to 38,400 bps with a V.32 modem or rates even greater than the 56,000 bps offered by digital leased-line service when used with a V.32bis modem. The advantages of reducing the time required to transmit files across a modem connection by a factor of four are obvious, especially if the telephone call is long distance.

The amount of compression that V.42bis can actually provide depends on the type of data being transmitted. Compression algorithms work by recognizing repeated patterns in data and substituting shorter symbols for them. This reduces the number of characters needed to represent a given set of information. The more repetition a data file has, the greater the compression. On the other hand, purely random data contains no patterns at all, and it is noncompressible.

Figure 3 provides a comparison of how well V.42bis works on various types of data. Assembly language and computer source code contain many short, repeated commands, since the language has a limited command set. As a result, data compression ratios on these types of files are generally quite high. Conversely, precompressed files such as .ARC or .ZIP files have already been processed to remove redundancy. Passing them through V.42bis usually does not provide much more improvement. Data files that have been encrypted through a randomization process will also show little reduction in file size and transmit time, because the data has been preprocessed to remove identifiable patterns. For the average personal computer user, however, V.42bis should reduce modem signaling time and expense considerably.

V.42bis began appearing in modem products this summer, first in V.22bis modems and later in V.32 modems. Many of the first V.32bis modems will have V.42bis compression capability as soon as they hit the market.

V.42bis relies on V.42 for its modem protocol and control

# JMP™ to a Higher Level of Discovery

## With JMP Software for Statistical Visualization

Make a quantum leap in data analysis with JMP software for your Apple Macintosh®. JMP combines traditional statistics with today's most innovative graphics.

### Discover more.

▲ Fit regression and Analysis of Variance models, but see them in a new way with leverage plots, showing how each point contributes to each hypothesis test. ▲ Fit means, but see the significance of their differences visually with comparison circles. ▲ Analyze high-dimensional data and extract principal components, but see both the points and variables in the same graph with a biplot, one that spins in 3D. ▲ Examine a correlation matrix, but see more with a matrix of scatterplots with density ellipses. See high-dimensional outlyingness of points with Mahalanobis distance plots. ▲ See your data always displayed in a familiar spreadsheet grid.

### Interact more.

▲ Point and Click to view, edit, or manipulate your data...to get an analysis...to identify points...to customize...to get context-sensitive help...to choose colors and marker symbols for your points in every graph. ▲ Point and Click on a calculator panel to make formulas for variables. ▲ Point and Click on your data in one graph, and the corresponding points will be highlighted in all the other graphs instantly. ▲ Click and Drag to change the intervals for histograms instantly...to spin your 3D graph smoothly in real time...to resize any graph. Cut and Paste your data within JMP or to other applications. ▲ Cut and Paste reports to other applications or journal them to a file.

### Understand more.

▲ JMP is simple to use, so you can spend your time studying your data, not your software. ▲ JMP presents statistical results visually, so you are always

looking at graphs as well as numbers, finding patterns, and noticing points that don't fit patterns. ▲ JMP organizes its statistical methods in a unified way. You approach your data more directly with fewer frustrations regarding the statistical recipes. You always have a method that takes into account the variable's measurement level: nominal, ordinal, or interval.

MacWEEK says "JMP is powerful and easy to use. The programmers' delight in writing JMP is evident throughout and makes the program intuitive and a pleasure to use."

### A Free Video Preview

For a free video preview of JMP, call our JMP Sales Department at (919) 677-8000. In Canada, call (416) 443-9811. Or, write us at the address below.

 **From SAS Institute Inc.,  
the number one name in data analysis software.**

SAS Institute Inc. □ JMP Sales Dept.  
Box 8000 □ SAS Circle □ Cary, NC 27512-8000  
Phone (919) 677-8000 □ Fax (919) 677-8123

To use JMP, you need an Apple Macintosh with 1+ meg, 2 meg recommended.

JMP is a trademark of SAS Institute Inc., Cary, NC, USA.  
Apple and Macintosh are registered trademarks of Apple Computer, Inc.  
Copyright © 1990 by SAS Institute Inc. Printed in the USA.

Circle 308 on Reader Service Card

# UPGRADE YOUR CURRENT COMPUTER TO 386-33 w/ 64 K CACHE ..... \$1,499 .....

**No Budget For A New Computer?**

Upgrade your existing one for a fraction of your repair budget.

Price includes:

**Motherboard 4 MB RAM Case & Power**

**486-25 for \$2,899**

**Hard Drives**

200 MB Conner \$875  
330 MB Maxtore \$1450  
760 MB Maxtore \$1895  
Syquest 40 MB \$525  
Removable cartridge \$85

**CD Drives**

Panasonic internal  
5.25 WORM 940 MB  
\$2,885

**New Systems Available**

Convert your Macintosh into a laptop!!! Call

**ABTECH Inc. 1-800-992-1978**  
1431 N. Potrero Ave. Tel: (818) 575-0007  
S. El Monte, CA 91733 Fax: (818) 575-1500

Industrial Control Systems  
LAN Terminals  
Diskless Systems

## ROMDISK™

For the IBM PC, XT,  
AT PC DOS\* or MS DOS\*

### SOLID STATE DISKETTE AND DRIVE EMULATORS FOR DISKLESS SYSTEMS

- Diskless systems with local DOS and program storage for client LAN terminals, and embedded and industrial control systems.
- Single or dual disk emulation of 5¼" or 3½" diskettes.
- EPROM, Flash EEPROM and SRAM technology. Flash EEPROM models are electrically erasable. SRAM models are battery backed. EPROM models are ultraviolet erasable.
- On-board EPROM programmer—simply copy a diskette to program the EPROMs or Flash EEPROMs. Flash EEPROMs remotely programmable on LANs.
- Two Autoboot modes, a File (read) and a Programming mode—automatic disk drive designation set-up during booting.
- Utilities and Users Manual included.
- List prices from \$195. OEM prices available.

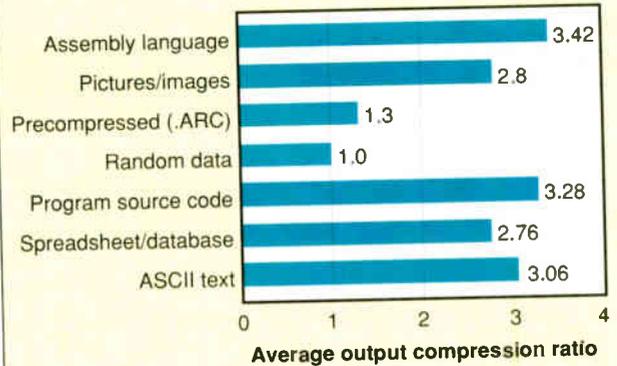


**CURTIS, INC.**  
2837 North Fairview Ave. • St. Paul, MN 55113  
612/631-9512 • Fax 612/631-9508

\* IBM PC, XT, AT, PS/2 and PC DOS are trademarks of IBM; MS DOS is a trademark of Microsoft



### DATA-COMPRESSON COMPARISON



**Figure 3:** The amount of data compression that V.42bis can provide depends on the type of data being sent between the modems. The more random the data, the less the compression, since truly random data follows no clear pattern. Data that has lots of repetition (such as text, source code, or pictures) can often be highly compressed. A compression ratio of 2.0 on this chart indicates that the data can be compressed by a factor of 2 and transmitted in half the time needed to transmit it uncompressed.

functions. Because of this, only those modems that have V.42 will contain V.42bis. Fortunately, since V.42bis is a software-intensive technique, it doesn't require extensive modem redesign, and most modem makers are offering it in their products at a minimal increase in cost.

#### Standards to Watch For

The CCITT is continuing to develop new modem standards, pushing the technology envelope a little further each time. A new effort is under way to standardize a 19,200-bps modem. Another CCITT standard currently under development will provide a uniform interworking procedure to ensure that modems implementing a number of different standards can communicate.

For example, if a V.32 modem calls a V.22bis modem, the new interworking protocol provides a way for the V.32 modem to identify the receiving modem's standard and fall back to V.22bis mode to match it. While many modems are already capable of this, there is no standardized format to ensure that all modems do it in the same way. The new interworking standard should improve compatibility by increasing conformity. Expect the new interworking scheme to begin appearing in modems by 1991.

Another important standards issue that the CCITT expects to take up soon involves interworking between cellular modems and regular telephone-line modems. There is currently no accepted way to guarantee that these modems can communicate, but with the explosive growth of cellular technology and the increased mobility of laptop computers, this will become a major issue in a few years. Hopefully, the CCITT will finalize a standard to solve this problem soon. ■

*Steven E. Turner is manager of technical staff research at UDS Motorola (Huntsville, AL), which manufactures modems. He participates in several TIA and CCITT committees that develop modem standards. He can be reached on BIX c/o "editors."*



# THE CONCEPT BEHIND OUR CASE PRODUCT.

**System Architect is perfect for the beginning CASE user, yet has the power and flexibility to meet the needs of the most experienced users and largest applications.**

System Architect has the power and flexibility you need from a CASE product. It works with today's most popular methodologies, including DeMarco/Yourdon, Gane & Sarson, Ward & Mellor (real-time), entity relation diagrams, decomposition diagrams, object oriented design (optional), state transition diagrams, and flow charts. It supports an integrated data dictionary/encyclopedia, and allows multi-user support both with and without a network. What's more, System Architect's open architecture lets you easily import and export data to other products.

"We're surprised with its flexibility and much taken with the idea of being able to link different kinds of diagrams, in effect moving between analysis and design and back again..." Cutter Information's CASE Strategies, July '89

Yet System Architect is more than just powerful. It's easy to use. Microsoft Windows-based and graphics oriented, System Architect lets you get up and running right away. And if you get lost, you can call on a context-sensitive help facility as well as a novice mode.

"We found System Architect to be extremely easy to use." ISI Systems, CASE Trends, Nov/Dec '89

At \$1,395, System Architect is quite affordable. It runs on almost any PC, and it won't run away with your budget.

"Think productivity has to be pricey? Think again. This product is truly a price performance leader" System Builder, Oct/Nov '89

If you're looking for a CASE product with power, ease of use, and affordability, look to System Architect. It's a concept whose time has come.

## SystemArchitect

Popkin Software & Systems Incorporated  
11 Park Place, 19th Floor, NY, NY 10007

**TO ORDER, CALL (212) 571-3434**  
Fax: (212) 571-3436



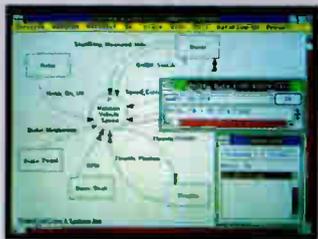
MICROSOFT  
WINDOWS  
Version 3.11 Compatible Product

Automated  
documenta-  
tion facility

RELEASE 2.0

SQL-like  
custom  
reporting

Windows-  
based  
Multiple  
methodologies  
User-defined  
attributes  
Requirements  
traceability  
Rules &  
balancing



Network  
version  
available

Matrix  
reporting

Auto  
leveling

Integrated  
data  
dictionary

Import/export  
capability

\$1,395

**Supporting IBM's AD/Cycle**

System Architect logo is a trademark of Popkin Software & Systems Incorporated. IBM is a registered trademark of IBM Corp. Microsoft is a registered trademark of Microsoft Corp. Price shown valid only for USA & Canada. All prices and specifications are subject to change without notice at the sole discretion of the company. Product delivery is subject to availability.

Circle 286 on Reader Service Card

# LOWER PC PRICES

## IVERSON SUPPORT WITH

### TURNKEY LANS

Design studies, site survey, factory checkout, total installation, training.

### CUSTOM SOFTWARE

Develop menus, drivers, application code, and documentation.

### CUSTOM HARDWARE

Customization of most types of PCs and file servers.

### FACTORY VISITS

Customers may visit factory and work with hardware/software engineers.

### MAINTENANCE/TRAINING

Company owned district offices in major U.S. and European Cities.

### COMPLETE R&D

Design, drafting, computerized sheet metal presses, PCB department.

### FCC LAB

Company owned and operated full service lab.

### TOTAL QC

Incoming, in line, test and burn in, cosmetic, packaging, and shipping.

### CUSTOM PACKING

Individual custom foam packing of each system insures safest shipping.

### LOAD SOFTWARE

Will load and test any software on mass storage device at factory.

### DETAILED SYSTEM GUIDE

Customized guide showing card slots, interrupts, and cabling map.

### COMPUTER PROS

Six Co. Officers began careers at IBM, average 23 years computer experience.

### DESIGNER LABEL

Label showing individual or company name as system designer.

### Knowledgeable Iverson Users

Arthur D. Little, Inc.  
AT&T  
Australia, Government of  
Boeing  
Booz-Allen & Hamilton  
Computer Sciences Corp.  
Digital Equipment Corp.  
Dow Chemical  
Electronic Data Systems  
Equitable Life  
Ford  
General Dynamics  
Goodyear  
Grumman Aerospace Corp.  
Harris Corporation  
Hewlett-Packard Co.  
Hughes Aircraft  
IBM Corp.  
Kodak  
Litton  
Lockheed Missiles & Space Co.  
Massachusetts Institute of Technology  
McDonnell Douglas Aerospace  
Motorola  
NATO  
Nigeria, Government of  
Norway, Government of  
Texas Instruments  
TRW, Inc.  
United Technology Corp.  
plus 350 Government agencies  
in the free world.

**We're best at all the rest, too.**

24-hour delivery on most orders. A 24-hour toll-free technical support hotline. On-site technical support and training. All purchases include a 30-day, money-back guarantee and a 1-year limited warranty. Payment by Mastercard, VISA, and personal check. Purchase orders accepted with credit approval. Quantity discounts available.

It all adds up to the best support and service in the industry. And it's all part of Iverson's "Total Solution Package" of Needs Analysis, Customized Hardware and Software, Systems Integration, Training, Installation, and Maintenance.

### 386SX/16MHz SYSTEM



# BEST BUY!

## COMPLETE 386/SX SYSTEM

# \$1997

- Intel 386SX-16MHz Microprocessor
- 2 MB Memory 80 ns
- 80 MB removable hard drive, 19 ms, 3.5" form factor
- 101 Keyboard
- Flash-lite disk cache software
- ElnShim virus protection software
- DOS 4.01
- 1.2 MB Floppy
- 1.44 MB Floppy
- Baby AT case
- 200 Watt power supply
- 16 Bit VGA adapter w/512K
- 14" VGA 1024 x 768 monitor .28 DP
- One year on-site warranty
- 24 hour technical support line

ORDER NOW!  
CALL

# 1-800-444-PC90

8AM-9PM  
EST  
MONDAY-  
FRIDAY

# FROM OLD PRO

FOUNDED  
1978

## BEST PRICE/PERFORMANCE

\$1,194

386/25MHz



- Intel® 80386-25 MHz CPU
- 2 MB RAM Memory optional 4, 8, 12, or 16 MB on motherboard
- 5.25" 1.2 MB or 3.5" 1.44 MB floppy drive
- Enhanced 101 keyboard
- 1 Parallel and 2 Serial ports
- 8 industry standard expansion slots (six available)
- Integrated high performance hard disk interface and disk controller (IDE)
- 80387-25 Coprocessor socket
- Add \$387 for optional 64 KB cache 35 ns S RAM Memory
- Add \$60 for optional Mini-Tower case
- Add \$120 for optional Full Tower case

Prices include above CPU with same standard options

Display	12" Mono TTL	14" Mono VGA Flat Screen	14" Color VGA 640 x 480	14" Color VGA 1024 x 768
Hard Drive				
40 MB	\$2093	\$2183	\$2484	\$2509
80 MB	2310	2400	2701	2726
100 MB	2453	2543	2844	2869
200 MB	2890	2980	3281	3306
330 MB	3609	3699	4000	4024
1 GB (Erasable Optical Cartridge)	7334	7424	7726	7750

\$1,789

386/33MHz



- Intel® 80386-33 MHz CPU
- 2 MB RAM Memory optional 4, 8, 12, or 16 MB on motherboard
- 64 KB cache S RAM Memory expandable to 256 KB cache
- 5.25" 1.2 MB or 3.5" 1.44 MB floppy drive
- Enhanced 101 keyboard
- 1 Parallel and 2 Serial ports
- 8 industry standard expansion slots (six available)
- Integrated high performance hard disk interface and disk controller (IDE)
- 80387-33 Coprocessor socket
- Add \$60 for optional Mini-Tower case
- Add \$120 for optional Full Tower case

Prices include above CPU with same standard options

Display	12" Mono TTL	14" Mono VGA Flat Screen	14" Color VGA 640 x 480	14" Color VGA 1024 x 768
Hard Drive				
40 MB	\$2300	\$2390	\$2691	\$2716
80 MB	2517	2607	2909	2933
100 MB	2660	2750	3051	3076
200 MB	3097	3187	3489	3513
330 MB	3816	3906	4207	4231
1 GB (Erasable Optical Cartridge)	7541	7631	7933	7957

\$3,589

486/25MHz



- Intel® 80486-25 MHz CPU with built-in floating point coprocessor
- 4 MB RAM Memory optional 8, 12, or 16 MB on motherboard
- 5.25" 1.2 MB or 3.5" 1.44 MB floppy drive
- Enhanced 101 keyboard
- 1 Parallel and 2 Serial ports
- 8 industry standard expansion slots (six available)
- Integrated high performance hard disk interface and disk controller (IDE)
- Add \$60 for optional Mini-Tower case
- Add \$120 for optional Full Tower case

Prices include above CPU with same standard options

Display	12" Mono TTL	14" Mono VGA Flat Screen	14" Color VGA 640 x 480	14" Color VGA 1024 x 768
Hard Drive				
40 MB	\$4100	\$4190	\$4491	\$4516
80 MB	4317	4407	4709	4733
200 MB	4897	4987	5289	5313
330 MB	5616	5706	6007	6031
670 MB	6473	6563	6864	6889
1 GB (Erasable Optical Cartridge)	9341	9431	9733	9757

All systems shipped with the industry's best Search and Destroy Virus Eradication and Disk Cache software included at no extra charge!

**Free Video!**  
For qualified prospects  
Includes installation instructions

Circle 187 on Reader Service Card

### Iverson: Your Solutions Partner.

For the past 12 years, Iverson Technology Corporation has manufactured computers for the biggest and toughest customer in the world—the U.S. Government—meeting their stringent security and military standards with the industry's most exacting quality control.

In that time, our dedicated staff of mechanical, electrical and software engineers have also provided total systems support for large integration projects for over 700 government contractors and agencies from Australia to Norway.

Now we're bringing the industry's highest quality personal computers—and the broadest range of support and service—to the commercial market.

### Find out more about our "Total Solution Package."

Discover why *Forbes*, *Fortune*, *Business Week, INC.*, and *The Washington Post* have used words like "Best" "Top" and "Number 1" to describe our financial performance.

*Your Solutions Partner*

BYB90

Meets "Buy American" Act

## IVERSON FOUNDED IN 1978

COMPUTER CORPORATION Parent Company (IVT) Traded On AMEX

1356 BEVERLY ROAD . MCLEAN, VA 22101

TEL: (703) 749-1200 FAX: (703) 893-2396 TELEX: 289 1271TC UR

## PART 2

# A KNOWLEDGE ENGINEERING TOOLKIT

*Your own knowledge engineering toolkit  
for building expert systems*

*Marc Eisenstadt and Mike Brayshaw*



As we discussed in last month's installment, there is a difference between knowledge engineering shells and toolkits. The shells are ready-made solutions and, as such, are restrictive. With this freely available toolkit, MIKE (which stands for Micro Interpreter for Knowledge Engineering), you can build your own solutions to knowledge engineering problems.

This month we continue with our account of the implementation and use of MIKE. For this discussion, it is important to keep in mind that the knowledge base is maintained in structured representations, called *frames*, that are rendered more readable in MIKE by declaring keywords and symbols such as `with`, `instance_of`, and the colon (`:`) to be infix operators. Frames can then be stored as ordinary database facts, as in the following:

```
fred_smith instance_of person with
  age: 40,
  citizenship: UK,
  weight: 160,
  occupations: [teacher, lifeguard, parent].
```

## Inheritance

Inheritance is a recursive search along `instance_of` and `subclass_of` relations. Finding answers to queries frequently requires no more than a simple `fetch` of the appropriate database fact. For example, if we want to know Fred Smith's weight, given the representation presented earlier, we can find it out directly from the stored frame for Fred Smith because the slot:filler pair `weight : 160` is stored there. We explained in last month's section entitled "Frames as Database Facts" that the essential innards of the frame representation could be obtained with a query such as `?- fred_smith instance_of X with Y`, and that the variable `Y` would contain the relevant information. The crucial step, then, is to search along the conjunction of slot:filler pairs until a successful match is found. Failing that, an-

other possibility is to look further up in the class hierarchy (e.g., under the frame for person) to see if an appropriate value can be "inherited."

When developing the code to carry out our intentions, we first define a "surface form" for the user's benefit, and an internal form that actually does the work. The surface form we would like you to use is as follows:

```
?- the weight of fred_smith is X.
```

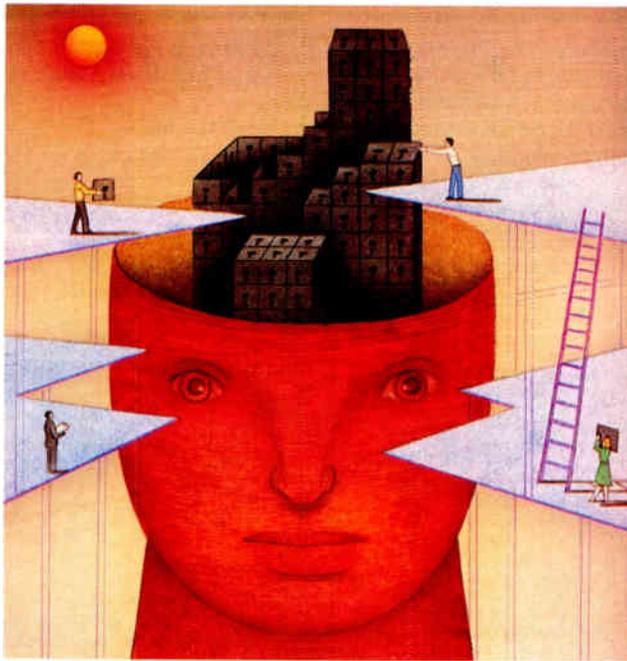
The relevant Prolog code is in listing 1, assuming our operators had already been defined as in last month's listings. The first clause converts the surface form into our internal form. The two clauses of `fetch` cater to the cases in which the object is stored either as an `instance_of something` or as a `subclass_of something`.

The real work is done by the clauses of `retrieve` and, in particular, by its final argument. The first clause of `retrieve` represents the case where the slot:filler pair `Attr:Val` (a) just happens to be the only slot:filler pair, (b) has a filler that is not a list (i.e., does not syntactically match the form `[_|_]`), and (c) is a successful match with the slot:filler pair we are searching for.

The second clause is similar, but in this case, the slot:filler pair `Attr:Val` is the very first pair in the (possibly long) conjunction of many. The third and fourth clauses are analogous to the first and second, but cater to the case when the filler is a list of values, such as `[teacher, lifeguard, parent]`, and it is therefore necessary to invoke `member` to see whether `Val` is a member of the list of `Vals`.

The fifth clause of `retrieve` optimistically tries to do more of the same, but this time matching against `Rest` (i.e., all but the very first of the slot:filler pairs). This is a standard cliché in Prolog, used for traversing lists or conjunctions of items.

The final clause of `retrieve` is reached only when the first five have failed. It invokes `fetch`, but this time passing in `Super` as the first argument to `fetch`, so that the searching ac-



tivity begins with the superordinate object in the class hierarchy (e.g., person, in the case of `fred_smith`). This provides for the cases when the slot:filler pair is not retrievable for a given object, so an attempt is made to retrieve the information further up the chain—this is essentially what “inheritance” means.

There are some important details that are omitted here, especially the problem of what to do when there is a conflict between “directly stored” slot:filler pairs and inherited slot:filler pairs. MIKE handles this correctly (e.g., the knowledge that “an ostrich cannot fly” overrides the knowledge that “birds can fly”), as illustrated in the commented MIKE source code. [Editor’s note: *The Open University’s MIKE source code and Expert Systems’ Prolog interpreter are available in electronic format. See page 5 for details.*]

### Backward Chaining in MIKE

MIKE’s implementation of backward chaining is straightforward because it merely requires an invocation of the basic Prolog proof procedure. There are four main cases to deal with:

- Conjunction of goals (e.g., ‘it is raining’ & ‘it is cold’ & ‘it is Tuesday’). The technique is to invoke the proof procedure recursively on the first conjunct, and then on the remaining conjuncts.
- Frame access (e.g., the age of John is 32). The technique is to invoke the workhorse predicate `fetch`.
- Ordinary working-memory element (e.g., ‘it is raining’). Working-memory elements such as ‘it is raining’ are stored internally using the predicate `wm`, so we just need to see whether `wm(pattern)` succeeds.
- Anything else. The technique is to try to find a stored rule whose conclusion matches the argument passed to prove and then recursively prove the premises of that rule.

These four cases map precisely onto the four clauses of `prove`, shown in listing 2.

### Forward Chaining

Forward chaining searches for the first rule that has all its conditions already satisfied. It represents opportunistic processing (in contrast to goal-directed processing). The basic processing technique is to find any rule, all of whose left-side patterns (premises) are satisfied (i.e., in working memory), and then perform the associated RHS (right-hand-side) actions of that rule. The next thing is to do more forward chaining.

Successful termination occurs when the symbol `halt` is placed into working memory. The three clauses shown in listing 3 capture this processing concept concisely, with the final clause merely representing the terminating condition when no further suitable rules can be found.

As demonstrated in listing 4, a top-level goal `fc` (forward chain) ensures that working memory is cleared up prior to execution and places the special symbol `start` in working memory before invoking the workhorse `forward_chain`.

During forward chaining, a rule’s left-side pattern is said to be satisfied either by being present in working memory or by being retrievable from frame memory. Working-memory elements are stored internally using the predicate `wm`, so in the most general case we just need to see whether `wm(pattern)` succeeds. More special cases exist for dealing with patterns such as the `X of Y is Z`. So the first four clauses of `in_mem` (listing 5) cater for these cases while the general case is left for last.

In a pure production system interpreter, the concept of performing RHS actions is restricted to adding or removing elements from working memory. In MIKE, we make this explicit with the operators `add` and `remove` and allow other special actions as well, such as `announce` and `halt`. The first clause of listing 6 handles conjunctions of RHS elements, while the second and third clauses deal with adding and removing working-memory elements, respectively. The fourth clause provides for cosmetic printout routines, and the final clause adds the special symbol `halt` to working memory for the benefit of the `forward_chain` workhorse routine.

Other cases of RHSes are dealt within the full implementa-

**Listing 1: Fetching from the database. The first clause converts the surface form into our internal form. The two clauses of fetch cater to the cases in which the object is stored either as an instance\_of something or when it is stored as a subclass\_of something.**

```

the Attribute of Object is Value :- % Surface form for user.
  fetch(Object, Attribute, Value). % Our internal form.

fetch(Object, Attribute, Value) :- % Here's its definition.
  (Object instance_of SuperObject % Get stored frame.
   with Stuff),
  retrieve(Object, Attribute, Value, % Invoke real workhorse.
   SuperObject, Stuff).

fetch(Object, Attribute, Value) :- % Alternatively,
  (Object subclass_of Class % stored frame might
   with Stuff), % be found here
  retrieve(Object, Attribute, Value, % so invoke real
   Class, Stuff). % workhorse.

retrieve(Obj, Attr, Val, Super, % Direct hit (single
  (Attr:Val)) :- % slot:filler).
  not(Val = [_ | _]). % Assumes singleton
  % value, not a list.

retrieve(Obj, Attr, Val, Super, % Direct hit (first
  (Attr:Val, Rest)) :- % slot:filler pair of
  % many).
  not(Val = [_ | _]). % Assumes singleton
  % value, not a list.

retrieve(Obj, Attr, Val, Super, % Single slot with
  (Attr:Vals)) :- % filler, which is a
  % list,
  member(Val, Vals). % so see that Val is on
  % list of Vals.

retrieve(Obj, Attr, Val, Super, % First pair of many,
  (Attr:Vals, Rest)) :- % filler is a list,
  % so see that Val is
  % on list of Vals.

retrieve(Obj, Attr, Val, Super, % Last arg is nasty
  (_, Rest)) :- % conjunct,
  retrieve(Obj, Attr, Val, Super, % so traverse it,
  Rest). % searching for direct
  % hit.

retrieve(Obj, Attr, Val, % Direct hits must have
  Super, _) :- % failed,
  fetch(Super, Attr, Val). % so recursively check
  % out the superset!

```

**Listing 2: Examples of conjunction of goals, frame access, ordinary working-memory element, and conclusion of a rule.**

```

prove(First & Rest) :- % Conjunction of goals,
  prove(First), % so prove the first
  prove(Rest). % one,
  % then prove the rest.

prove(the Attribute of Object % Frame access,
  is Value) :- % so invoke frame-
  fetch(Object, Attribute, Value). % access workhorse.

prove(Pattern) :- % A pattern is
  wm(Pattern). % 'satisfied'
  % if it is stored
  % in 'working memory.'

prove(Conclusion) :- % A conclusion can be
  (rule R backward if Premises % proved by retrieving
  then Conclusion), % a rule in which it
  prove(Premises). % appears
  % and then proving
  % that rule's premises.

```

**Listing 3: Forward chaining searches for the first rule, which has all its conditions already satisfied.**

```

forward_chain :- % Deliberate
  % termination occurs if
  wm(halt), % the symbol 'halt' is
  % added to working
  % memory,
  nl, write('Successful % so inform user
  termination. '), nl. % accordingly.

forward_chain :- % Find a rule,
  (rule RuleName forward if LHS % all of whose
  then RHS), % left-side patterns
  % are satisfied,
  all_in_mem(LHS), % and which we haven't
  not(already_did(RuleName, LHS)), % already performed,
  % then perform
  perform(RHS), % associated right-
  % hand-side actions.
  assert(already_did(RuleName, LHS)), % Make a note to avoid
  % repeating this
  % exact case,
  forward_chain. % then carry on
  % forward-chaining.

forward_chain :- % This case only
  % reached when above
  % clause fails,
  % so inform user
  nl, write('No (more) applicable rules. '), % accordingly.
  nl.

```

tion of MIKE, including those that let you perform arbitrary calls to Prolog code. But MIKE still needs to include a few bells and whistles.

The code given so far is sufficient to provide only the barest bones of a toy implementation of MIKE. We have presented the essence of the code to give you a feel for the basic concepts involved. In addition to providing numerous efficiency improvements (including protection against mindless backtracking), the full implementation has to deal with many conceptual extras, like true defaults, facets, conflict resolution, fast forward chaining, daemons, explanation facilities, and tracing.

### True Defaults

Default reasoning means that we accept knowledge in the absence of information to the contrary. This requires an implementation of fetch that deals separately with instantiated and uninstantiated variables. In the example presented in last month's listing 1, you'll notice that the default `r_and_d_budgets` of `high_tech_consumer_market` are increasing (in the absence of information to the contrary). Nevertheless, the following query will erroneously succeed in the implementation just presented, even though the stored `r_and_d_budgets` of `home_computer_market` are actually decreasing:

```
?- the_r_and_d_budgets of
   home_computer_market is increasing.
```

The query succeeds because, in the simplified implementation shown, it is possible to prove both cases (i.e., that `r_and_d_budgets` are decreasing and also that `r_and_d_budgets` are increasing). In the full implementation of MIKE, the above query correctly fails.

### Facets

The implementation described above provides only for a simplified slot:filler notation, whereas the full implementation of MIKE allows a richer structure for fillers using fine-grained

**Listing 4: A top-level goal forward\_chain.**

```

fc :-                               % Top-level invocation.
abolish(wm, 1),                     % Clear out working
                                   % memory.
assert(wm(start)),                 % Add special 'start'
                                   % symbol.
abolish (already_did, 2),
forward_chain.                       % Invoke forward_chain
                                   % workhorse.

```

**Listing 5: Checking to see if a rule's left-side pattern is either in working memory or in frame memory.**

```

all_in_mem(First & Rest) :-        % Conjunction of
                                   % left-side patterns.
in_mem(First),                     % See if the first one
                                   % is satisfied.
all_in_mem(Rest).                  % Recursively see if
                                   % rest are satisfied.

all_in_mem(X) :-                   % Singleton pattern.
not(X = (_ & _)),                  % This ensures that it
                                   % really is just a
                                   % singleton, not a
                                   % conjunction.
in_mem(X).                          % See if it is stored
                                   % in working memory
                                   % or in frame memory.

in_mem(the Attr of Obj is Val) :-  % Patterns of this form
                                   % require frame access,
                                   % so invoke the
                                   % frame-retrieval
                                   % workhorse.
fetch(Obj, Attr, Val).

in_mem(X instance_of Y) :-         % This is useful for
                                   % looking up
                                   % instance_of
                                   % relations,
                                   % in which case we just
                                   % ignore the details
                                   % following 'with.'
(X instance_of Y with _).

in_mem(X subclass_of Y) :-        % This is useful for
                                   % looking up
                                   % subclass_of
                                   % relations,
                                   % in which case we just
                                   % ignore the details
                                   % following 'with.'
(X subclass_of Y with _).

in_mem(deduce X) :-               % This is how we invoke
                                   % a backward-chaining
                                   % rule,
                                   % in which case we let
                                   % the workhorse
                                   % do the work.
prove(X).

in_mem(X) :-                       % This is the usual
                                   % case, i.e., looking
                                   % for an arbitrary
                                   % pattern.
wm(X).                              % Just see if it is in
                                   % the Prolog database
                                   % in this form.

```

attribute descriptors called *facets*. For example, consider the following frame for *dog*:

```

dog subclass_of animal with
number_of_legs: 4,
consumes: [dog_food, meat].

```

Here is the same frame using the richer facet notation:

```

dog subclass_of animal with
number_of_legs:

```

**Listing 6: Additional RHS actions that MIKE provides for: conjunction of elements, adding elements, removing elements, cosmetic printout, and a trap for halt.**

```

perform(First & Rest) :-          % Conjunction of right-
                                   % hand-side patterns.
perform(First),                   % Do the first one
                                   % (this will involve
                                   % one of the clauses
                                   % below),
                                   % and then do the rest.

perform(Rest).

perform(add X) :-                 % MIKE operator 'add'
                                   % signifies 'add WM
                                   % pattern.'
assert(wm(X)).                    % Invoke Prolog's
                                   % assert, which stores
                                   % pattern in database.

perform(remove X) :-             % MIKE operator
                                   % 'remove' signifies
                                   % 'remove WM pattern.'
retract(wm(X)).                   % Invoke Prolog's
                                   % retract, which erases
                                   % pattern from database.

perform(announce X) :-          % Cosmetic printout,
                                   % e.g., announce
                                   % ['hi there,' X].
writel(X).                         % Invoke user-defined
                                   % Prolog utility to
                                   % perform printout.

perform(halt) :-                 % Special trap for
                                   % 'halt' action.
assert(wm(halt)).                 % Just add pattern for
                                   % forward_chain
                                   % to notice.

```

```

[value: 4,
type: integer,
cardinality: 1,
inheritance: supersede],
consumes:
[value: [dog_food, meat],
inheritance: merge].

```

The value facet specifies what the actual filler is, whereas the type facet specifies a run-time restriction that traps anomalous assertions applied to subclasses or instances of the class *dog*, as the following interaction illustrates (assume we have already stored *fido* instance\_of *dog*):

```

?- note the number_of_legs of
fido is mumble.
Warning: 'mumble' violates the
'type' facet of 'dog' for
slot 'number_of_legs',
which specifies type: 'integer'.

```

The cardinality facet specifies how many values are allowed to fill the slot. The inheritance facet allows the user to distinguish between values that supersede inherited values (e.g., ?- note the number\_of\_legs of *fido* is 3 would supersede *dog's* 4 legs) and those that merge with (i.e., augment) inherited values.

Consequently, the inheritance:merge specification for slot consumes of class *dog* allows the inference that dogs consume not only *dog\_food* and *meat*, but also whatever is in the consumes slot of class *animal*. In the full implementation of MIKE, both simple slot:filler and complex slot:[facet:filler] notations are allowed.

# Laptop

## External SCSI Hard Drive

for your Laptop Computer

Tulin Corporation now offers a full line of SCSI hard drives for the laptop computers. A-Hive, Hermit Crab, Half Shell are now available for both the desktop computers and the laptop computers using the parallel port. Tulin continues their tradition of serving their customers with affordable price and performance in their products.

A-Hive	(9.9"X9.6"X4.3")
	30MB
	48MB
	65MB
	85MB
	100MB
	120MB
	170MB
	200MB
	340MB
	675MB
	1000MB
Cartridge Drive	44MB



A-Hive Jr.	(7.1"X7.1"X2.2")
	30MB
	48MB
	60MB
	80MB
	100MB
	150MB
	170MB
	200MB



Hermit Crab	(7.8"X5.5"X2.8") and additional shock mounts
	20MB
	30MB



Half Shell	(7.5"X5.5"X1.1")
	20MB
	30MB



Tulin Corporation

2156H O'Toole Ave., San Jose, CA 95131

Tel: 408-432-9025

Fax: 408-943-0782

# MIKE

*incorporates three conflict-resolution strategies and allows the user to select combinations from among these, or even to add more.*

### Conflict Resolution

The definition of forward\_chain presented here so far doesn't specify what to do if several rules have all their left-side patterns satisfied; in that event, it will choose the first one. But a true conflict-resolution strategy requires a *principled* selection of a winner.

MIKE incorporates three conflict-resolution strategies and allows the user to select combinations from among these, or even to add more. The supplied strategies are:

- *refractoriness*, which prevents identical rule instantiations from firing multiple times,
- *recency*, which prefers rules that apply to the most recently added working-memory elements, and
- *specificity*, which prefers rules that have a greater number of conditions on their left sides.

The simple implementation presented above simulates refractoriness by means of the database flag already\_did (Rule-Name, LHS).

### Fast Forward Chaining

The definition of forward\_chain embodies a very naive algorithm (i.e., "Find some rule and test whether all its left-side conditions are satisfied") and incurs huge overheads when the set of rules is large. Fast indexing algorithms (e.g., RETE and TREAT) ensure that the only rules that ever get considered are those whose left-side conditions involve recently modified working-memory patterns. Future releases of MIKE will incorporate such an algorithm.

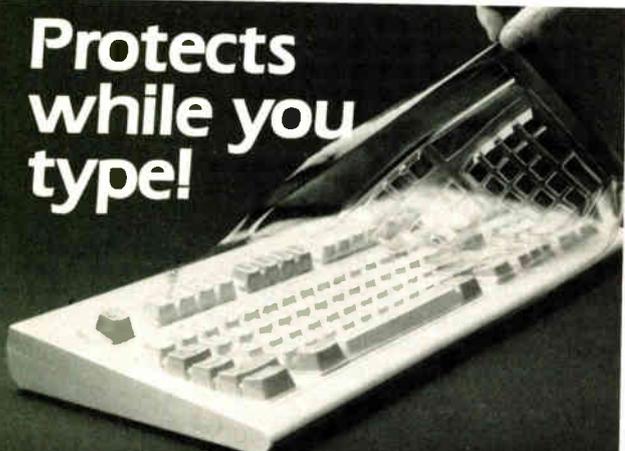
### Daemons

Actions associated directly with specific slots in a frame object can be invoked either when slots are accessed or when slots are changed. In MIKE, these are specified by extra facets called access\_rule and change\_rule. They use the same syntax as MIKE's rule notation. For example, here is an access\_rule daemon that calculates (at run time) the volume of any instance of class vessel:

```
vessel subclass_of object with
  volume:
    [value: unknown,

  access_rule:
    (if
     the height of ?self is H &
     the width of ?self is W &
     the depth of ?self is D &
     prolog(Vol is H*W*D)
```

# Protects while you type!



- **Remains In Place** while you use your computer.
- **Avoids Costly Repairs.** Protects delicate electronics from dust, spills, smoke, ashes, staples.
- **Soft, Flexible,** retains normal keyboard feel.
- **Washable, Durable High-Tech Polymer** lasts years.
- **Hundreds of Models.** SafeSkin is available for most PCs, laptops, workstations and clone keyboards.
- **Office • Home • Factory • Classroom • Laboratory**

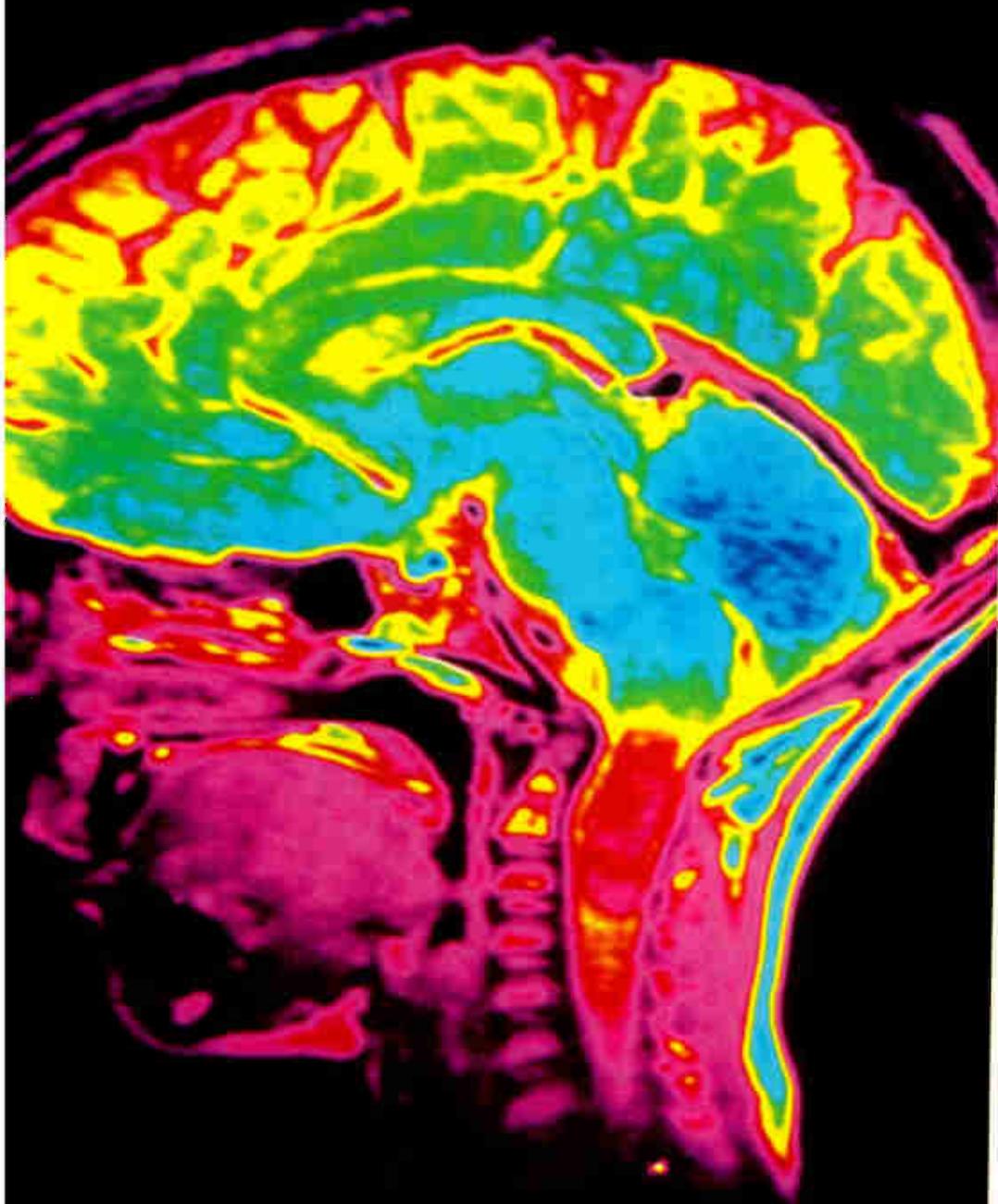
List Price \$29.95. Please call or write for free color brochure. Dealer Inquiries encouraged.

## SafeSkin™

KEYBOARD PROTECTOR

Merritt Computer Products, Inc. 5565 Red Bird Center Drive  
Suite 150, Dallas, Texas 75237/(214) 339-0753 • FAX (214) 339-1313  
In Canada call 1-800-663-1061

At Mount Sinai Hospital,  
some of the best brains in the  
country rely on Sony.



Fortunately, critical patient data  
is tucked into the safest place of all.  
A Sony data cartridge.

In fact, hundreds of detailed files  
can be accessed from one, single,  
solitary data cartridge.

Which is how the renowned  
doctors at Mount Sinai Hospital  
in New York City store patient  
diagnostic data.

Not one byte can be lost.

That's why Sony produces, with  
exacting care, a range of mini and  
ultra-high capacity data cartridges  
up to 525 megabytes.

And if Sony data cartridges can  
do all of this, they can also back up  
another vitally important life force  
with the utmost integrity.

Your business operations.



**SONY**

Circle 318 on Reader Service Card

**Listing 7: Rule graph for a sample interpreter run.**

RULE NAME	CYCLE NUMBER(1-13)
initialization_rule	.....1..
boilingWater_UnplugKettle	*+++++++
boilingWater_FillKettle	* ++++++
boilingWater_PlugInKettle	*
boilingWater_SwitchOn	*
boilingWater_WaterBoiled	*+++++++
makingTea_AddTeabag	*+++++++
makingTea_AddBoilingWater	++++*++++
makingTea_BrewingTea	**
makingTea_RemoveTeaBag	*
makingTea_MilkAndSugar	**
makingTea_MilkRequired	+++
makingTea_SugarRequired	+++
makingTea_StirringMilkAndSugar	**
makingTea_StirringMilk	++
makingTea_StirringSugar	++
makingTea_StirringTea	+++
makingTea_TeaIsMade	*

**ITEMS DISCUSSED****MIKE**

Part of a text/video package "Knowledge Engineering" (#PD624). Comes with a Prolog interpreter for MS-DOS. The Open University Learning Material Sales Office P.O. Box 188 Milton Keynes MK7 6DD U.K. 44-908-653338 Inquiry 1016.

**Prolog Interpreter**  
Supplied with MIKE; a version of Prolog-2. Expert Systems, Ltd. Unit 12, 7 West Way Oxford OX2 0RD U.K. 44-865-794474 Inquiry 1017.

```
then
the volume of ?self is Vol)].
```

Now, suppose you have the following instance of vessel defined:

```
tank1 instance_of vessel with
height: 10,
width: 10,
depth: 10.
```

The next interaction shows the effect of invoking the access\_rule daemon:

```
?- the volume of tank1 is What.
What = 1000.
```

**Explanation Facilities**

During execution, it is useful to be able to pose "how" and "why" queries that specify, in a comprehensible format, how particular conclusions are justified and why a particular question is being asked. This capability is included in the full implementation of MIKE.

**Tracing**

Monitoring the details of rule execution is critical for debugging purposes. MIKE provides both coarse-grained and fine-

grained views of the execution process to facilitate debugging.

The special command ?- show history produces a display of the behavior of each rule at each cycle of execution during forward chaining. The style of the graph is based on TRI (Transparent Rule Interpreter), a powerful "click, point, and zoom" rule-tracing environment implemented on a Symbolics AI workstation by our colleague, John Domingue.

In the example in listing 7, cycle numbers are shown along the top row (with a "." for each cycle, a ":" for every fifth cycle, and an integer for every tenth cycle). The left side of the display shows the name of each rule. The symbols in the table indicate the fate of each rule on each cycle. A "+" symbol means that the rule entered the conflict set (i.e., it was a potential candidate), but it was not actually fired. A "\*" symbol means that the rule not only entered the conflict set, but was also the one selected for firing. Listing 7 is a sample history trace showing a simple forward-chaining rule base designed to make a cup of tea.

**The Value of MIKE**

MIKE forms the backbone of an Open University Study Pack on Knowledge Engineering, which includes text and video material that is centered around case studies of knowledge-elicitation exercises, and a review of commercial knowledge engineering toolkits.

MIKE fulfills three purposes in the context of the Open University's Knowledge Engineering course:

- It provides a "paper and pencil" surface syntax that helps to concretize discussions about different styles of knowledge representation;
- It provides a working implementation that encourages user experimentation via numerous hands-on exercises; and
- It provides fully commented source code that illustrates how to implement a knowledge engineering environment from scratch.

In the interest of portability, a conservative subset of "Edinburgh-syntax" Prolog was used to develop MIKE, and graphics were completely avoided. Even the tracing facilities are essentially "glass teletype." This may seem somewhat surprising, given our own commitment to state-of-the-art environments for both knowledge engineering and graphical rule tracing in Prolog. However, we thought it preferable to adopt a least-common-denominator strategy to encourage the most widespread dissemination of our courseware. We are encouraging users to modify MIKE software and to give us suggestions and improvements for incorporation into future iterations.

An important motive of this whole exercise has been mass consciousness-raising. MIKE contributes to the dissemination of knowledge engineering techniques, and the design and implementation of knowledge engineering environments. ■

**ACKNOWLEDGMENT**

The software described in this article was designed and developed under the auspices of a grant from the U.K. Science and Engineering Research Council. The "rule graph" notation was directly inspired by the work of our colleague, John Domingue.

Marc Eisenstadt is a professor of AI. Mike Brayshaw is a Research Fellow. Both authors work at the Human Cognition Research Laboratory at the Open University in England, where they are currently focusing on program visualization and the Prolog programming language. They can be reached at the Open University or on BIX c/o "editors."

# DBMS Case Study:

# Security for the Goodwill Games™\*



## The Problem

The 1990 Goodwill Games: 2500 athletes in 22 events at 15 locations, drawing hundreds of thousands to watch them perform. A show-place for international goodwill. A potential target for terrorists. A challenge for security agencies.

With only 3,000 off-duty officers to fill 30,000 assignments, there's no room for confusion in scheduling. And scheduling must respond to last minute changes, as event times slip, as dignitaries arrive on short notice, or as threats arise. Hand-scheduling can't meet the challenge. But the Games' Integrated Police Planning Group (IPPG) found that no automated system had ever been developed for securing such events.

## The Application

Automated Manpower On-line Scheduling

(AMOS) matches personnel to scheduling requirements, taking into account special training, language skills, and other factors. AMOS prepares an assignment sheet for each individual, explaining the assignment, when and where to report, how to get there — even where to park.

AMOS responds to changes quickly. The database is large and complex, yet thanks to the innovative

# db\_VISTA III™

## Database Management System

### Specifications

High performance. C language portability. Complete C source code available. No royalties.

Network data model. Relational B-tree indexing. Relational SQL query and report writer. Single & multi-user. Automatic recovery. Built-in referential integrity. Complete schema revision capability. Supports: VMS, UNIX, QNX, SunOS, XENIX, Macintosh, MS-DOS, MS Windows, OS/2 compatible. Most C Compilers and LANs supported.

**Raima Corporation** 3245 146th Place S.E., Bellevue, WA 98007 USA (206)747-5570 Telex: 6503018237 MCI UW FAX: (206)747-1991

**International Distributors:** Argentina: 54 1 313 5371 Australia: 61 2 419 7177 Austria: 43 22 43 81861 Brazil: 55 11 829 1687 Central America: 506 28 07 64 Denmark: 45 42 887 249

France: 33 1 46092784 Italy: 39 45 584711 Japan: 81 3 865 21-0 Mexico: 52 83 57 35 94 The Netherlands: 31 02159 46 814 Norway: 47 244 8855 Sweden: 46 013 124780

Switzerland: 41 64 517475 Taiwan: 886 2 552 3277 United Kingdom: 44 092 500919 Uruguay: 598 2-92 0959 USSR: 01 32 35 99 07: 812 292 19 65: 0142 437952 West Germany: 49 \*022 34077

Copyright ©1991 Raima Corporation. All rights reserved. \* "Goodwill Games" is a trademark of the Turner Broadcasting Company db is registered in the U.S. Patent and Trademark Office.

combined technology of the underlying db\_VISTA database engine, search, match, and update times are negligible. Data integrity is assured by avoiding data redundancy. That means the information is reliable.

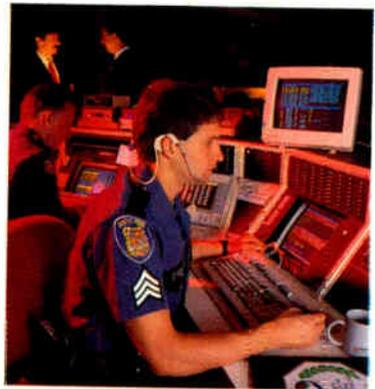
## The Solution

AMOS was created by Raima's services subsidiary, Vista Development Corp., using the db\_VISTA III DBMS. "We looked for months for a database that was fast, flexible, and could handle a huge volume of data while still maintaining speed," said Sgt. Alan Bernstein of the IPPG. "We also wanted to find a company that could not only furnish the product, but provide the development services." They discovered Raima and db\_VISTA III.

Your end users may not be fighting terrorists, but they still need fast, reliable information to get their jobs done. If you develop applications for MS-DOS, MS Windows, UNIX, QNX, OS/2, VMS, Macintosh, and other environments, db\_VISTA III is the solution.

**Call 1-800-db-RAIMA (1-800-327-2462)**

Circle 392 on Reader Service Card



Command center personnel can adjust schedules without delay or confusion, thanks to db\_VISTA III's ability to handle large volumes of data with speed and accuracy.

# Anti-Obsolescent. Forval Super High-Speed Modems.

Enhancements for your modem are just a phone call away. Simply dial FORVAL's headquarters and FORVAL-Link™ assures speed or feature upgrades automatically. Your modem is protected against obsolescence.

With FORVAL Turbo Interface,™ data integrity is ensured even at speeds greater than 19.2Kbps.

Modem can be used horizontally—or vertically when you need to save desktop space.



Forval's super high-speed dial-up modems are currently the fastest full duplex modems on the market—up to six times faster than ordinary V.32 modems.

Completely compatible with CCITT dial-up standards.

Controls and displays ensure complete visibility and management over modem operation.

Now you can get all this for the same amount you would spend on an ordinary V.32 modem.

Introducing the SA14400 from Forval. The first super high-speed modem designed to discourage obsolescence.

And don't worry about compatibility. Forval modems are compatible with all dial-up modem standards. So you can talk to anyone. Anywhere. No matter what the line conditions.

Your investment is also protected with a five-year warranty. And free high-speed communications software is included in the package.

So if you want a super high-speed modem that has it all, think of us.

Forval.

To learn more about our complete



Also available in board model for internal PC use.

line of modems, call us today at **1-800-FORVAL-1.**

FORVAL AMERICA, INC.,  
Modem Division, 6985 Union Park  
Center, Suite 425, Midvale,  
Utah 84047, Tel: (801) 561-8080,  
Fax: (801) 561-8777.

The Modem With A Future.™

# HOT LINKS TO GO

*Dynamic Data Exchange lets Windows and OS/2 applications share data easily*

*Michael Vose*



Windows 3.0 and OS/2 Presentation Manager (PM) endow application programs with a common look and feel. Programs running simultaneously almost seem to blend together. When they employ a service called Dynamic Data Exchange, they functionally do. With DDE, a program can use another program's data as though it were its own. This intimate sharing of information promises to integrate tomorrow's programs as never before.

While graphical user interfaces (GUIs) abound these days, DDE sets Windows and PM apart from the rest. I'll look at how DDE works and describe how you can use it to realize a new level of interprogram harmony.

## The Information Melting Pot

Both Windows and PM can multitask different applications, as well as instances of the same application (sharing code across instances). PM applications can also multitask internally—a program might dedicate one thread to menu handling and another to screen updating. Furthermore, with the multiple-document interface, a Windows or PM application can maintain several active documents. All this concurrent activity, along with a common look and feel across programs, encourages users to view the system as a whole and to expect the parts—including data—to work together.

Getting information from one program to another has always been a thorny problem. In the character-based world of DOS, nearly every application specifies its own unique format for storing and displaying information. To exchange information, you have to negotiate some sort of format conversion.

GUIs and some character-based windowing systems try to overcome this problem with cutting and pasting. Although well understood and useful, cutting and pasting suffers from several limitations. It involves several steps: You have to select the information, cut or copy it, indicate a destination, and then paste the information. Cutting and pasting can limit you to text- or character-only information exchanges. Additional information

(in the case of text, fonts and emphasis) often doesn't survive the transfer. Most important, information exchanged by cutting and pasting is static; if the original information changes, you have to redo the data exchange.

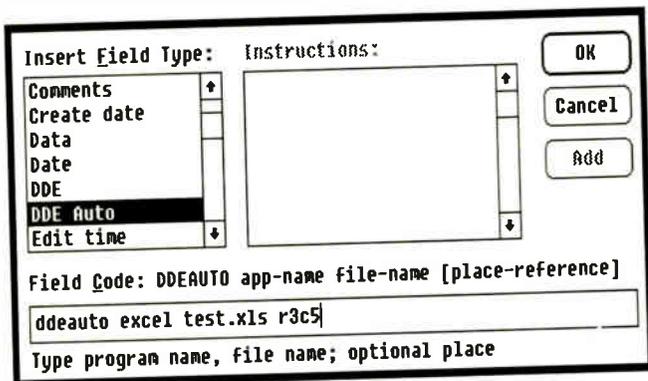
DDE addresses these information-exchange inadequacies. As its name implies, DDE enables programs to share information even as the information changes. In addition, DDE operates automatically once a user connects one or more applications.

The programming team that wrote Microsoft Excel invented DDE to show how to use Windows' message-based interprocess-communications facilities. Windows incorporated DDE in version 2.0; PM had it from the start. (A special dynamic link library to implement DDE under Windows 1.0 appeared just before Windows 2.0 was released.) DDE extends the message-based architecture of Windows and PM. Developers can incorporate DDE, which is a documented protocol for interprocess communication, into any Windows or PM program. Such programs can then exchange information whenever instructed to do so.

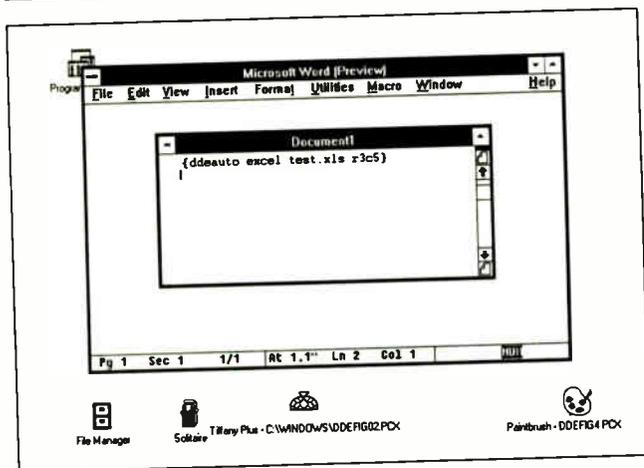
## DDE's Many Uses

Although DDE has been around for some time, not many programs use it yet. The programs that do support DDE illustrate a variety of information-exchange scenarios:

- *Stock reports with hot links to real-time data.* With a telecommunications hookup to a stock-reporting service like Lotus Signal (which uses an FM radio sideband to transmit stock data), a DDE-capable spreadsheet receives data from a stock-tracking program, records every change in the price of one or more stocks, and recalculates the value of a portfolio.
- *On-line airline reservations.* A network of PCs links a reservation database to a graphics program showing an up-to-date diagram of the available seats on any scheduled flight. This application uses a background "redirector" that intercepts DDE traffic, converts it to the appropriate network protocol, and



Screen 1: This is the Word edit box for creating a field in a document. This example creates a DDE field that links a cell in an Excel spreadsheet to a Word document.



Screen 2: In this Word document, the DDE field displays the DDE application topic and item names. Alternatively, it could show the value of the referenced spreadsheet cell.

sends it across the network to another station where a similar redirector converts it back to DDE.

- **Compound documents.** These are DDE-linked word processing elements that each manipulate a separate document but share some common text with each other and are thereby always up-to-date—even if the individual documents are on different machines on a network.
- **Data queries across applications.** A spreadsheet queries a database for information that updates itself whenever the database changes. The PM version of AutoCAD uses this kind of DDE link to let an Excel spreadsheet's materials worksheet control an AutoCAD drawing.
- **Links to remote mainframes.** DDE-capable communication programs link mainframe databases to PC-based spreadsheets or word processing programs.
- **Remote data gathering.** Using data acquisition hardware, a DDE-based software module collects data and simultaneously saves it to disk, links it to a chart program that diagrams the incoming data, and also links it to a spreadsheet that computes averages.
- **Downloads from E-mail or communications services.** Instead of reading information on-line, a DDE-based telecommunications program saves messages to disk or places them into a word processor document for later perusal.

In each case, automatic transfer of data between applications frees users from mundane and repetitive cutting and pasting and welds individual programs together to create metaprograms that are more than the sum of their parts.

### On the Links

DDE supports both temporary and permanent information exchanges. Temporary exchanges are simple transactions. A program requests information and receives it or sends information and receives an acknowledgment. Permanent exchanges come in two varieties: hot and warm. When sender and receiver communicate by way of a DDE "hot link," information flows only when the sender has new data to transmit. In the case of a "warm link," the sender tells the receiver that there's new data, but doesn't send it until the receiver asks for it.

A program's user establishes temporary or permanent links between applications. In a DDE spreadsheet like Excel, for example, you do that by placing a formula into a worksheet cell. This formula describes the target application and the nature of the link. For example, to link an Excel spreadsheet to the Quotes stock market reporting program, you place a formula into a cell as follows:

```
= 'QUOTE' | 'NYSE' ! IBM
```

This formula contains the three essential pieces of DDE syntax: application, topic, and item names.

In Microsoft Word, DDE links are fields. Along with time, date, and comment fields, Word also supports a DDE field. To link a Word document to an Excel spreadsheet, you specify the DDE names. The edit box in screen 1 gives an example. Following the field code DDEAUTO there is the target application's name (excel), the topic name (test.xls, a data file), and the item name (r3c5, the cell that has the information).

Once established, this link will place whatever value resides in that worksheet cell into the Word document and will change it automatically if the worksheet value changes. The Word document can either display the value or, as screen 2 illustrates, show the field specification that governs the value. As you can see, it takes just a few steps to link programs together. You can terminate a link just as easily.

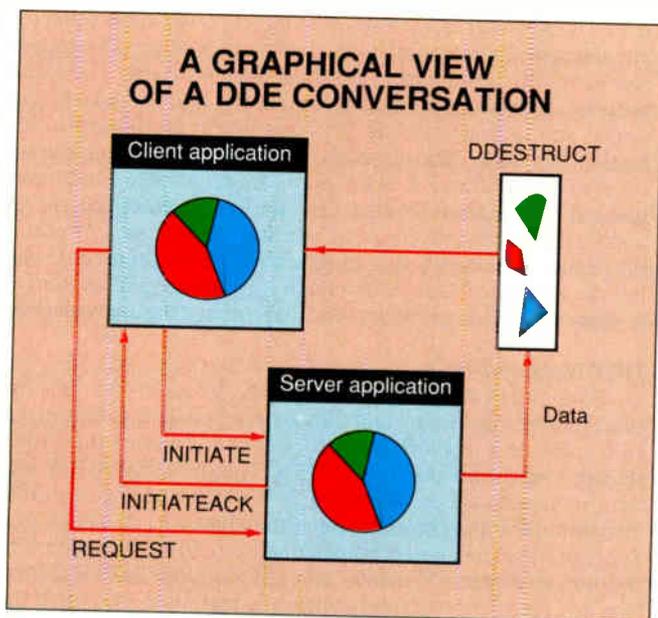
Links between programs can refer to fields within files, or to entire files. File-level links ensure that changes to a master file propagate to any files linked to that master. These secondary files need to be open to stay in sync with the original.

Users of programs that support DDE don't generally need to worry about whether they're running under Windows or PM. Most programs that support the two environments forge DDE links the same way. Internally, as you'll see, Windows and PM handle DDE a bit differently.

### How DDE Works

The underlying mechanisms that make DDE possible depend on the message-based architecture of Windows and PM. Under these environments, when anything happens—a mouse-click, key press, window-dragging operation, or menu selection—the operating system broadcasts a message. These messages accumulate in either a system message queue or an application message queue. Within every Windows or PM application, a message loop continually examines these messages, selects those that it needs to handle, and ignores the rest.

Windows' cooperative style of multitasking relies on the messaging system. Whenever any application retrieves a message from the system message queue and acts on it, Windows gives that application control of the CPU. Before it can check



*In a typical DDE conversation, the client initiates the conversation, and the server acknowledges. The client then requests data, which the server puts in shared memory.*

the message queue again, all other running programs get a crack at the queue and a chance to gain control. Although PM structures the retrieval and processing of messages in a similar way, OS/2 handles multitasking differently. A scheduler in the operating-system kernel parcels out CPU time to program threads.

The stream of messages flowing within Windows and PM enables DDE. It is simply a message protocol: the definition of a series of messages that Windows and PM programs can respond to and act on.

#### **The Client-Server Model and Conversations**

The *client-server model* and the *conversation* are the two key conceptual ingredients of DDE. With the client-server model, a DDE server provides data, and a DDE client consumes it. This apparently simple model can get complicated, however, because a client can have multiple servers, and a single program can function as both a client and a server. These complex scenarios are particularly likely under multitasking systems. For example, one application can receive data from a second as a client and then act as a server to pass information along to a third. Applications can simultaneously play the role of both client and server (in two separate conversations) to simulate a two-way peer-to-peer interaction.

The interactions between a DDE client and server are called conversations. Conversations between programs work like telephone conversations between people. One program initiates a conversation, the other acknowledges that a conversation has begun (like someone answering a phone), information flows, and, finally, one program terminates the conversation.

Conversations from a client program not only target a server application but also specify a topic and an item. A topic is typically a filename, and an item is any specific data object—usually specified by a field, cell, or range—within that file. Each data object requires a separate request.

The behind-the-scenes logic of a DDE conversation goes like this (see the figure): The client starts a conversation by sending

## Subscription Problems?



## We want to help!

*If you have a problem with your **BYTE** subscription, write us with the details. We'll do our best to set it right. But we must have the name, address, and zip of the subscription (new and old address, if it's a change of address). If the problem involves a payment, be sure to include copies of the credit card statement, or front and back of cancelled checks. Include a "business hours" phone number if possible.*

# BYTE

Subscriber Service  
P.O. Box 555  
Hightstown, NJ 08520



### DDE MESSAGES

*The DDE message sets for Windows and Presentation Manager. The two sets share nine messages. PM adds a tenth: WM\_DDE\_INITIATEACK.*

DDE MessagePurpose	
WM_DDE_INITIATE	Request the start of a DDE conversation.
WM_DDE_INITIATEACK	Acknowledge the start of a DDE conversation (PM only).
WM_DDE_TERMINATE	Halt a conversation.
WM_DDE_ACK	Acknowledge a DDE message.
WM_DDE_REQUEST	Ask server to provide data.
WM_DDE_DATA	Notify client that data is available.
WM_DDE_ADVISE	Ask server to update data whenever it changes.
WM_DDE_UNADVISE	Tell server that a data item should no longer be updated.
WM_DDE_POKE	Ask server to accept unsolicited data.
WM_DDE_EXECUTE	Sends a command string to server.

**Listing 1: API calls to initiate a DDE conversation under Windows and PM.**

#### Windows

```
SendMessage(
    (HWND) -1,
    WM_DDE_INITIATE,
    hMyWnd,
    MAKELONG(aApp, aTopic)
);
```

#### Presentation Manager

```
WinDdeInitiate(hwnd, "AppName", "TopicName");
```

**Listing 2: Presentation Manager DDEINIT and DDESTRUCT data structures. The DDEINIT structure holds the application and topic names (Windows stores these in atoms). DDESTRUCT holds the name of the item, its format, and the item's data.**

```
typedef struct _DDESTRUCT {
    ULONG      cbdata;
    USHORT    fsStatus;
    USHORT    usFormat;
    USHORT    offszItemName;
    USHORT    offabData;
} DDESTRUCT;

typedef struct _DDEINIT {
    USHORT    cb;
    PSZ      pszAppName;
    PSZ      pszTopic;
} DDEINIT;
```

out a DDE-initiation message. The target server application (or any interested application if the client names no specific target) responds with an initiation-acknowledged message. The client program next sends a message containing a topic and an item name, and it requests either a permanent or temporary information exchange. The server then responds by sending the requested information. A client application can also send unrequested information to a server and can instruct the server application to execute one of its internal commands. For example, under Windows 3.0, a program's installation module can tell the Program Manager to create a group and add an item to it. Either the client or the server can terminate the conversation.

### DDE Nuts and Bolts

DDE relies on a series of nine messages (10 under PM—see the table) and several important data structures. These data structures provide a memory format for the information that flows during a conversation. The DDEINIT and DDESTRUCT PM data structures appear in listing 2. Windows uses global data structures that programs create with calls to the GlobalAlloc function. Parameters accompanying each DDE message point to these structures. Windows and PM store the DDE information itself (e.g., spreadsheet values and text) in memory that the client and server share. The client application program must allocate memory for all DDE data structures when it initiates a DDE conversation.

A DDE conversation begins when a client broadcasts a WM\_DDE\_INITIATE message. Under Windows, you use the generic application programming interface function SendMessage; under PM, there's a special WinDdeInitiate call (see listing 1). Similarly, Windows uses SendMessage and PostMessage API calls for sending subsequent DDE messages, while PM uses a special call, WinDdePostMsg.

Once a DDE conversation has begun, a client application conducts an exchange by performing the following actions:

- *Allocate memory for the DDE memory object.* This action creates the shared memory area that both applications will use.
- *Create a format for the information to be exchanged.* Windows and PM provide a predefined format (clipboard format) for exchanging string data. A program must create its own format for exchanging other data, like graphics.
- *Select an information-exchange type.* The client program specifies whether an exchange will be one-time-only, a hot link, or a warm link.
- *Send a DDE message.*
- *Deallocate DDE shared memory.* This step cleans up memory after the completion of a DDE.

Each DDE conversation requires a separate window on both ends. It might be a main application window, a window associated with a specific document, or a hidden window that never appears on the screen.

### Differences Between Windows and PM DDE

Although their DDE message sets are nearly identical, Windows and PM use slightly different schemes for passing information among applications. This difference results from a key distinction between the memory-addressing design of their respective underlying operating systems.

Windows DDE uses 16-bit handles to global memory objects to locate exchangeable data. PM limits access to global memory and instead uses a 32-bit memory selector to pass data between OS/2 processes.

There are two parameters available as arguments for any

given DDE message. The first designates the handle of the target window. A second 32-bit parameter contains all other conversation particulars, including memory selectors. The designers of PM foresaw that this parameter could not forever accommodate the ever-increasing size of processor address spaces and LAN communications needs, along with strings to identify DDE objects. So, under PM, the second parameter of DDE messages became a pointer to one of two DDE data structures. These structures contain all the necessary DDE conversation parameters, as well as the actual data being exchanged. This scheme ensures that PM can accommodate future system software changes and new hardware architectures without altering the DDE message format.

Windows uses atoms (i.e., integers that identify character strings) to refer to the information being passed between a client and a server, and global memory handles to refer to the data structures that actually contain the data. These atoms and handles form the contents of the second parameter sent with every DDE message (the first being the target window handles). PM uses a separate DDE data structure (pointed to by the second DDE message parameter) in which to package conversation parameters and data. This makes using atoms unnecessary.

Because of the restrictions that OS/2 places on a process when it attempts to access another process, PM uses a special set of DDE API calls that grant this access automatically. These special calls include WinDdeInitiate, WinDdeRespond, and WinDdePostMsg.

### DDE and the Integrated Desktop

Multitasking and DDE will increasingly display a symbiosis within the next generation of PC applications. Multitasking provides for the functional integration of applications, and DDE furnishes the concordance of information. Once they discover that they can connect disparate applications seamlessly, users will stop thinking about tools (applications) and start focusing on specific documents or tasks. Windows 3.0 and PM both provide a way to group tasks according to the needs of any user. The ability to group all the documents needed to produce a firm's annual report, for example, helps the person working on the report focus on the pieces of the project rather than on the tools used to complete it.

Grouped tasks lead to the organization of computer desktops into workspaces—a workspace for the annual report, a workspace for the new building proposal, and so on. Within each workspace, many applications and documents will be open; some of these will share information via DDE links.

DDE extends an application by enabling it to use information from another program that it otherwise could not generate itself. For example, when you use DDE to embed a chart from a program like Microsoft PowerPoint into a word processing document, you add to the word processing program a capability that it otherwise would not have.

Because DDE preserves the format of exchanged information, it eliminates such problems as having to alter the font or point size of data linked from an Excel spreadsheet to a Word document: DDE can send font and size information with the data. This preservation of format further enforces the idea that pieces of information are objects that users can mix and match.

With all these benefits and possibilities, you can bet that DDE is a term you will be hearing about much more frequently in the not-too-distant future. ■

*Michael Vose is the author of the book Windows 3.0: A Definitive Guide for DOS Users (Addison-Wesley, 1990). He can be reached on BIX c/o "editors."*

## WRITE US... SO THEY WON'T CALL YOU

Many people enjoy receiving information about products or services in their homes by telephone.

But if you want fewer phone calls from national advertisers, we can help.

Telephone Preference Service can effectively reduce phone calls from national advertisers. And, it's absolutely FREE. Just send us your name, full address, area code and phone number. We'll tell participating national advertisers to remove your name from their calling lists.

After all, they only want to talk to people who want to listen.



Telephone Preference Service  
Direct Marketing Association  
11 West 42 Street  
P.O. Box 3861  
New York City, NY 10163-3861

Name	_____
Street	_____ Apt. _____
City	_____
State	_____ ZIP _____
Area Code	_____ Telephone Number _____

## ■ New Topic: Graphics

You may already be participating in discussions on graphics within our telecomm.pgms/objective.tc topic. Here the discussion has expanded from typical character-mode telecomm interface to graphical interface. The subject has become so hot that we've opened up a new graphics topic. Join us while we discuss data compression and extending the existing BBS-independent macro command concept to incorporate graphics, among other things of course. (join telecomm.pgms/graphics)

## ■ Mac Exchange Update

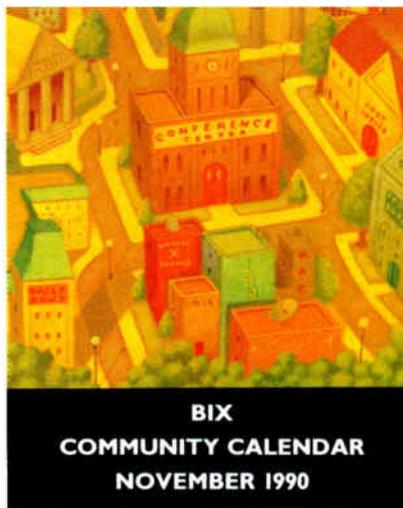
This month we'll continue our group project on making a Mac-like front end program for BIXing. Both users and coders are contributing some excellent ideas. You'll definitely want to get in on the action. (join mac.hack/general)

With the holiday season drawing nearer, the Mac.hack/products topic is where it's at. We'll have vital information on Mac products for all you holiday shoppers, including the latest on high-capacity hard drives for your Mac. (join mac.hack/products)

As usual, Wednesday nights (8:30 to 10:00 EST) feature the ever-popular get-togethers in CBix. Join us for the tech expertise and camaraderie you won't find anywhere else as we explore how the Mac interfaces with society. (join mac.sandbox/political)

## ■ Hobbies for the Holidays

As the holiday season approaches, what do we all start thinking about but ourselves? And our hobbies. Now you can gab on BIX about whatever interests you the most. We'll cover



everything from woodworking to model trains, sheep-raising to knitting, cold-weather bicycling to tropical fish collecting. And it could get weirder. A great source of ideas for the holidays. (join hobby)

## ■ CNN. FNN. Who needs 'em?

You can get all the up-to-the-minute money news you'll ever want or need right here. We give you hard facts as well as compelling commentary, always with an emphasis on the financial implications. (join financial/global)

## ■ New AeroSpace Conference

Another exciting BIX innovation. The Tech Transfer conference brings together developers and potential end-users of National AeroSpace Plane technology. It's an experiment now, but ultimately the conference could reduce the time lag between government technology development and domestic industrial use from 12-16 years down to 2-4 years. It's not too late to get in on the ground floor and put the power of BIX to the test. You might even improve American industry's competitiveness in the emerging world market. (join tech.transfer)

## ■ Special Session on Desqview-X and QEMM

Get the inside scoop on the release

of Desqview-X and QEMM with Quarterdeck's Bob Perry. It happens Tuesday, November 6 at 7:00 pm PST (join desqview/cbix)

## Some favorite exchanges you'll want to try...

### ■ Amiga Exchange

amiga.user	Exchange ideas, solve problems, compare notes
amiga.sw	Amiga programming and developer issues
amiga.hw	Amiga hardware design, use, and hookup
amiga.arts	Artistry using the Amiga
amiga.int	Developing for the international Amiga
amiga.special	Special guests and events
amiga.dev	Commodore's conference for developers

### ■ IBM Exchange

ibm.pc	The venerable PC
ibm.at	The AT series and workalikes
ibm.ps	The PS/2 series
ibm.os2	OS/2 operating system
ibm.dos	PC/DOS & MS/DOS
ibm.os.386	Alternative 386 operating systems
ibm.utils	Utility software
ibm.repair-shop	Garage and Tune-up Shop
ibm.newprods	New products for IBM computers
ibm.exchange	IBM Exchange clearinghouse
ibm.listings	Index to IBM files
ibm.other	Applications, printers, modems, etc.
microsoft	Products from Microsoft

### ■ Writers' Exchange

desktop.pub	Using microcomputers for publishing
journalism	Reporting and writing
journalism.pro	Interaction for working press only
marketing	High Tech PR
new.writers	Getting started in the writing business
poetry.pros	Writing both types of English
sf	For Science Fiction, Star Trek, and fantasy fans
sfwa	The Science Fiction Writers of America
tech.news	Discuss news

**BEAM YOURSELF  
TO A PLACE  
WHERE COMPUTER SAVVY  
ABOUNDS.**

■ Imagine a setting in which communal wisdom is on tap. A place that has the fit and feel of a small, friendly town, yet the sophistication and resources of a global community. One which you can visit electronically—to increase your knowledge of computers and their applications, hone your skills, share insights with thousands of other computer pros, and have fun. Such a community would be called BIX.

**Subscribe to BIX, the flat-fee, on-line information service.**

BIX is your access to industry news. And to many special interest Exchanges—such as our *Amiga*, *IBM*, *Mac*, *Writers'*, and *Interactive Games* Exchanges—which include thousands of free, downloadable programs. All for just \$39 per quarter.\*

**Subscribe via your computer...**

Set your program for full duplex, 7 bits, even parity, 1 stop bit. Call BIX on our registration-only number: 800-225-4129. In MA: call 617-861-9767. International: call NUI310690157800. Then hit the return key, and respond:

<b>Prompt:</b>	<b>You Enter:</b>
login	bix
Name?	bix.ville

You may buy off-peak access via *Tymnet* at \$20 per month or \$3 per hour, or you may buy peak access at \$6 per hour.\*\*

\*Based on a \$156 annual fee, billed quarterly. Telecommunications charges are extra. You may cancel at any time without future charges.

\*\*Available only in contiguous 48 states. Tymnet rates subject to change.

800-227-2983 • In NH 603-924-7681

# BIX

# CompuClassics

**"Your Source For Software"**

PLEASE CALL US FOR PRODUCTS NOT LISTED,  
WE SHIPTO APO & FPO ADDRESSES CALL US FOR A CATALOG  
Please Specify Disk Size When Ordering

**FREE!**

**"Dog And Pony"  
MOUSEPAD  
In Full Color  
with purchase of  
HARVARD GRAPHICS**

<b>CAD</b>	Autosketch 3.0	145.00
	Design Cad 3D 3.0	205.00
	Design Cad 4.0	155.00
	Generic 3D Drafting	195.00
	Generic Cadd Level 3	219.00
<b>COMMUNICATIONS</b>	Carbon Copy Plus 5.2	115.00
	Close Up Support 3.0	165.00
	Crosstalk Mark 4	139.00
	PC Anywhere IV	99.00
	Procom Plus	59.00
	Smarterm 240 3.1	195.00
<b>DATABASE</b>	Clarion Professional Devel 2.1	475.00
	Clipper (Summer '87)	429.00
	DBase IV 1.1	499.00
	Foxbase Plus	199.00
	Foxpro Lan	679.00
	Foxpro Single User	479.00
	Paradox V 3.0	459.00
	PC File 5.0	75.00
	R & R Relational Report Writer	105.00
<b>DESKTOP PUBLISHING</b>	Bitstream Fonts (each)	95.00
	Freedom of Press	250.00
	Go Script Plus Ver. 3	195.00
	Go Script Ver. 3	99.00
	PFS 1st Publisher 3.0	95.00
	The New Print Shop	39.00
	Ultrascript PC Plus 2.1	249.00
	Ventura Publisher Gold	559.00
	Wordscan Plus	689.00
<b>EDUCATION &amp; ENTERTAINMENT</b>	Flight Simulator 4.0	42.00
	Leisure Suit Larry III	39.00
	Microsoft Learning DCS	35.00
	Go Globe 3.0	39.00
	Playroom	32.00
	Simcity	33.00
	Tetris	22.00
	Typing Tutor IV Plus	35.00
	Where - Is Carmen San Diego	30.00

Flowcharting III	149.00
Formwork with Fill File 2.5	85.00
Interactive Easyflow 6.1	109.00
Drp Plus Advanced 5.0	69.00
<b>PerForm 2.1</b>	<b>159.00</b>
<b>GRAPHICS</b>	
Autodesk Animator	245.00
Dan Bricklin Page Garden	62.00
Deluxe Paint II Enhanced	89.00
Drawperfect 1.1	279.00
Freelance Plus 3.01	339.00
Grapher	145.00
<b>Harvard Graphics 2.3</b>	<b>299.00</b>
Hijaak	85.00
Hot Shot Graphics	159.00
Inset Plus (w/Hijaak)	109.00
PC Paintbrush IV Plus	119.00
Pixazz Plus 2.0	65.00
Print A Plot 2.0	199.00
Show Partner FX 3.5	229.00
Surfer	359.00
<b>HARDWARE &amp; PERIPHERALS</b>	
ATI VGA Wonder 512 W/ Mse	349.00
Copy II Option Board Deluxe	115.00
Logitech Bus Mouse C9	85.00
Logitech Scan Man Plus	185.00
Logitech Trackman Serial/Bus	89.00
Masterpiece Plus	105.00
Micrsft Mouse w/Windows 3.0	159.00
Microspeed PC Trac Serial	75.00
MS Mouse w/Paint Serial/Bus	109.00
Pacific Data 1-2-4 Brid w/OMB	135.00
Pacific Data 1-2-4 Brid w/1MB	182.00
Pacific Data 1-2-4 Brid w/2MB	255.00
Pacific Data 4 Memory w/OMB	82.00
Pacific Data 4 Memory w/1MB	139.00
Pacific Data 4 Memory w/2MB	199.00
Pacific Data 25-in-1	289.00
Pacific Data 25-in-1 vers. III	355.00
Pacific Outline I	209.00
Pacific Data PacificPage I/II/III	379.00
Pacific Data 25-in-one	289.00
Pacific Data PacificPage	489.00
Pacific Data PacificPage for IP	369.00
Plotter In A Cartridge	259.00
Pacific Outline I	209.00
Pacific Print	245.00
Postscript Cartridge by Adobe	255.00
Prac Periph 2400 Ext w/MNP	209.00
Prac Periph 2400 Int w/MNP	175.00
Sota 286i Accelerator	305.00
Sota 386i Accelerator	409.00
Super Cartridge 1 -IQ Enging	275.00

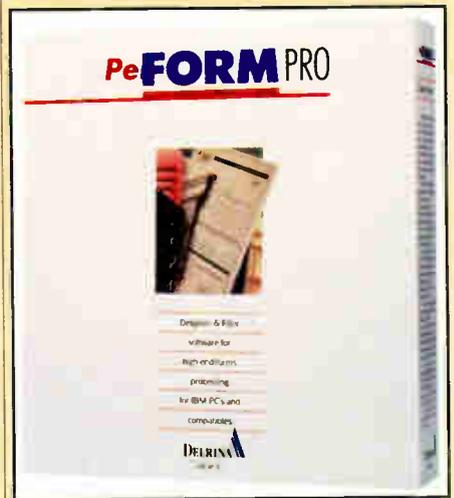
Super Cartridge 2 -IQ Enging	449.00
Worldport 2400 Modem w/MNP	345.00
Worldport 2496 Fax Modem	485.00
<b>INFORMATION MANAGEMENT</b>	
Agenda	275.00
askSam	175.00
Best Choice	59.00
Infoselect 1.1	55.00
Instant Recall	79.00
Who What When 2.0	179.00
MS Works 2.0	95.00
PFS First Choice	92.00
Q & A 3.0 (Networkable)	229.00
Symphony 2.2	519.00
<b>LANGUAGE &amp; PROGRAMMING</b>	
Brief	159.00
Btrieve	179.00
C Tools Plus	95.00
Clear + for C (or dBase)	135.00
Macro Assembler	99.00
Matrix Layout 2.0	135.00
MS Basic 7.1 Devel System	329.00
MS C 6.0	329.00
MS Fortran	299.00
MS Quick Basic	67.00
MS Quick C 2.5	67.00
MS Quick C w/ Quick Assm 2.5	135.00
Object Professional	109.00
Quickpac Professional	149.00
Smalltalk V286	129.00
Sourcer w/Bos	159.00
Turbo C ++ Prof.	199.00
Turbo C Tools	95.00
Turbo Pascal 5.5 Prof.	179.00
Power Tools Plus	115.00
Turbo Professional	79.00
Windows Developmt Toolkit	329.00
Zortech C ++ 2.0	149.00
<b>NETWORKING</b>	
Lantastic 2MBPS Adapter	189.00
Lantastic 2MBPS Starter Kit	409.00
Lantastic Ethernet Adapter	259.00
Lantastic Ethrnet StrKit10MBPS	555.00
NE1000	175.00
NE2000	205.00
Netremote 4.0	419.00
Western Digital Ethercard Plus	179.00
<b>OPERATING ENVIRONMENT</b>	
Desqview 2.3	77.00
Desqview 386 2.3	125.00
IBM DGS 3.3	109.00
IBM DDS 4.01	129.00
MS Windows 3.0	99.00

<b>OS/2</b>	DS/2 Standard Edition 1.2	295.00
	Excel for DS/2	329.00
	Multiscopy 1.1	325.00
	MS DS/2 Pres Mngtr Toolkit	329.00
	Smalltalk/VP M	329.00
	Wordperfect for DS/2	319.00
<b>PROJECT MANAGEMENT</b>	Harvard Project 3.0	439.00
	Sector Project Scheduler IV	429.00
	Superproject Expert	449.00
	Timeline 4.0	469.00
<b>SCIENTIFIC / STAT</b>	Brainmaker	149.00
	Derive	125.00
	Mathcad 2.5	325.00
	Mathematica 386 w/387 Suprt	845.00
	SPSS/PC Plus	549.00
	Statgraphics	579.00
	Systat w/ Graphics	679.00
<b>SPREADSHEET</b>	Allways (Lotus 1-2-3 or Symphy)	115.00
	Lotus 1-2-3 Ver. 2.2	349.00
	Lotus 1-2-3 Ver. 3.0	419.00
	P D Queue	59.00
	Quattro Pro	319.00
	Quattro Pro Upgrade	99.00
	Sideways 3.2	42.00
	Supercalc V	315.00
	The Baler	359.00
	VP Planner Plus 3D	155.00
<b>UTILITIES</b>	1 Dir Plus 3.0	49.00
	386 To The Max 5.0	79.00
	Above Disk	65.00
	Automenu	39.00
	Brooklyn Bridge 3.0	89.00
	Check It	85.00
	Copy II PC 5.0	27.00
	Copywriter/ZeroDisk w/Rescue	55.00
	Direct Access 5.0	55.00
	Disk Technician Advanced	95.00
	Fastback Plus	119.00
	Headroom	69.00
	Hyperpad 2.0	85.00
	Lap Link Release III	92.00
	Mace Utilities 1990	95.00
	Magellan 2.0	109.00
	Norton Commander 3.0	99.00
	Norton Utilities Advanced 5.0	119.00
	Pathfinder Plus	79.00
	PC Tools Deluxe 6.0	80.00
	Print Cache (Laserator)	99.00
	Q-Dos II	39.00



**We're ready to talk turkey...  
Gobble up these savings!!**

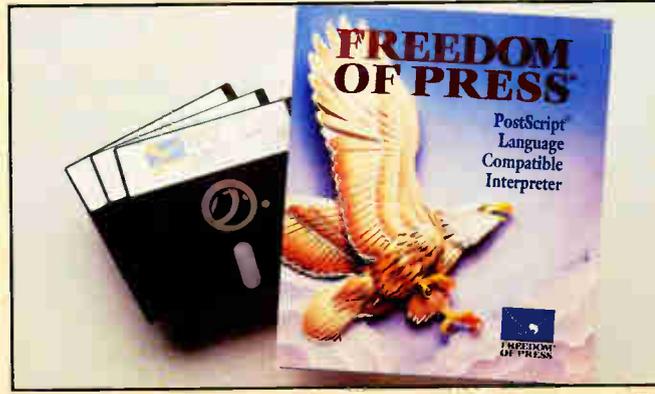
QEMM 5.1	59.00	Pagemaker 3.01	499.00
Software Bridge 4.1	79.00	<b>PerForm Pro</b>	<b>289.00</b>
Software Carousel	55.00	PC Paintbrush Plus for Windows	99.00
Spirite II	67.00	Powerpoint	329.00
PC-Kwik Powerpak	79.00	Prompt 1.0	79.00
Switch It	89.00	Pubtech File Organizer	119.00
Virex P C	82.00	Soft Type (Z Soft)	119.00
XTree Pro Gold	82.00	Superbase 4 for Windows	429.00
Adobe Illustrator Windows	285.00	Tempo	75.00
Adobe Streamline	235.00	Toolbook by Asymetrix	305.00
		Wingz	335.00



**PerFORM PRO - Windows 3.0 Compatible!** PerFORM PRO is a sophisticated forms processor for high end form processing on IBM PC's or compatibles. Features include: •A full set of drawing tools for creating forms. •A complete array of graphic file support to import logos pre-printed forms or other documents. •Electronic signatures and password security. •Standard and advanced math such as logic, date, financial and other functions. •Data linking from one form to another. •Extensive dBase and ASCII file support. • Support for printer macros and cartridges. **Special \$289**

Adobe Type Manager	65.00	Word for Windows	329.00
AMI Professional	309.00	Xerox Formbase	325.00
Corel Draw Windows 1.2	329.00	<b>WORD PROCESSING</b>	
Crosstalk For Windows	125.00	Displaywrite V	255.00
DaVince E-Mail (8 users)	269.00	Grammatik IV	52.00
Dragnet 1.0	89.00	Nota Bene	335.00
DB Fast/Windows	209.00	Rightwriter	55.00
Excel	319.00	Word 5.0	209.00
Formwork for Windows	149.00	Word Perfect 5.1	249.00
hDC Windows Express 3.0	52.00	Word Perfect Net Add-On 5.1	169.00
IBM Current	239.00	Wordstar 6.0	249.00
Language Master	62.00	<b>XENIX/UNIX</b>	
Micrografx Designer 3.01	489.00	SCD Foabase + 386	655.00
Micrografx Charisma	355.00	SCD Unix Dev. System 386	655.00
Microsoft Project for Windows	469.00	SCD Unix Operating Sys 386	609.00
Omnipage 386 2.1	599.00	SCD Xenix Operating Sys 386	479.00
Packrat	255.00	WordPerf. SCCXenix 386 5User	519.00

**WE WELCOME CORPORATE ACCOUNTS  
AND INTERNATIONAL ORDERS**



Print monochrome and/or color text and graphics files to your non-Postscript printer! **FREEDOM OF PRESS** software can print to over 50 different output devices including Laser, Ink Jet, 24-wire dot matrix, Color Thermal Printers and Film Recorders. **ALSO, FREEDOM OF PRESS software comes standard with 35 fonts, equivalent to those found on the Apple Laser-writer Plus. FREEDOM OF PRESS is available in both PC and/or Macintosh versions. \$249**

**INTERNATIONAL ORDERS 818 • 347 • 2444 ♦ FAX YOUR ORDER 818 • 347 • 9977  
PHONE YOUR ORDER 800 • 733 • 3888**

Immediate shipment on purchase orders from government and state agencies, cities, counties, school and universities. • Prices subject to change without notice. • We ship the latest versions. • We accept Visa, Master Card, and American Express. • 2% surcharge on American Express. • 15% restocking fee for all non-defective items returned. • Please call (818) 347-9400 for an authorization number on defective goods or your return will not be accepted. • Due to copyright laws we cannot take back any software where the seal has been broken. (Domestic Sales) \$5.50 minimum shipping per item, less on bulk orders. • \$10 Blue Label shipping • \$4.50 C.O.D. charge. • International sales call for freight pricing. • Heavier items are charged accordingly. • We do not guarantee compatibility. • Call for prices for any software item not included in this ad. • Order desk open 7 A.M. to 5 P.M. Monday to Friday (PST), Saturday 10 A.M. to 2 P.M. **P.O. Box 10598, Canoga Park, CA 91309 Showroom: 7959 Deering Ave., Canoga Park, California 91304.**

Circle 73 on Reader Service Card

# PICK: OS OR DBMS?

*An ancient breeze still blows  
through the database world*

*Ben Smith*

## PART Four

Pick: It's an operating system; it's a database system. It's both. Although Pick is most often found as a stand-alone operating system, you may see it implemented as a database engine working under other multi-

user operating systems, such as Unix. Databases have their own special needs for optimal data storage and retrieval. Pick meets those needs and provides the data organization that makes for efficient database operations.

### Prehistoric Synergism

Many computers are used for the single purpose of database operations. In this case, Pick is all you need. It includes all the layers and activities of an operating system: everything from virtual memory management, terminal control, and print spooling and control up through multiuser task, account, and file management, as well as a command interpreter and scripting language. Pick also includes all the tools for database operations: programs to structure the data, a language for data entry and data manipulation, and a report formatter.

Pick is more than a collection of utilities and libraries; it is a completely integrated operating system/database engine—greater than the sum of its parts. There is nothing new about this idea, but that may be because Pick is far from new. Richard A. Pick and his colleagues at TRW started development on the IBM System/360 in 1965. That makes Pick older than CP/M (1977) and even Unix (1970).

Pick's organization of data helped it survive all those years and through all the changes in the computer industry. The entire system is consistently built using the same data structure: a tree of data dictionaries and data files, usually paired together. Even the Pick commands are held in this structure. As a result, nearly everything in Pick is a database and can be manipulated any way you like.

From the average user's point of view, the operating system and database operations (e.g., input, search, and report) are simple and fast. But the developer must come to Pick with as

few preconceptions as possible. Developing Pick applications is unlike working in any modern development environment.

At first glance, Pick appears to be hopelessly atavistic. The environment consists of a primitive, uppercase-only command interpreter, a special-purpose line editor, and a steroid-mutated BASIC. If you are used to fancy window- and menu-based data management tools, Pick will seem rough and unfriendly. But under this crude surface, there are many fine ideas, implemented in a refined (though Spartan) manner.

### Operating-System Sorts of Things

Pick's multitasking (and multiuser) capabilities are bare bones. The operating system maintains separate user log-in accounts, each with its own *master dictionary*, a file that holds pointers to all of the account's files and commands.

Accounts are linked more closely with the data they hold than with the people who use them. Everyone using an inventory-control database, for example, would likely share an account. The system has commands for managing these accounts, handling system backups and restores, and monitoring system use. There are utilities for transferring files to and from MS-DOS partitions that might coexist with the Pick partitions on a PC.

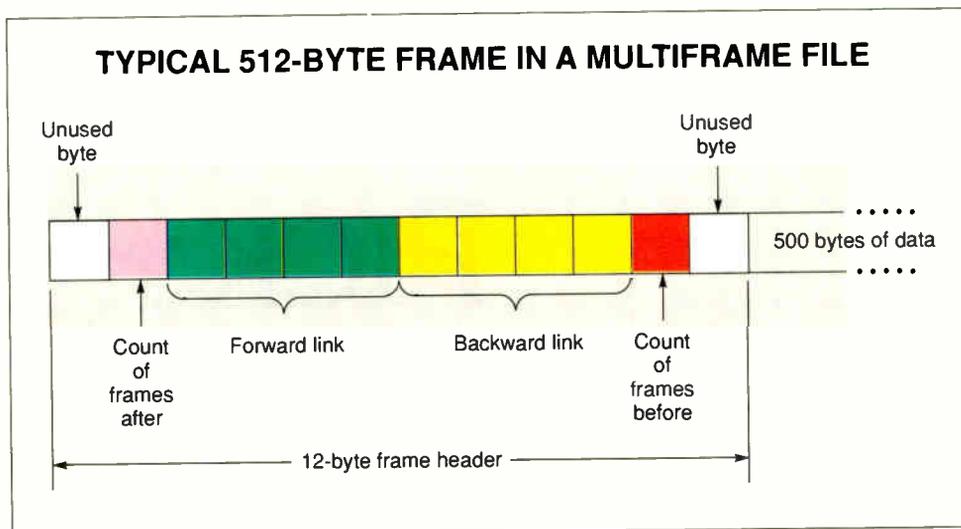
Installation of external terminals and printers is easy on a Pick system. There is one file describing terminal capabilities, another to configure serial ports, and another that describes the parallel printer ports.

A user can have more than one task running at a time (in

### ITEMS DISCUSSED

Pick (single-user PC license) ..... \$2195  
Pick Systems  
1691 Browning  
Irvine, CA 92714  
(714) 261-7425  
Inquiry 1020.

A frame is the basic Pick unit of memory; different implementations of Pick use different frame sizes. On the PC, frames for executables and workspace are 2048 bytes, while frames for files (shown here) are 512 bytes. Frames are linked together through a pair of pointers at the front of each block.



addition to print spooling). Such tasks are called *phantom processes*. They handle administrative duties while users are busy with applications. But there isn't any path to client/server communications on a single machine; there are no interprocess communications links other than semaphores. However, different Pick machines *can* communicate with each other; even MS-DOS can communicate with Pick.

### Virtual Memory

The Pick operating system addresses both memory and disk as a single mass. This mass is divided into a file area at the high addresses, and executable and work areas at the low addresses.

A *frame* is the basic Pick unit of memory. Each frame is referenced by a unique frame identifier. Different implementations of Pick use different frame sizes.

On the PC, there are two sizes of frames. Frames for the executables and workspace are 2048 bytes in size and are not linked. Frames for files take 512 bytes and often form doubly linked lists using 12 bytes (of the 512) of data to create the connections (see the figure). Alternatively, file space can be allocated in blocks of contiguous frames, in which case the block does not require the 12 bytes per frame for memory management; all 512 bytes is available in each contiguous frame.

The virtual memory manager, which tracks the location of data, works directly with the hard disk and RAM. This invis-

ible layer of device control is responsible for Pick's efficiency on otherwise inefficient or obsolete computers.

### The Database

The data files and associated dictionaries allow you to build a complex interrelationship between data files, since a data item in one file can be a pointer to data in another file. This kind of structure is more akin to a hierarchical data structure than the relational structure that is common on microcomputer databases. Most relational database systems have fixed-length data fields, but Pick data fields are held in a variable-length format. As you will see, this is a very important feature.

Both of the data pair (dictionary and data) files have the same structure. The dictionary contains the definitions of fields (*attributes*, in Pick terminology) in the data file, and pointers to the fields that use the defined structure. Not only can each attribute within a record (or *item*) contain a value, but each value can be composed of subvalues. Each item within a file must have a unique (to the file) *item-ID* with which Pick manages its data operations. The item-ID may actually be data itself—for example, a part number.

With this structure, an attribute value (or subvalue) may be the item-ID of another file, or even of the same file. This last capability solves the vexing database problem of how to organize data so that items can be assemblies of peer items. For

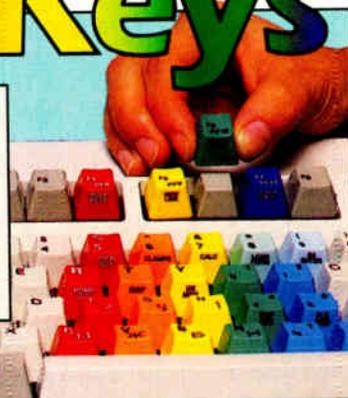
# Custom IBM® Keys

Imagine the benefits of having your software commands color-coded and imprinted on your keyboard. Solve your training and productivity problems with Hooleon's full line of Custom Keyboard Services, including made-to-order custom keys, custom imprinted adhesive keytop labels, keyboard templates and more! Kits available for immediate delivery include WordPerfect™ and 5250 SnapCap™ Kits or Adhesive Keytop Labels, language conversions, relegendable keys for IBM®, Wyse™, Key Tronic™, and much more. Call for your FREE 1990-91 Catalog

From the Leader in Keytop Innovations™...  
**Hooleon**  
CORPORATION

800 937-1337  
Phone: (602) 634-7515  
Fax: (602) 634-4620  
P. O. Box 230, Dept. BYTE  
Cornville, Arizona 86325

See us at  
**FALL**  
**COMDEX**  
Sands  
Booth N2293



“We chose TARGA® boards because that’s what’s used in the field.”



Graphic created by Bill Tinker using the TARGA board with TIPS®, LUMENA™ and RIO™. For more information contact Cheryl Stockton at (212) 925-8481.



Cheryl Stockton  
Pratt Institute  
New York, New York

“We believe in providing hands-on training utilizing state-of-the-art technology. Our students work with TARGA boards here because, chances are, that’s what they’ll be using out there.”

It’s true. Truevision’s TARGA has the biggest installed base in the business. It’s become the industry standard. So, designing an update meant integrating exciting new features while remaining 100% compatible with previous TARGA modes and with over 300 products. Which makes upgrading easy. The way it should be.

Introducing the Truevision TARGA+. The next generation TARGA for the next generation TARGA user.



7340 Shadeland Station, Indianapolis, IN 46256  
INTERNATIONAL: Canada 416/940-8727 France 33-1-3-952-6253 Italy 39-2-242-4551  
Switzerland 41-1-825-0949 U.K. 44-628-77-7800 West Germany 49-89-612-0010 Other 617/229-6900

RIO is a trademark of AT&T. LUMENA is a trademark of Time Arts Inc.

Circle 355 on Reader Service Card

Call  
800-858-TRUE

For more information



# Reading worth writing for.

If you're looking for some good reading, you've just found it. The free Consumer Information Catalog.

The Catalog lists about 200 federal publications, many of them free. They can help you eat right, manage your money, stay healthy, plan your child's education, learn about federal benefits and more.

So sharpen your pencil. Write for the free Consumer Information Catalog. And get reading worth writing for.



**Consumer Information Center  
Department RW  
Pueblo, Colorado 81009**

A public service of this publication and the Consumer Information Center of the U.S. General Services Administration.

example, a parts-numbering scheme usually has unique numbers for both assemblies and the items included in the assemblies. Some of the assemblies may also contain subassemblies. Since the items can vary in length, each item can have a different substructure. Some items may list other items or subassemblies, and some items may just be elements in themselves.

### Other Strengths and Weaknesses

Since Pick is a multiuser database/operating system, it necessarily includes a form of record locking to prevent collisions of data operations on the same sets of data. There is also a very limited form of process locking. As more than one user can run the same program at the same time, the PROC scripting language contains a semaphore for control between concurrent users. But the semaphores are local to each PROC script and so do not offer any way for different programs to communicate.

The way data is written and read is a weakness. Pick searches data using the unique item-IDs of a file, but the search is sequential since there is no index. On the plus side, the overhead and restrictions imposed by maintaining an index don't exist. You can create any kind of index with a data file; the recursive structure of a data tree is already there.

A strength comes from the variable-length data items in a file: A file can actually be a single piece of text, a script, or a Pick BASIC program. Like dictionary files, these file forms don't have a structure defined elsewhere.

### New Era

Pick has been around a long time. Respect, as well as many applications, has accrued over the years. Word processors, spreadsheets, and other typical business fare are available. Most important, there are thousands of proven vertical applications that run on hundreds of different species of computers.

Recent months have marked the beginning of a new era for Pick with the introduction of Advanced Pick and Pick running under Unix. Advanced Pick is backward-compatible with the original, but this crispy version includes many features that will attract modern applications developers: a screen editor, secondary indexing and B-trees, transaction logging (necessary for good computer-based accounting systems), and new utilities for developing screens and tuning an organization of data without resorting to Pick BASIC.

Pick under Unix fulfills needs in both computing realms: Unix gains an efficient database engine; Pick gains the connectivity and utility of Unix. Because the Unix file system was not designed with database operations in mind, you need a separate database file system for Pick. Turbo Informix, another popular Unix database manager, uses a similar method to improve its performance. But the integration of Pick and Unix goes beyond coexistence; Pick can call Unix functions, and Unix can call Pick functions. Data flows freely between the two.

Pick's strength is not as an operating system (it is outdated technology), but in its flexibility and efficiency in handling data. For this reason, Pick not only will survive, but will flourish as a database engine implemented under other, more capable operating systems. ■

### ACKNOWLEDGMENT

Many thanks to Tim Thomas of Mini Business Systems, Inc. (Southbury, CT), for being a source of Pick technical information and enthusiasm.

*Ben Smith is a technical editor for BYTE and the author of the book Unix Step-by-Step (Howard Sams, 1990). He can be reached on BIX as "bensmith."*

# MODULA-3

*A practical and predictable OOP language  
for team projects*

*Sam Harbison*



If you are a Pascal or Modula-2 programmer, you may have found yourself choking in the dust behind the stampede to C++. Choke no longer. Modula-3 has arrived.

Modula-3 is not an extension to Modula-2, but a new language in the spirit of Pascal and Modula-2. It combines the best features of a modular, strongly typed language with support for object-oriented programming (OOP), exceptions, and concurrency. As a result, Modula-3 is an effective tool for building large, maintainable, robust systems.

## Roots

Modula-3 was developed by researchers at Digital Equipment's Systems Research Center and the Olivetti Research Center. It borrows from two evolutionary lines of programming languages: an academic line, represented by Niklaus Wirth's Pascal, Modula-2, and Oberon languages; and an industrial research line, represented by the Mesa, Cedar, and Euclid languages from Xerox's Palo Alto Research Center (PARC). Its immediate precursor is an extended version of Modula-2 called Modula-2+, which was developed at SRC in the early 1980s and used there for the development of all its research systems.

In 1986, an effort to clean up Modula-2+ became a design for a new language, christened Modula-3 with Niklaus Wirth's blessing. The language and two working implementations by SRC and Olivetti were completed in 1989 (see figure 1). The SRC implementation is available; I'll tell you how to get it later.

Modula-3 is a systems programming language based on two general principles: simplicity and safety. Programming can be a difficult, complicated, and risky activity, made even worse by programming languages that are themselves difficult, complicated, and risky.

Rather than spending their time inventing clever solutions for textbook programming problems, Modula-3's designers selected features proven through experience in other languages, especially features that support good program structure (mod-

ules, objects, threads) and those that support robustness (garbage collection, isolation of unsafe code, and exceptions). They simplified and unified the underlying language concepts, discarding features that did not pull their own weight.

## Basics

To get a feel for Modula-3, start with Modula-2, Ada, or one of the modern Pascal dialects (Turbo Pascal or Apple's Object Pascal). The general syntax of statements, expressions, and declarations is similar to that found in the other languages. The customary basic data types are integers, Booleans, reals, characters, sets, enumerations, arrays, records, and pointers.

There are also all the arithmetic, logical, and set operations and the usual set of basic statements: conditional (IF and CASE), loops (WHILE, FOR, REPEAT), blocks, and so on. Modula-3 includes type, constant, procedure, variable, and exception declarations. Like Modula-2 and C, Modula-3 provides procedure types, and its variable names are case-sensitive.

Although it resembles the other languages, Modula-3 has a number of features that you can use to make programs more readable and maintainable.

## Readability

Listing 1 and figure 2 show a simple insertion sort procedure in Modula-3. Line 1 has the declaration of an open array parameter, *V*; within the procedure, the bounds of the array will be from 0 to *LAST(V)*. (The expression *FIRST(V)* used in lines 3 and 8 will always be 0, but its use makes the program a bit more readable.) The index variable *i* in line 3 is automatically declared local to the loop body; it cannot be modified except by the FOR loop control; and it takes its type from the initial and final values.

Lines 4-13 introduce a nested block with two new variables, *Temp* and *j*. Both variables are initialized where they are declared, and their types are taken from the initialization expressions (INTEGER, in both cases).

Lines 8-11 are a WHILE loop containing two statements.

**Listing 1:** A simple example: InsertSort in Modula-3 sorts V[0]..V[**LAST**(V)] into ascending order. (Line numbers are not part of the code but are included here for reference.)

```

1  PROCEDURE InsertSort(VAR V: ARRAY OF INTEGER) =
2  BEGIN
3    FOR I := FIRST(V)+1 TO LAST(V) DO
4      VAR
5        Temp := V[I];
6        J   := I-1;
7      BEGIN
8        WHILE J >= FIRST(V) AND V[J] > Temp DO
9          V[J+1] := V[J];
10         DEC(J);
11       END;
12       V[J+1] := Temp;
13     END
14   END;
15 END InsertSort;

```

**Listing 2:** InsertSort demonstrates more features of data-type declarations.

```

TYPE
  A_type = ARRAY [1..10] OF INTEGER;
VAR
  A := A_type[1,9,3,5,4,..];
BEGIN
  InsertSort( V := A );
END

```

Modula-3 permits multiple statements wherever a single statement is allowed, so there is no need to clutter your program with extra BEGIN-END brackets. The DEC (decrement) statement in line 10 is equivalent to  $j := j - 1$ . Modula-3 also has an INC statement. Both can take an optional second argument to specify how much to increment or decrement the first argument.

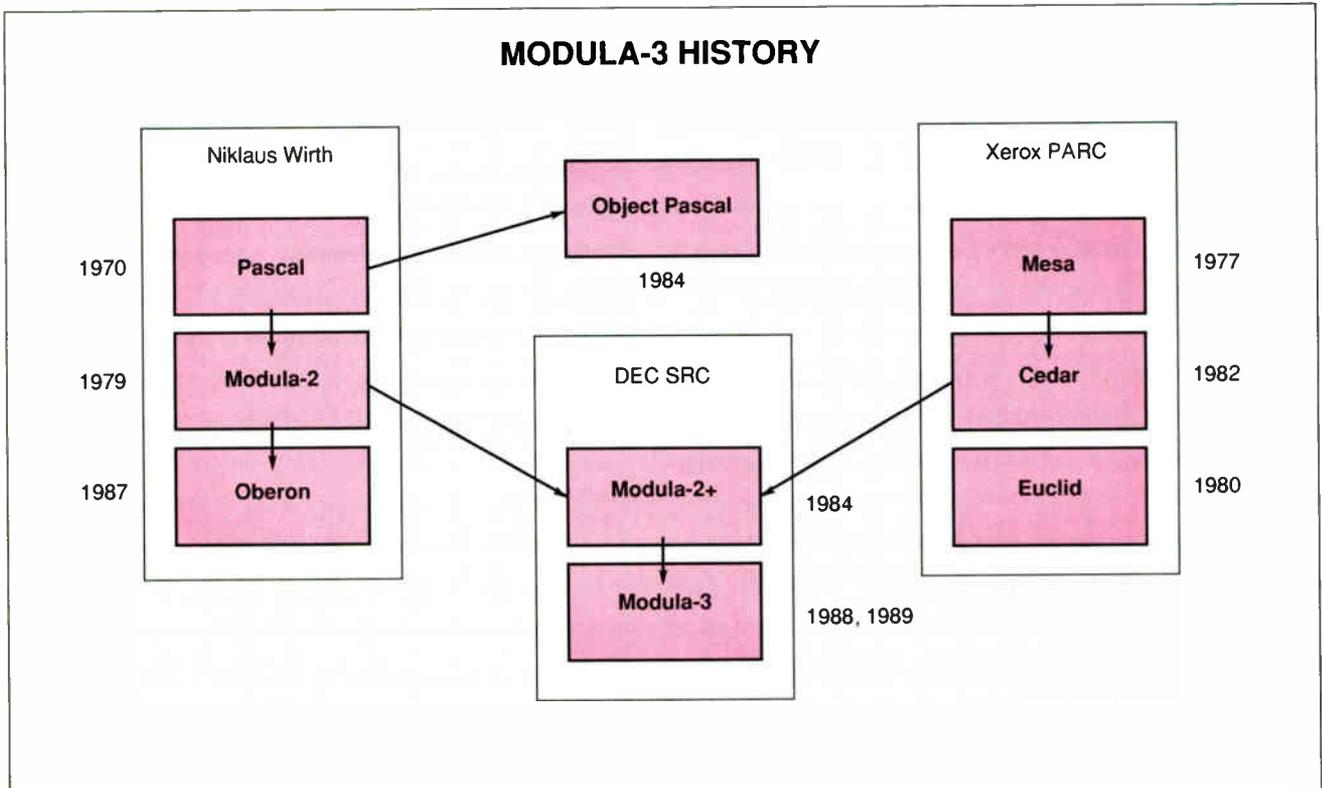
More features can be seen in the code of listing 2, which calls InsertSort. The declaration of the fixed array A uses an array constructor to create an initialized array. The “..” indicates that the last value in the list (4) is used to fill out the remaining elements of the array. The call on InsertSort demonstrates the use of the optional parameter names at the site of the call.

### Modules

The backbone of Modula-3 programming is the module. Modules come in two pieces: the *interface* part, which contains the public types, objects, and procedures provided by the module; and the *implementation* part, which contains private declarations and the bodies of the public procedures. To use the public facilities of a module in another module, you must import the compiled interface of the referenced module. You don't actually need the implementation part to compile your module, but you will need something (at least some “stub” code) in the implementation to have a program that runs.

The module concept is a very powerful tool supporting information hiding, abstraction, and top-down programming. Listing 3 shows a complete example of module Unique that provides a Next procedure, which returns successive integers in the sequence 1, 2, 3. A Reset procedure is provided to restart the sequence at a specified point.

The interface (lines 1-5 of listing 3) and implementation



**Figure 1:** Modula-3 is a descendant of the work of Niklaus Wirth (the designer of Pascal and Modula-2) and of Cedar from Xerox PARC.

(lines 6–28) of the module would normally be contained in separate files. The interface declares the two public procedures and a constant integer; this is the only information a user of the module needs to know.

The implementation part of Unique imports two standard library interfaces, Wr and Stdio, which implement simple text streams. There are actually two ways to import an interface. For one, if you specify only the interface name (as on line 7), all names from that module must be qualified by the interface name (e.g., Wr.PutText on line 15). However, if you list individual names (as on line 8), you can use them without qualification (e.g., the stderr on line 15). In either case, the origins of the imported names are explicit in the program, making it easy for any reader to locate the proper interface. It is possible to import interfaces into other interfaces, but that wasn't necessary in this example; the I/O is performed only in the private part of the module.

In line 9, a static integer variable, Next\_Value, is declared at the top level of the module and is initialized in the module's body (lines 26–28). (Stylistically, it is better to initialize Next\_Value where it is declared, but I wanted to show the module body.) The Modula-3 compilation system ensures that each module's initialization code is executed in the proper order, that is, before the module's facilities are used by any other module. One module must be designated as the main module; that module's initialization code becomes the program entry point, executed after all other modules have been initialized.

Line 22 shows the procedure declaration for Reset with a default parameter value. As a result of this kind of declaration, if Reset is called without parameters, the Next parameter takes on the value First\_Value, or 1.

**Listing 3: Interface and implementation parts to a module.**

```

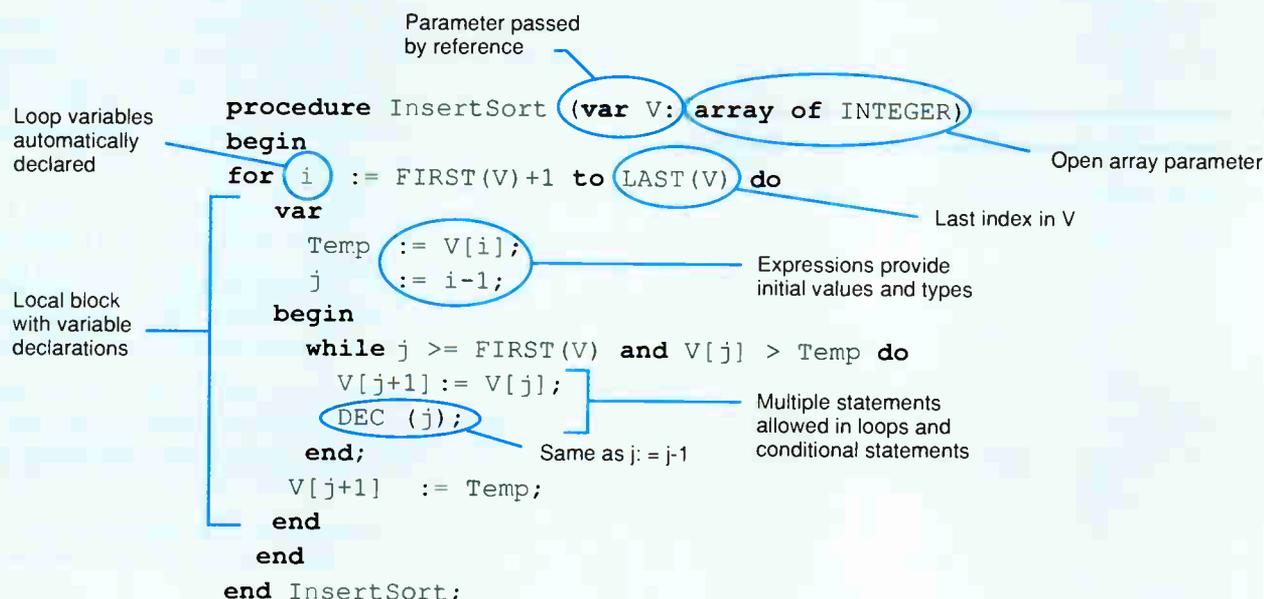
1 INTERFACE Unique;
2   CONST First_Value = 1;
3   PROCEDURE Next() : INTEGER;
4   PROCEDURE Reset( Next := First_Value);
5 END Unique.
6 MODULE Unique;
7   IMPORT Wr;
8   FROM Stdio IMPORT stderr;
9   VAR Next_Value : INTEGER;
10  PROCEDURE Next() : INTEGER =
11    VAR
12      This_Value := Next_Value;
13  BEGIN
14    IF Next_Value = LAST(INTEGER) THEN
15      Wr.PutText(stderr,"Next() is wrapping around");
16      Next_Value := FIRST(INTEGER); (* e.g., -2**31 *)
17    ELSE
18      INC(This_Value);
19    END;
20    RETURN This_Value;
21  END Next;
22  PROCEDURE Reset( Next := First_Value ) =
23  BEGIN
24    Next_Value := Next;
25  END Reset;
26 BEGIN
27   Next_Value := 1;
28 END Unique.

```

**Exceptions**

An *exception* is an event that suspends normal program execution and causes control to be transferred to a *handler* for that exception. After the exception is handled, execution resumes at some well-defined location in the program, but not necessarily

**ALTERNATE TREATMENT OF SAMPLE PROGRAMS WITH COMMENTARY**



**Figure 2:** Although Modula-3 looks very much like Pascal and Modula-2, declarations can incorporate initial values, and data typing can be implicit.

where the exception was first raised.

Exception-handling mechanisms are important for robust programs. Without them, you must manually check status values returned by all procedure calls or depend on awkward library facilities. Modula-3's exception mechanism is similar to the one used in Ada; it has low overhead and is easy to use. Listing 4 shows an interface, `Copy_Stuff`, that uses exceptions. A portion of the implementation of `Copy_Stuff` is also shown, along with a main module that uses it.

**Listing 4: An example of Modula-3 exceptions.**

```

1 INTERFACE Copy_Stuff;
2   EXCEPTION Error (TEXT);
3   EXCEPTION EOF;
4   PROCEDURE GetText(): TEXT RAISES {Error,EOF};
5   PROCEDURE PutText(T: TEXT) RAISES {Error};
6 END Copy_Stuff.
7 MODULE Main;
8   FROM Copy_Stuff IMPORT GetText,PutText,Error,EOF;
9   FROM OSIO IMPORT Exit, Success, Failure;
10  VAR Buffer : TEXT;
11 BEGIN
12   TRY
13     LOOP
14       Buffer := GetText();
15       PutText(Buffer);
16     END;
17   EXCEPT
18     EOF => Exit(Success); |
19     Error => Exit(Failure);
20   END;
21 END Main.
22 MODULE Copy_Stuff;
23   IMPORT OSIO;
24   ...
25   PROCEDURE GetText(): TEXT RAISES {Error,EOF} =
26   BEGIN
27     ...
28     Status := OSIO.LoadBuffer();
29     IF Status = OSIO.Error THEN
30       RAISE Error("OS error reading file");
31     ELSIF Status = OSIO.EOF THEN
32       RAISE EOF
33     END;
34   END GetText;
35   ...
36 END Copy_Stuff.

```

The exception declarations appear in lines 2 and 3; the `Error` exception takes a parameter of type `TEXT` (a Modula-3 dynamic string). Notice that `GetText` and `PutText` explicitly list the exceptions they may raise (lines 4 and 5); this optional declaration improves readability and maintainability. (The compiler will check that no unlisted exceptions are propagated out of the procedures at run time.)

The central code in `Main` is simply an infinite loop (lines 13-16), which is terminated when an exception is propagated out of either `GetText` or `PutText`. The surrounding `TRY-EXCEPT` statement (lines 12-20) holds the two exception handlers (lines 18 and 19), which terminate the program with or without an error. The excerpt from the implementation of `GetText` (lines 24-32) shows how the exceptions might be raised.

### Objects

OOP is becoming an increasingly popular tool for the programmer. Its advantages include increased maintainability and extensibility of code. There are three critical elements needed in languages that support OOP:

- The ability to define classes (types) of objects that include their own data and methods (procedures).
- The ability for a class to inherit data and methods from another class (its ancestor), and to change or extend them.
- The ability to create objects (instances of classes) and access data and methods through those objects.

Modula-3 provides all these elements of OOP. In fact, by providing both modules and objects, Modula-3 gives the programmer much more flexibility than languages that provide only one (e.g., Modula-2 and Ada) or the other (e.g., C++).

Listing 5 is an example of a module that provides the abstraction of a geometric point, that is, a location in a two-dimensional plane. In the example, particular attention is paid to hiding as much information as possible from the user of the class.

Following a common Modula-3 convention, I have named the interface `Point` and the enclosed class simply `T`. Users of the class will use the interface name as a qualifier and call the class `Point.T`. Line 3 identifies `T` as an *opaque type*: the declaration `T<: Public_T` means that `T` is an unspecified descendant (subtype) of class (type) `Public_T`, which is declared in line 4 as an object type with two methods, `PosX` and `PosY`.

The interface also declares a `New` procedure to create instances of the class. `New` is a normal procedure, not a method. Its declaration reflects a Modula-3 philosophy that not all procedures should be forced into methods if they more naturally stand alone. The text `<*INLINE*>` is a Modula-3 "pragma" requesting that the Modula-3 compiler expand all calls to `New` inline.

The implementation of `Point` is shown in lines 11-27. The first declaration reveals the concrete definition of the type `T`, introducing its two data fields, `X` and `Y`, and establishing the actual method procedures for the class, `PosXProc` and `PosYProc`.

Notice that the first parameter to these procedures is `p`: `T`. This "self" parameter was implicit in the method declarations on lines 6 and 7.

The keyword `BRANDED` on line 13 ensures that the type is unique. It is required by the Modula-3 type system for reasons I won't go into here.

The `Point.New` procedure on lines 19-22 is worthy of discussion. It calls the built-in Modula-3 function `NEW` to dynamically allocate an object, and it can set the values of any data field or method; that is, Modula-3 objects from the same class

**Listing 5: Objects and opaque types in Modula-3.**

```

1 INTERFACE Point;
2   TYPE
3     T <: Public_T;
4     Public_T = OBJECT
5       METHODS
6         PosX(): REAL; (* X position *)
7         PosY(): REAL; (* Y position *)
8     END;
9     <*INLINE*> PROCEDURE New(x, y: REAL): T;
10 END Point.
11 MODULE Point;
12   REVEAL
13     T = Public_T BRANDED OBJECT
14       X, Y: REAL;
15     METHODS
16       PosX := PosXProc;
17       PosY := PosYProc;
18     END;
19   PROCEDURE New(x, y: REAL): T =
20   BEGIN
21     RETURN NEW(T, X:=x, Y:=y);
22   END New;
23   PROCEDURE PosXProc(p: T): REAL =
24   BEGIN RETURN p.X; END PosXProc;
25   PROCEDURE PosYProc(p: T): REAL =
26   BEGIN RETURN p.Y; END PosYProc;
27 BEGIN
28 END Point.

```

# BREAK AWAY FROM BLACK, WHITE AND GRAY!

Presenting DFI's CHS-4000 Color Handy Scanner®



Our Booth Number: W474

Depart from the humdrum of ordinary handheld scanners. To get your message across in a world of color, the usual black, white and gray just don't measure up. Until now. Presenting DFI's CHS-4000 Color Handy Scanner.

For the serious scanning enthusiast, the CHS-4000 has the features that let you realize your full creative potentials. 400 dpi resolution, color gray scale output, six gamma correction patterns among others. Plus PC Paintbrush IV+, the world's best. And the quality that you've come to expect from the company that started handheld scanning.

Live up to your creative scanning possibilities with DFI's CHS-4000. Who knows where it will lead you to?

Circle 395 on Reader Service Card

**DFI**®

West Sacramento, CA  
Tel: 916 373 1234  
Fax: 916 373 0221

East Brunswick, NJ  
Tel: 201 390 2815  
Fax: 201 390 2817

Miami, FL  
Tel: 305 477 1988  
Fax: 305 594 0607

West Germany  
Tel: 040 234 766  
Fax: 040 233 666

United Kingdom  
Tel: 81 462 9290  
Fax: 81 462 7538

Taiwan, ROC  
Tel: 02 543 3966  
Fax: 02 537 7458

World Radio History

## Introduction

# C++ / Views™

for Microsoft Windows

An application development framework with the **most complete C++ object class library** for MS Windows 3.0 development.

A powerful object-oriented development environment with the **first fully functional object class Browser for C++**.

A cost-effective productivity tool for the next generation of software. **Order today** at the introductory price of **\$495.00** (plus shipping). **Comes with full source code for over 65 classes - NO Royalties.**

CNS, Inc. - Software Products  
7090 Shady Oak Rd., Minneapolis, MN 55344  
612-944-0170, Fax 612-944-0923



... providing and advancing  
object-oriented methodology.

## PC Compatible Single Board Computers for the OEM

DR DOS® Now Available

### Quark®/PC +

- NEC V-40® Processor
- Video/LCD Controller
- 8 or 10 MHz Frequency
- Up to 768K Memory



4" x 6"



4" x 6"

### Quark®/PC II

- 80386 SX based
- EGA® Video/Color LCD Controller
- SCSI Hard Disk Control
- Floppy Disk Control
- Up to 4 Mbytes Memory

To order or enquire call us today.

Megatel Computer Corporation  
(416) 245-2953 FAX (416) 245-6505

125 Wendell Ave., Weston, Ontario M9N 3K9

REPS: Italy 39 331 256 524	Austria 43 222 587 6475
W. Germany 49 6074 98031	Finland 358 0757 1711
U.K. 44 959 71011	Sweden 46 4097 1090
Netherlands 31 838 541 301	Norway 47 986 9970
Australia 61 03 568 0988	Denmark 45 244 0488
France 1 47 46 94 52	

Trademarks: Quark - F + K. Manufacturing Co.  
DRDOS - Digital Research Ltd. EGA - IBM Corp. V-40 - NEC Corp.

# megatel

can have different methods installed when they are created. This is a powerful feature not found in many object-oriented languages. In this example, only the data fields are set by NEW; the default methods provided on lines 16 and 17 are retained.

As implied in the example, all Modula-3 objects are dynamically allocated. In Modula-3, there are no constructors or destructors to create and destroy objects automatically. Programmers must write explicit initialization routines or allow the user to invoke NEW directly. Destructors in other languages are most often used to deallocate dynamic storage. But since Modula-3 has automatic garbage collection, destructors are not usually needed.

### Threads and Programming for Concurrency

Concurrent programming—the management of multiple, simultaneous control flows—is the third major structuring facility in Modula-3 (after modules and objects). Concurrency is useful in many programming situations: when you want to take advantage of multiprocessing; when you want to provide background processing during slow user interactions; and when you are handling naturally asynchronous or independent tasks, like handling separate windows in a graphical user interface.

Few other languages provide direct support for concurrency: Modula-2 provides a weak coroutine-based facility, and Ada a complex rendezvous mechanism. In contrast, Modula-3 adopts the *thread* model in which concurrent threads of control are managed within the same program and address space, each with its own local call stack but with shared access to all global data. This is the model increasingly supported by new operating systems. Threads are typically much more efficient than *processes*, which are identified with a separate address space.

A detailed example of programming with threads is outside the scope of this article. Suffice it to say that Modula-3 has a standard library interface that provides facilities to fork and join threads, to use mutual-exclusion semaphores and condition variables, and to alert (interrupt) running threads.

### Safety

Safety is a principal goal of Modula-3. Most of the language is safe in the sense that the compiler guarantees that run-time invariants (e.g., variable ranges, array indexes, and the validity of pointers) are not violated. In contrast to this, Appendix F in the ANSI C standard lists 97 different circumstances in which the behavior of a C program is undefined at either compile time or run time. Modula-3 guarantees safety through a combination of compile-time analysis and run-time checking. This can vastly reduce the time it takes to debug a large application.

Systems programming can be unsafe by its very nature. Storage allocators and garbage collectors typically must have access to the unsafe features of a language. In Modula-3 these features include the ability to perform arbitrary type coercions, to perform arithmetic on pointers, and to call the DISPOSE procedure to explicitly free dynamic memory allocated with NEW.

To use the unsafe language features, you must insert the modifier UNSAFE in your interface or module. Otherwise, the compiler will restrict you to the safe language subset. A good way to include unsafe elements into Modula-3 programs is to create a module with a safe interface for others to use, and then to implement that interface with an unsafe module. You must be the guarantor that using the interface is safe; Modula-3 cannot completely check it.

### Garbage Collection

Some of the most insidious run-time errors are caused by misusing pointers, especially by using pointers after the storage

Now Under X-Windows

Introducing DADiSP 2.0

Now with Data-Acquisition Support



# DADiSP. The Big Picture in Data Analysis

**DADiSP** — interactive graphics and data analysis software for scientists and engineers. DADiSP 2.0 delivers unprecedented power, through easy-to-use menus. Choose from hundreds of analysis functions and graphic views — from tables to 3-D. Simultaneously display multiple windows, each with different data or analyses, for unlimited perspective on your toughest data analysis problems.

**Build your own analysis worksheets** — build and display an entire data analysis worksheet, *without programming*. And DADiSP's powerful graphic spreadsheet automatically recalculates and updates the entire worksheet if you change your data or an analysis step.

**Do serious signal processing...** the way you always pictured it! FFTs, digital filter design, convolutions, waterfall plots, and more — all at the press of a key.

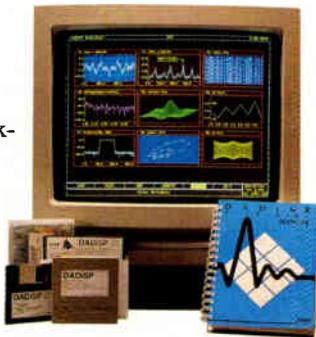
**Let your instruments do the talking** — use DADiSP-488 to bring data from your instruments directly into a DADiSP window for immediate viewing and analysis.

**Flexible, expandable, customizable** — annotate your graphs and send them to printers, plotters, or publishing packages. Create your own macros, automate routine tasks, and run any program written in any language from within DADiSP. *DADiSP even lets you build your own menus.*

**A proven standard** — already used by thousands of engineers and scientists worldwide, in a whole range of applications like medical research, signal processing, chemistry, vibration analysis, communications, manufacturing quality control, test & measurement, and more. DADiSP supports the IBM PC and PS/2, SUN, DEC VAX, HP 9000 and Concurrent families of personal computers and workstations.

**GET THE PICTURE! 800-424-3131  
IN MA 617-577-1133**

Ask for our Evaluation Disk. For more information, write to DSP Development Corporation, One Kendall Square, Cambridge, MA 02139, or FAX: 617-577-8211.



Australia-Interworld Electronics, 03 521-2952; England-Adept Scientific, (0462) 480055; Biosoft (0223) 68622; France-SM2I, (1) 34810178; Sacasa, 69077802; West Germany-Datalog, (02166) 46082; Stemmer Elektronik, 089-809 02-0; Israel-Racom Electronics, 03-491-922; Italy-BPS Computers, (02) 61290221; Japan-Astrodesign, 044-751-1011; Netherlands-Computer Engineering Roosendaal, 01650-57417; New Zealand-GTS Engineering, (09) 392 464; Sweden-Systek, 013 110140; Switzerland-Urech & Harr AG, 61 611325; Taiwan-Advantech, 2-351-2117

Circle 120 on Reader Service Card

World Radio History

## 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



they point to has been deallocated. Modula-3 removes this problem once and for all by providing automatic garbage collection in the run-time environment. Since the programmer using the safe language cannot write a DISPOSE operation, the compiler can guarantee that no storage will be freed if there are outstanding references to it. Dangling references are a thing of the past, and programming becomes much simpler when you do not have to worry about storage management.

There is a side benefit to garbage collection. Since type information must be kept for pointer types, using the REFANY type (a pointer to anything) is safe, and the TYPECASE statement can be used to determine the type of a pointer at run time.

### Points of Contention

There are a few design choices in Modula-3 that some programmers will question. In all cases, the choices were made deliberately, and usually because either the alternative had little (proven) utility, it was too complex in all its ramifications, or it was unsafe.

Modula-3 is biased toward dynamic allocation. Introducing garbage collection was a calculated technological bet. Do the value of program safety and the efficiency of modern collection algorithms together make garbage collection acceptable in a systems programming language? I think so, but for the doubters, Modula-3 doesn't completely depend on garbage collection: The modifier UNTRACED can be applied to any pointer or object type to keep it from the collector (even in the safe language subset).

Even though Modula-3's OOP model is flexible and is simpler than that of many other languages, Modula-3 does not support multiple inheritance, constructors, or destructors, and all methods are virtual (to use C++ and Eiffel terminology). This means that you must pay for a level of indirection in all method calls, but nonvirtual methods can be written as ordinary procedures if efficiency is important. Multiple inheritance doesn't seem to be essential, and, besides, it introduces additional complexity and problems whose solutions require additional features.

On the other hand, Modula-3's data-type system uses a structural-equivalence model. In other words, two types are always treated as the same if their structure is the same. This model is simpler to understand than the more common name-equivalence model, and it more naturally addresses problems in distributed systems, where separate programs may share typed data.

Modula-3 makes a serious attempt to bring together the long-term maintainability of Ada, the simplicity of Modula-2, and the modern OOP facilities of C++. The result is a clean language that provides programmers who want safety and maintainability with a language to carry them through the 1990s.

If you would like more information on the Modula-3 language, you can write for Research Reports 52 and 53 from Digital Equipment Corp., Systems Research Center, 130 Lytton Ave., Palo Alto, CA 94301. The SRC implementation of Modula-3 is also available on Internet and via UUCP (Unix-to-Unix copy). The system consists of a Modula-3-to-C translator with many tools and libraries. It is distributed in source form and has been ported to a variety of Unix workstations. It is available on BIX as modula.3; see page 5 for more information and downloading details. ■

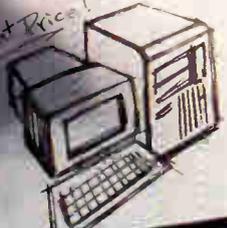
---

*Sam Harbison (Pittsburgh, PA) is the author of C: A Reference Manual and president of Pine Creek Software, a consulting firm specializing in programming languages and environments. He can be reached on BIX as "samharbison."*

MiStation 216s  
30 SX  
Intelligent Terminal  
ALSO a PC!



MiStation 216s  
High-end File Servers  
(not Price!)



MiStation 216s  
Cost-effective  
OK-LAN Station



Connectivity is  
Easier with MITAC  
Equipment and Support



Link Intelligent  
terminals via  
Ethernet,  
Arpanet  
or Token  
ring



## Networking is a Simple Concept, Your Network Solution Should Be Too

If you are involved in networking, you know how complicated it is to plan a network, source various vendors' hardware and software, put it together, and make it all work as planned. To help make your task easier, MITAC complements its powerful networking computers with the services of its Connectivity Support Group.

From MITAC's high performance, Novell-certified 33 MHz MPC4000G server to its cost-effective MiStation 316S LAN node, MITAC computer products are designed for networking.

Specifically, MiTAC engineers have tested hundreds of software and hardware products in Novell, Banyan, 3Com and even Unix environments. The Connectivity Support Group gives you access to this wealth of experience along with MITAC's recommendations and the advice of its trained technical personnel.

For more information about networking with MITAC products and for a guide to MITAC's complete line of computers, please call American MITAC Corporation at (800) 638-2287 x 348.



# Recording the Past... ...Plotting the Future



Our reputation precedes us! From 5 subsidiaries and 35 distributors in more than 40 countries worldwide, thousands of customers purchased more in 1989 than ever before. And they were able to choose new products from an ever-expanding array of plotters, penless plotters, digitizers, recorders and supplies.

The Graphtec reputation is one of building products that work well and last a long time. We earned that reputation the hard way, by delivering over 40 years of the best innovation, support, and after-sales service in the industry.

One of the finest examples of Graphtec innovation is incorporated into our new TM1110/1210 series of thermal plotters. These plotters are unique thanks to the world's first single-substrate, large-format thermal head. The single head ensures a uniform, high-quality printout with superb 406 dpi (16 dots/mm) resolution.

Hard copies can be made on three types of media: regular, thermal transfer and clear film. Also, RS-232C and Centronics interfaces come standard, as do GP-GL and HP-GL™ command sets.



TM1110 A1-size Thermal Plotter



**GRAPHTEC CORPORATION** Mita 43rd Mori Bldg., 13-16, Mita 3-chome, Minato-ku, Tokyo 108, Japan Tel: (03) 453-0511 Telex: 02422687 (GRAPH-J)  
U.S.A.: American Graphtec, Inc. Tel: (714) 261-7568 (800) 654-7568 Fax: (714) 833-7568 Australia: Southern Graphtec Pty. Ltd. Tel: (02) 748-4888 Fax: (02) 748-4882  
Europe: Graphtec Europe GmbH Tel: (040) 511-5059 Telex: 2165630 (GTEC D) United Kingdom: Graphtec (UK) Ltd. Tel: (0270) 625-115 Fax: (0270) 626-730

Circle 147 on Reader Service Card

HP-GL is a trademark of the Hewlett-Packard Company

# THE MOUSE THAT ROARED

The history, anatomy, and physiology of the desktop rodent

**M**ice! Suddenly they're everywhere—about a quarter of all PCs users have them. PC mice have grown steadily in popularity since their 1982 introduction. The increased availability of programs that support mice will continue to accelerate this trend. In particular, the phenomenal success of graphical user interfaces (GUIs) for the PC—most notably Microsoft Windows 3.0—is having a dramatic effect on the demand for PC mice. Before long most PCs, like all Macintoshes, will have one scurrying around next to their keyboard.

## The Way it Was

Douglas Engelbart invented the mouse in 1963, at the Stanford Research Institute. At that time Engelbart was exploring various computer input device possibilities. His first prototype mouse was made of wood, with metal disks for rollers that detected the mouse movement. After using the mouse, Engelbart concluded that it was superior to the other alternatives and that it would remain the best pointing device for computer users until something better came along.

Xerox further developed the mouse concept in the early 1970s at its Palo Alto Research Center (PARC), under the direction of Jack S. Hawley. Unlike Engelbart's mouse, which used variable resistors and an A/D conversion circuit, Hawley's was the first digital mouse. Much of Hawley's basic design has been carried into the modern PC mouse.

In 1982, Mouse Systems introduced the first mouse for the IBM PC. With no real software available with mouse support, initial sales of the three-button

mouse were primarily to computer users who were curious about the creatures, and those attracted to the novelty.

Around that time, Microsoft also started seeing the mouse as a device with a lot of potential in the PC marketplace and, being a software company, the company had the wherewithal to encourage mouse use by writing mouse support into its software.

Microsoft introduced its own two-button PC mouse in mid-1983. With the subsequent introduction of such programs as Microsoft Word, and later Windows and Excel, Microsoft showed PC users that a mouse can make working on computers easier and more efficient (and more fun).

When the Macintosh appeared in 1984, sporting a mouse and a user-friendly GUI, users everywhere became even more aware of the benefits of the mouse. Meanwhile, mouse-supporting applications continued to trickle into the PC marketplace.

Mouse vendors further encouraged mouse use by supplying pop-up menus that allowed their mice to work with standard nonmouse applications. Mouse-based PC paint programs also began to appear, and it was common to buy a mouse that included a bundled paint program.

The use of mice on PCs continued to grow. In mid-1988 Microsoft recorded its one-millionth mouse sale and ended the 1990 fiscal year in June with nearly two million mouse sales—about half of all PC mice sold that year. Other major mouse suppliers have also benefited from the increased popularity of mice, including Logitech, Mouse Systems, and IBM. According to International Data Corp. (Framingham, MA), 1989 mouse sales in the U.S. totaled around 3.2 million units, with worldwide sales for that year of around 5.5 million units.

As Engelbart predicted, the mouse has indeed withstood the test of time. There are far more mice on PCs than any of the alternative pointing devices (i.e., track-

balls, graphics tablets, light pens, and touch-screens).

## Mouse Anatomy

Mice come in two species: mechanical and optical. Mechanical mice, in turn, belong to two subspecies: electromechanical and optomechanical.

Figure 1 illustrates the operation of an electromechanical mouse. A rubber-coated metal ball protrudes from the bottom of the mouse; as you move the mouse, it turns. Two rollers touching the ball record its movements along the *x* and *y* axes. As the rollers rotate, encoders make and break electrical contacts that send electrical pulses the computer can use to track the mouse.

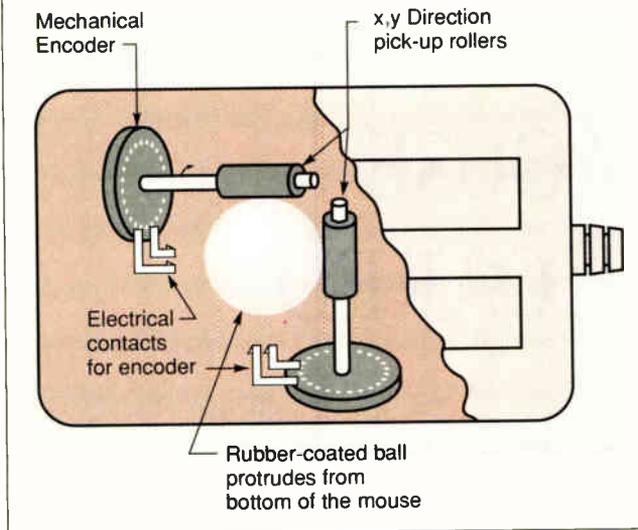
Alternatively, some mechanical mice, like the Manager Mouse from Numonics, don't use a roller ball. Instead, two rollers protrude from the bottom of the mouse to sense the *x* and *y* directional movements.

The optomechanical mouse illustrated in figure 2 works differently. LEDs shine through holes in the encoders onto photodetectors. As the rollers rotate, the encoders alternately make and break light beams between the LEDs and the photodetectors. Corresponding electrical signals sent to the computer describe the motions of the mouse.

Note that the optomechanical mouse needs two LED/photodetector pairs in order to determine the direction of rotation. A single LED/photodetector pair can only determine rotational speed.

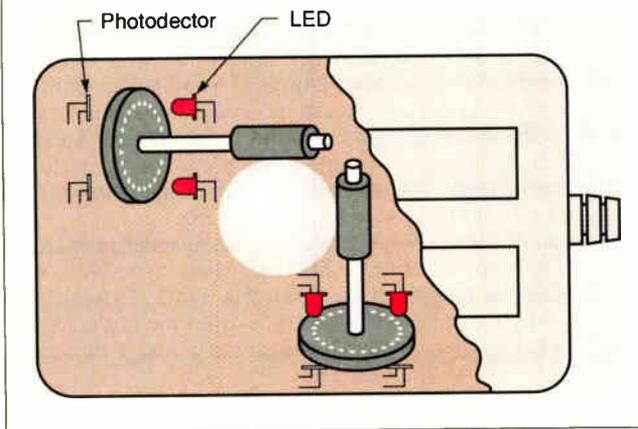
Figure 3 shows how an optical mouse works. It requires a special reflective mouse pad with a grid of black and blue lines. The mouse has two LEDs that shine onto the mouse pad, one red and one infrared. The reflected light beams reenter the mouse through lenses, and then reflect onto photodetectors. The blue lines absorb the red light, and the black lines absorb the infrared light. As the mouse moves, the pad alternately absorbs and reflects light. The photodetec-

## ELECTROMECHANICAL MOUSE



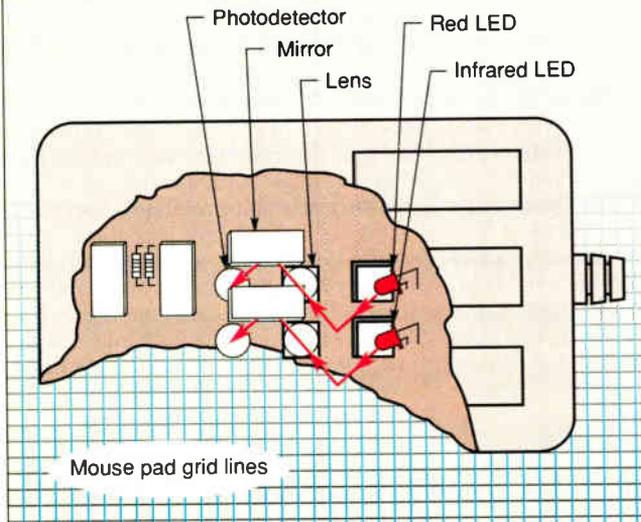
**Figure 1:** In an electromechanical mouse, a rubber ball drives the encoders, which make and break electrical contacts.

## OPTOMECHANICAL MOUSE



**Figure 2:** As with an electromechanical mouse, a rubber ball inside an optomechanical mouse drives the encoders. In this case, however, LEDs shine through holes in the encoders. The optical encoding scheme eliminates wear on the encoders.

## OPTICAL MOUSE



**Figure 3:** Red and infrared LEDs shine from an optical mouse onto a special pad. Reflected beams pass through lenses, then reflect onto photodetectors.

tors detect the “makes” and “breaks,” which the mouse converts to signals that it sends to the PC. As with all species of mice, additional signals tell the computer about push-button events.

Most PC mice have either two or three push buttons (in contrast to the Mac’s single button). Mouse-based PC programs generally require just two buttons, but can often assign a function to a third button. Mouse push buttons can also work in combinations (e.g., two buttons simultaneously) to specify other functions. Some programs support the double-click—two button presses in rapid succession—to specify more functions.

What are the relative merits of optical versus mechanical mice? Optical mouse proponents claim greater reliability for their favorite, thanks to its solid-state, no-moving-parts design. The “opticians” also point out that the optical mouse is maintenance-free, unlike mechanical mice, which require periodic cleaning of the roller ball to eliminate the inevitable build-up of foreign substances. They also claim the optical mouse is more accurate. If an optical mouse moves from one point to another on its mouse pad, then back, the cursor on your screen should be back exactly where it started. In contrast, the mechanical nature of mechanical mice makes them more susceptible to slight variations, including minor ball skipping and alterations in the registration of the roller ball to the encoder shafts. Move a mechanical mouse from one point to another and back, and you’ll typically find the cursor slightly off its starting point.

The mechanical-mouse proponents argue that modern mechanical mice have shown no reliability penalty, and that the roller ball rarely needs cleaning—especially when used on a rubber mouse pad. Furthermore, the mechanical mouse doesn’t need a pad, as an optical mouse does. Some users don’t want to give up the desk space, or restrict the mouse to a limited field.

Finally, the mechanical design more readily accommodates higher mouse resolutions. You can cram only so many black and blue lines onto an optical mouse pad before you begin to lose the ability to resolve them.

What about the two species of mechanical mice? Electromechanical mice suffer from a couple of problems that their optomechanical cousins solve. With an electromechanical mouse, the electrical contacts on the encoders can “bounce” a bit. This affects accuracy and requires a compensating circuit design. Electromechanical mice also tend

to wear out their encoders, since there are always points of physical contact. The optomechanical design eliminates bounce, and there's no encoder wear (except at rotational joints). The optoelectronic design of the encoders also supports higher resolution. Most high-resolution mice are optomechanical (although the 350-point-per-inch PC Mouse III optical mouse from Mouse Systems is the exception to this rule).

### The Resolution Revolution

The resolution of a mouse refers to the number of points it can detect for every inch of movement. The distance between two adjacent points (the shortest distance the mouse can resolve) is measured in a half-dozen different units. Programmers who work with mice have whimsically coined the unit *mickey*, but the industry is using more common ones, including dots per inch (dpi), counts per inch (cpi), pulses per inch (ppi), and points per inch (another ppi, and the one used for this article).

Early mice, like the original Microsoft mouse, had a resolution of 100 ppi. Most of today's mice have a 200-ppi resolution, as did Microsoft's second- and third-generation mice. Some newer high-resolution mice register between 320 and 400 ppi, including Microsoft's latest 400-ppi entry. There has been some debate over the necessity of resolutions as high as 400 ppi, but some users claim smoother mouse operation on high-resolution screens when using a high-resolution mouse.

### Mouse Interfaces

In what form do the signals enter your PC, and how does the PC process them? That depends. Three primary types of mouse interfaces are common in the PC world: bus, serial, and special port.

The earliest mice were bus mice. They came with a half-size interface board that plugged into one of the PC's expansion bus slots; the board drew its power from the expansion bus. The board processed signals from the mouse, and periodically generated interrupts to pass mouse movement and button-press information to the mouse driver.

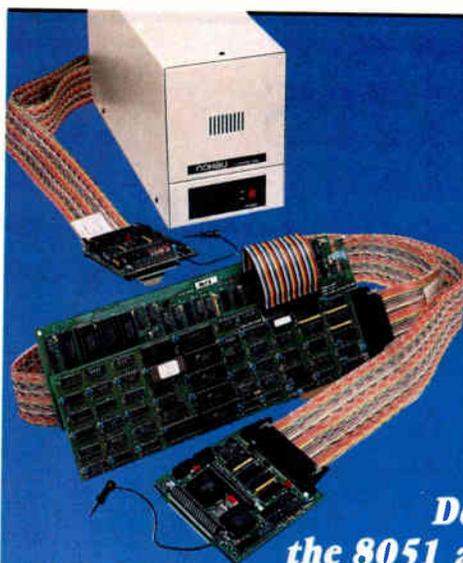
Microsoft made a substantial contribution to the PC mouse market when it introduced a serial version of its mouse in 1984. The serial mouse could plug into a standard COM1 or COM2 RS-232C serial port. It didn't need a bus interface board or any other external circuitry. The mouse included a small controller that sent packets of information to the PC via the serial port. The controller re-

quired so little power that it could operate without an external power source, simply by drawing its power from the RS-232C request-to-send (RTS) handshake line. This became a trend in the mouse industry, and now most mice are of the serial variety.

I should mention one caution concerning the use of serial mice with laptop computers. Since these mice draw their power from the serial port itself, they expect to see the typical PC voltage of

around +12V on the RTS handshake line. When laptops are operating on battery power, however, a lower voltage is often used to generate the serial-port signals. This prevents many serial mice from working properly with the system. If you use the laptop's AC adapter, of course, there won't be a problem.

If you don't count Microsoft's brief flirtation with its Mach 10 PC turbo board (using the company's proprietary InPort mouse interface), IBM was the



# 8051 & 68HC11

PC-Based  
In-Circuit Emulators

**Nohau**  
Covers All Your  
Development Needs for  
the 8051 and 68HC11 Families!

### Free Demo

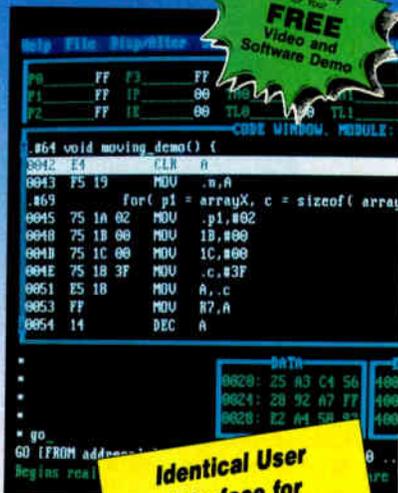
You can start your debugging with this FREE demo simulator. You can load up to 512 bytes of code, assembler, C, or PL/M and do full debugging/simulation in assembly and source level. A great way to get started for FREE. Fantastic for schools! Just call and we'll send it!

### Full Simulator

The full-blown simulator is an extension of the DEMO. You can load up to 64K of code and use 64K of XDATA space. You can program an "external environment" to interact with your code to simulate your target system. The emulator is the hardware extension of the simulator!

### In-Circuit Emulation

The 24MHz real-time emulator has been the industry standard for years. With its complex breakpoint logic and advanced trace, nobody can beat it for performance. Plug-in or RS-232 configuration. All 8051 derivatives are supported!



**NOHAU**  
CORPORATION

51 E. Campbell Avenue, Campbell, CA 95008  
(408) 866-1820 • FAX (408) 378-7869

Australia (02) 654 1873, Austria (0222) 38 76 38, Benelux +31 1858-16133, Canada (514) 689-5889, Denmark (42) 65 11 11, Finland 90-452 1255, France (01)-69 41 28 01, Great Britain 0962-73 31 40, Israel (03) 48 48 32, Italy (011) 771 00 10, Korea (02) 784 784 1, New Zealand (09) 392-464, Portugal (01) 81 50 454, Sweden, Norway (040) 92 24 25, Singapore (065) 284-6077, Spain (93) 217 2340, Switzerland (01) 740 41 05, Taiwan (02) 7640215, Thailand (02) 281-9596, West Germany 08131-1687,

first company to include a mouse port (aka, "pointing device" port) on its systems. The mouse port on IBM's PS/2 systems (Models 50 and up) is essentially a bus-mouse interface built into the system motherboard.

Some of the newer bus mice have taken a different approach to implementing the PC/mouse interface. Rather than offer two different mice—one serial and one bus—some manufacturers combine the two into a single serial mouse. The "bus

interface" in this situation is functionally little more than a standard serial port that maps to an I/O address other than COM1 or COM2.

#### How Serial Mice Communicate

Serial mice send multiple-byte packets of information to the PC to indicate the directional movement of the mouse and the status of the mouse push buttons. A couple of packet formats have emerged as the predominant standards in the industry.

Most applications, however, don't need to worry about them; the mouse driver hides the packet formats.

The two-button Microsoft packet format is the most popular format in use. The packet comprises 3 bytes; only the 7 low-order bits of each byte are significant. The first byte includes the 2 high-order bits of both the x- and y-position values, and the status of the two push buttons. The second byte contains the remaining 6 low-order x-position bits, while the third byte contains the remaining 6 low-order y-position bits.

The 8-bit binary position values are in two's-complement format (ranging from -128 to +127), with a negative value indicating movement left or up, and a positive value indicating movement right or down. The mouse sends the packet only when there's a change of state, such as a movement of the mouse or a press or release of a button. The x- and y-position values sent in the packet indicate the number of points the mouse has moved in each direction since the last packet.

Transmitting only an 8-bit value for each direction isn't a limitation—even for high-resolution mice—because the values indicate only the *change* in mouse position since the last packet was sent.

For example, a typical serial mouse operates at 1200 bps. That means each byte needs about 7.5 milliseconds to pass from the mouse to the PC (7 data bits, 1 start bit, and 1 stop bit), and each 3-byte packet takes about 22.5 ms. Each packet can specify a maximum position change value of 127 (in each positive direction), so the mouse can specify a position change of up to 5644 (127/0.0225) points per second. Even with a 400-ppi mouse, this scheme allows for movement of over 14 inches per second.

Of course, the baud rate can always be increased if this becomes a limitation. At 9600 bps, a serial mouse using the 3-byte Microsoft packet format can support a velocity of up to 112 inches per second.

The three-button Mouse Systems packet format comprises 5 bytes. The first byte reflects the current state of the three buttons. The second byte specifies the "first" x-position value and the third byte specifies the "first" y-position value. The fourth and fifth bytes are similar to the second and third, but specifying the "second" x- and y-position values instead of the first; that is, the change in the x- and y-positions since the readings sent in the second and third bytes. This can, for example, be helpful in determining mouse velocity.

As with the Microsoft packet format, the x- and y-position values are in two's

## "Compiler Ads Are Confusing"

**T**hey all claim that their products are the fastest and most powerful. Buzz words like optimized, integrated, and modular are everywhere—never meaning quite the same thing.

We'd like to be more direct. We'll tell you what you can do with our compiler—then you make the comparisons.

- **DUAL PERFORMANCE** You have two compilers in one integrated package—Quick for speed applications development and optimizing for the best code generation—with a simple menu option to move between the two.
- **FLEXIBILITY** You can interface directly with C or any other language. Write only one set of sources for DOS and OS/2, run the most complex applications with no change.
- **COMPATIBILITY** You can generate code compatible with Microsoft Windows, using all window facilities. And develop Presentation Manager applications with no additional software.
- **OPTIMIZATION** You get true global optimization, using data flow analysis and proprietary techniques, not just the standard peephole optimization and automatic assignment of variables to registers.
- **ENVIRONMENT** You have many features you won't find in any other environment—like the ability to organize your code into separate libraries and set compiler options both globally and on a per-module basis. And a make facility that is so well integrated, you don't even know it's there.
- **TOOLS** You get a debugger, profiler, object librarian and overlay linker with unique capabilities. And a runtime library with surprises like interrupt driven serial communications, true multitasking, graphics, and mouse interface modules.

Stony Brook Professional Modula-2 (both the Quick and optimizing compilers for DOS and OS/2) for \$295. Stony Brook QuickMod (for DOS or OS/2) for \$95.

Stony Brook—we eliminate the confusion.

■ The fine print version of this information with all the details, including our benchmark performances, will be mailed to you within 24 hours if you call our 800 number.

800/624-7487 805/496-5837 California and International

805/496-7429 Fax 187 East Wilbur Road, Suite 9  
Thousand Oaks, CA 91360

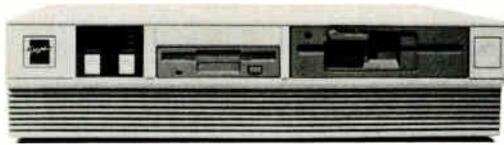
*Stony Brook*  
SOFTWARE

Your Partner  
in Software Development

© 1989 Gogesch Micro Systems, Inc.



# A Higher Standard of Standard Features



## DATAStation 386/25™ **\$3,995**

- 80386-25 CPU
- 4MB RAM
- 128K Cache RAM
- 1.2MB 5 1/4" and 1.44MB 3.5" Drives
- 200MB, 15MS SCSI Drives
- 16 Bit VGA with 512K
- 14" 1024 x 768 VGA Color Monitor
- External SCSI Port
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- Options:
  - 40MB, 80MB, 100MB, 320MB Hard Drives



### TECH™ 386SX ..... **\$1,895**

- 80386SX-16 CPU
- 1MB RAM expandable to 8MB on motherboard
- 1.2MB 5 1/4" or 1.44MB 3.5" drive
- 40MB IDE hard drive
- 16-bit VGA with 512K
- 14" 1024 x 768 VGA color monitor
- 1 parallel, 2 serial & 1 game ports
- 101 key keyboard
- MS DOS 3.3 or 4.01

### TECH™ 286 ..... **\$1,495**

- 80286-12 CPU
- 1MB RAM expandable to 8MB on motherboard
- 1.2MB 5 1/4" or 1.44MB 3.5" drive
- 40MB IDE hard drive
- 16-bit VGA with 512K
- 14" 1024 x 768 VGA color monitor
- 1 parallel, 2 serial & 1 game ports
- 101 key keyboard
- MS DOS 3.3 or 4.01

Call For System Options



### PONI Microsystems 386SX-LT ... **\$2,995**

- i80C386SX-16 CPU
- 1MB RAM expandable to 6MB
- VGA with 256K
- 1.44 MB 3.5" diskette drive
- 40MB hard drive
- 85 key keyboard
- External ports for floppy drive, keyboard and VGA monitor
- Parallel and serial ports
- UL, CSA, FCC-B approved

### PONI Microsystems 286-LT ..... **\$2,495**

- 80286-12 CPU
- 1MB RAM expandable to 6MB
- VGA with 256K
- 1.44MB 3.5" diskette drive
- 40MB hard drive
- 85 key keyboard
- External ports for floppy drive, keyboard and VGA monitor
- Parallel and serial ports
- UL, CSA, FCC-B approved

## PRE-CONFIGURED MULTI-USER SYSTEMS

6-User Computer Systems Ready To Plug In And Install Your Application Software



### Authorized Xenix ..... **\$9,995**

- 6 WYSE terminals
- 1 main computer
- 386-25MHz-128KB cache
- 8MB RAM
- 8 serial ports
- 1 parallel port
- 3.5" 1.44 floppy drive
- 200 MB hard drive
- 150MB tape drive
- 2400 Baud modem
- Communications software
- 1 Xenix operating system installed
- 6 cables with labels for terminals



### Authorized Novell... **\$14,995**

- 6 386SX workstations
- 1MB RAM
- Monochrome monitors
- 1 150MB tape drive
- 1 2400 Baud modem
- Communications software
- 1 main computer
- 386-25MHz-128KB Cache
- 8MB RAM
- 2 serial ports
- 1 parallel port
- 3.5" 1.44 floppy drive
- 200MB hard drive
- 1 Novell ELSII® Network operating system, Ethernet cards
- All cables and connections

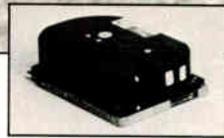
Options: Printers • Word Processing • Spreadsheets • Accounting • Larger Hard Drives • Custom Configurations • Maintenance Contracts

# TECH CITY

## 800-828-3110

6 A.M. TO 6 P.M. PST  
 (714) 385-1219, FAX (714) 937-5414  
 TECHNICAL SUPPORT (714) 956-9593  
 1300 E. Katella Ave., Anaheim, CA 92805

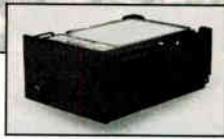
Circle 336 on Reader Service Card (RESELLERS: 337)



### 200MB, 3.5" High Performance Hard Drive Kits

MAXTOR LXT200A, IDE	\$1,095.00
CONNER CP3204, IDE	1,095.00
IMPRIMIS 94351, IDE	1,095.00
MAXTOR, LXT200S, SCSI	1,395.00
CONNER CP3200, SCSI	1,395.00
IMPRIMIS 94351, SCSI	1,395.00

Each kit comes complete with 16-bit hard/floppy controller (SCSI kit comes with Adapter AHA 1542B, 16-bit 15MHz SCSI controller) • "1 to 1" interface • "Look Ahead" read buffer • cables • installation guide



### High Performance 5.25" Hard Drives

MANUFACTURER/MODEL #	CAPACITY	DRIVE ONLY	DRIVE KIT
MICROPOLIS MC1654	160MB	\$ 995	\$1,195
MC1664	330MB	1,495	1,695
MC1568	660MB	2,295	2,495
MC1598	1.2GB	4,795	4,995
MAXTOR T8380E	370MB	1,595	1,795
XT8760E	680MB	2,395	2,595
TAHITI 1GB	5,695	5,995	
NEC D5655	150MB	995	1,195

Each kit comes complete with Adapter AHA 2322 ESDI Controller for dual floppy/dual hard drives. All kits includes cables, mounting hardware, installation software and installation guide. Novell/XENIX drivers available. SCSI versions are available for additional \$200.



### High Performance 3.5" Hard Drives

MANUFACTURER/MODEL #	CAPACITY	DRIVE ONLY	DRIVE KIT
CONNER CP3044	40MB	\$ 365	\$ 395
CP3184	80MB	565	595
CP3104	100MB	665	695
CP3204	200MB	1,065	1,095
TEAC 40MB		365	395
SEAGATE ST157A	44MB	335	365
TOSHIBA MK234FC	100MB	655	685
IMPRIMIS 94356	105MB	655	695

Drive kit comes complete with 16-bit hard/floppy controller (SCSI kit comes with adapter AHA1542B, 16-bit, 15 MHz SCSI controller) • "1 to 1" interface • "Look Ahead" read buffer • cables • installation guide. SCSI versions are available for additional \$200.



### Enhancement Products

NEC 2A VGA MONITOR 14"	\$475
NEC 3D VGA MONITOR 14"	595
SCEPTRE VGA MONO MONITOR 14"	165
LOOP VGA COLOR MONITOR 14"	365
SCEPTRE TTL MONO MONITOR 14"	125
VGA CARD W/256K, 16-BIT	95
VGA CARD W/512K, 16-BIT	155
MONO GRAPHIC CARD W/P.P.	25
256K SIMM 80NS	30
1MB SIMM 80NS	75
2400B MODEM INT.	90

■ 30-day Money-Back Guarantee

■ 1 Year Warranty

■ No additional charges for Credit Card

■ No Credit Card charge until shipment

**DEALER VAR/OEM DISTRIBUTOR WELCOME**

complement format. A positive value indicates movement right or up; a negative value indicates movement left or down.

### The Software Perspective

It is probably obvious that Microsoft has set the standard for PC mice. You'd be hard-pressed to find one that doesn't tout "Microsoft Mouse compatibility."

DOS applications generally access the mouse movement and button information by making calls to a mouse driver. Vir-

tually every PC mouse includes a mouse driver that emulates the Microsoft Mouse driver to make the mouse look like a Microsoft Mouse to the application. Many mice also come with a driver to emulate a Mouse Systems PC Mouse.

Interestingly, the mouse driver interacts directly with the video adapter to control mouse cursor movement. The driver must therefore include support for the video adapter you use to ensure proper operation on your system. Naturally,

all current mouse drivers support the standard video adapters, including MDA, CGA, EGA and VGA, but if you are using something a little newer (like an 8514/A adapter) or something out of the ordinary, the mouse driver may not support it. Check if you are unsure.

Microsoft's mouse driver supports 35 function calls (see the table). The driver offers a lot of flexibility to the mouse programmer. While it is not possible to describe all the functions in detail here, I will briefly describe some of them.

The Mouse Reset and Status function (0) sets several mouse parameters to default values (e.g., the mickeys-per-pixel ratio), and returns the current status of the mouse; that is, whether or not the mouse has been found, and which mouse buttons, if any, are currently pressed. This function also hides the mouse cursor on the screen if it is displayed.

The Show Cursor and Hide Cursor functions (1 and 2) control whether or not the mouse displays its cursor on the screen. A counter value determines when to display the cursor. When the counter is 0 the cursor appears, otherwise it does not. The counter decrements with each Hide Cursor call and increments with each Show Cursor (although it cannot be incremented past 0). Thus, it takes three Show Cursor calls to undo three Hide Cursor calls.

The Get Button Status and Mouse Position function (3) returns the current status of the mouse buttons and the current cursor position on the screen. Beware, however, that the mouse driver uses a "virtual screen" matrix for determining the position of its cursor, and that virtual screen isn't always the same as the physical pixel array on the screen.

In the case of a medium-resolution graphics screen with a 320- by 200-pixel matrix, the mouse's virtual screen would be 640 by 200 pixels. The virtual screen concept is intended to simplify mouse programming. You can address the virtual screen (which is always a minimum of 640 by 200 pixels) and allow the mouse driver to translate the addressed position to the correct location on the display, based on the current video mode. For some high-resolution EGA and VGA modes, the virtual screen expands to 640 by 350 or 640 by 480 pixels, but for all other modes, the virtual screen remains at 640 by 200 pixels.

Function 15, Set Mickey/Pixel Ratio allows you to adjust the mouse sensitivity by selecting the number of mickeys, or points, required to move the mouse cursor eight pixels on the screen. You can set the value to anything between 1 and

## Never buy another ribbon!

Over 150,000 sold Shipping \$5.00



**Universal Cartridge (includes one adapter) .....75.00**

**Multicolor Adapter (specify printer) .....40.00**

**Epson only MacInker mod. 271EP .....45.00**

**Imagewriter only MacInker™ mod. 234IM.....45.00**

**Universal Spool MacInker .....75.00**

**Heat Transfer Adapter .....25.00**

Extra Ink Bottle, black .....3.00      pint .....18.50

Colored Ink Bottle .....4.00      extra reservoir .....6.00

All models delivered complete with bottle of ink, ink meter, reservoir, reservoir cover. **Go color !!** Single & multicolor, standard and heat transfer cartridges available: red, green, blue, brown, purple, yellow, orange, white, silver and gold. Indelible and OCR ink cartridges available.

Universal Cartridge unit shown with Epson cartridge **\$75.00**

Over 24,000 printers supported. Better than new print quality. Extended printhead life thanks to lubricated ink. Average cartridge can be re-inked 60-100 times at 5cents/re-inking. Multicolor adapters re-ink multiband cartridges. Documented customer savings of up to \$30,000/year. Detailed free catalog.

---

### MacBond II Auto-Ribbon Welder

Make your own ribbons! MacBond II splices and bonds in seconds ribbons of any size and inked in any ink and color. First real alternative to ribbon bonding machines costing thousands of \$\$\$\$. We have a complete range of bulk ribbons, color and multicolor, heat transfer etc. for your application.



Shipping \$9.00

**\$299.00 !!**

---

### Modems

4800 b throughput, full duplex. 9600, 4800, 2400, 1200 bps. CCIT V.22bis, V.22, Bell 212A & 103J modes • Auto speed selection • MNP cl. 5 error cor-rection • Synch & asynchronous modes • Cable and software included ( PC or MAC) • 2 year warranty

**9600 baud mnp cl 5 v.32 .....599.00**

**LightFax 9624 faxmodem .....399.00**

LightSpeed 9624E is a V.32, mnp 5, 9600 b modem. LightFax 9624 is a full featured group III, 9600 b fax & 2400 b modem combined, shipped with software & cable for PC or MAC (specify). Ring-On is a power center which senses an incoming call to turn on computer & modem.

**LightSpeed 2400LE(MNP cl 5).....159.00**

**Ring-On Remote Power Center .....199.00**

Shipping \$7.00



**2400b MNP cl 5 \$159.00 !!**

---

## Full Page Hand Scanner !

Shipping \$8.00



New

**\$599.00!!**

Have all the advantages of a handy scanner in a FULL PAGE SCANNER, for half the price of a desktop scanner. Includes 10 sheet document reader for sheet fed use. Scanner detaches for hand held use on photos, books etc. Compatible with most OCR software, a very high quality (100 to 400 dpi) input for OCR. Complete with sheet feeder, interface card and LightPaint software. 1 yr warranty. Order part #400 P.

---

### Diskette Doublor

Increase 3.5" disk capacity to 1.44 Megs with this ingenious and simple device. Only \$15.00 !!

---

**Computer Friends, Inc.**  
14250 NW Science Park Dr.  
Portland OR 97229

**Order Toll Free 1-800-547-3303**  
In Oregon (503)626-2291  
fax (503)643-5379 telex 4949559 CF

Satisfaction or 30 day refund - Immediate shipment - Major credit cards - PO's from National Accounts

32,767, inclusive. Another way to adjust the mouse sensitivity is to use Function 26, Set Mouse Sensitivity.

Function 36, Get Driver Version, Mouse Type, and IRQ (interrupt request) Number, returns the mouse driver version, the mouse type (e.g., bus, serial, InPort, or PS/2), and the IRQ number. This information can help determine if the current mouse and driver is compatible with the application.

An application can access a mouse driver in a couple of ways. One option is to link a .LIB file containing the driver with the application program. That way, the application supports the mouse directly. More commonly, however, users install the driver by way of the CONFIG.SYS file (DEVICE=MOUSE.SYS) or the AUTOEXEC.BAT file (MOUSE.COM), and the application accesses the driver functions by making calls to software interrupt 33 hexadecimal.

The *Microsoft Mouse Programmer's Reference* (Microsoft Press, 1989) fully describes the operation of the Microsoft Mouse driver.

MOUSE.SYS and MOUSE.COM work well enough in the DOS world (although I have seen incompatibilities), but the whole picture changes when you switch to a protected-mode operating system. OS/2 and Unix can't use a standard MOUSE.SYS driver to allow a mouse to emulate a Microsoft mouse, because such drivers won't work in protected mode. If these operating systems don't include support for your mouse, you'll need a special driver. Generally, you'll have more options with a serial mouse—particularly one that supports the Microsoft Mouse packet format.

### ICBM: Infinitely Configurable Ballistic Mice

An increasing number of mice support a feature known as *ballistic tracking* (or variable acceleration). At times, you may need to use your mouse for some detailed cursor movement at one part of your screen and then move clear across the screen for some further detailed work. Operating at high resolution, the trek across the screen can take a long time, and require several repeated movements of your mouse.

With ballistic tracking, the mouse can detect when you move it faster. As its velocity increases, it automatically changes the number of points per inch to allow faster travel across long distances. As it slows down, it reduces the number of points per inch to again allow more detailed cursor movement.

Ballistic tracking can be implemented

with an on-board controller or in the mouse driver software. Although most who have tried it like ballistic tracking (it beats repeatedly pounding your desk with your mouse to get the cursor across the screen) some find it irritating. If you're unsure, make sure your mouse has the option to disable the feature.

### A Faithful Companion

The mouse has come a long way in the past five years, but in terms of technology, little has changed. The basic mouse design remains essentially the same, with increments in resolution being the only real thing to show for the longevity of the mouse.

Experience has shown that mice in general are quite reliable, most operate basically as well as others, and resolution is often not a big concern. Some users prefer optical mice because there are no moving parts and nothing to clean; the mouse pad, however, takes up a chunk of your valuable desk space. Other users prefer the mechanical mouse to avoid the

optical mouse pad; but the roller ball gets dirty and must be cleaned periodically.

A serial mouse or a bus mouse? All other things being equal, it depends on whether you can more easily spare a serial port or an expansion bus slot. The final decision usually comes down to whether you like the size, the style, the color, the length of the tail, the number of push buttons, and the price.

PC mice will continue to grow in popularity. Continuing evolution of the PC mouse will be in the area of ergonomics; I doubt resolution will push much beyond 400 ppi. Other pointing devices, especially trackballs, will gain some ground but the mouse is not likely to give away very much of its cheese. ■

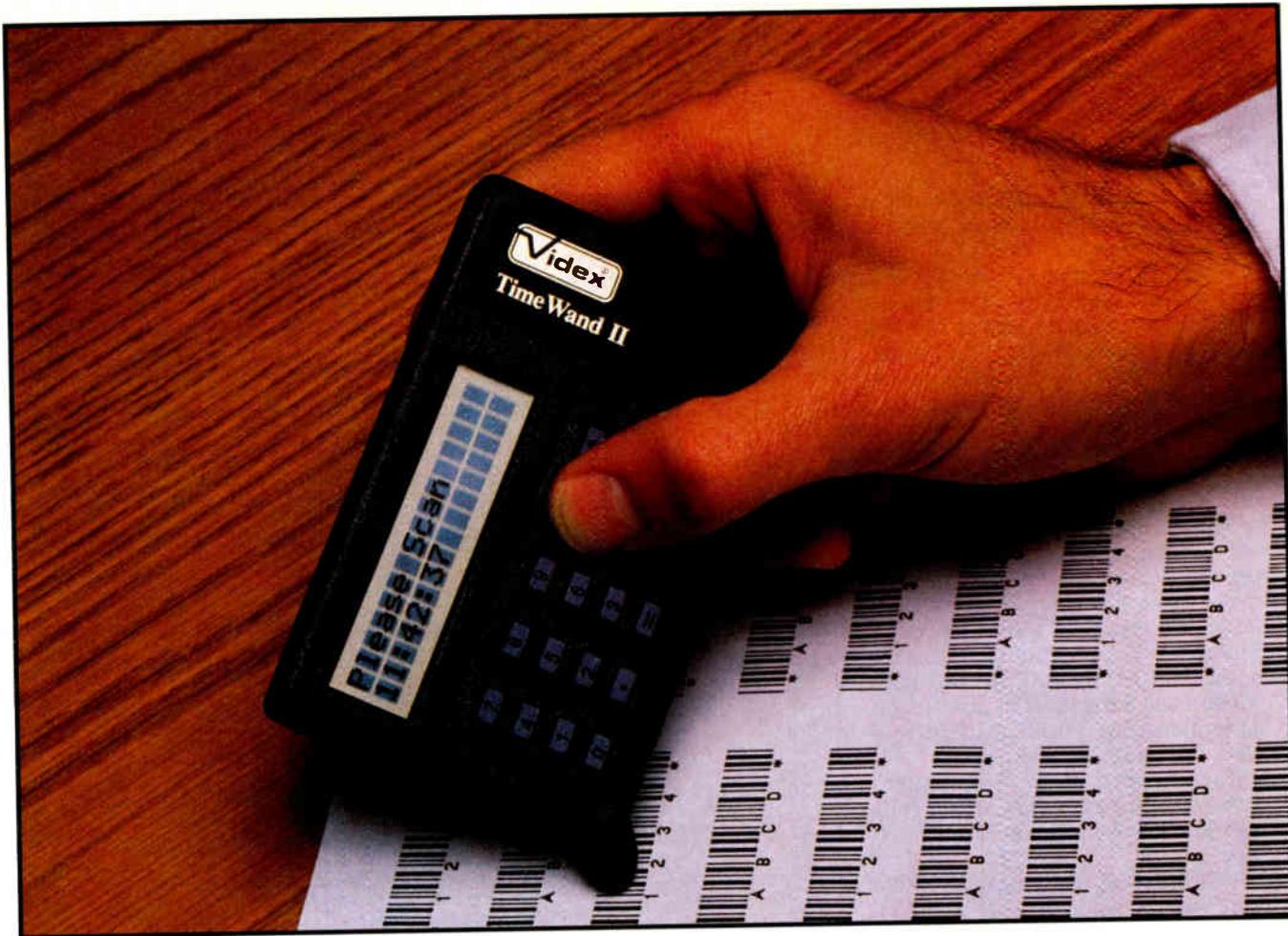
*Roger Alford is a computer design engineer and a freelance writer. He can be reached on BIX c/o "editors."*

*Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

## MICROSOFT MOUSE DRIVER FUNCTION CALLS

*Microsoft's mouse driver supports 35 functions, which provide a great deal of flexibility to the mouse programmer.*

Function number	Description
0	Mouse Reset and Status
1	Show Cursor
2	Hide Cursor
3	Get Button Status and Mouse Position
4	Set Mouse Cursor Position
5	Get Button Press Information
6	Get Button Release Information
7	Set Minimum and Maximum Horizontal Cursor Position
8	Set Minimum and Maximum Vertical Cursor Position
9	Set Graphics Cursor Block
10	Set Text Cursor
11	Read Mouse Motion Counters
12	Set Interrupt Subroutine Call Mask and Address
13	Light Pen Emulation Mode On
14	Light Pen Emulation Mode Off
15	Set Mickey/Pixel Ratio
16	Conditional Off
19	Set double-speed threshold
20	Swap interrupt subroutines
21	Get mouse driver state storage requirements
22	Save mouse driver state
23	Restore mouse driver state
24	Set alternate subroutine call mask and address
25	Get user alternate interrupt address
26	Set mouse sensitivity
27	Get mouse sensitivity
28	Set mouse interrupt rate
29	Set CRT page number
30	Get CRT page number
31	Disable mouse driver
32	Enable mouse driver
33	Software reset
34	Set languages for messages
35	Get language number
36	Get driver version, mouse type, and IRQ number



## TimeWands - The Obvious Choice

You have specific bar coding requirements.  
**That's why we give you a choice!**

The **TimeWand II** is a **ruggedized** bar code reader ready for heavy-duty use. Its programmability allows your custom applications to be pre-set with prompts and cross-reference files. The large internal memory sizes of 32, 64, and 128K easily hold a day's worth of transactions along with the date and time of each entry.

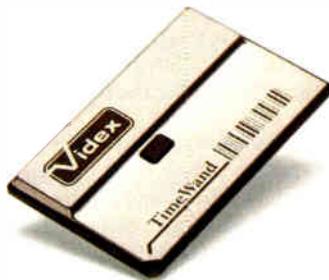
If your data collection needs are simpler, the original **TimeWand** offers a cost effective alternative. The TimeWand date and time stamps each bar code scan, like the TimeWand II, but is contained in a smaller and lighter package. Even though it is compact, the TimeWand can still gather an impressive 2000 scans.

Videx and TimeWand are registered trademarks of Videx, Inc.

Both TimeWands transfer their data through the host computer's serial port where the data is stored in an ASCII text file. This allows the data to be easily combined with a wide variety of software packages.

Choosing either the original TimeWand or TimeWand II provides you with a quality bar code reader at an affordable price. **Call Videx at 503-758-0521 and ask for your free information kit**

TimeWand (8K).....\$248.00  
 TimeWand II (32K).....\$698.00



1105 NE Circle Blvd.  
 Corvallis, OR 97330-4285  
**503-758-0521 \* FAX 503-752-5285**

*See us at COMDEX, November 12-16, Las Vegas,  
 BOOTHS #2998 and #N4571*

**Circle 368 on Reader Service Card (RESELLERS: 369)**

World Radio History



## PART 2

## TALKING TASKS

## A look at how OS/2 and Unix handle interprocess communications

**T**his month, I will continue my tour of interprocess communications. So far, I have looked at the IPC facilities provided by Quarterdeck's Desqview and Microsoft's Windows. I'll now focus on OS/2 and Unix.

The fact that OS/2 and Unix appear in the same column is more or less an accident—but it's a happy one. As it turns out, remarkable similarities exist between the IPC facilities of both operating systems. The similarities appear at a high level—the implementations are quite different—but this lets me present the material in an overlapped fashion.

### Pipes

In the wide array of IPC structures, the pipe is perhaps the simplest. It's a unidirectional communication path, usually leading from a parent process to one of its offspring processes, or vice versa. Data passes through a pipe in a purely unstructured form: a "stream" of bytes whose members come out the receiving end in the same order they were poured in at the sending end. Thus, the name *pipe* (see figure 1).

Since pipes are one-way streets, you usually acquire them in pairs.

### OS/2 and Pipes

You create OS/2 pipes using the `DosMakePipe()` routine, which returns two handles: one for the read pipe, and the other for the write pipe. This looks strikingly similar to the Unix System V `pipe()` system call that I discuss later.

You'll notice I said that pipes are "usually" connected between a parent pro-

cess and a child process. This is not so for named pipes, which can connect unrelated processes (see figure 2).

As their title suggests, you can attach identifying names to named pipes, and these names are accessible to other processes. The name you pick actually conforms to OS/2 filenaming conventions and has the form `\pipe\mypipe`, which specifies a pipe called "mypipe."

OS/2 named pipes operate in a client-server fashion: A server task creates the named pipe and awaits the connection of a client. An example is shown in the code fragments of listing 1, where the server builds a named pipe called "mypipe."

The server task will wait at the `DosConnectNmPipe()` call until the client executes a `DosOpen()` on the named pipe. At that time, the connection is established, and the two tasks can communicate. (Once you create pipes, you can read and write to them as though they were files.)

In the example I've given, the server has created an inbound pipe, meaning that the client can only write to the pipe and the server can only read from it.

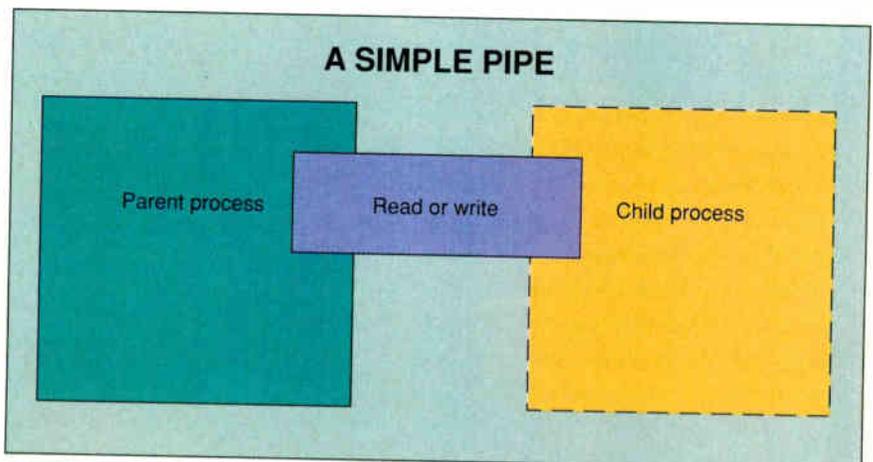
Named pipes can be inbound, outbound, or duplex (i.e., bidirectional).

OS/2's named pipes enjoy another feature: They can be byte-wide or message-wide. A byte-wide pipe is a pipe in the strict sense; data is sent through the pipe as a byte-at-a-time stream. However, a message-wide pipe looks much like a message queue. You can send data in chunks of arbitrary size. (Interestingly, OS/2's `DosTransactNmPipe()` function lets you read *and* write data through a pipe at a single call. Of course, this works only if you open the pipe in duplex mode.)

### The Pipes of Unix

You create a Unix System V pipe with a `pipe(descriptors)` call, where `descriptors` is a two-element integer array. The first member of the array is the file descriptor for reading the pipe; the second member is the file descriptor for writing the pipe.

Typically, you create a pipe between a parent process and a child process. The example most often given in Unix texts is



**Figure 1:** A pipe provides a single read or write connection between a parent process and a child process. If you create a pipe for writing from the parent process, you must open it for reading from the child, and vice versa. Two-way communication requires two pipes.

redirecting standard input through the pipe and executing a program. It looks something like what's shown in listing 2.

In listing 2, you simply point the character pointer variable `cmd` to some string holding the name of a command you want to execute, `grep` perhaps. The program issues a `fork()` system call, and the child process does the dirty work of redirecting the plumbing so that the parent task can write down the pipe, and the program launched by the `execl()` system call will see that data coming in through standard input.

Unix implements the equivalent of named pipes by using a special file type, FIFO, the acronym for first-in/first-out. Although FIFOs are not commonly used, they are the mechanism used by the Unix print spooler. Since a FIFO file is an entity of the Unix file system, it has owner, group, and world permissions and ownership as any other file. You need to pay special attention to ownership and permissions when you create a FIFO.

The function call looks like `mknod (pathname, mode, 0)`, where `pathname` is the name of the FIFO, and `mode` is the

permissions ORed with the `S_IFIFO` flag (defined in `sys/stat.h`) to indicate that a FIFO is being created. (The `mknod` function is used for creating all the directories and file types in the file system.) Once you have a FIFO, you can open it for reading or writing with the same functions that are available for standard files.

Generally, FIFOs are opened only for reading by a daemon (background process), which uses whatever is poured in as its input. Then, as other processes need the facilities of the daemon, they send their data to it. The System V print spooler uses a FIFO to communicate between the user's `lp` processes and the system's printer daemon, `lpsched`. The FIFO also handles communications between other processes and the daemon. If each message is less than the capacity of the FIFO (i.e., 4096 bytes), it is guaranteed to be atomic; messages cannot mix. FIFOs provide a simple many-to-one IPC that does not require the processes to be related.

**Listing 1: Creating an OS/2 named pipe. The pipe is an inbound pipe, and it's byte-wide. I've reserved 512 bytes for the input buffer, and I'll specify a default wait of 500 milliseconds for the `DosWaitNmPipe()`—other tasks will use that function when trying to open this pipe.**

```
DosMakeNmPipe("pipe \\ mypipe", &myphand, PIPE_ACCESS_INBOUND,
    PIPE_READMODE_BYTE | PIPE_TYPE_BYTE | PIPE_WAIT,
    0, 512, 500L);
/*
** Wait for a connection to this pipe.
*/
DosConnectNmPipe(&myphand);
/*
** Read from the pipe.
** Read 50 bytes into buff (which should be char *).
*/
Dosread(myphand, buff, 50, &bytesred);
/*
** Close the pipe down.
*/
Dos DisconnectNmPipe(myphand);
DosClose(myphand);
```

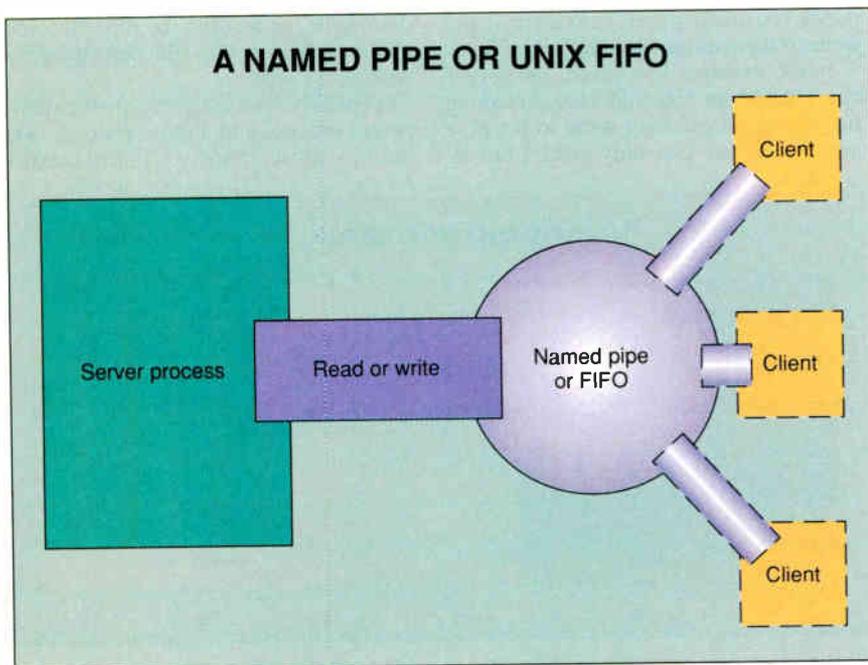
### Semaphores

Semaphores stand apart from the other IPC structures I've discussed. Unlike pipes, mailboxes, and such, it is not their job to pass data from one task to another. Rather, a semaphore exists to control access to a shared resource. It might be easier to think of a semaphore as a form of interprocess *coordination*, rather than interprocess *communication*.

In essence, a semaphore is a variable. What makes it special is that your program performs *indivisible* operations on the variable. That is, while your program is accessing the semaphore variable, it is doing so exclusively (see figure 3).

For example, suppose that you have a printer server that—for reasons of memory constraint—manages a request queue that can hold no more than 10 filenames. If you build a semaphore to manage access to the queue, you would initialize the semaphore variable to a value of 10. Thereafter, whenever a client program wishes to send a request down the queue, the client first examines the value of the semaphore.

If the value is greater than zero, there is room in the queue and the client task proceeds to insert the request. The client then decrements the semaphore variable to indicate that the request has consumed a queue slot. If the client program sees that the semaphore is zero (indicating that the queue is full), the program either indicates the queue-full condition to an operator or waits for the semaphore to assume a nonzero value.



**Figure 2: Named pipes do not require a parent-child relationship between the communicating processes. The client processes can come and go independently from the server.**

**Turn your favorite  
C compiler into a  
powerful database  
manager with the**

# **C/Database Toolchest**

The **C/Database Toolchest™** adds sophisticated file management functions to your Power C™, Turbo C®, QuickC®, or Microsoft® C compiler. With the **C/Database Toolchest™**, your data requires much less disk space than with programs like dBASE®, and you can access your data much faster. Of course the full power of C provides you with an unlimited amount of programming flexibility.

The **C/Database Toolchest™** includes three major components:

- 1) An advanced B+tree library gives you instant access to your data.
- 2) A high-level ISAM library provides you with an easy-to-use C interface, and

3) A complete database manager (with C source code included) shows you how to create impressive applications.

You also receive a comprehensive 350 page manual and a utility for converting dBASE® files.

The **C/Database Toolchest™** supports features that you'd expect to find only in products costing ten times as much. Advanced features include variable length records, variable length keys, multiple keys per index, and multiple indexes stored in a single file. Your data files can contain an unlimited number of records, and each record can be as large as 32K bytes in length.

About the only thing that the **C/Database Toolchest™** doesn't do is cost you a lot of money. We've kept our price low so you can manage your budget as easily as your data.

**Now Only \$19.95!**

## **Order Coupon**

Name \_\_\_\_\_  
 Street \_\_\_\_\_  
 City \_\_\_\_\_  
 State \_\_\_\_\_ Zip \_\_\_\_\_  
 Telephone \_\_\_\_\_  
 Paying By \_\_\_\_\_ Money Order \_\_\_\_\_ Check \_\_\_\_\_  
 \_\_\_\_\_ Visa \_\_\_\_\_ MC \_\_\_\_\_ AX \_\_\_\_\_ Disc \_\_\_\_\_  
 Card# \_\_\_\_\_  
 Exp. Date \_\_\_\_\_  
 Disk Size \_\_\_\_\_ 5 1/4" \_\_\_\_\_ 3 1/2"

Qty.	Product	Price	Subtotal
_____	C/Database Toolchest.....	\$19.95	_____
_____	C/Database Library Source	\$10.00	_____
_____	B+tree & ISAM library source code	_____	_____
Add Shipping (\$5 USA \$20 Foreign).....		_____	_____
Texas Residents Add 8% Sales Tax.....		_____	_____
Total Amount of Your Order.....			_____

Order now by calling our toll free number or mail the coupon to:

**Mix Software**  
 1132 Commerce Drive  
 Richardson, TX 75081

**1-800-333-0330**

**60 Day Money Back Guarantee**

Not Copy Protected ■ Royalty Free  
 For technical support, please call:  
 1-214-783-6001

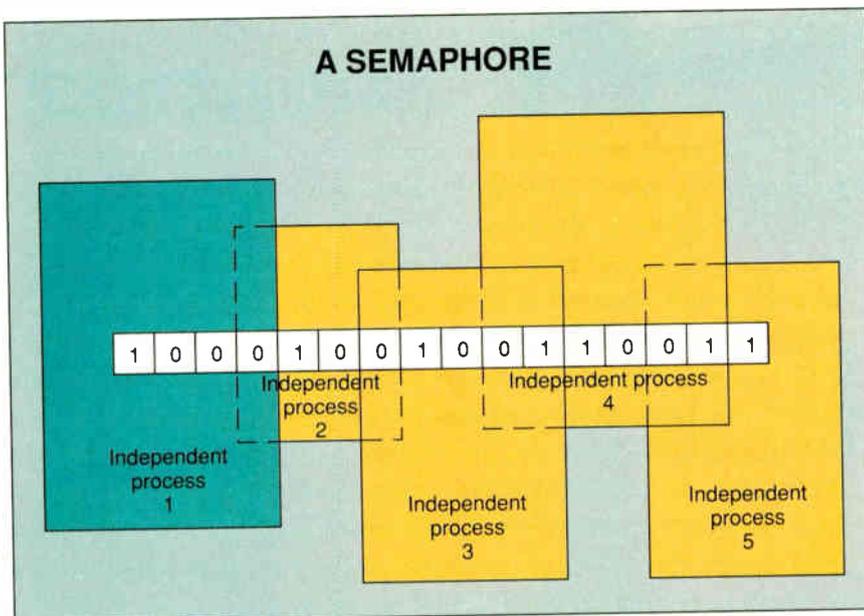


**Listing 2: Creating a Unix pipe that writes to a child process.**

```
int pipedesc[2];
char *cmd;
/*
** Make a pipe. Return NULL if failure.
**/
if(pipe(pipedesc)==ERROR) return(NULL);
/*
** Fork a new process to execute program.
**/
if((pid=fork())==0)
{ /* Child process here */
/* Close writing side of pipe */
close(pipedesc[1]);
/* Close standard input. */
close(0);
/* Dup read side-becomes standard input */
dup(pipedesc[0]);
/* Close old read side of pipe */
close(pipedesc[0]);
/* Execute the a program */
execl("/bin/sh","sh","-c",cmd,0);
exit(1);
}
/*
** Parent process here.
** Handle fork failure.
**/
if(pid==-1) return(NULL);
/*
** Close reading side of the pipe.
**/
close(pipedesc[0]);
/*
** Now, anything I write to pipedesc[1] will
** be passed to the program specified in cmd.
**/
```

As requests are taken off the queue, the server increments the semaphore to indicate that queue slots have become available. All these increments, decrements, and comparisons on the semaphore variable occur so that only one pro-

cess has control of the semaphore at a time. This is critical in a multitasking system: While one process is examining the value of the semaphore variable, you can be sure that another process is not in the midst of modifying that variable.



**Figure 3: A semaphore is a variable that is shared among processes. Only one process can act on the variable at a time. Thus, a semaphore is ideal for control of other forms of interprocess communications.**

### OS/2 Semaphores

OS/2 provides several kinds of semaphores and a variety of supporting functions. System semaphores are named objects, as were the named pipes that I described earlier. Consequently, you create a system semaphore by specifying a name that conforms to the OS/2 file-naming convention, and the operating system returns a handle by which your program can reference that semaphore. For example, the following routine:

```
DosCreateSem(CSEM_PUBLIC,
&semhand, '\\sem\\mysem');
```

creates a public semaphore called "mysem."

The first argument to the function is a system-defined constant that specifies that this particular semaphore's value can be modified by other tasks. (If I had created the semaphore with a first argument of CSEM\_PRIVATE, the other tasks could only read the semaphore's contents.) OS/2 places the handle to this semaphore in the doubleword variable semhand. Another task in the system can gain access to this semaphore with the following call:

```
DosOpenSem(&semhand,
 '\\sem\\mysem');
```

Unlike a system semaphore, a RAM semaphore is not maintained by the OS/2 kernel. Rather, it is simply an unsigned long variable that you create as a global variable in the owning process. This presumes some discipline on your part: If you create a variable that is to become a RAM semaphore, you must manipulate that variable only through OS/2 semaphore functions. To do otherwise could violate the indivisibility of semaphore access and would surely result in flaky code.

Since a RAM semaphore is simply a global variable, processes don't need to call DosCreateSem() to construct them, or DosOpenSem to gain access to them. In fact, only threads local to the process can access the RAM semaphore, so a call to DosOpenSem makes no real sense in the context of a RAM semaphore.

OS/2 semaphores are binary semaphores: They are either set or cleared. You can create the effect of a multivalued semaphore (also known as a general semaphore)—as in the print-queue example I gave earlier—by constructing a semaphore that permits access to a variable in a shared-memory segment. (I'll discuss shared memory later.) The OS/2 routines for managing semaphores can



# This Noisy World Is Out To Crash Your Data

## New *BLAST* Solves Your Connectivity Problem

Now with new, easier-to-use, more compatible *BLAST* you can have the same robust, professional software used by the most demanding data communications managers and VARs.

*BLAST* guarantees fast, 100% error-free file transfer and terminal emulation to connect UNIX and XENIX systems with PCs, Macs, VAXs, and mainframes. With *BLAST* you have *one* easy-to-use interface, *one* set of commands, *one* protocol, and *one* scripting language common to all systems.

## *BLAST* Clears Your Data's Path

Data communications is a dirty business – but you have to do it. Whether you send critical financial data, access your company's mini or mainframe, or simply tap into your favorite bulletin board, today's dirty, noisy phone lines conspire to distort, delay, and destroy your data.

*BLAST* communications software is engineered for high speed, error-free performance over today's real-world phone lines. It gets your data through when other programs have given up.

## You'll Appreciate *BLAST* Every Time You Use It

To learn more about noisy phone lines, how they can affect your data communications, and what you can do about it, give us a call at **800-24-BLAST** in the U.S.; **504-923-0888** outside the U.S. Or, send in the coupon for your free copy of our booklet:

*"Everything You Always Needed To Know About Dirty Phone Lines But Were Afraid To Hear."*

# **BLAST**

## Call 800-24-BLAST

504-923-0888 FAX 504-926-2155

*Communications Research Group*  
A U.S. Robotics Company

YES!!! I want to know what I can do about dirty phone lines.  
Please send my free booklet to:

Name: \_\_\_\_\_

Company: \_\_\_\_\_ Title: \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_

State: \_\_\_\_\_ Zip: \_\_\_\_\_ Phone: \_\_\_\_\_

Mail to: **Communications Research Group**  
**5615 Corporate Boulevard, Baton Rouge, LA 70808**

United Kingdom: 44-71-987-9021 • France: 33-01-6930-7172 • Germany: 49-02018-20190  
Italy: 39-02-837-8341 • Netherlands: 31-040-416-355 • Australia: 61-03-528-2711

BLAST is a registered trademark of Communications Research Group. Other product names are used for identification purposes only and may be trademarks and/or registered trademarks of their respective companies.

Circle 50 on Reader Service Card  
(RESELLERS: 51)

**Listing 3: Creating an OS/2 semaphore.**

```

/*
** Instance of semaphore.
*/
struct sembuf unlock = {0,1,SEM_UNDO};
/*
** Create a semaphore with one member.
*/
if((mysem=semget(SEMKEY,1,IPC_CREAT|IPC_EXCL|WMODE))==ERROR)
{
    printf("***Cannot create semaphore\n");
    exit(0);
}
/*
** Unlock the resource controlled by the semaphore.
*/
if(semop(mysem,&unlock,1)==ERROR)
{
    printf("***Semaphore error\n");
    exit(0);
}
/*
** Release the semaphore.
*/
semctl(mysem,0,IPC_RMID);

```

operate on RAM semaphores as well as system semaphores.

To set a semaphore, you call `DosSemSet(mysem)`, where `mysem` is either a handle to a system semaphore or the address of a RAM semaphore. You clear a semaphore with the call `DosSemClear(mysem)`. Finally, your program can wait for a specified semaphore to be cleared by calling `DosSemWait(mysem)`.

However, to securely manage a resource, the operations of waiting on the semaphore to clear and immediately setting it must occur without interruption (as I described above). You can accomplish this with the call `DosSemRequest(mysem,ltime)`, where `mysem` references a semaphore as before, and `ltime` is a doubleword specifying a millisecond time-out value.

`DosSemRequest()` will wait for the indicated semaphore to clear or until the time given in `ltime` has elapsed. If the

semaphore clears, `DosSemRequest()` immediately sets the semaphore and returns to the caller. If `DosSemRequest()` times out, it returns a value that is an error code indicating the time-out condition.

Finally, if you've got a number of semaphores riding herd on various events and you want to monitor them as a group, you can use `DosMuxSemWait()`. This routine accepts an array of semaphore handles and waits for *any* member of the set to clear.

### Unix Semaphores

Under Unix System V, you can create groups of semaphores—referred to as a semaphore set—with one call. Also, Unix semaphores can be multivalued, and the operating system provides a complex array of semaphore operations (i.e., the operations go beyond simply setting or clearing the semaphore).

Whereas OS/2 system semaphores are identified by name, Unix System V semaphores are identified by a unique number referred to as a facility key. This key is of type `key_t`, and on most Unix systems it is simply a 32-bit number. The key acts as the semaphore's system-wide identifier—any process that knows the identifier can access the semaphore. (You'll see the facility key cropping up several times before this article is done. It is roughly the Unix equivalent of OS/2's named objects.)

Unix System V provides three system calls for manipulating semaphores. They are:

- `semget()`, which lets you create semaphores;
- `semop()`, which lets you operate on semaphores; and
- `semctl()`, which provides a number of service functions for examining and modifying a semaphore's status.

You can also use `semctl()` to delete the semaphore.

I've provided some code fragments highlighting usage of semaphores in listing 3. The call to `semget()` creates a semaphore with an identifying key set by the constant `SEMKEY` and containing one member (the number of semaphores in the set is determined by the second argument). The third argument to `semget()` is a flags word that (in the example given) tells the system to create the semaphore if it doesn't already exist; if it does, return an error condition.

The `semop()` call also takes three arguments. The first is the semaphore's identifying key, the second is the pointer to an array of semaphore operation structures, and the third is the number of entries in that array. Since Unix System V

**GTEK**® INC.

**Make All The Right Connections With GTEK!**

**PCSS-81  
Eight Port Intelligent  
Coprocessor**

The PCSS-81 is GTEK's popular, cost effective, intelligent, 8 port serial I/O card featuring DYNAMEMORY™. The 15 MHz on board processor dynamically allocates and deallocates on board buffer ram to transmit and receive queues as necessary. The new lower price makes this board the obvious choice if you want an intelligent serial I/O card. Dos, SCO™ XENIX® and SCO™ UNIX® drivers included.



FULL  
1 YEAR  
WARRANTY



**PCSS-8T  
Compact Eight Port  
Serial Board**

The PCSS-8T is GTEK's popular PCSS-8 on a half sized card. It provides 8 serial ports for an even lower price than the PCSS-81. Modular RJ-11 jacks like those on the PCSS-81 provide 8 ports without any external brackets or spider cables. A Dos driver is included and a special version is available for SCO™ XENIX®.



All trademarks are property of their respective companies.

**Order Now Toll Free 1-800-282-GTEK (4835)**

Development Hardware & Software • P.O. Box 2310 • Bay St. Louis, MS 39521-2310 • Fax 601-467-0935 • MS & Technical Support 601-467-8048



# The Cream.



# The Crop.



There are plenty of places to get information in this industry. Too many. But if you want the best quality information, there's only one that rises to the top: **BYTEWEEK**, a weekly newsletter from the same professionals who produce **BYTE Magazine**.

Subscribe now and take advantage of a special subscription rate of \$395 (\$495 outside the U.S. and Canada). *Don't miss this opportunity!*

In the U.S. call **BYTEWEEK's** toll-free number: **1-800-258-5485**. In N.H. and outside the U.S. call **603-924-9281**.

**BYTEWEEK** offers a money-back guarantee if you are not completely satisfied.



One Phoenix Mill Lane  
Peterborough, NH 03458

lets you create sets of semaphores with one call (and identified by a single key), having the ability to pass in multiple operations per the `semop()` call is a real time and space saver.

In listing 3, the array consists of only one member, and you can see its definition near the beginning of the listing as structure unlock. The first element of

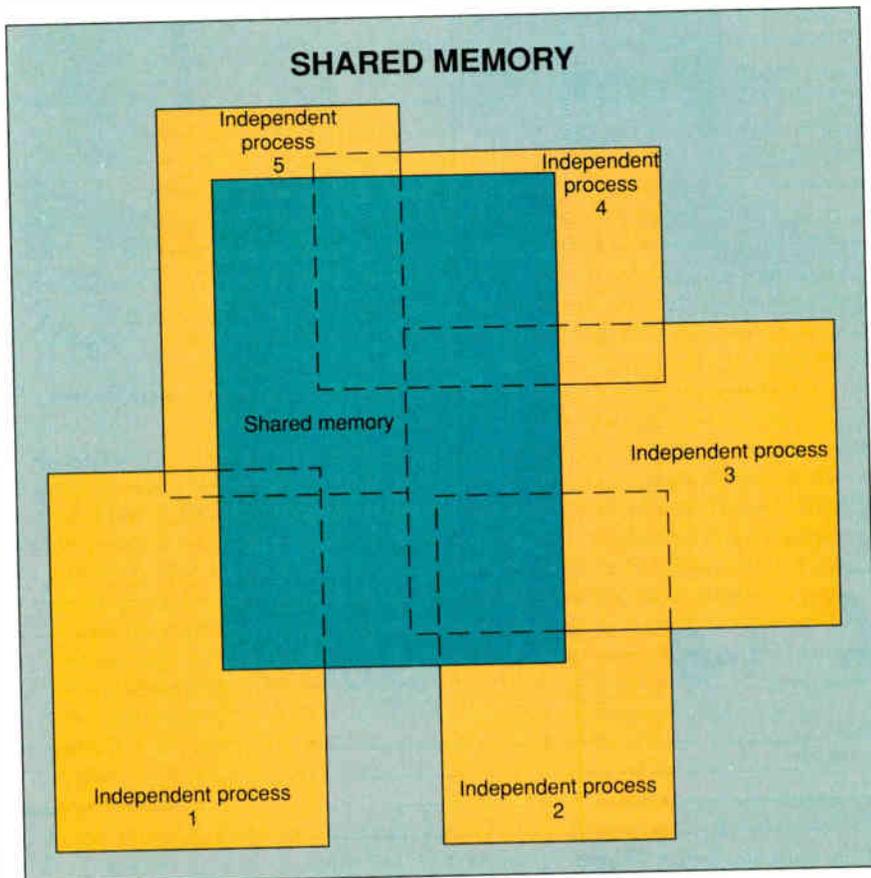
the semaphore operation structure array member (whew!) specifies the member of the semaphore set with which this particular operation is concerned—zero in the example, since there's only one member of the semaphore set. The second element specifies the operation itself: In listing 3, this operation value is 1, which tells the system to increment the

**Listing 4: OS/2 shared memory.**

```

/* Selector for shared segment */
SEL myselect;
/*
** See if shared segment exists.
** Create it if it doesn't.
*/
while(1)
if(DosGetShrSeg("\\sharemem\\myshrseg",&myselect)
== ERROR_FILE_NOT_FOUND)
{
    if(DosAllocShrSeg(1000,"sharemem//myshrseg",&myselect)==0)
        break;
}
else
    break;
}
/*
** Free the shared segment.
*/
DosFreeSeg(myselect);

```



**Figure 4: A region of memory that is shared among participating processes.**

## SOME ASSEMBLY REQUIRED

semaphore by 1. The third element carries a number of flags.

The example in listing 3 tells the system to increment a system variable by the amount that the operating system associates with the semaphore and the process. In this way, if the process dies unexpectedly, Unix knows by what amount to readjust the semaphore so that other processes waiting on the semaphore will not be stranded forever.

Finally, the program calls `semctl()` to release the semaphore. I should point out that you can use `semctl()` to do much more than I've shown in listing 3. For example, you can determine the process ID of the last process to perform an operation on the semaphore set, you can determine how many processes are currently waiting for the value of a particular semaphore to become greater than its present value, and more.

### Shared Memory

In structure, shared memory is perhaps the simplest of IPCs. Shared memory is just that—a region of memory shared among the participating processes.

This makes shared memory the fastest form of IPC; data doesn't really move from one place to another. Data written into the shared memory by one process is "instantly" available to all the processes enjoying access to that memory (see figure 4).

### OS/2 Shared Memory

OS/2 serves up shared memory in two flavors: global and local. (Because of the nature of the host processor, OS/2 documentation typically refers to shared memory as *shared segments*. So that I won't have to bog you down with *shared-memory segments*, I'll simply use *shared segments* for the rest of this section.) When you create a global shared segment, you attach a name to it (as in named pipes and semaphores). Thereafter, any process that knows the name of the segment can also access it.

Listing 4 shows a fragment of code in which a process first looks for a global shared segment and then—if the segment is not found—creates the segment.

The code in listing 4 appears convoluted, thanks to the nature of manipulating shared objects in a multitasking environment. If the call to `DosGetShrSeg()` fails because the segment does not exist (`ERROR_FILE_NOT_FOUND`), the `if` statement falls through to execute `DosAllocShrSeg()`, which actually creates the shared segment.

However, between the return of `DosGetShrSeg()` and the execution of `Dos-`

## NOW!—Non-DOS Formats for 3½ and 5¼ inch disks

### COPIES MOST FORMATS FLAWLESSLY.

**NEW:** The V3000 now supports non-dos formats, i.e., Unix, Xenix, NCR, etc., in addition to all IBM formats.

Attach a Victory V3000 Autoloader to your IBM/PC or Macintosh, enter one or more jobs, and walk away! The system automatically copies 5¼ or 3½ inch disks—up to 180

per hour. Switching the copy drive takes less than a minute. Auto-Dup tests the quality of each copy, sorting the disks into one of two output bins.

### Do-It-Yourself Servicing.

The Autoloader's simple component design and diagnostics for checking drive alignment and speed allow you to maintain the system without outside service.

Call (800) 421-0103. And ask about Victory's

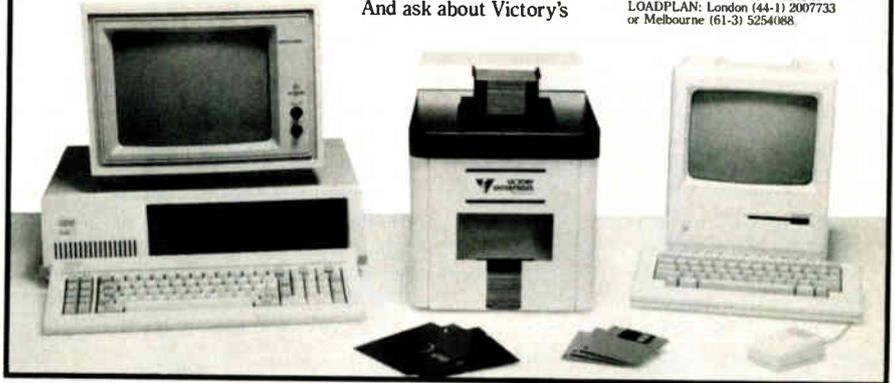
family of affordable Autoloaders that support Serialization and Custom Label Printing.



**VICTORY ENTERPRISES**  
Technology, Inc.

Victory Plaza  
1011 E. 53½ Street  
Austin, TX 78751-1728  
(512) 450-0801

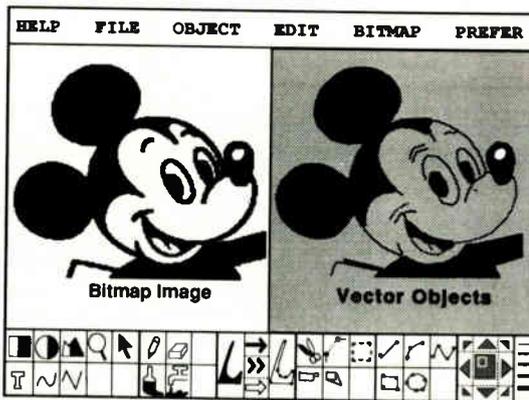
Internationally call BFI: Frankfurt (49-6074) 40980, London (44-622) 882467, Milan (39-2) 33100535, or LOADPLAN: London (44-1) 2007733 or Melbourne (61-3) 5254088.



Bring new life into your old graphics

## Xformer™

Transforms scanned (bitmap) images into vector objects for DTP or CAD Applications on your PC



### AUTOMATED TRACING

Accurate

### OBJECT MANIPULATIONS

Bezier, B-Spline, Ellipse...  
Rotate/Scale/Shear...

### OBJECT RECOGNITION

### BITMAP EDITING

### IMAGE PROCESSING

### FILE FORMATS

TIFF DXF  
PCX <=> EPS  
RLC ...

**FAST !**  
**INTELLIGENT !**  
**AVAILABLE NOW !**  
**\$449.-**

Visit our Booth R-8314  
Riviera Hotel

**COMDEX/Fall '90**

November 12-16, 1990  
Las Vegas, Nevada

Use Xformer to quickly and automatically turn your scanned or bitmap images into vectorized objects for use in DTP/CAD applications

Extensive Menu Commands and Toolboxes for easy editing of bitmapped images and manipulation of vectorized objects

Eicee Computek, Inc.  
500 NE Spanish River Blvd., Suite 102  
Boca Raton, FL 33431  
Ph (407)750-8061 Fax (407)750-8057

**Listing 5: Unix shared memory.**

```
int shmid; /* Shared memory identifier */
char *shmloc; /* Address where shared memory is mapped */
/*
** Create a 1K-byte shared memory segment.
*/
shmid=shmget(SHMKEY,1024,IPC_CREAT | IPC_EXCL | WMODE);
/*
** Attach it to our memory space.
** A second argument of 0 means we'll let Unix decide where to
** map the block.
** We can access the memory through pointer variable shmloc.
*/
shmloc=shmat(shmid,(char *)0,0);
/*
** Detach the shared memory block and release it.
*/
shmdt(shmloc);
shmctl(shmid,IPC_RMID);
```

AllocShrSeg(), there is a small chance that another process might be switched in by OS/2 and create the shared segment. If that happens, when the program of listing 4 resumes, the DosAllocShrSeg() will fail with an ERROR\_ALREADY\_EXISTS return code. Hence, the while loop, which reattempts the DosGetShrSeg() call and solves the problem.

OS/2's local shared segments are designed to be more secure than global shared segments. You don't reference the segment by name; you reference it by a segment selector. Since no globally accessible name is available for the segment, the process creating the shared segment can control which other processes have access to the segment.

For example, I can create a local shared segment of 1000 bytes with a call to the following:

```
DosAllocSeg(1000,&mysel,
SEG_GIVEABLE);
```

where mysel will hold the selector to the created segment. Of course, the segment doesn't become shared until I give it away.

To do this, I have to build a selector that the other process can use to access the segment. I do this with the following:

```
DosGiveSeg(mysel,hisid,
&hissel)
```

where hisid is the ID of the process to which I want to allow access to the segment. Upon return, the variable hissels holds the selector that I can now pass to the process identified by hisid. (Ironically, I would have to construct some other form of IPC [e.g., a named message queue or global shared segment] to pass the selector to the other process.)

The above example isn't the only way to manage local shared segments. I chose

to allocate the segment with attribute SEG\_GIVEABLE, which means it's my job to create the selectors that get passed to other tasks.

I could have created the segment with attribute SEG\_GETTABLE, in which case I would pass other processes a copy of my selector, and it would be their job to convert that selector to one they could use (via a call to DosGetSeg()).

**O** OS/2's  
*local shared segments  
are more secure than  
global shared segments.*

**Unix Shared Memory**

Unix System V makes no distinction between local and global shared memory (as in OS/2).

If I were to use OS/2 terminology, shared memory in Unix is always global. When you create a shared-memory block, you associate a facility key that has the same form as I described in the section on Unix semaphores. Any other process that knows the key can attach itself to the shared-memory block.

You use the shmget() call to create a shared-memory block. If shmget() completes successfully, it returns an integer handle to the shared memory.

Your program then passes this handle to the shmat() function, which "attaches" the memory block to your program and returns a pointer to the starting address of the shared-memory block. Your program can read and write into the

memory block as it would any other memory region.

At its completion, your program "detaches" the shared-memory block using a call to shmdt(). This call doesn't actually destroy the shared-memory block; it simply removes the caller's ability to access the memory. You have to call the shmctl() routine to free the memory. Typically, the task that built the shared-memory block in the first place will be the one to remove it.

I've given an example of creating and using a shared-memory block in listing 5. The listing is very brief. Usually, you will want to associate a semaphore with a shared-memory block and use the semaphore to coordinate access to the memory.

As with the semaphores, Unix associates a structure with every shared-memory block that the tasks create. This structure carries information regarding the shared-memory segment (e.g., the ID of the process that created the shared-memory block and the current number of attached processes). Although in the example in listing 5 I've used shmctl() only to release the shared-memory structure, you can use that function to manipulate information in the structure that Unix associates with the shared-memory block.

**Message Queues**

Actually, I have already given a cursory description of message queues. They first appeared last month when I talked about Desqview's mailboxes. Also, in OS/2, named pipes can do much of the work of message queues.

The message queue derives its name from its FIFO characteristics. Usually, however, operating systems provide ways to let important messages "cut in" the queue ahead of current members.

**OS/2 Queues**

OS/2 queues are not restricted to FIFO ordering of elements. When you create a queue, you can select the ordering to be one of the following:

- FIFO—which is a typical queue (see figure 5a)
- last-in/first-out (LIFO)—which causes the queue to behave like a stack (see figure 5b)
- element priority—The sending process can attach a priority to each message item. When the receiving process requests OS/2 to pull the next item off the queue, the operating system will select the item with the highest priority first.



MICROSOFT  
WINDOWS  
Version 3.0 Compatible Product

KnowledgePro (Windows)

Get into Windows FAST!

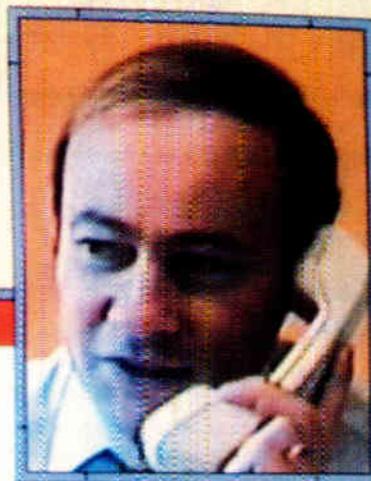
Interested in a product for creating Windows applications very quickly?

Yes     No     Maybe

With intelligent applications

Need high-level access to :

- Hypermedia?
- Expert Systems?
- Object-Oriented Programming?



But without the hard work!

Order KnowledgePro (Windows) today!

Phone 518-766-3000

What if I said that this screen, including calling my video image was created by me, a non-programmer using just *twenty* instructions? **Interested now?**



Un-retouched VGA screen image. Special hardware required for motion video.\*

# Introducing the door into Windows!

## Easy access to Windows

KnowledgePro (Windows) contains high-level commands for manipulating screen objects, lists, text, fonts, rules, external files and bitmap images. DLL and DDE support lets you integrate your own C routines with KnowledgePro and link your application directly to Excel and other Windows programs.

## At a price you can afford

KnowledgePro (Windows) costs \$695 with no runtime fees for applications. KnowledgePro for DOS costs \$495. The systems run on IBM PC, XT, AT and PS/2 compatible machines with 640k of memory and a hard disk. KnowledgePro (Windows) requires Microsoft Windows 286 or 386 version 2.x or greater.

Call **518-766-3000** (FAX 518-766-3003) for more information or write to: Knowledge Garden Inc., 473A Malden Bridge Rd., Nassau, NY 12123 USA. Amex, Visa or M/C accepted.

Another intelligent tool from



KnowledgePro is a registered trademark of Knowledge Garden. Excel is a trademark of Microsoft Corp. IBM, XT, AT and PS/2 are trademarks of International Business Machines Corp. \*VideoWindows digital video overlay board by New Media Graphics.

# BBS Sysops

- Are you looking for ways to improve your board? Something that will set you apart from other boards in your area?
- Are your subscribers interested in Microcomputers? Listen to this!

## Announcing the Bulletin Board EXchange

The Bulletin Board Exchange allows you to become a publisher of MicroBYTES Daily, an on-line news service from BYTE. Bulletin Board Exchange/MicroBYTES is a custom package of news and features designed especially for local BBSes, and is available only to sysops.

Every Monday through Friday you get articles about developments in micro-computing, telecommunications and selected new product announcements. Get the latest news about MS DOS machines, Amigas, Macintoshes, Unix workstations, Amigas, Atari STs, peripherals and software. All the stories are reported, written, and edited by the staff of BYTE Magazine, BYTEweek and BIX, and our world-wide network of reporters and editors.

Not only do you get a great resource for your subscribers, but you also get access to BIX which will cut your cost of exchanging information and conducting BBS network business.

**All this is just \$49 a quarter.**

Your one-year subscription to the Bulletin Board Exchange (billed quarterly) may be cancelled any time without further charge; just notify us. If you prefer, you may subscribe for three months only, at just \$69.

If you call BIX direct, you pay no hourly telecommunications charge. If you call using Tymnet, the rates are only \$3/hour on evenings and weekends and \$6/hour on weekdays. You may also purchase unlimited off-peak Tymnet for just \$20 a month.

**Subscribe today.**

# BIX

One Phoenix Mill Lane  
Peterborough, NH 03458  
800-227-2983  
In NH 603-924-7681

As with other named items, when you create a message queue, you must give OS/2 a unique file-type name to associate with the queue. The name must begin with the string `\\queues\\`, so a call to create a FIFO queue named "myqueue" looks like the following:

```
DosCreateQueue(&qhand,
  QUE_FIFO, '\\queues
  \\myqueue');
```

where `qhand` is a variable that will hold the queue handle when the call returns.

The creator of the queue is the only process allowed to remove elements from the queue. Other processes can write elements into the queue, but before they do, they must open the queue with the following call:

```
DosOpenQueue(&qowner, &qhand,
  '\\queues\\myqueue');
```

where `qhand` is the handle (as above), and `qowner` is a variable that receives the process ID of the queue's creator. Your program can then issue a write request to the queue with something like the following:

```
DosWriteQueue(qhand, rqid, 8,
  'A Message', priority);
```

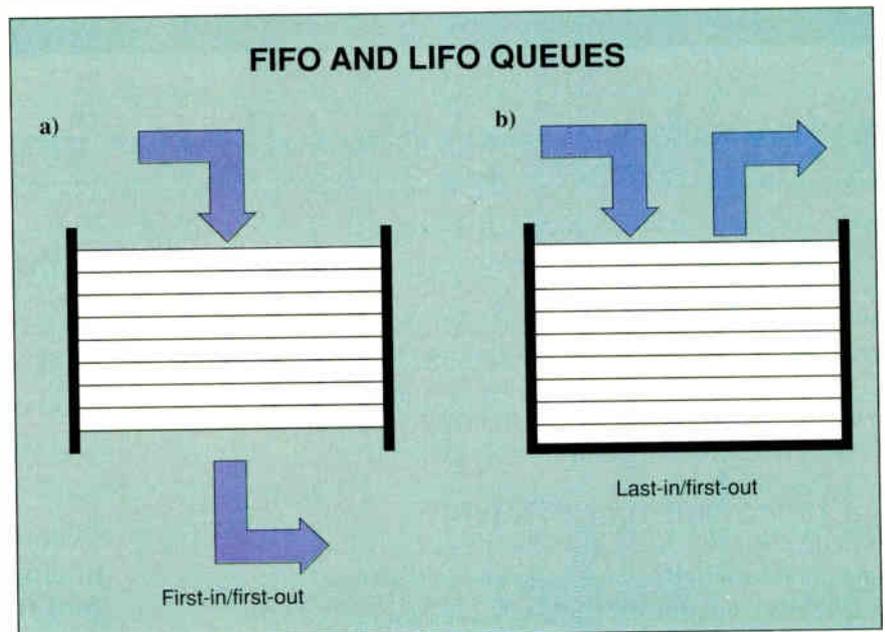
The first argument is the handle. The

second is a program-supplied request/identification field that your programs can use to support any sort of private protocol you dream up. The third argument is, obviously, the length of the message—a pointer to which follows as the fourth argument. The fifth and final argument is the priority, which can range from 0 to 15 (highest priority) and sets the message's element priority. As you might guess, the system recognizes the final argument only if the queue is an element-priority type. Otherwise, you read items off the queue in FIFO or LIFO order.

You read a queue with the following call:

```
DosReadQueue(qhand, &reqinf,
  &size, &qelement, 0, DCWW_WAIT,
  &priority, NULL);
```

which has a boatload of arguments. The first is the queue handle; that's easy. Next comes a structure that carries results of the read request (information like the process ID of the source of the message). The size variable holds the number of bytes of the queue element the program has just read. Next is a pointer to the buffer that will hold the queue element. The next argument indicates which member of the queue you want retrieved—for the standard FIFO queue, the argument is ignored, so I've set it to zero. I used `DCWW_WAIT` to tell OS/2 that I



**Figure 5:** (a) As with a pipe, the first data written to a first-in/first-out message queue is the first data read out by another process. (b) The last-in/first-out message queue is like a stack; the last data written to a LIFO message queue is the first data to be read.

# Unleash Your 386, 486 & i860!

NDP Fortran is your key to unlocking the numeric power of Intel's 32-bit CPUs, including the i860. If you're burning up a lot of VAX or Cray time, you should seriously consider the Number Smasher-860. It delivers super-computer throughput, running in an ISA bus, for about the price of a 486 system. With Number Smasher-860 and NDP C or Fortran-860, you can recompile all of your C or FORTRAN programs and run them in any 286, 386, or 486 AT system.

MicroWay's compilers come with the features you need to simplify porting to the 32-bit mode of the 386, 486, or i860, including a 99% VAX/VMS compatible FORTRAN and a dual dialect C which is UNIX System V and ANSI compatible. Each NDP compiler is designed to take maxi-

mum advantage of 32-bit protected mode operation, including the 4 gigabyte address space of the processor, plus access to coprocessors from Intel, Weitek and Cyrix. Each compiler includes a library of 135 character and pixel oriented graphics routines that automatically detect and support the full range of PC display adapters. In addition, we carry a full line of third party libraries and utilities that were ported with our languages.

The new releases of our languages include a linker that uses incremental links to speed up building very large programs, a new inlining facility that makes it possible to inline functions in any of our languages (this is an especially important C optimization) and a true C++ com-

piler that is AT&T version 2.0 compatible. NDP C++ contains a full ANSI C compiler as a subset. NDP C is your choice if you have to compile a mixture of ANSI, UNIX V, or K&R applications. Finally, ClearView, our new symbolic debugger, uses windowing and a C-like interpreter with FORTRAN extensions that make it easy to debug C or FORTRAN programs without resorting to an assembly language debugger.

MicroWay is still your best source for numeric coprocessors and accelerators. Call for your free copy of "The State of PC Numerics in 1990" by Stephen Fried.

For more information, please call our Technical Support Dept. at (508) 746-7341.

## 386, 486 & i860 Compilers

Our NDP family of compilers generate globally optimized, mainframe quality code that runs on the 386, 486 or i860 in protected mode under UNIX, XENIX, or extended DOS. The compilers address 4 gigabytes of memory while supporting the 80287, 80387, Weitek, and Cyrix coprocessors. Applications can mix code from all three compilers and assembly language. To simplify your ports, we have just released a full-featured, windowing symbolic debugger, ClearView-3/486, 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.

NDP C™ runs in two modes—K&R with Sys V and MSC extensions or 100% ANSI as validated by Plum Hall.

NDP Pascal™ is a full ANSI/IEEE Pascal, with extensions from C and BSD 4.2 Pascal.

NDP C++™ is a fully AT&T v.2.0 compatible C++ compiler (not a preprocessor) that contains a full ANSI C compiler as a C++ subset.

NDP-860 compilers ..... each \$1995  
 DOS 386SX versions-NDP Tools included \$595  
 DOS 386 versions-NDP Tools included ..... \$895  
 DOS 486 versions-NDP Tools included ..... \$1195  
 UNIX/XENIX versions ..... CALL  
 NDP VMEM Virtual Memory Manager ..... \$295  
 Eclipse or Phar Lap Tools ..... \$495  
 NDP Link - Incremental Linker ..... \$295

ClearView-3/486 Debugger™ ..... \$395  
 NDP Windows™ Library: \$125, C Source: \$250  
 NDP Plot™ ..... \$325  
 NDP/FFT™ NDP or 80x87 version ... ea. \$250  
 NDP to HALO '88 Graphics Interface ..... \$100  
 Media Cybernetics' Halo '88 ..... \$395

NDP NAG™ Workstation library is a subset of the NAG mainframe libraries. It contains 172 routines designed to solve differential equations and eigenvalue problems, perform matrix operations, fit curves, do statistics and regression analysis, etc. .... \$895

## RAMpak™ Your Compaq!

RAMpak™ - one or four meg 32-bit memory expansion module for Compaq Deskpro 386 20/25 One meg .. \$150, Four meg .. \$400

## Number Smasher-860™

The 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 over 10 double precision Linpack megaflops. The board comes standard with an ISA interface, two transputer link adapters, your choice of NDP Fortran, C++, C or Pascal for the i860 running under MS-DOS or UNIX, plus 8 megabytes of high speed memory. .... 33 MHz \$6995  
 40 MHz \$9200 32 MB version: add \$5000

## Parallel Processing

MicroWay's IBM compatible Monoputer, Quadputer, Videoputer, and Linkputer boards work together using Inmos transputers to provide expandable, plug-in mainframe performance for your desktop PC.

Monoputer™ — Includes one T800 and up to 16 meg of RAM for parallel code development. The 4 MWhetstones T800 makes it the ideal FORTRAN engine for cost-effective execution of your mainframe programs. .... from \$1145

Quadputer™ — This board for the AT or 386 can be purchased with 1 to 4 transputers and 1 or 4 meg of memory per transputer. Two or more Quadputers can be linked together to build networks of up to 100 or more transputers providing mainframe power. .... from \$1845

Linkputer™ — Links up to 8 boards to provide dynamic transputer topologies. .... \$1500

## Transputer Compilers and Utilities

These parallel languages are designed for use with the Monoputer, Quadputer and Videoputer.  
 Logical Systems Parallel C ..... \$595  
 3L Parallel C, FORTRAN, or Pascal ..... \$895  
 TBUG — debugger for 3L compilers ..... \$330  
 Parsec Parallel C/dynamic ..... \$1500  
 ParaSoft EXPRESS — Includes transputer communications libraries, parallel code development library, C source level debugger, and system performance monitor. .... \$1500  
 Helios PC/s ..... \$1250  
 Nexis Windows File Server. .... \$495  
 T800/NAG™ — Port of the complete NAG mainframe library. Contains 268 functions: \$2750

## Number Smasher-486™

*Personal Workstation magazine, June 1990, said, "The Number Smasher-486 lives up to its name. Its numeric performance exceeds that of all 25-MHz systems we've tested to date. It gives you top 486 performance for the best price."*

Number Smasher-486™ is a 25 MHz replacement motherboard for ATs and 80386s. This motherboard supports an optional Weitek 4167 numeric coprocessor and up to 16 megabytes of memory. Running with a 4167, our design delivers up to 10 megaflops. The Number Smasher-486 is priced from \$3195.

## Math Coprocessors

WEITEK, INTEL, CYRIX  
 4167-25 ..... \$995  
 4167-33 ..... \$1295  
 3167-20/-25/-33 ..... \$495/\$795/\$995  
 mW1167 Micro Channel-16/20 .. from \$495  
 mW3167 Micro Channel-25/33 .. from \$1295  
 mW3167/80387 Board ..... \$200  
 8087 ..... \$80 8087-2 ..... \$115  
 80287-8 ..... \$185 80387-16SX .. \$280  
 80387-16 ..... \$295 80387-20SX .. \$300  
 80387-20 ..... \$345 80387-25 ..... \$439  
 80287XL ..... \$210 80387-33 ..... \$540  
 287Turbo-20™ ..... \$345  
 Cyrix CX83D87 FasMath™ SX16MHz \$275  
 20 MHz: \$375 25 MHz: \$460 33 MHz: \$570

## 386 Your AT!

FASTCache-SX™ — The most cost effective accelerator we have ever manufactured. Plugs into the 286 socket, speeding up all applications by a factor of 2 to 4. Runs all 386 applications, OS/2 and Windows 3.0. Features a 16 or 20 MHz 80386-SX, a 4-way 32K cache (expandable to 64K) and a math coprocessor socket. 16MHz: \$495 20 MHz: \$595

NUMBER SMASHER-386™ — This full-sized card replaces the 80286 microprocessor on your IBM AT or compatible motherboard with an 80386 that runs at 20 or 25 MHz. It runs numerically intensive applications up to a factor of 60 times faster, while maintaining full hardware and software compatibility when running all 386 applications. Options include 64K of high speed cache memory, up to 8 megabytes of 32-bit memory, and an Intel 80387, Weitek, or Cyrix numeric coprocessor. .... from \$895

**Micro  
Way**

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341  
 32 High St., Kingston-Upon-Thames, U.K. 81-541-5466 USA FAX (508) 746-4678  
 Germany 069-75-2023 Italy 02-74.90.749 Holland 40 836455 Japan 3 222 0544

want to wait for an item to appear on the queue (if it's empty).

The priority variable carries the element's priority that was set by the sender in `DosWriteQueue()`. The last argument usually carries a system semaphore handle that can control access to the queue. However, it's ignored because I chose `DCWW_WAIT`.

As a final tidbit, there often comes a time when you want to see what's on the queue without actually taking anything off it. You can use `DosPeedQueue()` for the job.

### Unix Queues

In Unix, the creation and manipulation of message queues looks a lot like what I've already described in the sections on semaphores and shared memory. Message queues are identified by a facility key that is available systemwide.

By now, you've probably become familiar enough with the Unix conventions for working with IPCs that I won't have to go into much detail. You create a message queue with a call to `msgget()`; you release the queue by calling `msgctl()`. As with `semctl()` and `shmctl()`, `msgctl()` provides access to system-maintained status information associated with the queue. You can use `msgctl()` to determine such information as who created the queue, how many messages are on the queue, who last wrote to it, and who last read from it. (OS/2 has a counterpart to this routine in its `DosQueryQueue()` system call.)

Items sent through the queue are two-member structures. The first member is

**Y**ou can use the message type field to impose ordering on the items in a queue.

a long variable that identifies the message type. Ordinarily, Unix doesn't pay attention to this field, so your program can make whatever use of it you deem appropriate.

However, a process reading items from a queue can request the operating system to return the first item whose message type field is set to a particular value. So you can use the message type field to impose ordering on the items in a queue.

An example would be to designate a particular message type as being an "immediate attention" message. In that way, any process reading from the queue could check for such messages and handle their requests first.

The second member is simply an arbitrarily long array of characters. Your program can impose any structure on a message element it wishes.

The operating system doesn't care—it just treats them as a string of bytes. You send a message using the `msgsnd()` routine and receive a message using the `msgrcv()` routine.

### On the Menu

The source code for this month is a good illustration of Unix semaphores and message queues. (The source code is available through the usual sources; see page 5 for details.) It is the database simulation portion of BYTE's Unix benchmark programs and is composed of two source code files. One is a server program that builds a pair of message queues and a controlling semaphore. The program then launches a number of client processes (using the Unix `fork()` routine). The client processes begin making random database requests (i.e., read a record, write a record, or update a record) to the server.

One message queue acts as the client-request channel; the other is the server-response channel. When a client sends a request message, the program places its process ID in the message type field (described above). The process ID stays with the request, so the server's responding message also carries the process ID in the message type field. Consequently, even though several clients are reading from the same queue, each can extract the appropriate response. ■

*Rick Grehan is the director of the BYTE Lab. He has a B.S. in physics and applied mathematics and an M.S. in computer science/mathematics from Memphis State University. He can be reached on BIX as "rick\_g."*

*Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*



# Avoid screen building headaches with SMP

Screen Manager Professional, the advanced interface design library for C programmers, gives your applications:

- Windows
- Keyboard Support
- Menus
- Context Sensitive Help
- Mouse Support
- Low RAM Overhead / High Speed

To order SMP call: : Magee Enterprises, Inc. 1-800-662-4330  
Demo Available: 404-446-0271  
BBS: 404-446-6650

See us at COMDEX/Fall '90 November 12-16, 1990 / Las Vegas, Nevada

# AVAILABLE

**CALL NOW FOR SPECIAL  
INTRODUCTORY OFFER!**

**(713)782-2700**

# UHC UNIX

## SYSTEM V RELEASE 4.0

Other companies currently may be offering UNIX System V Release 4.0 to "qualified" software and hardware developers, but ask them about a commercial release and it's quite a different story. "Around the end of the year," they say. Or, maybe, "early next year."

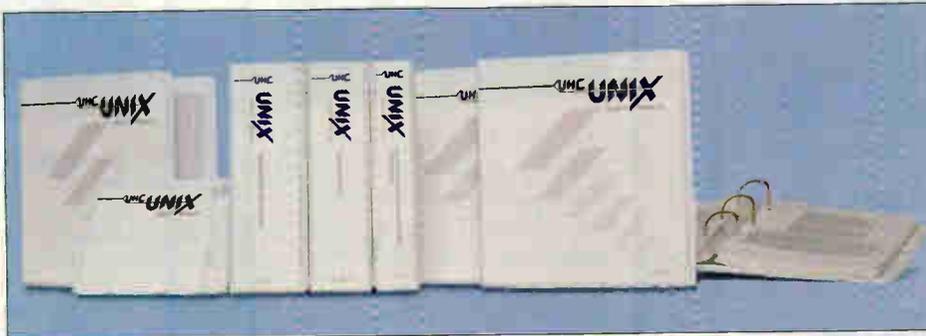
But right now, UHC UNIX System V Release 4.0 is available! To anybody! And, with complete printed documentation, too.

UHC UNIX System V Release 4.0 is a major new release of the UNIX operating system

for 386<sup>™</sup>/486<sup>™</sup> computers. If you're running XENIX<sup>®</sup> or BSD, Release 4.0 offers complete application compatibility.

UHC UNIX System V is available as a complete package or in four modules, including an X Window System<sup>™</sup> module that features both the OPEN LOOK<sup>™</sup> and OSF/Motif<sup>™</sup> graphical user interfaces.

You don't have to wait to make the move up to the latest and greatest! Call UHC today to order the only UNIX System V Release 4.0 package now commercially available.



# UHC

3600 South Gessner  
Houston, Texas 77063  
(713) 782-2700  
FAX (713) 782-3377

**FOUNDATION SET NOW \$895**

UHC and the UHC logo are trademarks of U.H. Corporation. UNIX is a registered trademark of AT&T. 386 and 486 are trademarks of Intel Corporation. XENIX is a registered trademark of Microsoft Corporation. X Window System is a trademark of MIT. OPEN LOOK is a trademark of AT&T. OSF/Motif is a trademark of the Open Software Foundation.

Circle 358 on Reader Service Card

**UNIX**  
INTERNATIONAL  
GENERAL MEMBER

## Intelligent multiport, supports RS-422

SmartLynx AT™ intelligent 4-port serial adapter for PC-AT and compatibles supports RS-422 and most multi-user operating systems. On-board processor takes burden off CPU.

For order info, call:  
**1-800-553-1170**



662 Wolf Ledges Parkway  
Akron, OH 44311

PC-AT is a trademark of IBM Corporation.

Circle 240 on Reader Service Card

## Eight Serial Ports One Board

Quatech's ES-100 provides eight RS/232 serial ports in a single AT slot. RJ-11 modular connectors. 16450 UARTS are standard. Optional buffered 16550 UARTS. PC-AT, ISA, or EISA compatible. Priced below \$500! Quantity Pricing Available!

Call for our PC Interface Handbook:  
**1-800-553-1170**



662 Wolf Ledges Parkway  
Akron, OH 44311

PC-AT is a trademark or registered trademark of IBM Corp.

Circle 241 on Reader Service Card

## RS-422/RS-485 Boards for AT, Micro Channel

RS-422/RS-485 asynchronous serial communication boards from Quatech! available in 1 to 4 ports for PC-AT and compatibles and 1 to 4 ports for PS/2 Micro Channel.

Call for our free  
PC Interface Handbook:  
**1-800-553-1170**



662 Wolf Ledges Parkway  
Akron, OH 44311

PC-AT, Micro Channel, and PS/2 are trademarks or registered trademarks of IBM Corp.

Circle 242 on Reader Service Card

## Synchronous Communication Boards for AT

Quatech synchronous/asynchronous serial boards for PC-AT and compatibles support RS-232, RS-422, and RS-485 communication.

Call for our free  
PC Interface Handbook:  
**1-800-553-1170**



662 Wolf Ledges Parkway  
Akron, OH 44311

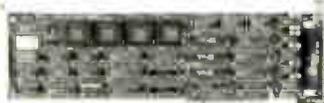
PC-AT and PC are registered trademarks of IBM Corp.

Circle 243 on Reader Service Card

## Communications Data Acquisition



"PC-AT (ISA) Interfaces"



"PS/2 Micro Channel Interfaces"



Phone: (216) 434-3154 • FAX: (216) 434-1409  
TELEX: 510-101-2726

PC-AT, PS/2 and Micro Channel are registered trademarks of IBM Corporation.

Circle 244 on Reader Service Card

## Digital I/O Board

Single-slot Quatech PXB-721 for PC-AT has 72 digital I/O lines. Connect three choices of data acquisition modules. Supports Labtech Notebook!™

Call for our free  
PC Interface Handbook:  
**1-800-553-1170**



662 Wolf Ledges Parkway  
Akron, OH 44311

LabTech Notebook is a trademark of Laboratories Technologies Corp.

Circle 245 on Reader Service Card

## Joystick Adapter for PS/2

GPA-1000 works with IBM Micro Channel for PS/2 Models 50, 60, 70, and 80. Connect two joysticks or four paddles. Also compatible with IBM Game Control Adapter for PC-XT and AT.

Call our toll free order line:  
**1-800-553-1170**



662 Wolf Ledges Parkway  
Akron, OH 44311

IBM, Micro Channel, PS/2, PC-XT, AT, and Game Control Adapter are trademarks or registered trademarks of IBM Corp.

Circle 246 on Reader Service Card

## 2 parallel, 2 serial, 1 board

Quatech DSDP-402 for PC-AT has two parallel ports, and two serial ports for any combination of RS-232, 422, and 485 communication. DSDP-100, two parallel and two RS-232 ports, available at lower cost.

For order info, call:  
**1-800-553-1170**



662 Wolf Ledges Parkway  
Akron, OH 44311

Circle 247 on Reader Service Card

## Wave Form 20MHz - 32K \$1290

The WSB-100 Wave Form Synthesizer Board from Quatech has the best set of numbers in the market. With speed to 20MHz and a 32K memory at \$1290, it's making waves in more ways than one. The WSB-100 is also a star performer as a digital pulse/word generator with the optional digital module.

Call for our free  
PC Interface Handbook  
**1-800-553-1170**



662 Wolf Ledges Parkway  
Akron, OH 44311

Circle 248 on Reader Service Card

**BYTE**

# PRODUCT SHOWCASE

■ BUYER'S MART

■ BYTE BITS

■ PRODUCT SPOTS

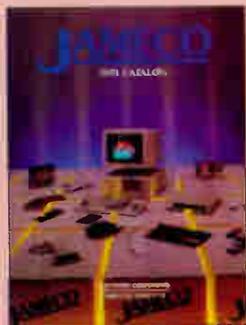
■ MICRO PRODUCT CENTER

■ CATALOG SHOWCASE



# Catalog Showcase

## Jameco Electronics



**30-day Money-back Guarantee...**  
**Large Selection, Competitive Prices...**  
**High Quality Technical Assistance...**  
 Our staff of 30 technicians is on hand eight hours a day to answer your technical questions before and after your purchase.  
**99.99% of all Products are in stock...**  
 Jameco stocks over 4,000 different products. 99.99% of these products are available for off-the-shelf shipment at any time.  
**Fast Shipment...**  
 Most orders shipped within 24 hours. Guaranteed shipment within 48 hours for all in-stock items.

1-415-592-8097  
 Circle 342 on Reader Service Card

## Annabooks



Send for Annabooks' free catalog of PC-compatible engineering products.

The newest publication, "AT Bus Design," has the official timing information for the AT bus and the 8- and 16-bit parts of the EISA bus. Over 200 pages and 100 diagrams. Author is member of IEEE P996. Available now for \$69.95. VISA, M/C, Amex, COD, P.O.s OK.

**Annabooks, 12145 Alta Carmel Ct. #250, San Diego CA 92128**

1-800-462-1042 FAX 619-592-0061

Readers Circle 382 on Reader Service Card  
 Resellers Circle 383 on Reader Service Card

## Hello Direct



**Business Telephone Accessories Catalog**

New 40-page catalog from Hello Direct features the latest products for today's business telephone user. Included are headsets for executives, managers, and telemarketers; fax machines and accessories; cellular phones, service and accessories. Also included are call amplifiers, cost control devices and home office products. Q1144

Call for free subscription, toll-free:

1-800-444-3556

Circle 159 on Reader Service Card

## Migraph



**Color & Monochrome Hand-held Scanners**

Now you can scan images quickly. Accurately. In exquisite detail—and 4096 colors, grayscale, and B&W, with one of Migraph's cost-effective hand-held scanners. Our literature provides the details you need to make an informed choice. Available for the IBM PC, Amiga, and Atari ST. Dealer and OEM inquiries welcome.

Call 9 AM-5 PM P.S.T.  
 206-838-4677 1-800-223-3729

Circle 228 on Reader Service Card

## Programmers Connection



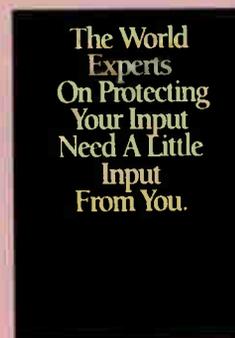
**"An Indispensable reference"**  
 THE CONNECTION is your Ultimate Buyer's Guide to the highest quality software available for your IBM PC. You'll find its easy-to-use cross references will guide you to a description of EVERY product including its system requirements, cross product compatibility, version numbers and more. THE CONNECTION is the *Only* software reference guide you'll ever need.

Call for your FREE copy!

USA 800-336-1166  
 CANADA 800-225-1166  
 FAX 216-494-5260

Circle 288 on Reader Service Card

## EXIDE ELECTRONICS



Over half of all computer problems reported today are caused by power surges, sags or brownouts. These fluctuations in power can cost a business thousands or even millions of dollars in lost systems availability.

Enter Exide Electronics. We're the world leader in the development and production of power protection products and services.

Our Powerware® Systems continually filter and condition commercial power to keep your computer operating smoothly and without interruption. And in an emergency Powerware Systems allow a controlled shutdown.

Call 1-800-554-3448 for a free brochure.

Circle 129 on Reader Service Card

## Virgin Mastertronic



Computer games publisher offers exciting new visions and bestselling classics. Play popular board games such as Monopoly, Risk, Deluxe Scrabble and Clue Master Detective on your home computer. Experience the most addictive strategy game since Tetris with SPOT The Computer Game. Play the incredible new windowed adventure Wonderland, hailed by the press as one of the most innovative games this Christmas! And live Spirit of Excalibur, the epic Arthurian FRP game. It's computer entertainment at its best. Just in time for Christmas!

714-833-8710

Circle 370 on Reader Service Card

## Boffin Limited



**THE LAPTOP SOURCE**  
**COMPETITIVE PRICING**  
**QUALITY SERVICE & SUPPORT**

- We Carry: Chaplet, Commax, Epson, Fora, Hyundai, Mitsubishi, NEC, Packard Bell, Panasonic, Samsung, Texas Instruments, Toshiba, Zenith
- A complete line of Boffin Laptops also available
- Authorized Service Center: Epson, Hyundai, Toshiba and Zenith

For free product catalog, call or write Boffin Limited, Attn: Kari Wujek, 2500 W. County Road 42, #5, Burnsville MN 55337.

612-894-0595

Circle 52 on Reader Service Card

# Catalog Showcase

Advertisers: For more information contact Ellen Perham at (603) 924-2598.

## Intel Development Tools



Choosing the right architecture and development support are two of the most important decisions you face today. For successful microcomputer development, Intel offers you the total solution with the most up-to-date and powerful tools available.

And we also offer you the easiest way to buy. Our Development Tools Catalog lists all our tools products in one guide. Call us at 1-800-874-6835, or FAX us at 503-696-4633 to get your free copy today.

Intel Corporation, Development Tools Operation, 5200 NE Elam Young Parkway, JF1-15, Hillsboro, OR 97124

1-800-874-6835 FAX 503-696-4633  
Circle 181 on Reader Service Card

## Lyben Computer Systems



Computer Supplies and Accessories  
at Discount Prices

Over 3500 Items  
93% of Orders Shipped Same Day  
Many Hard-to-Find Items  
30-Day Return Policy

A unique catalog company with a personal touch. Circle reader service to receive a free 100-page Introductory Catalog with special offers.

1-313-649-4500 FAX 313-649-2500

Circle 210 on Reader Service Card

## Businessland Direct



The most convenient, quick and inexpensive source for your complete business computer, supply and accessory needs. The Businessland Direct catalog features more than 1,000 products from 750 top manufacturers, with factual and comparative product information organized to help you make educated buying decisions for your company.

Call and ask for the free Businessland Direct catalog, and start getting computer product pricing and selections designed especially for business.

1001 Ridder Park, San Jose CA 95131

1-800-551-2468

Circle 58 on Reader Service Card

## Dispensamatic Label



Affix All Types of Pressure Sensitive Labels  
Fast and Efficiently

A complete selection of semi-automatic and manual dispensers offer reliable trouble-free affixing of all types of computer printout or printed roll labels without the need for technically trained mechanics or skilled operators.

For full information: Dispensa-matic Label Dispensers, 725 North 23rd Street, St. Louis, MO 63103.

1-800-325-7303 or FAX 314-621-1602

Circle 115 on Reader Service Card

## DATAWARE



MaxiMarker® SuperLabels™ are the world's first premium re-usable labels. Original and creative, SuperLabels are unique because they are permanent, yet infinitely changeable.

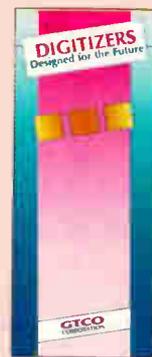
Information may be written on the durable laminated stock, but then it can be easily changed without affecting the appearance or surface of the label.

MaxiMarker SuperLabels are available for all types of magnetic media for office and home. Send for information on DATAWARE's full line of products

1-800-426-4844 FAX 713-432-1385

Circle 102 on Reader Service Card

## GTCO



GTCO manufactures the following digitizer lines: SketchMaster™, a high-resolution, low-cost digitizer available in both 12" x 12" and 12" x 18" sizes; DIGI-PAD® Super L SERIESTM, lightweight, high-resolution digitizers ranging in size from 17" x 24" to 42" x 60"; and Macintizer ADB™, a 12" x 12" digitizer compatible with Macintosh SE and II computers.

1-800-344-4723

Circle 151 on Reader Service Card

## The Card Shop



The Memory Board Experts at The Card Shop would like to introduce ourselves through some of our better-known associates, for example: PARITY PLUS by MEMREL, INTEL, AST, DFI and the exciting new offering everyone's talking about, WINDEX.

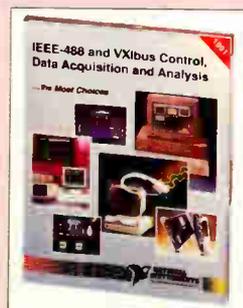
We invite you to call and talk to our knowledgeable, courteous staff about any of your memory board needs.

You'll also appreciate our Ten-Day, Money-Back Free Trial, Generous Warranties and Commitment to Excellence in all of the product lines that we carry.

1-800-346-0055 FAX 602-948-8458

Circle 341 on Reader Service Card

## National Instruments



Free 488-page full-color catalog describing instrumentation hardware and software products for personal computers and workstations. Application software for data analysis and presentation and for collecting data using instruments and plug-in boards. Features GPIB interfaces, data acquisition and DSP boards, driver level software, signal conditioning and VXI controllers.

1-512-794-0100

Circle 250 on Reader Service Card

# THE BUYER'S MART

## A Directory of Products and Services

THE BUYER'S MART is a monthly advertising section which enables readers to easily locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes a Reader Service number to assist interested readers in requesting information from participating advertisers.

Effective January 1, 1990.

RATES: 1x—\$590 3x—\$550 6x—\$525 12x—\$475 24x—\$450  
Prepayment must accompany each insertion. VISA/MC Accepted.

AD FORMAT: Each ad will be designed and typeset by BYTE. Advertisers must

furnish typewritten copy. Ads can include headline (23 characters maximum), descriptive text (250 characters is recommended, but up to 350 characters can be accommodated), plus company name, address and telephone number. Do not send logos or camera-ready artwork.

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to THE BUYER'S MART, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call Brian Higgins at 603-924-3754.

### ACADEMIC COMPUTING

#### 166 MHz PC

Proprietary technologies allow us to deliver our PC compatible workstation years ahead of the industry. Take advantage of inexpensive PC software (vs. UNIX), and the performance our platform offers, to execute applications previously run on minis and supers. We're offering the first 5000 of our 1993 production units at wholesale pricing. Educational and quantity discounts.

**Eclectech, Inc.**

Dept. 4142, P.O. Box 12887, Research Triangle Park, NC 27709

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.

Plot: • Background • Cosmic Rays • Clouds • Foods  
Call/Write for PC MAGAZINE review. • TSR • GM Tube  
VISA/MASTER Phone orders. Not satisfied? Full refund.

Tel: (302) 655-3800

**Aware Electronics Corp.**

P.O. Box 4299, Wilmington, DE 19807 \$149.50

Inquiry 702.

#### 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 703.

#### COMPANION AND EXTENDER

Place a keyboard and monitor up to 600' from your CPU with EXTENDER and COMPANION products. Keep a second Keyboard/Monitor at the CPU with COMPANION. Supports MDA, CGA, EGA, VGA, PS/2. Uses single 3/4" cable.

Prices start at \$149.00 for EXTENDER and \$219.00 for COMPANION 25 ft. unit complete.

**CYBEX CORPORATION**

2800-H Bob Wallace, Huntsville, AL 35805  
205-534-0011 International Fax #205-534-0010

Inquiry 704.

#### FREE CATALOG

A complete source for all your computer supplies — media, paper, cables, furniture, software, ribbons, laser, cleaning, FAX supplies, accessories & more!!

Order Bulk Disks, 100% Warranty, 25. Minimum

5.25" DS/DD 25° 3.5" DS/DD 45°

5.25" DS/HD 45° 3.5" DS/HD 99°

**GAAN COMPUTER SUPPLIES**

186 E East Sunnyoaks Ave., Campbell, CA 95008

Call (800) 523-1238

8AM - 5PM, Mon-Fri, California time

Inquiry 705.

422 BYTE • NOVEMBER 1990

### ACCESSORIES

#### FOR 386, 286 & PC

Modem 2400BPI Int.	\$ 69	FaxModem 4800/9600INT	\$139/259
640K PC Memory Card	\$ 29	2M AT Memory Card	\$ 99
MGP Graphic card+Paptors	\$ 25	16 Bits 800x600 VGA Card	\$ 72
XT HD/CD FD Controller	\$ 32	AT HD/FD Card MEM/RLL	\$89/119
XT I/O (FIS/PP/GC)	\$ 29	AT I/O (SP/F), IS/2S	\$19/25
XT-10286-12M/Board	\$65/130	386SX-16M/Board	\$360
386-25MHz M/Board	\$695/995	386 33 64K Cache M/Board	\$890

(Call for Complete Price List!!!)

**KOPEC INTERNATIONAL CO.**

838 N. Glenville Dr., Richardson, TX 75081  
Order: 800-654-8008 Tech: 214-907-1958 Fax: 214-907-1963

Inquiry 706.

#### HEWLETT PACKARD

Buy — Sell — Trade

Laser Jet II/III	Color Pro (7440)
Genuine HP 2 Mag/4 Mag	HP-7550A
Desk Jet	Draft Pro DXL/EXL
Rugged Writer	Draftmaster III
Electrostatic Plotters	C1600 (D Size)/C 1601 (E Size)

Science Accessories Corporation Sonic Digitizers  
36" x 48" (2750) 80" x 72" (3175)

**T. E. Dasher & Associates**

4117 Second Ave. S., Birmingham, AL 35222

Phone: (205) 591-4747 Fax: (205) 591-1108

(800) 638-4833

Inquiry 707.

### ARTIFICIAL INTELLIGENCE

#### NeuralWorks Explorer

NeuralWorks Explorer is a neural net tutorial that provides the novice user with a method of learning neural net theory as well as an environment in which to build practical real time applications such as targeted marketing, stock prediction, process control and more. PC and MAC. Price \$199. Visa/MC accepted.

**NeuralWare, Inc.**

412-787-8222

Inquiry 708.

#### Software Engineer Do Your Own Windows!

At last a LISP programming environment which takes advantage of a GUI and protected mode on the PC. Software Engineer™ for Windows™ 3.0 is a complete programming environment. It includes a LISP-aware text editor, allowing quick, easy and interactive Windows development. Software Engineer supports DDE, GDI, the clipboard, dialog boxes and menus. Software Engineer is priced at \$249.95.

**Raindrop Software Corporation**

845 E. Arapaho, Suite 105, Richardson, Texas 75081

(214) 234-2611 Fax (214) 234-2674

See our ad on page 222

Inquiry 709.

#### muLISP® 87 for MS-DOS

Fast, compact, efficient LISP programming environment. muLISP programs run 2 to 3 times faster & take 1/2 to 1/3 the space of other LISPs. 450 Common LISP functions, multi-window editing & debugging, flavors, graphics primitives, lessons & help, demo programs, comprehensive manual.

**Soft Warehouse, Inc.**

3615 Harding Ave., Suite 505, Honolulu, HI 96816

(808) 734-5801

Inquiry 710.

### ARTIFICIAL INTELLIGENCE

#### The SoundBytes Toolkit®

Add unlimited HUMAN SPEECH to your PC program in QuickBasic, C or any language. Fun & exciting—Your program will talk thru standard PC Speaker! Includes 24 more sound goodies, with Source Code, and free 76-page AI Catalog. Specify disk size preferred. \$59.95 check or m.o. only. Overseas add \$10 Postage, please. Guaranteed.

**Thinking Software, Inc.**

46-16 65th Place, Woodside, New York 11377

Inquiry 711.

### 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**

417A Ingalls St., Santa Cruz, CA 95060

(408) 458-9938

(800) 345-4220

Inquiry 712.

#### 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, magstrips, & slot badge readers. 30-day \$\$ back.

**Worthington Data Solutions**

417A Ingalls St., Santa Cruz, CA 95060

(408) 458-9938

(800) 345-4220

Inquiry 713.

#### 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**

417A Ingalls St., Santa Cruz, CA 95060

(408) 458-9938

(800) 345-4220

Inquiry 714.

#### 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 1/2" LaserJet up to 2". Font cartridges not required. \$179—\$239. 30-day \$\$ back.

**Worthington Data Solutions**

417A Ingalls St., Santa Cruz, CA 95060

(408) 458-9938

(800) 345-4220

Inquiry 715.

# THE BUYER'S MART

## BAR CODE

### 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, Eubess, 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, I 2/5, UPC A/E, EAN 8/13
- BIG TEXT & BAR CODE SOFTFOUNTS

#### AMERICAN MICROSYSTEMS

2190 A Regal Parkway, Eubess, TX 76040  
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

### BAR CODE PRINTING

Print bar codes from your custom program. ANSI C routines generate and print Code39, I25, Codabar, UPC A/E, EAN 8/13 and supplements. Supports LaserJet, OKI, and EPSON and custom printers. Works with UNIX/XENIX, MSDOS and others. All SOURCE CODE included. No royalties. Single pattern \$85. All patterns \$250.

#### Infinity Computer Services, Inc.

P.O. Box 269, Coopersburg, PA 18036  
Voice: 215-965-7699 BBS: 215-965-8028

Inquiry 712.

### PC-Wand Bar Code Solutions

Bar codes are easy with a FULL line of readers & printers. They plug & play with your existing systems, most all makes of CPU/printer/terminal/software in your office, store, truck, factory or warehouse. Our bar code DOS programs print on matrix or laser printers. 30 day refund, 1 year warranty.

#### International Technologies & Systems Corp.

655-K North Berry St., Brea, CA 92621  
TEL: (714) 990-1880 FAX: (714) 990-2503

Inquiry 713.

### Introducing ASP BAR CODE READERS

- Keyboard and RS232 readers distinguished by superior wand — \$395
  - Portable reader doubles as fixed reader — \$799
  - Wand, bar code printing utility, cable and wand holder included in price
  - Reads all major bar codes
  - Works with IBM compatible and non-standard PCs, terminals
  - 5 years experience with bar code solutions.
- Dealer inquiries welcome.

#### PACIFIC MICROSYSTEMS

2560 9th Street, Suite 214M, Berkeley, CA 94710  
(800) 242-5271 (415) 849-4147

Inquiry 714.

### 5-YR. WARRANTY AT PERCON

PERCON decoders are now covered by a five-year limited warranty. That means you won't spend one cent replacing your PERCON bar code decoder for five full years. That's reliability you can count on!

#### PERCON

2190 W. 11th Ave., Eugene, OR 97402  
Phone: (800) 873-7266 FAX: (503) 344-1399

See our ad on page 433

Inquiry 715.

## BAR CODE

### ENV

Prints bar coded envelopes for fast delivery. E... easy to use. N... nationally listed by USPS. V... value packed. ENV bar coded envelopes are quickly sorted and delivered by the US Post Office. Postage discounted when over 200 bar coded pieces. • Use with any Word Processor or Mail Merge package • ENV Batch, Pop-up and Mail Merge versions on disk • Print return address, special messages and logos • for HP LaserJets and EPSON LQ series printers. No new equipment required. Great program for any type and size business, church, club or association. Order for MSDOS computers NOW \$49.95

#### Pike Creek Computer Company

2 Galaxy Dr., Newark DE 19711-2920  
To Order: (302) 239-5113 Dealers call (800) SELL LOW

Inquiry 716.

### PC BAR CODE SPECIALISTS

Bar code readers designed for fast, reliable, cost-effective data entry. They emulate your keyboard, so scanned data looks just like it was typed in! Choose from stainless steel wand, laser gun, card slot reader, and magnetic stripe scanner. Also, powerful Bar Code and Text printing software. Great warranty. Generous dealer discounts.

#### Seagull Scientific Systems

15127 N.E. 24th, Suite 333, Redmond, WA 98052  
206-451-8966

### BAR CODE READERS

Among the best and most widely used bar code decoders. Reads all major codes (39, I 2/5, S 2/5, UPC/EAN/JAN, CODABAR, MSI). Connects between keyboard and system. IBM, PS/2, MAC, DEC-VT compatible. OS & software independent. Same day ship. 2 Year Warranty (pen incl).

Large Reseller Discounts

#### Solutions Engineering

4705 Langdrum Lane, Bethesda, MD 20815  
(800) 635-6533 (301) 652-2738

Inquiry 717.

### 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 718.

### VARIANT MICROSYSTEMS BAR CODE READERS DELIVER

WAND/LASER/MAGNETIC CARD CONNECTIVITY

- Keyboard wedges (Internal/External) for IBM PC/XT/AT, PS/2 and portables.
- RS232 wedges for WYSE, Link, Kimtron terminals
- Bar code and label printing software
- Full two-year warranty
- 30-Day Money-Back Guarantee
- Extensive VAR/Dealer Discounts

3140 De La Cruz Blvd., Suite 200/Santa Clara, CA 95054/(408) 980-1880  
800-666-4BAR FAX: (415) 623-1372

Inquiry 719.

## BASIC CLIP MUSIC

### 300 Songs & Sounds + 180 Pg. Book

Besides being a fun jukebox, *The Enter-tainer* teaches DOS, BASIC, bar file & display tricks. Many exciting music projects! It's geared for beginners, yet teaches pros how to run music behind QB or C apps. Source code, no royalties. Money-back guarantee 3.5" or two 5.25" disks. Needs BASIC 2.0 or later. \$29.95+\$3.50 s&h. (Europe, Canada & Mexico s/h=\$7, others=\$11, 1st class air) For fast VISA/MC orders - call:

(800) 727-4140 Price soon going up to \$45!

PDI Music Software, 1511 48th St., Boulder, CO 80303 (303) 440-4140

Inquiry 720.

## CABLE CONVERTERS

### Cable TV Converters Attention Cable Viewers

Jerrold, Zenith, Oak, Hamlin,  
Scientific Atlantic, Tocom,  
and many others.

**BEST PRICES!! • 1-800-826-7623**

Visa, American Express, MasterCard

**B&B INC.**, 4030 Beau-D-Rue Dr., Eagan, MN 55122

Inquiry 721.

## CAD

### Electro-CAD \$99

Designed specifically for schematics and double-sided board layouts. Electro-CAD produces high quality board images on standard dot-matrix printers up to 11 by 15 inches. Virtually instantaneous screen replots, rubber-banding, user definable images, and many other features make Electro-CAD the best tool for the job or your money back.

Call us for more information and fast delivery.

#### AEROUX Engineering

32 West Anapamu Suite 228, Santa Barbara, CA 93101  
(805) 962-9695

Inquiry 722.

### CAD-DRAWING VIEWSTATION

Allows non-CAD users to view drawings on PCs, print, plot, attach personal notes, and hyper-link between files. Change views and layers. Accurate entity representation. Easy to use.

- Sirlin VIEW/OWG for AutoCAD DWG files. \$295
- Sirlin VIEW/PLUS for DWG, DXF, HPGL and dBase: \$395

Developers: ask about linkable Sirlin VIEW/LIB. Dealers welcome.

#### Sirlin Computer Corporation

225 Lowell Road, Hudson, NH 03051  
(603) 595-0420

Inquiry 723.

## CAD/CAM

### CAD/CAM Developer's Kit

Save months writing AutoCAD ADS or  
standalone CAD/CAM applications!

(617) 628-5217

#### Building Block Software

PO Box 1373 Somerville, MA 02144

Inquiry 724.

## CD-ROM

### CD ROM PLAYERS FOR AS LOW AS \$499.00

Alde offers Chiron player, cable, card, and DOS extensions bundled with a disc at lowest prices. Alde carries a complete line of CDROM titles. Write, call or fax for complete product information.

#### ALDE PUBLISHING INC.

Box 1190, Glen Lake, MN 55345  
800/727-9724 (Voc) 612/934-2824 (Fax)

Inquiry 725.

### Largest Selection and Best Price

Microsoft Programmers Library & Drive \$949.  
Computer Library \$695 • Public Domain S/W \$49.  
NEC PC or Mac Drive Kit \$749 • Bookshelf-Best Price!

Drives from \$499. Hundreds of titles from \$29.  
MC/VISA/AMEX/COD, Money-back Guarantee.  
Call or write for free 120-page catalog.

#### Bureau of Electronic Publishing

141 New Road, Parsippany, NJ 07054

800-828-4766

THE SOURCE FOR CD-ROM

Inquiry 726.

# THE BUYER'S MART

## CD-ROM

### CD ROM, Inc.

CD-ROM, WORM, MAGNETO-OPTICAL DRIVES, CD-ROM DISCS FOR IBM AND MAC, OPTICAL CONSULTING SERVICES  
\* PUBLISHING \* DISTRIBUTION \* NETWORKING  
QUALITY PRODUCTS AND SERVICES AT COMPETITIVE PRICES  
FREE CATALOG

TEL. 303-231-9373

1667 COLE BLVD., SUITE 400, GOLDEN, CO 80401  
FAX: 303-231-9581, CIS: 72007544  
VISA/MC/AMEX/GOV'T Pcs

Inquiry 727.

## COMMUNICATIONS

### AEG MICTRON RS-232/RS-422 Adapter

- Extends serial communications to 4000 ft.
- Bi-directional—full duplex operation
- Selectable DCE or DTE operation
- 3 LED communication activity indicators
- Tri-state of RS-422 Output controlled by RS-232C RTS or DTR signal
- Optical Isolation Available Soon

Call 1-800-MICTRON Ext. 5587

Inquiry 728.

### PC SDLC SUPPORT

Use Sangoma hardware and software to provide a cost effective, robust and easy to use SDLC link from MS-DOS, XENIX, AIX, PICK, PC-MOS, etc.  
All real time communication functions performed by intelligent co-processor card.

X.25 support also available.

**Sangoma Technologies Inc.**  
(416) 474-1990

7170 Warden Avenue #2, Markham, Ontario, Canada L3R 8B2

Inquiry 729.

## COMPUTER INSURANCE

### INSURES YOUR COMPUTER

SAFEWARE provides full replacement of hardware, media and purchased software. As little as \$49 a year provides comprehensive coverage. Blanket coverage; no list of equipment needed. One call does it all. Call 8 am-10 pm ET. (Sat. 9 to 5)

TOLL FREE 1-800-848-3469

(Local 614-262-0559)

SAFEWARE, The Insurance Agency Inc.

Inquiry 730.

## COMPUTER UPGRADE

### THE COMPLETE XT UPGRADE

The K-311 Upgrade Kit converts your XT to full 32-bit, 20MHz 80386 CPU and high speed disk performance. The K-311 Kit includes 20MHz 80386 w/1Mb RAM, 16-bit Adaptec 1:1 controller, 63Mb 28Ms Mitsubishi disk drive, choice of 1.2 or 1.4Mb diskette drive, Key Tronic 101 Plus keyboard, 200 W PS, new drive cables. Matches or exceeds the performance of a new system but at far less cost. Top quality, easy installation, 1 year warranty. \$1,795

### 5G Corporation

4131 Spicewood Springs Road A-4, Austin TX 78759  
800-333-4131 512-345-9843 Fax 512-345-9575

Inquiry 731.

## CROSS ASSEMBLERS

### CROSS ASSEMBLERS

Universal Linker, Librarian

Targets for 36 Microprocessors

Hosts: PC/MS-DOS, micro VAX, VAX 8000

### ENERTEC, INC.

BOX 1312, 811 W. Fifth St.  
Lansdale, PA 19446

Tel: 215-362-0966 Fax: 215-362-2404

Inquiry 732.

424 B Y T E • NOVEMBER 1990

## CROSS ASSEMBLERS

### CROSS ASSEMBLERS/SIMULATORS

New unique full-function simulators for the 8096 and 80C196 controllers, featuring ALL MODES of interrupts, plus the HSI, HSO, and A/D functions.

We also support the 8048/49, 8080/85, 8051/52, and Z80 controllers with excellent, reasonably priced Cross Assemblers and Simulators.

### Lear Com Company

2440 Kipling St., Ste. 206, Lakewood, CO 80215  
(303) 232-2226 FAX: (303) 232-8721

Inquiry 733.

## CROSS ASSEMBLERS

Relocatable  
Macros  
PC Compatible

**GUARANTEED,  
SUPPORTED**

DEBUG SIMULATORS • DISASSEMBLERS  
EPROM PROGRAMMERS

### MICRO COMPUTER TOOLS CO.

Phone Toll Free (800) 443-0779

In CA (415) 825-4200

912 Hastings Dr., Concord, CA 94518

Inquiry 734.

## Cross-Assemblers Simulators Disassemblers

*PseudoCorp*

See our ad on page 451.

Inquiry 735.

## CROSS COMPILERS

### Focus on Performance

Fast, 6,000 lines per minute, C8805 Code Development System, first C compiler targeted to 6805 family. Built-in macro cross assembler, optimizing C compiler, integrated editor and development shell. MS-DOS with S1 or HEX output.  
Free next business day shipping in N. America.

Call now! (519) 888-6911

### Byte Craft Limited

421 King St. N., Waterloo, Ontario N2J 4E4 CAN

Inquiry 736.

## CROSS DISASSEMBLERS

### PROFESSIONAL PC SOFTWARE

#### • CROSS-DISASSEMBLERS

Analytic, Automatic Label Generation

#### • CROSS-ASSEMBLERS

Relocatable, Macro Universal Linker + Librarian

#### • C CROSS COMPILERS

#### • SOURCE TRANSLATION UTILITIES

Support for Intel, Motorola, Zilog, TI, RCA

Order Today: (408) 773-8465

### LOGISOFT

PO Box 61929, Sunnyvale, CA 94066  
FAX: (408) 773-8466

Inquiry 737.

## DATA CONVERSION

### CONVERTING YOUR DISKETTES? ENTRUST THEM TO US!

2500 Word Processor & Computer formats, 3 1/2", 5 1/4", 8" Disks, Mag Tapes, Mag Cards, Cartridges & Cassettes, Custom Conversions, Programming & Applications Development

DISK DUPLICATION  
OCR SCANNING SERVICES  
HIGH VOLUME LASER PRINTING

Call us for Quality, Best Prices and Quickest Turnaround Time.

**COMPANY COMPENDIA, INC.**, 55 E. Washington St., #237, Chicago, IL 60602 TEL: 312-419-8771 FAX: 312-419-1390

Inquiry 738.

## DATA CONVERSION

### MEDIA CONVERSION/DATA TRANSLATION

More than just a straight dump or ASCII transfer!  
Word Processing, DBMS, and Spreadsheet data on Disks or Tapes transferred directly into applications running on Mainframes, Minis, Micros, Dedicated Word Processors, Typesetters, and Electronic Publishing systems.

IBM PS/2 & Macintosh supported  
#1 in the translation industry!

### CompuData Translators, Inc.

3345 Wilshire Blvd., Suite 407, Los Angeles, CA 90010  
(213) 387-4477 1-800-825-8251

Inquiry 739.

## DBMS/COPY

### CONVERTS YOUR DATA INTO INFORMATION

Now your favorite stat package can access any database. DBMSCOPY can directly convert any database or spreadsheet file (ORACLE, PARADOX, dBASE, LOTUS etc.) into any stat package file (SAS, SPSS, SYSTAT, etc.) and vice versa. The PLUS version allows sorts, selections, and recalculations. \$195. 30-day guarantee. VISA/MC/AMEX/PO/OD. Call for free limited version.

### CONCEPTUAL SOFTWARE INC.

P.O. Box 56827, Houston, TX 77256  
(713) 667-4222 FAX: (713) 667-3FAX  
1-800-STATWOW

Inquiry 740.

## WE'LL DO IT BETTER... FOR LESS!

Conversion, Duplication, Any Format  
FREE TEST • SATISFACTION GUARANTEED

Plus, the Personal Touch. Ask Questions and we'll explain it to you in simple English!!!

### DATACOPY SERVICE

PO Box 820214, Dallas, TX 75382  
1-800-969-DATA 214-272-7751

Inquiry 741.

## ☆ America's Leaders In Data Conversion ☆

DISK • DISK • TAPE • DISK  
OPTICAL SCANNING

WE CONVERT MORE FORMATS THAN ANYONE ELSE!!!  
IBM, DEC, VAX/VMS, APPLE, WANG, XEROX, NBI, LANIER,

CPT, UNIX, Wordperfect.

QUICK—RELIABLE—HIGHEST QUALITY

NATIONAL DATA CONVERSION INSTITUTE

5 East 16th Str., NY, NY 10003 (212) 463-7511

Inquiry 742.

## DATA RECOVERY

### CRASHED?

Your valuable data can be recovered!

- 95% success rate • Fast turnaround
- Servicing Novell, DOS, Macintosh, Unix, Xenix, OS/2, Barnoulli and more!

### ONTRACK DATA RECOVERY, INC.

Keeping you in business is our business.

1-800-872-2599

Inquiry 743.

## DATA/DISK CONVERSION

### DISK CONVERSIONS

Media transfer to or from: IBM, Xerox, DEC, Wang, Lanier, CPT, Microm, NBI, CT, Exxon, WRDPLEX also WP, WS, MS/WRD, DW4, MM, Samna, DEC DX, MAS 11, Xerox-Writer, ASCII.

### FREE TEST CONVERSION CONVERSION SPECIALISTS

531 Main St., Ste. 835, El Segundo, CA 90245  
(213) 545-6551 (213) 322-6319

Inquiry 744.

# THE BUYER'S MART

## 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 or (612) 520-2345

FAX: (612) 588-8783

Inquiry 745.

## QUALITY CONVERSIONS

to or from virtually

### ANY TAPE OR DISK FORMAT!

Horan Data Services converts over 2000 formats incl. 9-track tape, 3480 Cartridge and 8", 5 1/4" or 3 1/2" diskettes. All densities & most operating systems supported. Formats include EBCDIC, ASCII, databases, spreadsheets, and dedicated or PC word processors.

Call 1-800-677-8885

Hours 8:00 AM to 5:30 PM Eastern Time  
817 Main Street, Third Floor, Cincinnati OH 45202

Inquiry 746.

## 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  
Oswego, IL 60543

708/554-3567

FAX 708/554-3573

Inquiry 747.

## CONVERSION SERVICES

Convert any 9-track magnetic tape to or from over 2000 formats including 3 1/2", 5 1/4", 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

## DATABASE

### INFO-TRAK

INFO-TRAK is a new menu-driven database/cataloguer program for the professional and the beginner. Ideal for business, home inventory, collections (books, stamps, coins, artworks, etc.), investments etc. Features include SEARCH, add/delete lines, edit data, create custom formats, PRINT and more. (IBM XT, AT and compatibles, DOS 2.0 & up)

Only \$59, \$3 shipping/handling (check or money order only)

### JA-DAL TECHNOLOGIES

P.O. Box 611, Yaphank, NY 11980  
(NY res. add 7.5% tax)

Inquiry 748.

## DATABASE MGMT SYSTEMS

### DBASE COMPATIBLE HYPERMEDIA

CoNET: AN INDUSTRIAL STRENGTH HYPERMEDIA SYSTEM. Provides database records, queries, hypertext editor, graphics, procedures—each object with buttons and labelled links to any object of any type. 100,000 objects + 2 million links per knowledge base in a dBASE compatible database—an open system. Usable interactively or programmable for applications. \$350

### CoNET Systems

5833 Humblebee Road, Columbia, Maryland, 21045  
(301) 997-4330

Inquiry 749.

## DATABASE MGMT SYSTEMS

### SAVE TIME & MONEY!

OCELOT2—THE SQLI is a stand-alone database engine with a complete DB2 compatible SQL interface for developers who use BASIC, C, PASCAL, or COBOL. • packs the full power of SQL into a 640KB PC; • requires only 320KB RAM for program development; • outperforms the rest!

For IBM and clones: \$195 & up. Free info.

### OCELOT COMPUTER SERVICES INC.

#1502, 10025-106 Street, Edmonton, AB, Canada, T5J 1G7  
(403) 421-4187

Inquiry 750.

### dBASE file access from C

Code Base 4 is a library of C routines which gives complete dBASE or Clipper functionality and file compatibility. Use DOS, Unix, OS/2 or MS Windows.

\$295 with Source! FREE DEMO

### Sequitur Software Inc.

Call (403) 448-0313 Fax (403) 448-0315

See our ad on page 244.

Inquiry 751.

## DISASSEMBLERS

### 80x86 .EXE/.COM to .ASM

- Accurately reconstruct, study & modify [64K+] programs with a minimum of input or editing of output.
- Assembly language output is MASM 5.x-compatible
- Exhaustive flow-trace distinguishes code from data
- Best formats for each. Commented BIOS calls/DOS functions. SEGMENT/PROC/other vital pseudo-ops.

PC-DISnDATA (5 1/4" disk & manual) \$165

### PRO/AM SOFTWARE

220 Cardigan Road, Centerville, OH 45459  
(513) 435-4480 (9 A.M.-5 P.M. EST M-F)

Inquiry 752.

## NO Source? . . . NO Problem for DISIDOC PROFESSIONAL

Automatically Disassembles EXE, COM, BIN, SYS, PGM files and ROM or RAM memory with interactive ability to change code, data or comments online. Disassembles 8086 to 80486 with no file size restrictions. Built in utility program EXE Unpacker, for unpacking packed files and BIO's Admission for disassembling BIOS's are included.

To order call (800) 336-1961 or info (203) 953-0236

Or write:

### RJSWANTEK INC.

178 Brookside Rd., Newington, CT 06111  
\* Only \$249.95 MCVISA accepted

Inquiry 753.

## DISK DRIVES

### BEST BUY!!!

HD Kits for AT: Drive, Controller, Rails & Cables

40MB - MFM - \$ 339

65MB - RLL - 459

80MB - MFM - 689

150MB - ESDI - 1099

### NEW, ONE YEAR WARRANTY

### jb TECHNOLOGIES, INC.

5105 Maureen Lane, Moorpark, CA 93021

(805) 529-0908 Fax (805) 529-7712

Inquiry 754.

### PS/2 DRIVES FOR PCs ATs

CompatiKit/PC . . . . . \$279

CompatiKit/AT . . . . . \$219

Built-in floppy controllers—no problem.

Supports multiple drives and formats. Lets your computer use IBM PS/2 1.4M diskettes *plus more!* Call for further information or to place an order.

VISA/MC/COD/CHECK.

### Micro Solutions Computer Products

132 W. Lincoln Hwy. DeKalb, IL 60115 815/756-3411

See our ad on page 318.

Inquiry 755.

## DOCUMENT CONVERSIONS

### Doc-to-Doc

Quickly and cleanly convert your documents to and from WordPerfect, MICROSOFT WORD, WordStar, MultiMate, ASCII, Tandy, DeskMate Text, Lotus 1-2-3, Enable, Wang and DisplayWrite. Retain special attributes and formatting. Doc-to-Doc gives you professional quality conversions at a consumer price—\$99.

### The MCS Group

2465 W. Chicago St., Rapid City, SD 57702

(605) 341-2166

Inquiry 756.

## DOS SHELL

### Multitasking for DOS

MultiDos Plus—the fastest multitasking DOS shell.

- Fully DOS compatible
- Tailored for real-time operation
- 4 years of proven reliability with thousands installed
- 30-day money back guarantee (\$15 restocking fee)

Call our BBS for free demo (508) 650-9552  
Complete software package only \$99 + \$2 S&H

### Nanosoft Inc.

13 Westfield Road, Natick, MA 01760

(800) 678-2141 (508) 651-0091 FAX: (508) 655-8860

Inquiry 757.

## 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 758.

## ENTERTAINMENT

### WHERE ADULTS COME TO PLAY! ACCESS LAI BBS

- Designed for Adult modem users • Low cost local access numbers covering 850 cities!
- Live online chat with other users!
- Large software file library!
- "Bulletin board" style Forums!
- Interactive online games!
- Matchmaker dating database!
- And much, much more. 24 hours a day!

We also can provide your company with national BBS services. Call (818) 358-0936 for details!

Information and Signup By Modem

(818) 358-6968 [3/12/24 Baud, 8/N/1, Must be over 18]  
Voice Information (818) 357-9570

Inquiry 759.

## .386 SPYS

386 SPYS, the energy, excitement and superior graphics you've been looking for in an animated arcade game. Written specifically for PC's with a 386/386SX processor, Hi Res EGA graphics, 1 meg of memory and a hard disk. You will find incredible detail and action throughout. Try a demo disk now for \$6.95 or the full game for \$49.95. Include \$3 S&H.

### GENKI SOFTWARE CORPORATION

"Imagination powered by the 386"

(800) 673-9038 Mastercard or Visa (301) 997-6333  
P.O. Box 2563, Columbia, MD 21045

Inquiry 760.

## NEMESIS™ Go Master®

Go, a game of strategic elegance, has been a way of life in the Orient for over four thousand years. Many consider Go to be the secret of the Japanese businessman's success. "While chess is a game of war, Go is a game of market share" [President of Nikko Hotels]

Chaos Manor 1990 User's Choice Award

BYTE 4/90, p.62

### Toyogo, Inc. The Leader in Computer Go.

PO Box F, Dept. Y, Kaneohe, HI 96744

(808) 254-1166 or 1-800-TOYOGO-9

Inquiry 761.

# THE BUYER'S MART

## FLOW CHARTS

### WINDOWS FLOWCHARTER \$129

RFFlow 2.0 is a professional drawing tool for flowcharts & org charts. Requires Microsoft Windows 3.0. 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

Inquiry 762.

## FRAME GRABBER

### FRAME GRABBERS

Publishers' VGA 256 Grey scales \$655.00  
Publishers' Color 256 colors \$830.00  
VGA-to-Video Adapter  
VGA-TV GE/O Genlock overlay \$830.00  
(Overlay text and graphics on live video and record it on a VCR)  
Manufactured in the U.S.A.  
3 Year Manufacturers Warranty  
**THE KRUEGER COMPANY**  
(800) 245-2235 (602) 820-5330

Inquiry 763.

## GRAPHICS

### PCXSLIDE

is an independent PCX format slide show Software everybody needs. From CGA-EGA to SVGA in 2 through 256 colors or grey scales. User has up to 800x600x256 maximum resolution with appropriate graphic board and monitor. Best graphic presentation for the nineties. Before importing, manipulating or printing, check pictures with PCXSLIDE. Only \$24. OEM/Bundled package negotiable. Advise if 5.25" or 3.5" and send money order/certified check. For IBM PC/PS or true compatibles, EGANGA.

#### DATALISION Inc.

9 East 45th Street, New York, NY 10017  
(212) 309-6888 FAX (201) 992-0302

Inquiry 764.

### EGAD Screen Print

Prints contents of VGA, EGA, CGA displays on variety of dot-matrix and laser printers. Prints in gray tones or color. Crop box lets you print any region of the screen. Enlarge graphics 1 to 4 times (reduction too). Setup program for picking printer colors, etc. \$35.00 Postpaid. Call or write for free catalog.

#### LINDLEY SYSTEMS

4257 Berwick Place, Woodbridge, VA 22192-5119  
(703) 590-8890

Inquiry 765.

### IMAGE CAPTURE BOARD

Capture images from any VCR or Camcorder. Resolution up to 512 x 480 pixels; 65,536 colors or 256 shades of grey. Images saved in GIF, PCX, TIFF formats and more. For XT/AT/PS2. Includes user friendly software and user's guide. One year warranty. VGA required. Can capture from live video (eliminates need for expensive digital video). Ideal for Desktop publishing, CAD, Animation, and Pictorial Databases.

\$749 VISA/MC/AMEX/I.C.O.D.

#### PEGA Micrographics

P.O. Box 713, Westerville, OH 43081, (614) 885-1007  
1-800-477-PEGA

Inquiry 766.

### Affordable Stereoscopic 3D

Finally, an affordable stereoscopic 3D system for EGA/VGA equipped PC's or compatibles. peSTEREOSCOPE's interface board and glasses, only \$350. Software Development System, with high speed graphics functions, animation and menuing, \$250. OEM applications include medical imaging and statistical data presentation. Hobbyist inquiries welcome.

#### Vision Research Graphics, Inc.

99 Madbury Road, Durham, NH 03824  
(603) 868-2270 FAX (603) 868-1352

Inquiry 767.

426 B Y T E • NOVEMBER

## HANDWRITING RECOGNIZER

### a Handwriting Recognizer

Avoid using your keyboard for heavy typing. For the same reason you prefer a mouse to cursor-arrows. Especially efficient for shorthand, standard or personalized. Any number of users can create their own symbol sets, arbitrary symbols in each. Every symbol may represent any last—a single letter, word, complete sentence, coded graphic symbol for CAD, etc. A signature can become a password. Requires DOS, a digitizing tablet with SummaSketch/BP emulation + stylus. Output: standard text file. For a single PC (NOT copy protected) \$195. A few hours evaluation: \$19, refundable. Networking available. Soon for MAC. Dealer inquiries welcome.

#### Nybble Engineering

14 Allayt Hanoar st., 67450 Tel Aviv, Israel  
Tel. 972-3-262-881

Inquiry 768.

## HARD DRIVE REPAIR

Beat the cost of replacement!  
10% Off Discount **REPAIR** Coupon 10% Off

### HARD DISC and FLOPPY DRIVES FULL WARRANTY PROTECTION

Fast Turnaround • Data Recovery

#### jb TECHNOLOGIES, INC.

5105 Maureen Lane, Moorpark, CA 93021

(805) 529-0908 Fax (805) 529-7712

Inquiry 769.

### HARD DISC DRIVES

Sales • EXCHANGE • Repair

Trade in your defective drive for NEW, with FULL WARRANTY!

TREMENDOUS SAVINGS!

TECHNICAL SUPPORT OF COURSE!

Large Inventory Hard and Floppy Drives

#### jb TECHNOLOGIES, INC.

5105 Maureen Lane, Moorpark, CA 93021

(805) 529-0908 Fax (805) 529-7712

Inquiry 770.

### DATA RECOVERY

SALES of new, remanufactured and removable disk drives

FULL TECHNICAL SUPPORT

#### ROTATING MEMORY SERVICE

1506 Dell Avenue, Campbell, CA 95008

(408) 370-3113

Inquiry 771.

## HARD DRIVE ASSISTANCE

HAVING HARD DRIVE PROBLEMS?

NEED TECHNICAL ASSISTANCE?

CALL THE EXPERTS AT H&W micro labs

1-800-235-0221 ext 911

HAVE YOUR MC, VISA OR AMEX READY

Inquiry 772.

## HARDWARE

### INDUSTRIAL STRENGTH SINGLE BOARD COMPUTER

Has optimum features for monitor + control applications:  
16 Chan A/D • 4 RS232/422 Ports • 48 Prog I/O Lines  
• 8 Opto I/Os • 8 HiDrive O/U's • 4 Timers • Watchdog  
• 104K Memory • 5.25 x 80 Options: Resident FORTH OS with Target Compiler, Editor, Assembler, + Auto Load/Start; 5 MHz 8085 • 4 Chan D/A • Battery Backed Clock/RAM • Networking • PC Support.

E-PAC 1000+ \$249.00 E-PAC 2000+ \$449.00

#### EMAC INC.

PO Box 2042, Carbondale IL 62902 (618) 529-4525

Inquiry 773.

## HARDWARE

### FREE INTERFACE CATALOG

Interfaces for IBM compatibles. Digital I/O (8255) and Analog input 8 bit resolution (0-255). Control relays, motors, lights, measure temperature, voltage. Sample interconnect circuits, BASIC programs, and I/O map are included.

#### John Bell Engineering, Inc.

400 Oxford Way, Belmont, CA 94002  
(415) 592-8411 9am to 4pm Pacific Time

Inquiry 774.

### LATEST AWARD BIOS

User definable hard drives, 101/102 keyboard and 3.5" 1.44Mb floppy support are now available in Award BIOS Ver. 3.1 for the IBM AT, 286 and 386 compatibles.

#### KOMPUTERWERK, INC.

851 Parkview Blvd., Pittsburgh, PA 15215

Orders: 800-423-3400

Tech: (412) 782-0384

Inquiry 775.

### APPLE® II & MACINTOSH®

• Systems • Peripherals • Parts

Look for us at  
**COMDEX**  
LAS VEGAS  
(The Sands  
Convention Center)  
Booth #N2591

Call for a CATALOG  
USA & Canada:  
**800-274-5343**  
International: 617-891-6851  
Fax: 617-891-3556

Save  
up to  
50%  
on Mac  
CPUs.

#### Pre-Owned Electronics, Inc.

30 Clematis Avenue • Waltham, MA 02154

Inquiry 776.

### ROM BIOS UPGRADES

For Your IBM or Compatible • A New BIOS Upgrade Will:  
• Support Windows 3.0 • Support 360K, 720K, 1.2 MB & 1.44 MB Floppy Drives • User defined hard drive types • Supports VGA • Novell & Netware compatible • Expanded hard drive table • Enhanced 101/102 keyboard • 100% IBM compatible • Complete documentation • Latest version • Complete set up in ROM.

Dealer/Distributor Inquiries Welcome Authorized Award Software Inc. Dist  
**800-800-BIOS Fax 508-683-1630**  
800-800-2467 508-686-6468

#### Unicore Software

599 Canal Street, Lawrence, MA 01840

See our ad on page 108

Inquiry 777.

## HARDWARE/COMPUTERS

What do you look for in board computers?

Small size? Low power? High level language? TD59092 has LCD and keyboard interfaces, on-board multitasking, interrupts, dual serial ports, RAM, EEPROM, IRQ bus and 35 I/O lines. Optional precision A/D and battery-backed RAM. A data logger can run 12 months on a small battery. Forth, the language of choice for embedded systems mixes with assembler. Used world-wide for machine control, data logging, robotics and automation.  
Call or fax for full details. 30-day Sale or Return. Only \$219 (25qty)

#### Saelig Company

1193 Moseley Rd., Victor, NY 14564  
Phone (716) 425-3753 Fax (716) 425-3835

Inquiry 778.

### EMBEDDED SYSTEMS COMPUTERS

SC/FOX®PCS (Parallel Coprocessor System) and PCS32 are PC/XT/AT plug-in boards, 16 and 32 bit, 15 MIPS average, 50 MIPS burst. PCS uses the Harris RTX 2000™ 16-bit real-time CPU with 1-cycle multiplier, 14 prioritized interrupts, 3 timer/counters, 8-channel I/O bus. PCS32 uses the new SC32 32-bit Forth CPU.  
SC/FOX SBC (Single Board Computer) is an 18 MIPS average, 60 MIPS burst, Eurocard-size RTX 2000 stand-alone computer.  
SC/FOX SCSI I/O Plug-on board for PCS or SBC with SCSI, floppy, 56K-baud serial, 16-bit parallel ports, and software drivers. Forth s/w included. C also available. Ideal for embedded real-time control, data acquisition, robotics, and signal processing.

**SILICON COMPOSERS INC.** (415) 322-8763  
208 California Avenue, Palo Alto, CA 94306

Inquiry 779.

# THE BUYER'S MART

## HARDWARE/COPROCESSOR

### DIGITAL SIGNAL PROCESSOR

DSP products for the IBM PC/XT/AT. Our TMS320C25 based Model 250, with extensive software, features 250 Khz multi-channel A/D and D/A, up to 192 Kwords RAM, very high throughput to PC RAM and disk, and is priced competitively with traditional Analog IO boards. Call us about your applications.

#### DALANCO SPRY

89 Westland Ave., Rochester, NY 14618  
(716) 473-3610

Inquiry 780.

### DSP32C PC/AT COPROCESSOR BOARD

25 MFLOP 32 bit Floating point DSP:  
• High speed NUMERICS and GRAPHICS  
• 640K DUAL PORTED on board memory  
• 32 bit parallel and serial IO headers  
• 15 ms 1024 point FFT from high level C  
• Assembler, monitor, and math libraries  
Base board and ALL software \$950, 640K \$300

#### SYMMETRIC RESEARCH

15 Central Way #9, Kirkland, WA 98033  
(206) 828-6560

Inquiry 781.

## INVENTORY MANAGEMENT

### STOCK-MASTER 4.0

Commercial grade inventory management software at micro prices.

- Supports all 12 transaction types
- Trend Analysis
- Quality Control
- Multiple Locations
- Purchase Order Tracking
- Open Order Reporting
- Serial/Lot # Tracking
- Stock Status Reporting
- Activity History Analysis
- Bill of Materials
- Purchase Order Writing
- Order Entry
- Material Requirements
- On Line Inquiry

#### Applied Micro Business Systems, Inc.

177-F Riverside Ave., Newport Beach, CA 92663 714-759-0582

Inquiry 782.

### dFELLER Inventory

Business inventory programs written in modifiable dBASE source code

dFELLER Inventory \$150.00

Requires dBASE II or III, PC-DOS/CPM

dFELLER Plus \$200.00

with History and Purchase Orders

Requires dBASE III or dBASE III Plus (For Stockrooms)

#### Feller Associates

550 CR PPA, Route 3, Ishpeming, MI 49849  
(906) 486-6024

Inquiry 783.

## LANs

### The \$25 Network

Try the 1st truly low-cost LAN

- Connect 2 or 3 PCs, XT's, AT's
- 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 784.

## LAPTOP COMPUTERS

### Laptop Savings

Laptops: Toshiba • Zenith • NEC • Sharp  
• Epson • Mitsubishi • Compaq

Also Laptop Accessories: Modems, Fax Modems, External Drives, Portable Printers, Memory, Key Pads, Hard Drives, Batteries, and Auto Adapters.

#### Computer Options Unlimited

12 Maiden Lane, Bound Brook, NJ 08805

Phone: 201-469-7678 (Fax: 201-469-7544)

Hours: 9am/10pm 7 days Worldwide sales

Inquiry 785.

## LAPTOP COMPUTERS

### New Laptop Products for:

Palmtops: Atari Portfolio, Poquet  
Notebooks: Compaq LTE, NEC-UL, Tandy 100/102, Tandy 1100, TI-M12, Toshiba SE/XE, Zenith-MS  
PC-Laptops: All major brands and models  
Accessories: Auto Adapters, Batteries, Carry Cases, Keypads  
Peripherals: Portable Printers, Hard Disks, 360K/1.2M Drives, Keyboard Covers, Modems, Barcode Wands, Laptop Software, etc.

For a free newsletter & catalogue, please call or write:  
**ULTRASOFT INNOVATIONS INC.**  
1 Transborder Drive, PO Box 247, Champaign, NY 12919  
Tel: (514) 487-9293 Fax: (514) 487-9295 9-6 EST  
Canadian Orders & Dealer Inquiries are Welcome

Inquiry 786.

## LAPTOP PERIPHERALS

### LAPTOP BACKLIGHTS

Factory Installed • 90-Day Warranty

Toshiba, Amstrad, Sanyo, DG,

Kaypro, IBM, HP, etc. \$295

The Portable Peripherals People

#### Axonlx Corporation

(801) 466-9797

Inquiry 787.

### TOSHIBA LAPTOP ENHANCEMENTS

FAK/MODEMS: 9600/2400 bps, software, acoustic port  
MODEMS, INTERNAL: 2400 bps, acoustic or serial port  
MODEM, DEDICATED: 2400 bps (TI200, TI600, T3200SX)  
SERIAL IO CARDS: RS232, RS422, SCSI, HPIL, Barcode  
BATTERY PACKS: 12V external battery • vehicle adapter

Contact us for more information:

#### PRODUCT R&D Corporation (Call)

805/546-9713, Fax: 805/546-9716

Inquiry 788.

## MEMORY BOARDS

### S.S.T. MEMORY UPGRADES

#### IBM PS/2

2MB module—Model 50, 70 \$230

2-8MB expan. bds.—Model 55, 70 \$520

#### COMPAQ

4MB module—DESKPRO 386/20E, 25, S \$460

4MB expan. brd.—DESKPRO 386/20E, 25, S \$540

8MB single slot module—SYSTEMPRO \$1600

#### H P LASER JET

2MB upgrades \$229

1-800-688-8993 5 YR. WARRANTY

Inquiry 789.

## MEMORY CHIPS

### PRICE MEETING & BEATING!

#### GRAMS

64K x 1-12, 10

64K x 4-80

256K x 1-15, 12, 10, 80, 70, 60

256K x 4-80

1MEG x 1-10, 80, 70, 60

INTEL/CYRIX/INT MATH CO'S

80287-8,10

80387-8,10

16, 20, 25, 33

CALL DRAM COMPANY (800) 488-DRAM

P.O. Box 590127 • S.F., CA 94159 (415) 398-2987

Inquiry 790.

#### SIMMS/SIPPS

256K x 9-10, 80, 70, 60

1MEG x 8-10, 80, 70, 60

1MEG x 9-10, 80, 70, 60

4MEG x 8-80

4MEG x 9-80

#### PS/2 TYPE SIMMS

Model 30 286

Model 50, 55, 60, 70, 80

## NEURAL NETWORKS

### BrainMaker:

"The most fascinating computer software I've ever seen... learn about this stuff!" *John Dvorak, PC Mag.* Predicts stocks, bonds, sales, inventories. Comprehensive documentation. Menus. Only \$195!  
Certified by Intel and Micro Devices

Free Brochure: 916/477-7481  
**California Scientific Software**

Inquiry 792.

## OPTICAL DISK

### ODIN & VOICE IMAGING SYSTEMS

ARCHIVING & RETRIEVAL SYSTEMS  
Utilizing WORM optical disk storage. ODIN runs on Unix workstations. VOICE runs on MS-DOS personal computers. Will scan documents up to "E" size. Proven system. Available now!

Telephone: 1-800-843-9377

#### Indus MIS, Inc.

340 S. Oak St., West Salem, WI 54669

Inquiry 793.

## PROGRAMMERS' TOOLS

### HYPERINTERFACE™ II

Menu Creator™ — An Interactive WYSIWYG editor to generate a menu-driven user interface for your software.  
Screen Creator™ — An Interactive WYSIWYG editor for quick and easy screen design and a screen database manager for your software. Advanced Library — Extended capability for data entry for your programs. FORTRAN, Pascal, C, BASIC supported.

#### Avanpro Corp.

P.O. Box 969, Pacific Palisades, CA 90272  
(213) 454-3866

Inquiry 794.

### TLIB™ 5.0 Version Control

"TLIB" is a great system! — *PC Tech Journal 3/88.* Full-featured configuration mgmt for software professionals. All versions of your code instantly available. Very compact, only changes are stored. Check-in/out locks, revision merge, branching, more. Mainframe deltas for Pansophic, ADR, IBM, Unibus. DOS \$139 (OS/2 \$195). 5-station LAN \$419 (OS/2 \$595)

#### BURTON SYSTEMS SOFTWARE

PO Box 4156, Cary, NC 27519 (919) 233-8128

Inquiry 795.

### The EE-100 EPROM Emulator™

Powerful, Versatile, and Compact Prog. Tool Closed loop development capability from source code generation through in-circuit debugging.

#### STANDARD EQUIPMENT

1-EE-100 Command Unit • 2-24 pin 2716-32 Detachable Header Cable • 2-28 pin 2764-256 Detachable Header Cable • 1-28 pin 27512 Detachable Header Cable • 1-Desk-Top Power Supply 110V AC to 5V DC • 1-User's Guide Manual

For more information call:

#### CompuLynk 1-800-969-9889

190-B Turnpike Rd., Westboro, MA 01581  
Tel: (508) 958-3731 • Fax: (508) 958-2548

Inquiry 796.

## MULTILINGUAL APPLICATIONS

### DTP/WP/Forms and Sign Making

Apple MAC & IBM PC. Available languages: Russian, E, European, Turkish, Greek & Indian. It's a DA on MAC, works with virtually any application program. It's a TSR on PC, for GEM based graphical WP, PerFORM & Ventura in WYSIWYG. Keybd remapping utility. Postscript, dot matrix, deskjet & laserjet fonts. Vinyl cutting sys. for sign making for any of the languages. Prices start at \$250, demo \$25. MCV/Visa

#### Solustan, Inc.

378 Hillside Ave., Needham MA 02194

Ph: 617-449-7666

Fax: 617-449-7759

Inquiry 791.

### Bsupport for Btrieve®

The "Notion Utilities" for Btrieve users.  
Bedit: DISPLAY, UPDATE, COPY, and DELETE.  
EXPORT SDF to dBASE & LOTUS. RECOVER damaged files.  
Edit/Insert using Data Dictionary.  
Bbug: TSR Btrieve debugger. Displays info in pop-up window.  
Brun: BUTIL replacement with Run-Time and C source.  
Bedit/Bbug: \$120. Brun: \$150. VISA/MC/COD/PO

800/359-2721 FAX: 517/887-2366

#### Information Architects, Inc.

P.O. Box 4184, East Lansing, MI 48826-4184

Inquiry 797.

# THE BUYER'S MART

## PROGRAMMERS' TOOLS

### Dazzle Your Users . . .

. . . by including a full-featured pop-up calculator with memory, a 100-line scrollable tape and more in your application. Takes minutes and costs as little as \$395 with no royalties. Demo disk and manual \$5.00. Specify language.

#### Liaison Systems, Inc.

P.O. Box 82720, Kenmore, WA 98028  
(206) 486-4996 — 30-day money back guarantee.

Inquiry 798.

## GW-BASIC PROGRAMMERS

Create professional quality programs with all the bells and whistles! You get 48 source code files which include Subroutines & Programs such as:

- Bar Menus
- Screen Manager
- Draw Forms
- Shell Sort
- Key Handlers
- Find File
- ANSISYS
- "Walk" Dir Tree
- Font Demo

Order: (800) 345-3808—\$29.00—MC/Visa Welcome

**MIPS, Inc.** • Box 3072 • Hammond, LA 70404  
for the IBM PC & 100% Compatibles

Inquiry 799.

## SPEED FORTRAN DEVELOPMENT AND CUT MAINTENANCE COSTS

**FORWARN**—Finds common programming errors such as mismatched parameter lists and common blocks, and uninitialized variables. Prints detailed cross-references and call-tree diagrams. \$329

**FORTRAN DEVELOPMENT TOOLS**—includes Pretty (indents, renumbers, changes GOTOs to IF-THEN-ELSE, etc.) and 6 more tools. \$129. For IBM PC. Also for UNIX—ask for details.

#### Qibus Enterprises, Inc.

3340 Marble Terrace, Colorado Springs, CO 80906  
(719) 527-1384

Inquiry 800.

- **MULTITASK Real Time**
  - **SERIAL COMMUNICATION by Interrupt**
- MTASK**® Professional was designed for the specific requirements of *Scientific Laboratories and Robotics Departments*. **Gratis:** demonstration diskette. Available for the present, for Turbo Pascal, Turbo C, Quick Pascal, Turbo Basic. Evaluation software for only \$95. Price \$495 + Shipping \$20. Taxes not included.

#### RAMSI® International

53 rue Bernard Iske, F-92350 Plessis Robinson, FRANCE  
International FAX: 33 (1) 46.32.48.37

Inquiry 801.

## PUBLIC DOMAIN

### SHAREWARE

FOR IBM™ AND COMPATIBLES

**FREE 112 PAGE CATALOG**  
OVER 3000 PROGRAMS

CALL 1-800-245-BYTE (2983)

#### BEST BITS & BYTES

P.O. Box 8225-B, Van Nuys, CA 91409  
FOREIGN COUNTRIES SEND \$4.00 FOR SHIPPING

Inquiry 802.

## FREE CATALOG

IBM SHAREWARE/PUBLIC DOMAIN  
LOW AS \$1.25/DISK

**1-800-321-4270**

**CRANSTON SOFTWARE**

PO Box 2679, Minneapolis, MN 55402-0679

Inquiry 803.

## PUBLIC DOMAIN

### 325 MEGABYTES Virus Free Share Ware

Dealers/Sysoops/Educators, Instant IBM Shareware Library for your Customers, user group or Students. Distributed in 25 Megabyte increments on HD 1.2/1.4 diskettes. \$30.00 for first 25 Megabytes, then add \$40.00 for each 25 Megabyte increment.

Add \$3.00 postage for each 25 Megabyte increment  
Add \$4.00/25 Meg increment for 1.44 diskettes

Orders Only: 1-800-876-8496

Info/Tech: 1-405-524-5233

#### SHARE-NET

POB 12368, Okla City, OK 73157

No Surcharge for Visa/MasterCard  
We gladly accept PO's from Educational, Fed/State Agencies

Inquiry 804.

## FREE SOFTWARE FOR IBM® PC's

TRY US! Get our SOLID GOLD HITS—Winter 1991 edition 15/5.25" or 6/3.5" disks full of our best-selling software—FREE! Great graphics, programmers utilities, desktop publishing, finance, games, education, and catalog.

Pay only \$5.00 for shipping — VISA/MC/AMEX

#### SMC SOFTWARE PUBLISHERS

CALL TODAY 619-942-9995

Inquiry 805.

## SOFTSHOPPE, INC.

Selected Programs, Latest Versions, As Low as \$1.50, Same Day Shipping, and No Minimum Order. For FREE CATALOG for IBM PD/Shareware, CALL 800-829-BEST (2378) or FAX 313-761-7639.

#### SOFTSHOPPE, INC.

P.O. BOX 3678, Ann Arbor, MI 48106-3678

Inquiry 806.

## SDK85 (8 bit) and SDK86 (16 bit)

NOW AVAILABLE ONLY FROM URDA, INC. which has an exclusive, world-wide, manufacturing and marketing license from Intel, Inc. The URDA SDK85 and SDK86 educational trainers and microprocessor development systems are now furnished fully assembled and boxed with manuals. Call URDA, Inc. for new low prices and delivery schedules. Other 8, 16 and 32 bit systems are available.

#### Phone URDA, Inc.

1-800-338-0517 or 412-683-8732

Inquiry 807.

## SECURITY

### FIGHT PIRACY!

Since 1986, companies worldwide have been choosing Az-Tech security products. If you demand the strongest protection available, why not choose one of these "proven leaders":

- EVERLOCK Copy Protection
- EVERTRAK Software Security
- EVERKEY Hardware "Key" Software Security

For IBM and Compatibles 30 day money back guarantee. Free info and demo disk available.

#### Az-Tech Software, Inc.

305 East Franklin, Richmond, MO 64085

(816) 776-2700  
(800) 227-0644 Fax: (816) 776-8398

Inquiry 808.

## THE ULTIMATE COPY PROTECTION

- Completely Menu Driven
- De/lets all Hardware/Software Copiers
- No Source Code Changes
- Multiple Layering
- No Damaged Media
- Full Hard Disk Support
- Unlimited Metering
- FREE Demo Disk

Quite  
Simply  
The Best  
Ways To  
Protect  
Your Valuable  
Software Investment

#### STOPVIEW™

#### STOPCOPY PLUS™

BBI COMPUTER SYSTEMS® (301) 871-1094  
14105 Heritage Ln., Silver Spring, MO 20906 FAX: (301) 460-7545

Inquiry 809.

## SECURITY

### COP's Copylock II

- Protects on standard diskettes
  - Cannot be copied by any device incl. Option Board
  - Fully hard disk installable
  - Normal back-up of protected programs
  - LAN-support
  - Creates safe demo version of your software
- Standard Version \$975, Automatic Version \$1950

#### DANCOTEC Computer

In US: 2835 Sierra Rd., San Jose, CA 95132 408-729-8162 or 1-800-344-2545  
Int'l: 2880 Baggaard, Denmark Phone +45-44440322 Fax -44440722

Inquiry 810.

## BIT-LOCK® SECURITY

Piracy SURVIVAL 5 YEARS proves effectiveness of powerful multilayered security. Rapid decryption algorithms. Reliable/small port-transparent security device. PARALLEL or SERIAL port. Complemented by economical KEY-LOK™ and multifeatured COMPUTE-LOCK™ including countdown, timeout, data encryption, and multiproduct protection. (Dos/Unix/Mac)

#### MICROCOMPUTER APPLICATIONS

3167 E. Otero Circle, Littleton, CO 80122  
(303) 770-1917

Inquiry 811.

## COPY PROTECTION

The world's leading software manufacturers depend on Softguard copy protection systems. Your FREE DISKETTE introduces you to SuperLock™—invisible copy protection for IBM-PC (and compatibles) and Macintosh.

- Hard disk support
- No source code changes
- Customized versions
- LAN support
- New upgrades available

(408) 773-9680

#### SOFTGUARD SYSTEMS, INC.

710 Lakeway, Suite 200, Sunnyvale, CA 94086  
FAX (408) 773-1405

Inquiry 812.

## HANDS OFF THE BOARD® 1/2 SIZE SECURITY BOARD

Stop floppy boot — Require password to boot PC Real-time disk encrypt — prevent boot sector virus Prevent DOS FORMAT/FDISK and low-level formats Set hard disk READ ONLY or turn ON/OFF Turn floppies, printers and COM ports ON/OFF IBM XT, AT Bus — DOS V3.0+ — \$149.95 + \$5.00 S/H

#### SYSTEMS CONSULTING INC.

PO BOX 111209, Pittsburgh, PA 15238  
(412) 781-5280

Inquiry 813.

## PUBLIC DOMAIN

### SHAREWARE

FOR IBM™ AND COMPATIBLES

**FREE 112 PAGE CATALOG**  
OVER 3000 PROGRAMS

CALL 1-800-245-BYTE (2983)

#### BEST BITS & BYTES

P.O. Box 8225-B, Van Nuys, CA 91409  
FOREIGN COUNTRIES SEND \$4.00 FOR SHIPPING

Inquiry 802.

## SECURITY

## SERVICES

### 900-258-SAVE

Call REFUNDED if not fully satisfied Find out who sells the product you're looking for at the best price BEFORE your next mail order. WIDE price variations exist for even low-cost products. Our system allows you to easily find software and hardware and hear vendors sorted by price. (\$1.50/min.)

#### The Consumer Connection™, Inc.

PO Box 399, Princeton, MA 01517  
508-464-5041

Inquiry 814.

## SOFTWARE/ACCOUNTING

### PC TIME CLOCK

AutoTime is an Employee Management System that allows you to turn any PC into an Electronic Time Clock. AutoTime provides Time & Attendance, Job Costing, Payroll Interface, and Labor Distribution reporting. Network compatible. Prices start at \$495. Other Business Products: Network FAX, Absence Call-In, db-EDI.

#### Chase Technologies

1617 Kingman Ave., San Jose, CA 95128  
(408) 998-2917

Inquiry 815.

# THE BUYER'S MART

## SOFTWARE/ACCOUNTING

### dBASE BUSINESS TOOLS

- GENERAL LEDGER
- PURCH ORD/INVENTORY
- ORDER ENTRY
- ACCOUNTS REC/VABLE
- JOB COSTING
- JOB ESTIMATING
- BILL OF MATLS
- SALES ANALYSIS
- PAYROLL
- ACCOUNTS PAYABLE

\$99 ea. + S&H

**DATAMAR SYSTEMS** Cred. Card-Check-COD  
4876-B Santa Monica Ave.  
San Diego, CA 92107 (619) 223-3344

Inquiry 816.

## 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. PC's from \$395 LAN version available

**FREE 30 day trial**

Computer Keys Tel: 206/776/6443  
21929 Makah Rd., Fax: 206/776-7210  
Woodway, WA 98020 USA: 800/356-0203

### LOCATE HARD-TO-FIND BUSINESS AND STATISTICAL SOFTWARE

Econometrics • Biometrics • Cluster Analysis • Multivariate Analysis  
• Marketing Statistics • Experimental Statistics • ANOVA • Regression  
• Linear Programming • Project Planner • Forecasting & Time Series  
• Sales & Market Forecasting • Quality Control and Industrial Experiments  
• Parameter and Tolerance Design • And Many More!

SEND FOR FREE PRODUCT GUIDE!

**Lionheart Press, Inc.**

PO. Box 379, Alburg, VT 05440  
(514) 933-4918 FAX: (514) 939-3087

Inquiry 817.

### StaffMinder™

Staff Administration Software — A must for all managers!  
Named for its inherent ability to "keep an eye on your staff," StaffMinder™ handles the following:

- Attendance tracking and analysis
- Salary, review, and bonus tracking
- Vacation planning and scheduling
- Compliance reporting
- Staff inventory
- Employee information

StaffMinder™ provides numerous informative reports. Free serial mouse included with each order. Simple point and click interface allows for easy implementation. Source code available.  
List price \$395 Ask for details on current special pricing!

### NEXT GENERATION SOFTWARE

Suite 1445, 3340 Peachtree Road, Atlanta, GA 30326  
CALL (800) 966-0707

Inquiry 818.

## SOFTWARE/ENGINEERING

### Affordable Engineering Software FREE APPLICATION GUIDE & CATALOG

Circuit Analysis • Root Locus • Thermal Analysis • Plotter Drivers • Engineering Graphics • Signal Processing • Active/Passive Filter Design • Transfer Function/FFT Analysis • Logic Simulation • Microstrip Design • PC/MS-DOS • Macintosh • VISA/MC

**BV Engineering Professional Software**  
2023 Chicago Ave., Suite B-13, Riverside, CA 92507  
(714) 781-0252

Inquiry 819.

### MATFOR

UNMATCHED VALUE FOR NUMERICAL COMPUTING

An interpreter with over 375 functions for Matrix Computations, Calculus, Differential/Nonlinear Equations, Optimization, Linear/Dynamic Programming, Graphics, Advanced Statistics, Signal Processing, Analysis/Design of Control Systems, and more. Extendible and Self-contained, \$150 IBM/compatibles. Editions using extended memory on 286/386 also available.

**Computational Engineering Associates**

3525 Del Mar Heights Rd., Suite 183, San Diego, CA 92130  
(619) 259-8863

Inquiry 820.

## SOFTWARE/ENGINEERING

### Mass2-MASS & VOLUME CALCULATOR with MATERIALS DATABASE

Easily calculate the volume & weight of hundreds of shapes. Never need to look up material densities against Differential and proportional comparisons made automatically. Menu driven with on-line context sensitive help. Flexible input system accepts Decimal, Fractional, and Exponential notation. For IBM PCs and Compatibles with 384K free.

**DEMPSEY'S FORGE, Software Division**  
Rt 2 Box 407, Gladys, VA 24554

Inquiry 821.

### PC BASED DATA ACQUISITION

Snap-Series Software is the best solution for Integrated Data Acquisition, Analysis, and Display without programming. Works with I/O hardware by 12 manufacturers, and allows extensive time and frequency domain analysis. Ideal for monitoring, waveform generation, and DSP.

### HEM Data Corporation

17336 12 Mile Road, Southfield, MI 48076  
Voice: (313) 559-5607 Fax: (313) 559-8008

Inquiry 822.

### Analog Circuit Simulation

- Macintosh and PC CAE
- Schematic Entry
- SPICE Simulator
- Model Libraries
- Monte Carlo Analysis
- Plotting/Graphics Output

### Intusoft

The leader in low cost, full featured CAE software  
PO. Box 6607, San Pedro, CA 90734  
(213) 833-0710 FAX (213) 833-9658

Inquiry 823.

### MICROSTRESS CORP.

New MICROSAFE 2D/3D Rel. 3.

Finite Element Analysis program for IBM PCs, MAC II Fam., and compatibles. Number of nodes, elements and conditions limited by disk space and model bandwidth (11000 d.o.f.) Color graphics support on various display cards (EGA, VGA, VEGA and Hercules) \$250. SAFECAD (bi-directional AUTOCAD interface) \$95. GRAFPLUS \$55. Plus \$/H.

Accept VISA/MasterCard. Send for brochure.

PO. Box 3194, Bellevue, WA 98009  
Tel./Fax (206) 643-9941

Inquiry 824.

### SIMULATION WITH GPSS/PC™

GPSS/PC™ is an MS-DOS compatible version of the popular mainframe simulation language GPSS. Graphics, animation and an extremely interactive environment allow a totally new view of your models. If you are contemplating the creation or modification of a complex system you need GPSS/PC to help you predict its behavior. Call now.

### MINUTEMAN Software

P.O. Box 1717, Slow, Massachusetts, U.S.A.  
(508) 897-5662 ext. 540 (800) 223-1430 ext. 540

Inquiry 825.

### Circuit Analysis — SPICE

Non-linear DC & Transient; Linear AC.

- \* Version 3B1 with BSIM, GaAs, JFET, MOSFET, BJT, diode, etc. models, screen graphics, improved speed and convergence.
- \* PC Version 2G6 available at \$95.

Call, write, or check inquiry # for more info.

### Northern Valley Software

28327 Rothrock Dr., Rancho Palos Verdes, CA 90274  
(213) 541-3677

Inquiry 826.

## SOFTWARE/ENGINEERING

### Worstcase Gets Even Better! Analog Circuit Simulation

ECA-2 Electronic Circuit Analysis offers the best Monte Carlo and Worst-Case analyses with all this and MORE Included:

- AC, DC, Transient
- Interactive/batch modes
- Fourier Temperature
- Full nonlinear simulator
- Sine, Pulse, PWL, SFFM, Graphics
- On Line, Real Time
- Exponential Graphics
- Multiple plots

### Tatum Labs, Inc.

3917 Research Park Dr., B-1, Ann Arbor, MI 48108  
(313) 663-8810

Inquiry 827.

## SOFTWARE/GEOLOGICAL

### GEOLOGY & GROUNDWATER PROGRAMS

Borehole Logs, E-Logs, Cross Sections, Stratigraphy, Well Drawings Fence, Contours, Isopachs, 3-D Diagrams, Pumping Tests, Groundwater Chemistry, Piper, Stiff, Durov etc. Used by EPA and State Agencies for RCRA & CERCLA. Our software is used by consultants, universities, and oil & coal companies in 26 countries. Free brochure and demo disks.

### Earthware of California

30100 town center dr. #196, Laguna Niguel, CA 92677  
Phone (714) 495-5727 FAX (714) 495-4820

Inquiry 828.

### GEOLOGICAL CATALOG

Geological software for log plotting, gridding/contouring, hydrology, digitizing, 3-D solid modelling, synthetic seismogram, fracture analysis, image processing, scout ticket manager, over 50 programs in catalog, Macintosh tool! Please call, or write, for Free Catalog!

### RockWare, Inc.

4251 Kipling St., Suite 595, Wheat Ridge, CO 80033 USA  
(303) 423-5645 Fax (303) 423-6171

## SOFTWARE/GRAPHICS

### SEGS 2.1 Scientific Engineering Graphics System

- Logarithmic, Time/Date & Linear Axes.
- Easy Curve Fitting and Data Smoothing.
- 1-2-3 Interface & Numeric Spreadsheet.
- Supports all Video & Device Standards.
- 10 Curves with up to 16,000 points each.

### Advanced Micro Solutions

3817 Windover Dr. 405-340-0697  
Edmond, OK 73013 800-284-3381

Inquiry 829.

### CHAOS: The Software™

Explore Chaos in nature for yourself, in a hands-on, visual way. Autodesk worked with James Gleick to transform some of the most famous equations from the new science of Chaos into a series of six interactive programs that let you create stunning visual patterns in high resolution color and sound. \$59.95

For IBM PC/XT/AT, PS/2 or compatibles with 640KB RAM, MS-DOS/PC-DOS, EGA/VGA

### Autodesk, Inc.

2320 Marinship Way, Sausalito, CA 94965  
(800) 223-2521

Inquiry 829.

### QuickGeometry Library

All the C geometry and DXF routines you expect... and more!

(617) 628-5217

### Building Block Software

PO Box 1373, Somerville, MA 02144

Inquiry 830.

# THE BUYER'S MART

## SOFTWARE/GRAPHICS

### The Ultimate CAD/CAM Engine

TurboGeometry Library 3.0. The most complete tool box of 2D & 3D routines available today! Over 300 routines. Surfacing, Solids, Hidden line, Volumes, Areas, Transforms, Perspectives, Decomp, Clipping, Tangents & more. 30 day guar., \$19995 w/source S&H Incl. Foreign \$225.00. MS/PC DOS 2.0+. Turbo Pascal, Turbo C, MSC, MIX C, Zortec C+., VISA/MC, PO, Chk, USA funds only.

#### Disk Software, Inc.

2116 E. Arapaho Rd., #487, Richardson, TX 75081  
(214) 423-7288, (800) 635-7760, FAX (214) 423-7288

Inquiry 831.

## RAINDROP™

FAST, compact PrtScr 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.

#### ELECTIC SYSTEMS

8106 St. David Ct., Springfield, VA 22153  
(703) 440-0064

Inquiry 832.

## PEN PLOTTER EMULATOR

FPLOT turns your dot matrix or laser printer into an HP pen plotter. Fast hires output. No jagged lines. Vary line width, color. Works with Autocad, Drafax, etc. Supports NEC P5/P6, IBM Proprinter, Epson LQ/FX, Toshiba, HP Laserjet, Okidata 29x/39x, Hercules/CGA/EGA/VGA. \$64 check/m.o./VISA/MC

#### Plot Corporation

24-16 Steinway St., Suite 605, Astoria, NY 11103  
(718) 545-3505

Inquiry 833.

## GRAPHICS PRINTER SUPPORT

AT LAST! Use the PrtSc key to make quality scaled B&W or color reproductions of your display on any dot matrix, inkjet, or laser printer (incl. Postscript) in up to 64 shades of gray or 256 colors. GRAFPLUS supports all versions of DOS with IBM (incl. EGA, VGA, Super VGA), Hercules, or compatible graphics boards. Linkable/OEM versions available. \$59.95

#### Jewell Technologies, Inc.

4740 - 44th Ave. SW, Seattle, WA 98116  
(800) 359-9000 x527 (206) 937-1081

Inquiry 834.

## GRAPHICS LIBRARIES for C, FORTRAN, PASCAL & QuickBASIC

- Supports VIDEO, PRINTERS & PLOTTERS.
- Linear, log, polar, smith, bar & pie charts.
- Scalable fonts, line types, markers.
- Multiple plots on a page.
- Over 100 routines with full source code.
- 240 page manual. No royalties.

\$295.00 (713) 491-2088

#### Sutrasoft

10506 Permian Dr. • Sugar Land, TX 77478

Inquiry 835.

## SOFTWARE/LANGUAGES

### DRUMA FORTH-83

Break the 64K barrier without speedup penalty. Powerful, attractively priced, '83 Standard.

- 1Mb+ automated memory management
- Full OS interface, extensive utilities
- On-line documentation, ASCII/block files
- Other products: windows, modules, profiler
- IBM PC/XT/AT including 386 compatibles

FREE learn/utility disks with purchase

#### DRUMA INC.

6448 Hwy. 290 East E103, Austin, TX 78723  
Orders: 512-323-5411 Fax: 512-323-0403

Inquiry 836.

430 B Y T E • NOVEMBER 1990

## SOFTWARE/LANGUAGES

### FINAL LIQUIDATION!!

IBM \* Compilers, SAVE UP TO 80%!

Title	Retail Sale
COBOL V2.0 (3 1/2" & 5 1/4")	\$900 \$100
Prof. FORTRAN V1.3 (3 1/2" & 5 1/4")	\$795 \$ 90
C Compiler (3 1/2" or 5 1/4")	\$395 \$ 50
BASIC Compiler V2.0 (3 1/2")	\$495 \$ 50
Macro Assembler V2.0 (3 1/2" or 5 1/4")	\$195 \$ 40
VISA, MC, Check accepted, S and H fee \$10 per order	

#### THE COMPUTER PLACE, INC.

12105 Darnestown Rd. #9A Tel: (301) 330-6016  
Gaithersburg, MD 20878 Fax: (301) 926-3415

Inquiry 837.

## SOFTWARE/MARKETING

The "Software Success Reference Book (1987-1988)" is a MUST READ if you want to market your software products successfully. Written by David H. Bowen, publisher of Software Success, the monthly newsletter on successfully running a software business, the Reference Book is a 268-page guide, organized by topic. Covers Lead Generation, Promotion, Pricing, Distribution, Support, etc. Only \$25. Check or Credit Card (VISA/MC/AE).

100% Money Back Guarantee

### Software Success

PO Box 9006, San Jose, CA 95157

(408) 446-2504 FAX (408) 255-1098

Inquiry 838.

## SOFTWARE/MATHEMATICS

### Fast WYSIWYG Editor

Leo — the best math editor available. See equations as you type. Menu and control key operation. Reads and writes TeX files.

Leo for PCs — \$199

### ABK Software

4495 Ottawa Pl., Boulder CO 80303

(303) 494-4872

Inquiry 839.

### MATH EDITING FOR THE PC

$$x_i^2 = \sum_{k=0}^{\infty} x_k^{2n} \left( \frac{1}{\sqrt{\alpha \pm \beta x}} \right)$$

- MathEdit constructs math equations to be inserted into WordPerfect, Word, WordStar, and others.
- WYSIWYG interface—no codes need to be learned.
- MathEdit—\$199

#### K-TALK COMMUNICATIONS

30 West First Avenue, Suite 100  
Columbus, Ohio 43201  
(614) 294-3535

Inquiry 840.

## MATHEMATICIANS—ENGINEERS

Have you ever seen functions of a complex variable? Would you like to really understand differential operators like div, grad and curl? How about a peek into the fourth dimension? Call or write for information on our latest PC and Macintosh software.

### Lascaux Graphics

3220 Steuben Ave., Bronx, NY 10467  
(212) 654-7429

Inquiry 841.

## ORDINARY/PARTIAL DIFFERENTIAL EQN SOLVER

FOR THE IBM PC & COMPATIBLES

### MICROCOMPATIBLES, INC.

301 Prelude Dr., Silver Spring, MD 20901

(301) 593-0683

Inquiry 842.

## SOFTWARE/MEDICAL

### Medical Systems with ECS

PPM offers a complete line of medical software ranging from simple insurance claims processing to comprehensive A/R management. PC CLAIM PLUS—claims processing with ECS to over 100 major insurance carriers—30-day money-back guarantee. THRESHOLD—complete A/R, patient billing, comprehensive practice management statistics. CLAIM NET—Nationwide electronic claims clearinghouse transmits claims to over 100 insurance carriers. Software prices start at \$459.00. Dealer inquiries welcome.

#### Physicians Practice Management

350 E. New York, Indianapolis, IN 46204  
800-428-3515 317-634-8080

Inquiry 843.

## SOFTWARE/SCANNERS

### Optical Character Recognition

PC-OCR™ software will convert typed or printed pages into editable text files for your word processor. Works with HP ScanJet, Canon, Panasonic & most other scanners. Supplied with over 20 popular fonts. User trainable; you can teach PC-OCR™ to read virtually any typestyle, incl. foreign fonts. Proportional text, matrix printer output. Xerox copies OK. From \$99. Check/VISA/MC/AmExp/COD

#### Essex Software Publishing, Inc.

P.O. Box 391, Cedar Grove, NJ 07009  
(201) 783-6940

Inquiry 844.

## INCREDIBLE OCR

A total solution to all your OCR needs. Recognizes many common text typefaces, and can quickly learn most others. Supports all the major word processors. Faster and more accurate than systems costing twice as much. Amazingly it works with virtually every brand of hand-held scanner, most full-page scanners, and all PC/Am boards. More than 15,000 satisfied users.

All for only \$184 including shipping!

\*International include \$25 for airmail shipping  
Check, money order, VISA, MC, and COD accepted.

#### PAI OCR

611 Tucker Street, Raleigh, NC 27603  
800-762-5542 FAX: 919-828-5196

Inquiry 845.

## SOFTWARE/SCIENTIFIC

### C Scientific Library

Create customized scientific and engineering tools with this comprehensive library of 800 functions including linear algebra, eigen-systems, matrix computations, time series, smoothing and filtering, statistics, regression, linear and integer programming, nonlinear systems, optimization, differential equations, curvefitting and graphics. Superior documentation. Usable, encapsulated, modular, reliable, mature, and affordable. Several licensing and system options are available starting at \$295. Request on company letterhead or send \$5 (refundable on purchase) for 50-page CSL Buyer's Guide.

#### Elgenware Technologies

13090 La Vista Drive, Saratoga, CA 95070  
(408) 867-1184 Fax: (408) 867-6575

Inquiry 846.

## FREE CATALOG 800-942-MATH

MicroMath Scientific Software

Salt Lake City, UT 84121-0550

Inquiry 847.

## Scientific/Engineering/Graphics Libraries

Turbo Pascal, Turbo+MS C, MS Fortran, Basic. Send for FREE catalogue of software tools for Scientists and Engineers. Includes: Scientific subroutine libraries, device independent graphics libraries (including EGA, HP plotter and Laserjet support), scientific charting libraries, 3-D plotting library, data acquisition libraries, menu-driven process control software. Versions available for a variety of popular languages.

#### Quinn-Curtis

1191 Chestnut St., Unit 2-5, Newton, MA 02164  
(617) 965-5660

Inquiry 848.

# THE BUYER'S MART

## 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 849.

## SOFTWARE/TOOLS

### CBASIC LIBRARY ON PC DOS

A general purpose CBASIC function library with over 100 functions. Most functions are written in assembly language for compactness and speed. Some commands include: Windows, access all keys on keyboard, complete screen control without using ANSI.SYS, do any BIOS calls, file and record locking, calculator, child processes, peek and poke at any location, Network compatibility, access any communication port and printer port, etc. Write or call now for FREE information. Only \$199.00 + \$5.00 SH. VISA/MC/COD. UPS Accepted.

### GOLDEN OAKS SOFTWARE

(Software Consulting)

4744 Madison Avenue, Sacramento, CA 95841

(916) 331-1111

Inquiry 850.

## SOFTWARE/UTILITIES

### Duplicate Disks Fast!

*DiskDupe* duplicates, formats and compares disks amazingly fast—up to 200 disks an hour! Its unique RELAY feature lets you quickly duplicate lots of master disks effortlessly. And you can protect your masters by storing disk images on your hard disk. Also supports high-density formats—plus a whole lot more! \$79 + S/H. Money Back Guarantee.

### Micro System Designs, Inc.

4962 El Camino, Suite 204, Los Altos, CA 94022

(415) 964-2844 Fax: (415) 964-4529

Inquiry 851.

## SOFTWARE/VOICE

### MULTI-VOICE® TOOLS

Multi-Voice Tools is a complete development Toolkit for Pascal or "C" to access all the features of the WATSON or DIALOGIC Speech Boards. It is also a high level library of procedures to build MULTI-LINE VOICE RESPONSE systems in minutes. A powerful TELEPHONE ANSWERING program is given as an example with source code. DIALOGIC, RHETOREX, VBX \$599, WATSON \$99, Visa/MC. Now available: Fax Tool Kit.

### ITI Logicle

1705 St. Joseph E, Suite 4, Montreal, PQ, Can. H2J 1N1  
(514) 861-5988

We can also write your Voice Response application programs.

## STATISTICS

### JUST RELEASED STATISTIX 3.1

PC Magazine Editor's Choice!

You can rely on STATISTIX to get your work done EASILY and QUICKLY. Menu-driven. Powerful yet compact. STATISTIX offers basic and advanced statistics with an easy-to-follow manual full of examples.

"Technical support was excellent"

PC Magazine

Get the quality you want at a price you can afford. U.S. & overseas price: \$199. Money-back-guarantee.

Tel: 612-631-2852 Fax: 612-636-3070

Analytical Software, PO Box 130204, St. Paul, MN 55113

Inquiry 852.

### Cover all the bases of design . . .

with Methodologist's Toolchest! A comprehensive package of five programs to aid in research design and analysis. Specifically, these programs offer assistance in sampling, data collection procedures, statistical analyses, experimental design, and measurement and scaling. \$499.95 + sh. VISA, MC, AMEX, PO. Checks accepted.

### The Idea Works, Inc.

100 West Briarwood, Columbia, MO 65203

1-800-537-4866 FAX 314-445-4589

Outside USA 314-445-4554

Inquiry 853.

## 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 854.

### SCA STATISTICAL SYSTEM

The *only* statistical software encompassing Forecasting & Time Series Analysis Quality and Productivity Improvement General Statistical Analysis

Available on DOS, OS/2 and Mac operating systems.

Call today for more information

### Scientific Computing Associates

4513 Lincoln Ave., Suite 106, Lisle, IL 60532, USA

Phone: (708) 960-1698 FAX: (708) 960-1815

Inquiry 855.

### Experience the POWER!

StatPac Gold is the award-winning statistics and forecasting package that delivers! It's fast, flexible, easy to use and dependable. Time-tested and loaded with features. Basic and advanced statistics with graphics. Over 14,000 satisfied customers. You be the judge! Call for your free brochure.

### StatPac Inc.

6500 Nicollet Ave. S., Minneapolis, MN 55423

(612) 866-9022

## TERMINAL EMULATION

### TEK 4207/4105/4014 Emulation

PC-PLOT-V is a complete communications program which includes file transfer, script files, VT-100/200 emulation plus Tektronix graphics terminal emulation. Supports COM1-4 plus support for DECnet, NETBIOS, U-B Net1. Graphics screenprint. \$225. Free Catalog.

### MicroPlot Systems Co.

1897 Red Fern Dr., Columbus, Ohio 43229

614-882-4786 614-882-3399 (BBS/FAX)

Inquiry 856.

## TRANSLATORS

### 100% PASCAL → C

P2C translates Turbo Pascal 3.4/5 into C code (Turbo, Microsoft, TopSpeed, ANSI) and supports all TP features: sets, nested functions, with, variant records, strings, files, interrupts, const expressions, graphics, units, dynamic memory management, mem & port arrays, absolute variables; in short—everything except inline and object-oriented features. Comes with full TP runtime library emulation and automatically generates project, make, header, and C files. English manual (130+ pages) included. Professional Edition includes complete source code for emulation library.

Standard Ed. \$395 Professional Ed. \$595 (MC, VISA, AMEX)

LAUER & WALLWITZ GmbH, Erlkoenigweg 9,  
D-6200 WIESBADEN, West Germany, Phone +49 (611) 42771

Inquiry 857.

## UNINTERRUPTIBLE POWER

### PROTECT YOUR COMPUTER! BATTERY BACK UPS

MICRO UPS provides standby emergency power and voltage irregularity protection! When irregularities occur, UPS kicks in immediately with the necessary power insuring continuous operation.

200 Watt #29033 \$149.00

400 Watt #29034 \$199.00

FREE CATALOG

\$5.00S/H

With your order. Call 1-800-776-3700 or send order to:

### AMERICAN DESIGN COMPONENTS

Dept. 211-110 815 Fairview Ave., P.O. Box 220, Fairview, NJ 07022

Inquiry 858.

## UNINTERRUPTIBLE POWER

### HOW TO PROTECT YOUR COMPUTER And Make It Last Longer

FREE money-saving literature tells you how to protect your computer and make it last longer with an uninterruptible power supply. 500VA through 18KVA models from the world's largest manufacturer of single-phase UPS.

### Best Power Technology, Inc.

P.O. Box 280, Necedah, WI 54646

Toll-Free (800) 356-5794, Ext. 3860

Telephone: (608) 565-7200, Ext. 3860

See our Ad on page 450.

Inquiry 859.

### DATASAVER AC POWER BACKUP

Provides reliable, affordable power protection for LAN Systems, Fileservers, CAD/CAM Systems, and all Desktop Microcomputers. Low profile, convection cooled and auto shutdown capabilities are some of the many user benefits. Highest quality. Made in the U. S. A. (Dealer, VAR, OEM inquiries welcome)

For Free Information Call or Write:

### CUESTA SYSTEM CORPORATION

3440 Roberto Court, San Luis Obispo, CA 93401

(800) 332-3440

(805) 541-4160

Inquiry 860.

## UTILITIES

### DEAL - STEAL - DEAL

Cardfile/Autodialer

- DBaseIII compatible
- More than 1,000,000 Records
- Not Copy protected
- Direct search and content search
- Any Mouse or none
- Not Memory Resident
- Cards can be sorted
- Any Phone and Modem

This is a MUST HAVE Utility. It's fast, easy, and you can afford it.

\$19.95

### Engineering Concepts

314 N. Newell Pl., Fullerton, CA 92632

(714) 525-3519

Inquiry 861.

### EZ-"DISK" COPY PLUS™

FLAWLESS DISKETTES FAST! on the PC you already own! THIS IS SOFTWARE ONLY! Bypasses DOS for the utmost speed. Great for publishers, developers, MIS directors, etc. 2X+ faster than DOS. Read diskette once, then, quickly & accurately mass duplicate 5.25" & 3.5" disks on your own PCXT/AT/etc. Formats, copies, verifies, optionally SERIALIZES & PRINTS LABELS, in 1 smooth operation. Save images to HD, more. Replaces dedicated hardware worth \$1000s. Only \$139 +S&H (for 1 machine) or \$495 (NCP for up to 10 machines)

EZX, 917 Oakgrove Dr.#101-B1090, Houston, TX 77058

Orders (V/MC/AX/D) & Catalogs Toll Free 1-800-359-9539

INFO 713/280-9900; FAX: 713/280-0525, BBS: 713/280-8180

Inquiry 862.

### COPY AT TO PC—BRIDGE-IT 3.5

"CPVTR2PC" RELIABLY writes 360KB floppies on 1.2 MB drives, saving a slot for a second hard disk or tape backup. Only \$79.00 + SH

"BRIDGE-IT 3.5" is a DEVICE DRIVER supporting 314" 720KB/144MB drives for PCXT/AT without upgrading DOS/BIOS. Only \$39.00 + SH

BRIDGE-IT 3.5 BUNDLED WITH INTERNAL 1.44MB DRIVE AT \$129.00 + SH

VISA/MC/COD UPS BR

### MICROBRIDGE COMPUTERS

655 Sky Way Suite 220, San Carlos, CA 94070

1-415-593-8777(CA) 1-415-593-7675 (FAX)

1-416-855-1993 (CANADA) 1-800-523-8777

0908-260-188 (UK) 4711 4020 (FRG)

Inquiry 863.

DELTA, the better text file comparison tool. Scrollable windowed presentations of file or directory comparisons, with a built-in editor window. Ideal for programmers! Requires DOS 2.0 or higher with at least 384K RAM. A hard disk is recommended. Order now. \$79.

DEMO available on our BBS

### OPENetwork

POWER TOOLS FOR POWER USERS

215 Berkely Pl. (B-1), Brooklyn, NY 11217

718-638-2240 BBS: 718-638-2239

Inquiry 864.

# THE BUYER'S MART

## UTILITIES

### Recover deleted files fast!

Disk Explorer now includes automatic file recovery. You type in the deleted file's name, Disk Explorer finds and restores it. Disk Explorer also shows what's really on disk: view, change or create formats, change a file's status, change data in any sector. MS-DOS \$75 U.S. Check/Credit card welcome.

**QUAID SOFTWARE LIMITED**  
45 Charles St. E. 3rd Fl.  
Toronto, Ontario, Canada M4Y 1S2  
(416) 961-8243

## COPYWRITE

CopyWrite  
Removes  
Copy Protection  
No more diskettes,  
manuals or  
codewheels.  
1000's of products copied.

US \$75

**QUAID SOFTWARE LIMITED**  
45 Charles St. E. 3rd Fl. Dept B.  
Toronto, Ontario, Canada M4Y 1S2  
(416) 961-8243 Fax (416) 961-6448

## REMOVE HARDWARE LOCKS

Software utility allows for the removal of hardware locks. Don't wait for your lock or key device to fail or be stolen.

**Guaranteed to work!** The following packages are available:

PCAD	\$199.00	CADKEY	\$ 99.00
MICROSTATION	\$99.00	PERSONAL DESIGNER	\$199.00
MasterCAM	\$250.00	SmartCAM	\$250.00
TANGO PCB	\$ 99.00	CADVANCE	\$99.00

PLUS SHIPPING AND HANDLING

PHONE (204) 669-4639 FAX (204) 668-3566

VISA and MASTERCARD Welcome

**SafeSoft Systems Inc.**

191 Kiriystone Way, Winnipeg, MB, Canada, R2G 3B6

Inquiry 865.

## UTILITIES

### 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 866.

## WINDOWS TOOLS

### Hermes DDE Library

The Hermes DDE Library is a powerful library of high level routines for MS-Windows™ programmers. Hermes provides support for DDE at a much higher level than that provided in the Windows SDK. Your program attains added functionality by interacting and communicating with other Windows applications. Compared to the Windows SDK, Hermes reduces the code required to implement DDE by hundreds of lines of 'C'. Hermes is priced at \$295.

**Raindrop Software Corporation**  
845 E. Arapaho, Suite 105, Richardson, Texas 75081  
(214) 234-2611 Fax (214) 234-2674  
See our ad on page 222.

Inquiry 867.

## WORD PROCESSING

### FARSI / GREEK / ARABIC / RUSSIAN

Hebrew, all European, Scandinavian, plus either Hindi, Punjabi, Bengali, Gujarati, Tamil, Thai, Korean, Viet, or IPA. Full-featured multi-language word processor supports on-screen foreign characters and NLQ printing with no hardware modifications. Includes Font Editor, \$355 dot matrix, \$150 add'l for laser; \$19 demo. S/H in U.S. incl'd. Req. PC, 640K, graphics. 30-day Guarantee. MC/VISA/AMEX

**GAMMA PRODUCTIONS, INC.**  
710 Wilshire Blvd., Suite 609, Santa Monica, CA 90401  
213/394-8622 Tlx: 5106008273 Gamma Pro SNM

Inquiry 868.

## WORD PROCESSING

### DuangJan

Bilingual word processor for English and: Armenian, Bengali, Burmese, Euro/Latin/African, Greek, Gujarati, Hindi, Khmer, Lao, Punjabi, Russian, Sinhalese, Tamil, Telugu, Thai, Ukrainian, Viet, ... Only \$109+\$5 s/h (foreign + \$12 s/h). Font editor included. For any IBM compatibles with dot-matrix & LaserJet printer. Demo \$9+\$1 s/h. Visa/MC

**MegaChomp Company**  
3438 Cottman Ave., Philadelphia, PA 19149-1606  
(215) 331-2748 FAX: (215) 331-4188

Inquiry 869.

## MULTI-WRITER™

MULTI-LINGUAL Word processor, 30+ languages! English, Eastern & Western European, Russian, Hebrew, Arabic, etc. No hardware modifications necessary! Font editor allows design & print out of custom-made characters. Customize keyboard layouts. Edits from right to left. Mail merge. Supports 9 & 24 pin printers & Laser Jet II. Req: IBM/PC/XT/AT/286K. Only \$200+\$12 s/h. Demo \$10 \$4 s/h. Visa/MC/Eurocheques

**Summit Software Ltd.**  
PO Box 2265, Jerusalem, Israel 91022  
Tel: 972-2-241003 Fax: 972-2-259239

Inquiry 870.

## YOUR SALES MESSAGE

about the special computer product or service that you provide belongs in print.

### THE BUYER'S MART

can help you reach computer professionals and produce valuable inquiries for your company!

Call Brian Higgins for more information

**603-924-3754**

or

**Fax: 603-924-2683**

## Attention U.S. BYTE Subscribers

Watch for the next **BYTE DECK** mailing that will be arriving in your mailbox soon!

Use this as a fast, convenient tool to purchase computer products and services. It's loaded with essential hardware and software products that you should be aware of when making your buying decisions...and it's absolutely FREE!

If you have a computer product or service, and would like to reach 275,000 influential **BYTE** magazine subscribers, please give Ed Ware a call today at (603) 924-2596.

# BYTE DECK

Here's what a **BYTE Deck** advertiser has to say:

*"Ten years ago we advertised in the very first **BYTE Deck**—the number of sales leads we received was enormous! The **BYTE Deck** was so successful for us, that we have continued to use it over the past ten years!"*

Lisa Tarpoff, Marketing Manager, Heath Company, Benton Harbor, MI



## VOICE MASTER KEY® SYSTEM II

VOICE RECOGNITION & SPEECH RESPONSE  
FOR IBM PC/XT/AT/386, PS/2, LAPTOPS, COMPATIBLES



FOR PRODUCTIVITY, PRESENTATIONS, SOFTWARE DESIGN, ENTERTAINMENT, LANGUAGE TRAINING, EDUCATION, MORE...  
**SPEECH/SOUND RECORDING AND PLAYBACK.** Desktop Audio sound editing allows you to create custom sound applications. Variable sample rate (to 20 KHz) and compression levels. A four-voice music synthesizer is included also!  
**VOICE RECOGNITION TSR** utility allows you to add voice command keyboard macros to your CAD, desktop publishing, word processing, spread sheet, or entertainment programs. Up to 64 voice commands in RAM at once—more from disk.  
**HARDWARE SYSTEM** contains built-in speaker with separate volume and tone controls, external speaker and headphone jacks. Enclosure made of sturdy vinyl-clad steel. Attaches to parallel printer port without affecting normal printer operation (U.S. Patent 4,812,847). Headset microphones, printer cable, 9 volt AC adapter (110 volt UL/CSA listed), and comprehensive user manual included.

QUALITY THROUGHOUT. MADE IN USA. ONLY \$219.95

ORDER HOTLINE: (503) 342-1271 Mon-Fri, 8 AM to 5 PM PST

Visa/MasterCard, company checks, money orders, CODs (with prior approval) accepted. Personal checks subject to 3 week shipping delay. Specify computer type when ordering. Add \$5 shipping charge for delivery in USA and Canada. Foreign inquiries contact Covox for C&F/CIF quotes. OEM configurations available.

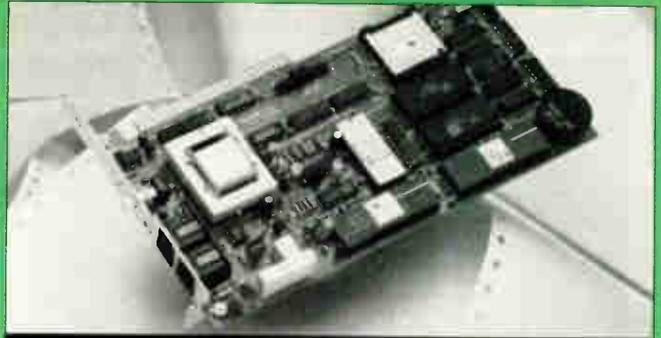
30 DAY MONEY BACK GUARANTEE IF NOT COMPLETELY SATISFIED.

CALL OR WRITE FOR FREE PRODUCT CATALOG



**COVOX INC.**  
675 Conger Street  
Eugene, Oregon 97402

TEL (503) 342-1271  
FAX (503) 342-1283  
BBS (503) 342-4135



# COMPUcom

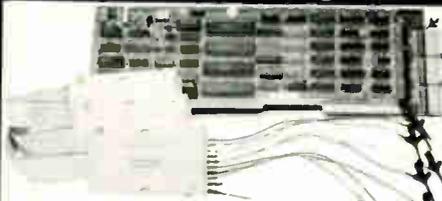
## 9,600-38,400 bps MODEM+FAX...\$279

NOW you can afford a **SPEEDMODEM**. Raw speed of 300 - 9600 bps and 4:1 data compression push throughput up to 38,400 bps. Dynamic Impedance Stabilization provides robust performance on noisy telephone circuits. A 9600 bps send/receive, full-featured FAX is included on the same card. Total communications capability—only \$279. It comes with a 30-day money back guarantee and a 5-year warranty. **BYTE** magazine said our 2400 bps modem was "a real deal"...well we've done it again... our **COMBO** is setting a new standard for value and performance. See for yourself... '3/89 p.102

(408) 732-4500 **CALL NOW 800 ACT ON IT** (800) 228-6648

Circle 74 on Reader Service Card

## 200 MHz Logic Analyzer



- 200 or 100MHz sampling
- 24 Channels
- Expansion to 72 channels
- 16 Levels of triggering
- 16K samples/channel
- Variable threshold levels
- 3 External Clocks
- 12 Clock Quality lines

\$ 799-12100 (100 MHz) \$ 1299-27100 (100 MHz) \$ 1899-27200 (200 MHz)

## UNIVERSAL PROGRAMMER

PAL  
GAL  
EPROM  
EEPROM  
PROM  
87xxx...



**\$475**

5ns PALs 4 Meg EPROMs  
FREE software updates on BBS

## GANG PROGRAMMER \$215

- 4 32pin Sockets (8 Socket option)
- 2716-27010 EPROMs

Call - (201) 994-6669  
**Link Computer Graphics, Inc.**  
4 Sparrow Dr., Livingston, NJ 07039 FAX:994-0730

Only your imagination  
limits how you benefit  
from **PERCON**®  
keyless data collection.



Checking out books or checking in employees—input data quickly and accurately using bar codes or magnetic stripes. PERCON has proven bar code solutions for IBM®, DEC™, and Apple Macintosh®. Call 1-800-8-PERCON.

### PERCON

2190 W. 11th Avenue, Eugene, Oregon 97402-3503  
(503)344-1189 FAX(503)344-1399

©1989 Percon, Inc. PERCON, IBM, DEC and Apple Macintosh are trademarks

# dBASE Data Entry

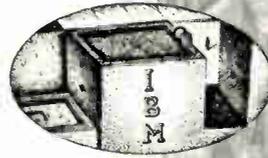


The TransTerm 5 is a work station data entry/display terminal for on-line shop floor data collection into PC/AT based systems. The unit is one of a family of such terminals which feature LC displays for operator prompting and data entry via a membrane keyboard or an optional barcode wand (Code 39). A multi-terminal polling controller (up to 250 stations) and a dBASE III+ compatible software package are also available. System costs below \$300.00 per station. Call for info.

Options—backlighting for display, RS-422 I/O, 20 Ma current loop I/O.  
dBASE is a registered trademark of Ashton-Tate, Inc.

## COMPUTERWISE, INC.

302 N. Winchester • Olathe, KS 66062 • 913-829-0600 • Fax 913-829-0810



2,168  
IBM PROGRAMS  
FREE.

■ Here in the BIX community, you can download your choice of 2,168 programs developed for IBM PCs and their compatibles. You can attend dozens of informative and provocative conferences, too. All this and more is yours in the *IBM Exchange*, with your subscription to BIX. Call our special Customer Service number for more information: 1-800-227-2983 (in NH, call 603-924-7681).

# BIX

## BYTE BACK ISSUES FOR SALE

	1987	1988	1989	1990
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
Inside the IBM PCs				

Issues Available

### Rates (postage and handling included):

1987-'90 BYTE Issues	\$6.00*	1985 Inside The IBM PCs	\$4.00
BYTE '83-'84 Index	\$4.00	1988 Inside The IBM PCs	\$6.00
BYTE 1985 Index	\$4.00		
BYTE 1988 Index	\$4.00		

\*June 1988 (Benchmarks) \$3.00  
\*December 1988 \$3.00

The above prices include postage in the US. Please add \$.50 per copy for Canada and Mexico; and \$2.00 per copy to foreign countries (surface delivery). European customers please refer to Back Issue order form in International Advertising section of book.

Please indicate which issues you would like by checking (✓) the boxes. Send requests with payment to:

BYTE Back Issues, One Phoenix Mill Lane, Peterborough, NH 03458  
(603) 924-9281

Check enclosed      Charge:  VISA     MasterCard

Card # \_\_\_\_\_  
Exp. Date \_\_\_\_\_  
Signature \_\_\_\_\_  
Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_  
State \_\_\_\_\_ Zip \_\_\_\_\_

All orders must be prepaid. Please allow four weeks for delivery.

**WOW**  
only  
**\$1295**

**TREND 386SX/16 COMPUTER SYSTEM 60 MG Hard Drive / 14" Monitor**

- 14" VGA Paper White Monitor
- 1.2 Floppy Drive
- 1 Game Port
- VGA Board w/ 256
- 60MB RLL Hard Drive
- 101-Key Click Keyboard
- Phoenix Bios.
- 2 Serial Ports
- 3 Button Mouse
- 1MG On/Bd Memory
- 2 Parallel Ports
- 3 Year Warranty

**SIMM MODULES**

	100ns	80ns	60ns
1MGx9	\$ 58	\$62	\$80
1MGx8	60	69	—
256x9	20	22	30
1MG 4x9 - 80 -	359		

Add \$5.00 for SIPP Modules.

**COMPAQ**

Modules	1MG	4MG
386/20/20E/25E	\$125	\$349

DeskPro 286E

**HARD DRIVES**

KAYLOCK 20MB XT 20MB, MFM, 3.5 HH, 40ms	\$215.00
256MB, 5.25 HH, 28ms	\$300.00
60MB, 5.25 HH, RLL, 28ms	\$400.00
CONNER 3204 200MB, 3.5 HH, RLL/IDE, 16ms	\$900.00

**IBM PS/2**

Models 30-286,50,50Z,60	
512K Kit	30F5348 \$ 67.50
2MB Kit	30F5360 159.00
Models 70-E61/121,55SX,65SX	
1MB	6450603 82.00
Models 70-E61/121,50Z,55SX	
2MB	6450604 170.00
Model 70-A21	
2MB	6450608 170.00
Models 55SX,65SX	
4MB	34F2933 499.00
Model 80-041	
1MB	6450375 139.00
Models 80-111/121/311/321	
2MB	6450379 219.00

**H.P. LASER JET**

	OK	1MG	2MG	4MG
II & IID	\$70	\$110	\$175	\$299
IIP & III	69	99	159	289

**LAPTOP MEMORY**

Toshiba	2MG		
T3100E	\$229.00	T3200SX	\$269.00
T1600	229.00	T5100	245.00
T3100SX	245.00	T5200	245.00
Zenith	1MG	4MG	
Super Sport/286	\$199	\$899	

**386 MATH CO-PROCESSORS**

16Mhz 20MHz 25MHz 33MHz	SX
CYRIX (83D87)	
\$305	\$350 \$450 \$549 —
II T (3C87)	
\$305	\$50 \$450 \$549 —
INTEL (80387)	
\$305	\$350 \$450 \$49 \$290

**EVEREX**

RAM 3000	\$ 89.00
0.3 MG. Will back fill to 640K LIM	
4 0/052 compatible Expanded and/or extended uses 256k D-RAM	
RAM 8000	190.00
0-8 MG Supports multitasking	
EMS 4.0 and EEMS compatible.	
Uses 1 MG D-RAM	

**D-RAM**

All Packages and Speeds Available.

**SPECIALS**

360K Floppy Drives	\$40.00
Panasonic & Mitsumi XT only DS/DD	
Mono VGA Monitor	\$95.00
14" Paper White Tilt & Swivel Base	



**OUR PRICES WILL MEET OR BEAT THE COMPETITION!**

**800-678-2818**

WE BUY EXCESS INVENTORY



TREND SYSTEMS INC.

**TERMS AND CONDITIONS**

Terms: Cash, MC or VISA - no surcharge. AMEX only add 4% handling fee. 20% restocking fee on non-defective returns. We accept Purchase Orders from Qualified Firms, Universities and Government Agencies. Prices subject to change.

No. 9 Exchange Place, Suite 900, Salt Lake City, Utah 84111 Telephone: 801/350-9180 Fax: 801/350-9179



**Spectacular Performance. Now Playing On 9-Track Tape.**

Overland Data subsystems deliver spectacular performance play after play. Stay for the credits and you'll see why:

**Speed.** Overland Data offers subsystems with the fastest data rates in the industry. There's never a dull moment.

**All Star Cast.** We offer eight different tape drives by major manufacturers. And our new TXi controller card transfers data so fast, it may just steal the show.

**Versatile Performance.** Exchange data between your PC's, mainframes and mini's. Use any IBM PC, compatible, or PS/2. Run under DOS, UNIX, XENIX and PICK. Convert from EBCDIC to ASCII and back. Backup your hard disk. And more...

**Well Developed Characters.** We develop our own custom software for advanced data transfer, conversion, and backup.

**A Great Supporting Cast.** You have all of Overland Data behind your subsystem. Expert sales and customer service staff are always ready to help you by phone. We can deliver to you in 24 hours. We back your tape drive for one year and your controller card for two years. And your subsystem comes with a 30-day, money back guarantee that it will meet your application needs.

All of which means that whenever you play 9-track tape on an Overland Data subsystem, you're in for a spectacular performance. To reserve your seat, call us at

**1-800-PC9-TRAK**

**OVERLAND DATA**  
San Diego, CA

1-800-729-8725 • 1-619-571-5555 • FAX 1-619-571-0982 • TELEX 754923 OVERLAND

# Scottsdale Systems — Since 1980 — 1-800-777-2369

## COMPUTERS SCOTTSDALE SYSTEMS

386 SX w/K B Monitor 1 Meg of RAM \$1655  
386-33 MHz w/K B Monitor 4 Meg of RAM \$3925  
Choice of Full Size Desktop Case or Full Size Tower Case  
Each Scottsdale Machine Has a 1 Year Warranty on Parts & Labor via Overnight Service on Warranted Products

Altos W/Xenix **SAVE**  
WYSE 386 25 MHz WYSE 286 \$1284  
1 Year Warranty Model 2112 \$1351  
WYSE 386 16 MHz Model 2116

### TERMINALS/MONITORS

**WYSE TERMINALS**  
WY-30 G/A-w/Keyboard \$290  
WY-50 G/A-w/Keyboard 377  
WY-60 G/A-w/Keyboard 405  
WY-99 G/A-w/Keyboard 468  
WY-150 G/A-w/Keyboard 367  
WY-212 G/A-w/Keyboard 1489  
WY Height Adjustable Arm 95

**MONITORS** \$499/649  
NEC 2A/3D 1180/2385  
NEC 4D/5D 528  
Mitsubishi Diamond Scan 615  
Seiko 1440 615  
Sony 1303/1302/1304 .577/648/685  
Hitachi Super Scan 1999  
Phillips 20" Hi-Res 2059

### WYSE MONITORS

QVT 101 Plus G/A/W \$316  
QVT 119 Plus G/A/W 395  
QVT 203 Plus G/A/W 443  
QVT PCT G/A/W 385

WY 530 G/A 14 Mono \$169  
WY 550 AW 14 Mono 179  
WY 650 12 VGR Color 459  
WY 700 W 15 Mono 695

### IBM TERMINALS

IBM 3151 3 Year Warranty \$465  
Link MC 5 405  
Altos 7 457

ImTec 1270/1470 \$80/121  
ImTec 1430/1441V 348/293  
ImTec 1432M 425

### KIMTRON

KT-70PC \$349

ACER 438  
4 Multiscan 14" VGA 640x480 349  
14" Amber nonglare 129

Authorized Service for WYSE  
LEASING AVAILABLE

INTERNATIONAL ORDERS WELCOME

### IDLINE

A&D/LP 3500 \$2339  
A&D/LP 3700 2889  
LP-3700 B 3129  
LP-4000-1 w/ Roll Feed 3579  
LP-4000-8 w/ Roll Feed 3935  
Vinyl Cutting Machines  
Blades & Hot Tips

### HOUSTON INSTRUMENTS

img Mki \$982  
DMP 52 52 MP 2425/2866  
DMP 61 62 2941/3895  
DMP 61 DL 3743  
DMP 62 DL 4737

### ENTER

SP600 \$599

### CALCOMP

1023 1025 \$3715/4519  
1043DM 11044 5869/8739  
5902 5902A 3819/4275  
DM 52224 11,919

### HEWLETT PACKARD

### OPTICAL SCANNER & SOFTWARE

Data Copy  
Panasonic RS-505/506 \$1037/1315  
Microtek  
AMT ACCEL 500 Intelli-Plot \$1699

### KURTA

Lifetime Warranty On Kurta IS-1  
IS-1 12x12 Cordless 4-button  
cursor pen stylus and  
interface kit \$439

### IS-1

12x17 Cordless 4-button  
cursor pen stylus and  
interface kit 629

### CALCOMP

Cal Comp 23120 12x12 \$365  
Cal Comp 9100 Series \$AVE  
Cal Comp 9500 Series \$AVE  
Cal Comp Wiz 165

### PLOTTERS

#### ROLAND DESKTOP PLOTTERS

1 Year Warranty \$895  
DXV-1100  
DXV-1200 Electrostatic 1295  
DXV-1300 Electrostatic 1625

#### ROLAND DRAFTING PLOTTERS

1 Year Warranty \$3695  
GRX-300 AR 3559  
GRX-400 AR

#### ROLAND FLATBED PLOTTERS

1 Year Warranty \$4275  
DPX-2500 Pen or Pencil  
DPX-3500 Pen or Pencil w/Stand 4628

#### ROLAND THERMAL PLOTTERS

LTX-420 \$9259  
LTX-320 7125  
LTX-120 2135

#### ROLAND CAMM MACHINES

Authorized Service for  
Roland Plotters and CAMM Machines  
SOFTWARE & ACCESSORIES \$AVE  
UNITED INNOVATIONS  
Model 7000A-C \$1899  
Model 8000A-D 2059  
Model 9000A-E 2829

### OPTICIZERS

#### SUMMAGRAPHICS

Lifetime Limited Warranty  
12x12 Summasketch II \$355  
12x18 Professional 620

#### HITACHI

#### GENIUS TABLET

12x12 w/ Cursor Stylus & Software  
3 Year Warranty on Tablet \$299

Call For Pricing On  
Larger Digitizers

### PRINTERS

ALPS Allegro \$345  
ALPS 324E 735  
AMT ACCEL 1299  
Canon BJ 130E 725  
Panasonic 1191 237  
Panasonic 1180 185

#### Dkidata all models

Toshiba all models  
Citizen all models  
Dicomx 150P/300P \$315  
NEC P-2200 505  
NEC P-5300 659  
NEC LC-890 3159

#### Authorized Service for

#### TriMatrix

Genoa/Intel  
Verticom All Models  
BOCA  
VMI/Cobra All Models  
Paradise VGA Plus  
Paradise Prof  
Control Systems/NEC  
Number Nine/Laicomp  
MODEM  
U S Robotics all models  
MULTITECH SYSTEMS  
All Models

#### NOVELL

#### ARCNET

Coax Startology \$112  
16 Bit Coax \$360

#### TIARA ETHERNET

#### TIARA ARCHNET

#### SYNOPTICS

2500/2510 Workgroup CALL

### LASER PRINTERS

QUME Apple & IBM \$3199  
H P Laser III 1799  
Panasonic 4420 1199  
Panasonic 4450 1385  
LPB 8111 1785  
LPB 4 959

### LAPTOPS

Samsung 286 \$2199  
Texas Instruments \$AVE

### OMEGA

Bernoulli Box  
B-120-1 21.4 MB Internal \$895  
144-1 44 MB Internal 1095  
Prices do not include interface

### ALLOY

Alloy IMP 2 & IMP 8 Cards \$AVE  
Multiware 386 & 286 Versions \$AVE  
Retriever 60 or 200 \$AVE

### POWER PROTECTION

Datashield  
Safe Power Systems \$AVE  
TrippLife \$AVE

### TAPE BACKUPS

Emerald Systems all models \$AVE  
Genoa all models \$AVE  
Irwin all models \$AVE

### HARD DRIVES

CDC IMPRIMIS \$AVE  
1 Year Warranty \$AVE  
72 MB thru 600 MB \$AVE  
Maxtor \$AVE

### SOFTWARE

MULTI USER  
SCO Xenix 386 \$110  
Concurrent DOS 386 10 User \$110  
Compuone 4 to 16 Port Boards \$110

All software sales are final  
CALL SERVICE FOR REPAIRS  
ON PRINTERS, TERMINALS,  
MONITORS, COMPUTERS.

1555 W. University Dr. #101, Tempe, AZ 85281

Prices listed are for cash. Discovery MasterCard and Visa add 1-1.7% AZ residents add 6-1.2% tax, add 3% for C.O.D. add 5% for P.O. International orders welcome. All items are new with manufacturer's warranty. Returned products subject to 20% restocking fee and in new condition in original packaging, with all warranty cards, manuals and cables. No credit issued after 30 days from date of shipment. We do not guarantee compatibility. Personal and company checks take up to 5 days to clear. Prices and specifications subject to change. Product subject to availability. All applicable trademarks recognized and on file.

602-966-8609

SERVICES (Mon.-Fri.) 602-731-4742

FAX 602-966-8634



## “Parlez-vous Q-TEL™?”

Oui... Si... Ja... now the answer

is Yes *wherever* you go internationally—thanks to our *new* Q-TEL International Database.

Q-TEL speaks everyone's language when you're talking about *one single source* of telecommunications rate, tariff and regulatory information. Domestically, you've already seen how our Q-TEL Databases (Q-TEL 1000, Q-TEL 5000 Plus, Q-TEL 7000 and Q-TEL 9000) can define a better bottom line for you. Now watch how the newest Q-TEL database translates into maximum cost savings for you internationally.

All our Q-TEL products have superior performance packaging, adapting easily to your applications with the most current and accurate rate, tariff and regulatory information to keep you updated and on top of industry activity.

So why not parlay our advanced telecommunications capabilities into a unique profit opportunity for you. Remember, whatever your role in telecommunications—manufacturer, seller, user of equipment or services—you also get our 20 years of telecommunications experience, backed by the information network of McGraw-Hill. Parlez with us today... Call: 1-800-526-5307 ext.: 290



First-Rate Information



# A-BUS™ NEWS

## New Products

Alpha Products proudly announces two new product lines: C-Net serial communications devices, and Alpha Box interfaces. These new products are not merely A-Bus accessories, but complete sets of products for all of your interfacing needs.

All the products are used to connect different types of devices to your computer. Our communications devices help you connect devices that have computer interfaces already built in. C-Net provides the option of connecting many different RS-232 devices to a single serial port on your computer. We also carry converters to other standards, including RS-422, RS-485 and IEEE-488.

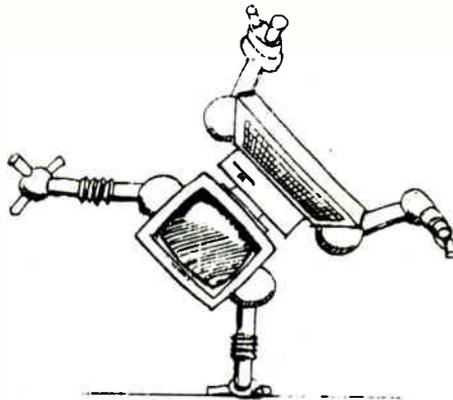
- \* C-Net Adapter. Connects the master control computer to C-Net. \$74
- \* Quad C-Net Module: Connect 4 RS-232 serial devices to C-Net. Each device is configurable (baud rate, parity, etc.) and has 4.8K byte input and output buffers. \$695
- \* C-Net Device Module: Connect any RS-232 Device to C-Net for data collection or communication, with handshaking. \$195

Alpha Boxes and A-Bus cards both provide ways to interface other types of devices to your computer. Alpha Boxes sense, measure, switch and govern. They feature:

- \* Each box is an attractively packaged self contained module that connects directly to the computer and includes power supply.
- \* The input boxes offer the option of logging data "off-line" and downloading it rapidly to the computer.
- \* Built-in intelligence provides a simple and consistent interface to your software.

### A Sampling of Alpha Box Products:

- \* Digital Input: 64 TTL/CMOS/0.5V input channels. \$495
- \* Digital Output: 64 TTL/CMOS/0.5V level outputs. \$495. 120VAC control available.
- \* Digital I/O: 32 TTL Level (0.5V) Inputs and 32 Outputs. \$495
- \* Analog Input: 16 channels. 0-5.1V, 20mV steps (8 bit), 2000 readings/sec. \$495.
- Expansion Option: 16 more channels. \$100
- \* 12 Bit Analog Input: 16 channels, programmable gain. 10000 inputs/sec. max. \$995. Option: 16 more inputs. \$200
- \* Analog Output: 4 channel, 12 bit D/A. ±5.1V outputs. \$495. Expander Option: 12 more outputs. \$200
- \* Counter: 16 inputs, 24 bit. \$595



"We can make your PC do things you wouldn't believe."

## C<sup>3</sup> From Your PC

- Command
- Control
- Communications

Bring new dimensions to your computer with A-Bus, C-Net and Alpha Boxes. No longer is your computer limited to number crunching or word processing. Now you can connect to all types of equipment, sensors or machines. This offers unprecedented power from production lines to experiments to home control.

Each product is designed to fit your needs: They're **affordable**. Compare our prices; the cost of a solution is surprisingly low. They're **simple** and easy to connect to your computer and your application, and carefully designed to adapt to your software easily. They're **versatile**. An infinite number of combinations is possible; one of them is right for you. Easily expanded or changed for future projects. They're **proven** by customers around the world, including Fortune 100 companies, universities, governments and individuals.

Call for a Catalog (800) 221-0916

### Overseas distributors

**Asia:** Batam DA, Singapore  
Tel: 473-4518 Fax: 479-6496

**Japan:** Japan Crescent  
Tel: 03-824-7449 Fax: 03-818-8914

**Scandinavia:** A/S Con-Trade Norway  
Tel: (04) 41 83 51 Fax: (04) 41 94 72

**Spain:** Arteca S.C.P.  
Tel: (93) 423.77.05 Fax: (93) 325.70.16

## Low Cost Data Acquisition and Control

### A-Bus Sensing & Measuring:

Read switch status. Detect or measure voltage. Read pressure, temperature, weight and other sensors. For example:

- \* High-Speed 12-bit A/D converter: 8 10 $\mu$ s analog inputs. 1 mV resolution \$179
- \* 8 Bit A/D: 8 inputs. 0-5.1V in 20mV steps, 7500 conversions/sec. \$142
- \* 12 Bit A/D: ±4V in 1mV steps, 130ms conversion time. 1 input, expandable \$153
- \* Temperature Sensor: 0-200°F 1° Accuracy. 10mV/°F. \$12
- \* Digital Input: 8 opto-isolated. Read voltage presence, switch closure. \$65
- \* Latched Input: Each individually latched to catch switch closures or alarm loops. \$85
- \* Touch Tone Decoder: \$87
- \* Counter/Timer: 3 16-bit counters. Generate or count pulses. Time events. \$132
- \* Clock with Alarm: real time clock with calendar and battery backup. \$98

### A-Bus Switching & Governing:

Switch any type of electrical device. Adjust level or position. A sampling:

- \* Relay Card: 8 individually controlled industrial relays. 3A at 120VAC, SPST. \$142
- \* Digital Output Driver: 8 outputs: 250mA at 12V. For relays, solenoids... \$78
- \* Reed Relay Card: 8 individually controlled relays. 20mA @ 60VDC, SPST. \$109
- \* Multiplexer: Switch up to 32 channels to a single common. \$83
- \* Smart Stepper Motor Control: Microprocessor controls 4 motors. English commands for position, speed, units, limits, etc. \$299
- \* Telephone Control Card: On/off hook, generate and decode touch tones, call progress detection. \$159
- \* X-10 Controller: Control and sense standard wall outlet power modules. \$149
- \* Voice Synthesizer: Unlimited vocabulary, text to speech software built in. \$159
- \* D/A: Four 8 Bit Outputs. Adjustable full scale. \$149
- \* 24 line TTL I/O: Connect 24 signal, TTL 0/5V levels or switches. (8255A) \$72

### A-Bus Adapters and Software:

Adapters connect A-Bus cards to your particular computer.

- \* Plug-in adapters for IBM PC/XT/AT/386 and compatibles (\$69), Micro-Channel (\$93), Apple II, Commodore, TRS-80.
- \* Serial adapters for Mac, PC, etc.
- \* Odin PC compatible software. Control relays from analog inputs or time schedules. Logging. Runs in background. \$129

# ALPHA Products

242-B West Ave, Darien, CT 06820 USA (203) 656-1806 Fax 203 656 0756

Circle 16 on Reader Service Card

NOVEMBER 1990 • BYTE 437

World Radio History



ESTABLISHED 1976

Unitex, Inc

MAIL ORDER DIVISION

# Computer Memory and Peripherals

## SIMM SIPP MODULES

	150ns	120ns	100ns	80ns	70ns	60ns
4MG X 9	---	---	\$365	\$385	\$415	---
1MG X 9	---	\$60	\$65	\$69	\$79	\$90
1MG X 8	---	\$50	\$55	\$62	---	---
256 X 8	\$16	\$24	\$29	---	---	---
256 X 9	---	\$18	\$20	\$24	\$33	---

## D-RAM

	150ns	120ns	100ns	80ns	70ns	60ns
1MG X 1	---	\$5.50	\$6.00	\$6.50	\$7.00	\$9.00
256 X 1	\$1.80	\$2.00	\$2.25	\$2.75	\$3.25	\$3.75
256 X 4	---	\$5.50	\$6.50	\$7.00	---	---
64 X 1	\$1.00	\$1.85	\$2.49	---	---	---
64 X 4	\$2.25	\$2.50	\$2.75	\$3.50	---	---
256 X 4 Static Col	---	---	\$10.00	\$11.00	---	---
256 X 1 Static Col	---	---	\$2.25	\$3.00	\$4.25	---

## 286 MATH CO-PROCESSORS

	6MHz	8MHz	10MHz	12MHz	12.5MHz	20MHz
IIT (2C87)	---	\$183	\$208	---	\$280	\$324
INTEL (80287)	\$120	\$183	\$208	\$280	---	---

## 8088 MATH CO-PROCESSORS

	5MHz	8MHz	10MHz
INTEL (8087)	\$88	\$115	\$165

## 386 MATH CO-PROCESSORS

	16MHz	20MHz	25MHz	33MHz	SX
CYRIX (83D87)	\$305	\$350	\$450	\$549	---
IIT (3C87)	\$305	\$350	\$450	\$549	---
INTEL (80387)	\$305	\$350	\$450	\$549	\$290

## ZENITH 386 SIMM MODULES

For Model	1MG	2MG	4MG
386/20,25,33,33E	\$89	\$225	\$599
386/SX	\$89	\$225	\$599

## ZENITH EXPANSION CARDS

For Model	1MG	2MG
SuperSport SX;286E	\$269	\$425
SuperSport SX	---	\$425 (Alpha)
SuperSport SX	---	\$425 (Beta)

## PS-2 PRODUCT

### MODEL 70 & 80 SIMM

34F2933 - 4MG Memory Module for 55SX, 65SX	
Memory Option IBM P/N 34F3077;34F3011	\$469
6450372 - 2MG Module for 6450367	\$309
6450375 - 1MG Memory Bd for 80-041	\$139
6450379 - 2MG Memory Bd for 80-111,311-121, 321	\$249
6450603 - 1MG Module for 70-E61;121, Adaptor Board IBM P/N 6450605, 6450609, 34F3011 & 34F3077	\$95
6450604 - 2MG Module for 70-061;E61-121,50Z;55SX;65SX;P70	
Adaptor Board IBM P/N 6450605, 6450609, 34F3011 & 34F3077	\$185
*10 or more units	\$175
6450608 for Model 70A21, A61, B-21, B61	\$185
6451060 - 4MG Memory Bd for 80-A21-A31	\$559

### MODEL 30-286 SIMM

1MG x 9 - 100ns	\$75
30F5360 (Kit-2ea)	\$150
256 x 9 - 120ns	\$28
30F5348 (Kit-2ea)	\$56

## MEMORY EXPANSION BOARDS

6450605 - w/2MG Expands to 8MG	\$499
1497259 - w/2MG Expands to 8MG	\$499
34F3011 - w/4MG Expands to 16MG	\$749

## LAPTOP MEMORY

2MG Card-Toshiba Portable T1200e	\$445
2MG Card-Toshiba Portable T1600	\$275
2MG Card-Toshiba Portable T3100SX	\$275
4MG Card-Toshiba Portable T3100SX	\$625
512K Card-Toshiba Portable T3100e	\$149
2MG Card-Toshiba Portable T3100e	\$269
2MG Card-Toshiba Portable T3200SX	\$289
4MG Card-Toshiba Portable T3200SX	\$699
2MG Card-Toshiba Portable T3200	\$429
2MG Card-Toshiba Portable T5100	\$275
2MG Module-Toshiba Portable T5200	\$275
2MG Module-Toshiba Desktop T8500	\$349

## MARSTEK HAND SCANNERS

MARS 105 PLUS 64 Half tone levels (dithered), scan kit utility offers 1) Same size printing 2) Pixel Editing 3) EMS Support 4) Quick Merge. Features: 1) 105 MM (4 1/8") scanning width 2) Selectable 400/300/200/100 DPI 3) 160,000 dots per inch area resolution 4) 3 X 8 halftone patterns, 1 line at	
Includes PC Paint Brush and Cat Reader OCR Software (Marstek Version)	\$189
MARS 800 SCANNER 800 DPI, 64 Shades of Gray, Inverse Mode, Resolution 6400 dot-in squared, 12 halftone patterns. ONLY	\$278

## CITIZEN

120D	\$139
180 D	\$299
GSX 140	\$299
GSX 200 GX Color	\$199
HSP500	\$329
HSP550	\$449

## PALMTRONIC

1124	\$299
1180	\$179
1624	\$399
1695	\$419
4450 Laser	\$1449

## Retail Office

1025 E. Twain  
Las Vegas, NV 89109  
Phone: (702) 732-8689  
Fax: (702) 732-0390  
**1-(800)-843-8414**  
Mon - Fri 8am - 6pm  
Sat 8am - 2pm

## TERMS AND CONDITIONS

No surcharge for MC or VISA  
Terms: MC - VISA - C.O.D. - CASH - AMEX add 4%  
Purchase Orders from qualified firms.  
20% restocking fee on non-refundable returns  
Prices subject to change.

**SEND ALL MAIL ORDERS TO**  
P.O. Box 19772  
Irvine, CA 92713

We Accept Purchase Orders from Qualified Firms,  
Universities and Government Agencies  
FROM ANYWHERE IN THE U.S.,  
CANADA, PUERTO RICO AND  
THE VIRGIN ISLANDS.

# 1-(800)-533-0055



We Accept International Orders  
with fast delivery via DHL, Federal Express, Air Mail  
**INTERNATIONAL ORDERS: (714) 251-8689**

## MONTHLY SPECIALS

### HEWLETT-PACKARD LASERJET MEMORY

#### 2P & 3

0K	\$79
1MG	\$100
2MG	\$169
4MG	\$299

#### QTY PRICING AVAILABLE

#### 2 & 2D

0K	\$89
1MG	\$135
2MG	\$169
4MG	\$305

## EPSON LASER PRINTER

Memory Upgrade for Model L8000  
CANON FACIT FUJITSU AND TOSHIBA ALSO AVAIL

1MG	\$299
2MG	\$399
4MG	\$529

## IBM LASER PRINTER

Memory Upgrade for Model 4019, 4019E  
Runs in any empty ROM Socket

1MG	\$299
2MG	\$399
3.5MG	\$529

## NO SLOT CLOCK

Runs in any empty ROM Socket  
\$25

## NEW FAST PRODUCT

RAMVantage! for 286 AT Systems. Split Memory Addressing. Does Backfill to 640K and extended memory up to 3MG. Uses 256 D-RAM SuperPak Software only. \$69

## SIX PAK 286

Up to 4 MB EMS 4.0 extended and/or expanded memory and does backfill to 640K 1 serial, 1 car. port avail. For AT & compatibles. Uses 256K or 1MG SIMMS. Headroom TSR Memory Management Software included with 0K \$119 with 512K \$159 with 4MG \$399

## RAMPAGE PLUS 286

Up to 8MG Expanded Memory. Uses 256 x 9 or 1MG x 9 SIMM Supports LIM4.0 and OS/2 - Up to 12.5MHz bus for AT (16 bit bus) with 0K \$319 with 2MG \$489

## MEMORY EXPANSION BOARDS

### COMPAQ MEMORY

MODEL	1MG	2MG	4MG
386/20/25E/25E DESK PRO 286E,386S	\$129	---	\$350
MODEL	---	8MG	32MG
386/33, 486/25 & SYSTEM PRO	---	\$269	\$1695 \$7900

### MEMORY EXPANSION BOARDS

MODEL	512K	1MG	2MG	4MG	8MG
386/16	\$325	\$495	\$799	\$1299	---
386/20E/25E 386S	\$209	---	\$299	---	---
Portable 386	---	---	\$895	---	---
Portable LTE	\$139	\$169	\$299	---	---
SLT286	---	\$199	---	\$999	---

### MEMORY UPGRADE KITS

MODEL	8MG	2MG	4MG
Portable III	\$70	\$178	---
DESKPRO 386/16	---	\$199	\$499

## ORCHID

**RAMQUEST 8/16** The only card expandable to 32MG, for IBM PCs, XT, AT, PS/2 Model 30-286 as well as compatibles. Supports both 8 and 16 bit bus. Uses 256K, 1MG or 4MG Modules. w/0K \$269

**RAMQUEST EXTRA 16/32** The only 9-8MG, 9 wait state card for PS/2 mod 50, 60, & 80 which fully supports both 16 and 32-bit memory access. Includes 1 SER and 1 PAR port plus free serial cable. EMS 4.0 and OS/2 compatible. Uses 256k and/or 1MG SIMMS \$299

## ACCELERATORS

**TINY TURBO 286** Low cost, high speed, half slot PC/XT - Accelerates your PC/XT up to 4 times faster with a 12 MHz 80286 microprocessor. 80287 math chip socket. \$229

**TINY TURBO XT** High speed half slot accelerator for PC/XT - Accelerates your PC/XT up to 4 times faster with a 12 MHz 80286 microprocessor. 80287 Math chip socket. \$259

## D-RAM TESTERS

**UNI-002 RT** Tests speed plus parameters \$149.95

**UNI-003 RT** Tests standard SIMM Modules 256 X 8, 256 X 9, 1MG X 9, 1MG X8 CALL FOR OTHER OPTIONS AVAILABLE \$199.95

## VIDEO ADAPTERS

### BOCA RESEARCH

**1024 VGA** 1024 X 768 in 16 simultaneous colors. 640/480 in 256 colors. 132 col X 50, 43,25. 1024 X 768 + 800/600 drivers/ 132 col \$159

**SUPER VGA** 800 X 600 Resolution/ 256K RAM/ 8 or 16 bit. 132 col X 50,43,25/ LIM Drivers/ 800 X 600 drivers for Windows, Auto CAD \$109

**VGA 640 X 480 Resolution/ 256K RAM, 8 or 16 bit** \$99

**Multi EGA** 640 X 480 Resolution on multiple frequency monitors- 640 X 480 + 752 X 410/ 256K RAM/ Drivers for Auto CAD, Windows and Lotus. \$89

## ATI TECHNOLOGIES

**VGA WONDER 256M** 256K video memory, user upgradeable) Same as VGA wonder 512M except with 800x600 in 16 colors and 1024x768 in 4 colors. Includes Microsoft compatible mouse \$249

## UNITEX

**EGA CARD** 640 X 480, 16 color, EGA/MGA/ CGA/Hercules \$89

**VGA CARD** 1024 X 768, 16 color, VGA/ EGA/ MGA/CGA \$119

**MONO CARD** w/parallel port \$25  
**CGA CARD** w/parallel port \$25

## SOFTWARE

DOS 3.3/GW BASIC \$59  
DOS 4.0/GW BASIC \$65  
PAINT BRUSH \$39

### BOCA RESEARCH

**TOPHAT** - Does backfill conventional memory from 512 to 640K on AT/ with 0K \$69

**TOPHAT II** - Same as TophAT/ with 128K \$85

**BOCARAM XT** Provides up to 2MG of expanded memory for 8 bit bus. Operates up to 12 MHz. Uses 256K D-RAM/ with 0K \$109 with 512K \$169

**BOCARAM AT** Provides up to 2MG LIMEMS 4.0 and/or 4MG of extended, expanded or backfill memory. For 16 bit bus. Operates up to 16MHz. Uses 256K D-RAM/ with 0K \$109 with 512K \$169

**BOCARAM AT PLUS** Provides up to 8MG of extended, expanded or backfill memory. Operates up to 33MHz and is set thru software. Uses 1MG D-RAM/ with 0K \$129 with 2MG \$299

**BOCARAM AT I/O PLUS** Provides up to 4MG of extended, expanded or backfill memory. For 16 bit bus. Operates up to 33 MHz and is set thru software. Has serial and parallel port. Uses 1MG D-RAM/ with 0K \$165 with 2MG \$319

**BOCARAM 30** Provides up to 2MG of expanded memory for IBM PS/2 model 25, 30 and 8-bit bus PC that utilize 3.5 in. floppy disks. Uses 256K D-RAM/ with 0K \$149 with 2MG \$289

**BOCARAM 50Z** Provides up to 2MG, 0 wait state, expanded or extended memory for IBM PS/2 model 50, 50Z, 60. Uses 1MG D-RAM/ with 0K \$160 with 2MG \$299

**BOCARAM 50/60** Provides up to 4MG expanded, extended or backfill memory for PS/2 model 50, 60. Uses 1MG D-RAM/ with 0K \$160 with 2MG \$299

**I/O XT 02 41** For 8-bit bus. Has clock, parallel port, serial port, and optional 2nd serial port. \$49

**I/O AT** For 16-bit bus. Has parallel port, serial port, and optional 2nd serial port. \$69

**I/O SER 2** Add 2nd serial port. to I/O AT or I/O XT \$15.95

**BOCA MCA PARALLEL CARD** Adds 1 parallel port to PS/2 System \$69

**BOCA MCA SERIAL/PARALLEL CARD** Adds 2 serial and 1 parallel port to PS/2 System \$119

## EVEREX

**RAM 3000 DELUXE** Up to 3MG. Selectable memory addresses. Expanded Memory Specifications. Fully compatible with Lotus, Intel, Microsoft, EMS 4.0, OS/2. Can be used to backfill base memory up to 640K and then test as expanded and/or extended memory. Uses 256K D-RAM \$99 With 512K \$139

**RAM 8000** Up to 8MG capacity/support to base, extended or expanded memory in any combination. Fully compatible with Lotus, Intel, Microsoft, EMS 4.0, EEMS. Supports Multi-Tasking and DMA Multi-Tasking in hardware. Software configurable (no dip switches to set). Full 16MG window for future expansion. Zero wait state. Uses 1MG D-RAM \$239

**RAM 10000** Up to 10MG capacity/support to base, extended or expanded memory in any combination. Compatible with Lotus, Intel, Microsoft, EMS 4.0. Operates with no additional wait states. Uses 1MG D-RAM \$159

## UNITEX

**DFI 3 BUTTON MOUSE** -Microsoft Compatible w/software included \$35

**384 Multifunction Card** \$89 for PC/XT Expands to 394K. SER/PAR/CLK/ Game port. Uses 64K DRAM

## MARSTEK 3 BUTTON MOUSE

Microsoft/Mouse Systems Compatible w/ Adjustable DPI up to 1280 (software) \$39

## Mail Order Division & Retail Store

17222 Armstrong Ave. - Irvine, CA 92714  
Phone: (714) 251-UNTX(251-8 6 8 9)  
Fax: (714) 251-8943

# 1-(800)-533-0055

Mon - Fri 7am - 5pm  
Sat 8am - 2pm



ESTABLISHED 1976

Unitex, Inc  
MAIL ORDER DIVISION

# Computer Systems and Hardware

We Accept Purchase Orders from Qualified Firms  
Universities and Government Agencies

FROM ANYWHERE IN THE U.S.,  
CANADA, PUERTO RICO AND  
THE VIRGIN ISLANDS.

**1-(800)-533-0054**



**CALL for pricing on additional  
FLOPPY DISK DRIVES, HARD DISK DRIVES,  
PRINTERS AND MONITORS**



**Check Out these Great  
Computer Systems Buys !!**



## SPECIALS

<b>DFI Mouse</b> 3-Button Mouse with Selectable Sensitivity Software Included  \$35	<b>200MB Hard Drives</b> Conner 3204 \$899 Rodime RO3259A \$825
<b>360K Floppy Drives</b> Panasonic & Mitsumi XT Only DS/DD \$39	<b>Mono VGA Monitor</b> 14" Paper White, Tilt & Swivel Base \$99 ea. \$89-10 or more

## HARD DRIVES

KALOCK 20MB XT 20MB, MFM, 3.5 HH, 40ms	\$225
MITSUBISHI 40MB, 5.25HH, MFM, 28ms	\$319
MITSUBISHI 60MB, 5.25HH, RLL, 28ms	\$419
CONNOR 3204 200MB, 3.5HH, RLL/IDE, 16ms	\$899
RODIME RO3259A 200MB, 3.5HH, IDE	\$825

## MODEMS



Internal 1200 BAUD	\$69
Internal 2400 BAUD	\$129
Internal 2400 BAUD w/MNP 5	\$169
External 2400 BAUD w/MNP 5	\$199

## Unitex (HAYES COMPATIBLES)

Internal 1200 BAUD	\$59
External 1200 BAUD	\$99
Internal 2400 BAUD	\$69
External 2400 BAUD	\$129

## FAX BOARDS



Now works with  
Windows 3.0!

The most highly functional, Fully loaded, Cost effective FAX board  
manufactured.  
CCITT Group III

Provides fully concurrent background operation. Allows user to transmit, receive  
and view documents on screen. Once in memory, the transmissions may be  
edited for retransmission, printed, stored for future, or discarded off your hard  
drive. **SOFTWARE INCLUDED**

CAL 001FX (4800 baud)	Unitex Price	\$189
CAL 002FX (9600 baud)	Unitex Price	\$269

ZOLTRIX 96/24 9600 baud, send/receive fax card with 2400 baud modem.	
SOFTWARE INCLUDED	\$239

## SCANNERS

**LOGITECH SCAN MAN** Compatible with the Calculus EZ-FAX. Scan man is a 1-400 Multi-Resolution Scanner. Real time screen image generation while scanning. Using this hand scanner makes faxing your scanned images a simple wave of the hand.  
CAL 002BL **INCLUDES CALCULUS EZ-FAX \$389**

**DEST PERSONAL SCAN** Combines two of the best scanning platforms into one, compact unit. Full page hand held and ten page sheet feed scanning in one device. Perform "free-hand" scanning with the full page hand held unit—books, maps, technical documents, oddly-shaped originals are easily scanned. Place the hand held unit into the feeder base and automatically scan up to ten pages at a time, within seconds.  
The DEST Personal Scanner comes bundled with Recognizer! DEST's critically acclaimed omnifont optical character recognition (OCR) software. Together these innovative products offer the most cost effective, high accuracy OCR solution available for the P.C.  
300 dpi resolution, Halftone scanning with 64 levels of gray. \$649

## UNITEX COMPUTER SYSTEMS

WITH FULL 1 YEAR WARRANTY

The New 386 Personal Computer Systems from Unitex have some incredible features that outperform machines that cost hundreds of dollars more! We have the configuration with exactly the options you want.

**ALL SYSTEMS INCLUDE DOS 3.3 AND GW BASIC**

### UNITEX 386 SX/16

- 14" VGA Paper White Monitor
- Phoenix Bios.
- 1MG on Board Memory (expandable to 8)
- 1.2MB Floppy Drive
- 2 EA. Serial and Parallel Ports
- 1 Game Port
- 101-Key Click Keyboard
- 3 Button Mouse included
- Supports E MS/LIM 4.0
- Has Mathco Socket

**INCLUDES  
60 MB HD**

**OUR PRICE  
\$1295**

**INCLUDES 60MB RLL HARD DRIVE**

### UNITEX-386-20

- 20MHz
- 1 MG RAM (expandable to 8 MB)
- 1.2MB Floppy Drive
- Fast IDE 1.1 hard/floppy drive controller
- 200 Watt Power Supply
- FCC Class B approved
- 101 keyboard
- Supports E MS/LIM 4.0
- Has Mathco Socket

**OUR PRICE  
\$899**

### UNITEX-386-25

- 25MHz
- 1MG RAM (expandable to 8 MB)
- 1.2MB Floppy Drive
- Fast IDE 1.1 hard/floppy drive controller
- 200 Watt Power Supply
- FCC Class B approved
- 101 Keyboard
- Supports E MS/LIM 4.0
- Has Mathco Socket

**AVAIL. WITH  
64K CACHE**

**OUR PRICE  
\$1199**

### UNITEX-386-33

- 33MHz
- 1MG RAM (expandable to 8 MB)
- 1.2MB Floppy Drive
- Fast IDE 1.1 hard/floppy drive controller
- 200 Watt Power Supply
- FCC Class B approved
- 101 keyboard
- Supports E MS/LIM 4.0
- Has Mathco Socket

**INCLUDES  
64K CACHE**

**OUR PRICE  
\$1899**

## VENDEX HEADSTART 286/12MHz COMPUTER SYSTEM

- 12mhz Motherboard
- 80287 Math Co-processor Socket
- Switchable Speed
- 8 Expansion Slots
- 1MB RAM
- 1.1 IDE FD/HD Controller
- 1.2MB Floppy Drive
- 1 YEAR WARRANTY
- 2 Parallel Printer Port
- 1 Serial Port (RS-232 Interface)
- 101-Key Enhanced Keyboard
- DOS 3.3 & GW Basic
- 200 Watt Power Supply
- FCC Class B approved
- Award BIOS
- MADE BY SAMSUNG

**OUR PRICE  
\$579**

## SYSTEM OPTIONS (Add-ons to systems only)

FLOPPY DRIVES	MONITORS	VIDEO CARDS	CASES	POWER SUPP.
√ 360K.....\$60	√ 12" Amber w/tilt and swivel base.....\$79	√ Monochrome(720X) or Color Graphics(320X) with parallel port.....\$25	√ Baby.....\$100	√ XT 200W.....\$30
√ 720K.....\$75	√ 14" Paper w/tilt and swivel base.....\$99	√ Boca EGA.....\$89	√ Mini Tower.....\$100	√ AT 230W.....\$30
√ 1.2MB.....\$79	√ EGA Color.....\$299	√ Boca VEGA.....\$99	√ Full Size Tower..\$150	<b>MOUSE</b>
√ 1.44MB(3.5")....\$89	√ VGA Color.....\$319	√ Boca Super VGA..\$109		√ 2 Button.....\$19
	√ Super VGA Color.\$419	√ ATI-VGA Wonder..\$279		√ 3 Button.....\$35
				(Includes Software)

**Retail Office**  
1025 E. Twain  
Las Vegas, NV 89109  
Phone: (702) 732-8689  
FAX: (702) 732-0390  
**1-(800)-843-8414**  
Mon - Fri 8am - 6pm  
Sat 8am - 2pm

### TERMS AND CONDITIONS

Terms: Cash • MC or VISA • no surcharge  
AMEX only add 4% handling fee  
COD: Purchase Orders from qualified firms.  
20% restocking fee on non-defective returns.  
Prices subject to change.

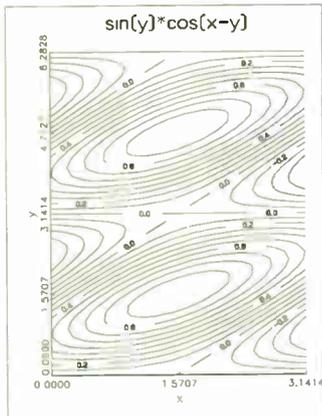
**SEND ALL MAIL ORDERS TO**  
P.O. Box 19772  
Irvine, CA 92713

**Mail Order Division & Retail Store**  
17222 Armstrong Ave. • Irvine, CA 92714  
Phone: (714) 251-UNTX(251-8 6 8 9)  
Fax: (714) 251-8943  
**1-(800)-533-0055**  
Mon - Fri 7am - 5pm  
Sat 8am - 2pm

# GraphiC<sup>TM</sup>

*"gives you all the C language routines you need to write an impressive scientific graphing program of your own. Highly recommended.\*"*

– PC Magazine



IBM<sup>®</sup> PC (with source code) \$395

Circle 309 on Reader Service Card

Macintosh<sup>®</sup> (no source code) \$295

Circle 310 on Reader Service Card

Licensed for *personal* use only

## VTEK-HP<sup>TM</sup> 1.0

**DEC<sup>®</sup> VT220/102/52 & Tektronix<sup>®</sup> 4010/4014/4105 Terminal Emulator for IBM<sup>®</sup> PCs**

Circle 311 on Reader Service Card

VTEK-HP has added full VT220 emulation to VTEK  
New High Performance features:

- ▶ TIFF export
- ▶ Color PostScript<sup>®</sup> and viewable EPS
- ▶ HP-GL/2<sup>™</sup> and PaintJet XL<sup>™</sup> support
- ▶ Full national character set support
- ▶ Telephone dialer
- ▶ faster and uses less memory
- ▶ requires 286 or 386 and VGA/EGA

VTEK-HP \$245                      VTEK \$195

**Scientific Endeavors**  
508 North Kentucky Street  
Kingston, TN 37763 USA  
(615) 376-4146 FAX: (615) 376-1571



## QUARTERHORSE

High Capacity  
Tape Subsystems

for Disk Backup, Data Acquisition, and Archiving

Everything you need in a single, high-quality package: Drive, SCSI Host Adapter, Enclosure, and DSI's Backup Software.

- 320/520 Mb 1/4" CT . . . . \$1,495
  - 1.2 Gb 4mm DAT . . . . . \$3,195
  - 2.3 Gb 8mm HS . . . . . \$3,695
- New: 450 Mb 3480 CT . . . . \$4,295

Optional Application Interface Library (in "C") available. Full Support.  
Terms: U.S.-Visa, COD, pre-appvd. credit.  
Other: Prepaid wire transfer, International letter of credit.

**DATA STRATEGIES  
INTERNATIONAL, INC.**

9020 Capital of TX Hwy, Ste. 420, Austin, TX 78759  
(512) 338-4745 FAX (512) 345-1328

Circle 97 on Reader Service Card

## PC Communications Coprocessors



Our communications coprocessors offload serial and parallel communications tasks from PC's used in dedicated applications. RS232 and RS485 style communications. Easily programmed using C. A memory mapped interface to the host PC allows high speed data transfer and simple buffer schemes. From 64k to 512k of memory local to the coprocessor but accessible from the host PC. Used in many industrial and business systems to dramatically improve performance compared to standard PC serial port implementations.

**Z-World Engineering**  
1340 Covell Blvd., Davis, CA 95616  
(916) 753-3722  
Fax: (916) 753-5141

Circle 380 on Reader Service Card

## 9 Track Tape Subsystem for PC/XT/AT/386/PS2



\$1995 for 1600/3200 BPI  
\$4995 for 1600/6250 BPI  
\$6995 for 800/1600/3200/6250 BPI  
CALL 1-800-289-4TAPE

**Laguna Conversion Systems**  
1401 South Pacific Coast Highway  
Laguna Beach, CA 92651

Circle 198 on Reader Service Card

## 9-Track Tape Subsystem for the IBM PC/XT/AT



Now you can exchange data files between your IBM PC and any mainframe or mini-computer using IBM compatible 1600 or 6250 BPI 9-Track tape. System can also be used for disk backup. Transfer rate is up to 4 megabytes per minute on PCs and compatibles. Subsystems include 7" or 10 1/2" streaming tape drive, tape coupler card and DOS compatible software. For more information, call us today!

**QUALSTAR<sup>®</sup>**

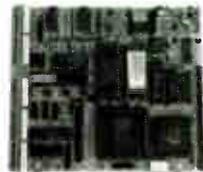
9621 Irondale Ave., Chatsworth, CA 91311  
Telephone: (818) 882-5822

Circle 294 on Reader Service Card

## Little Giant<sup>TM</sup>

C Programmable Controller

This shirt pocket sized computer interfaces directly to the outside world. Use it to control anything. Instantly programmable using your PC with Dynamic C. ROM and battery backed RAM to 1024k bytes. 8 Channel, 10/12 bit, A/D with conditioning. High voltage and current drivers. Battery backed time and date clock. Watchdog and power fail. 4 serial channels. 24 parallel I/O lines. Timers. Integral power supply. Terminations for field wiring. Expansion connector. Plastic or metal field packaging available. OEM versions from \$199.00.



**Z-World Engineering**  
1340 Covell Blvd., Davis, CA 95616  
(916) 753-3722  
Fax: (916) 753-5141

Circle 381 on Reader Service Card

Introducing  
**ITR VISION**  
Software  
**\$695<sup>00</sup>**  
Special Offer

### The Software Solution To Image Compression

- IBM Compatible MS-DOS 3.0 or Higher
- Uses EMS 3.2 or above to Handle Large Images
- Variable Compression—Up to half a bit per pixel
- No Extra Hardware Needed
- Uses High Resolution TGA Files
- Includes Proposed JPEG Standard Compression Modes

**CALL NOW TO ORDER**  
**1-800-966-4487**

MAJOR CREDIT CARDS ACCEPTED

Circle 186 on Reader Service Card

# SOFTWARE

## ACCOUNTING

Accounting	\$146
Accounting II	\$146
Accounting III	\$146
Accounting IV	\$146
Accounting V	\$146
Accounting VI	\$146
Accounting VII	\$146
Accounting VIII	\$146
Accounting IX	\$146
Accounting X	\$146
Accounting XI	\$146
Accounting XII	\$146
Accounting XIII	\$146
Accounting XIV	\$146
Accounting XV	\$146
Accounting XVI	\$146
Accounting XVII	\$146
Accounting XVIII	\$146
Accounting XIX	\$146
Accounting XX	\$146
Accounting XXI	\$146
Accounting XXII	\$146
Accounting XXIII	\$146
Accounting XXIV	\$146
Accounting XXV	\$146
Accounting XXVI	\$146
Accounting XXVII	\$146
Accounting XXVIII	\$146
Accounting XXIX	\$146
Accounting XXX	\$146

## DESKTOP PUB

Desktop Publisher	\$146
Desktop Publisher II	\$146
Desktop Publisher III	\$146
Desktop Publisher IV	\$146
Desktop Publisher V	\$146
Desktop Publisher VI	\$146
Desktop Publisher VII	\$146
Desktop Publisher VIII	\$146
Desktop Publisher IX	\$146
Desktop Publisher X	\$146
Desktop Publisher XI	\$146
Desktop Publisher XII	\$146
Desktop Publisher XIII	\$146
Desktop Publisher XIV	\$146
Desktop Publisher XV	\$146
Desktop Publisher XVI	\$146
Desktop Publisher XVII	\$146
Desktop Publisher XVIII	\$146
Desktop Publisher XIX	\$146
Desktop Publisher XX	\$146
Desktop Publisher XXI	\$146
Desktop Publisher XXII	\$146
Desktop Publisher XXIII	\$146
Desktop Publisher XXIV	\$146
Desktop Publisher XXV	\$146
Desktop Publisher XXVI	\$146
Desktop Publisher XXVII	\$146
Desktop Publisher XXVIII	\$146
Desktop Publisher XXIX	\$146
Desktop Publisher XXX	\$146

## CAD & ENG

CAD	\$146
CAD II	\$146
CAD III	\$146
CAD IV	\$146
CAD V	\$146
CAD VI	\$146
CAD VII	\$146
CAD VIII	\$146
CAD IX	\$146
CAD X	\$146
CAD XI	\$146
CAD XII	\$146
CAD XIII	\$146
CAD XIV	\$146
CAD XV	\$146
CAD XVI	\$146
CAD XVII	\$146
CAD XVIII	\$146
CAD XIX	\$146
CAD XX	\$146
CAD XXI	\$146
CAD XXII	\$146
CAD XXIII	\$146
CAD XXIV	\$146
CAD XXV	\$146
CAD XXVI	\$146
CAD XXVII	\$146
CAD XXVIII	\$146
CAD XXIX	\$146
CAD XXX	\$146

## DATA BASE

Database	\$146
Database II	\$146
Database III	\$146
Database IV	\$146
Database V	\$146
Database VI	\$146
Database VII	\$146
Database VIII	\$146
Database IX	\$146
Database X	\$146
Database XI	\$146
Database XII	\$146
Database XIII	\$146
Database XIV	\$146
Database XV	\$146
Database XVI	\$146
Database XVII	\$146
Database XVIII	\$146
Database XIX	\$146
Database XX	\$146
Database XXI	\$146
Database XXII	\$146
Database XXIII	\$146
Database XXIV	\$146
Database XXV	\$146
Database XXVI	\$146
Database XXVII	\$146
Database XXVIII	\$146
Database XXIX	\$146
Database XXX	\$146

## LANGUAGES

Language	\$146
Language II	\$146
Language III	\$146
Language IV	\$146
Language V	\$146
Language VI	\$146
Language VII	\$146
Language VIII	\$146
Language IX	\$146
Language X	\$146
Language XI	\$146
Language XII	\$146
Language XIII	\$146
Language XIV	\$146
Language XV	\$146
Language XVI	\$146
Language XVII	\$146
Language XVIII	\$146
Language XIX	\$146
Language XX	\$146
Language XXI	\$146
Language XXII	\$146
Language XXIII	\$146
Language XXIV	\$146
Language XXV	\$146
Language XXVI	\$146
Language XXVII	\$146
Language XXVIII	\$146
Language XXIX	\$146
Language XXX	\$146

## SPRDSHEETS

Spreadsheet	\$146
Spreadsheet II	\$146
Spreadsheet III	\$146
Spreadsheet IV	\$146
Spreadsheet V	\$146
Spreadsheet VI	\$146
Spreadsheet VII	\$146
Spreadsheet VIII	\$146
Spreadsheet IX	\$146
Spreadsheet X	\$146
Spreadsheet XI	\$146
Spreadsheet XII	\$146
Spreadsheet XIII	\$146
Spreadsheet XIV	\$146
Spreadsheet XV	\$146
Spreadsheet XVI	\$146
Spreadsheet XVII	\$146
Spreadsheet XVIII	\$146
Spreadsheet XIX	\$146
Spreadsheet XX	\$146
Spreadsheet XXI	\$146
Spreadsheet XXII	\$146
Spreadsheet XXIII	\$146
Spreadsheet XXIV	\$146
Spreadsheet XXV	\$146
Spreadsheet XXVI	\$146
Spreadsheet XXVII	\$146
Spreadsheet XXVIII	\$146
Spreadsheet XXIX	\$146
Spreadsheet XXX	\$146

## PRJCT MGMT

Project Mgmt	\$146
Project Mgmt II	\$146
Project Mgmt III	\$146
Project Mgmt IV	\$146
Project Mgmt V	\$146
Project Mgmt VI	\$146
Project Mgmt VII	\$146
Project Mgmt VIII	\$146
Project Mgmt IX	\$146
Project Mgmt X	\$146
Project Mgmt XI	\$146
Project Mgmt XII	\$146
Project Mgmt XIII	\$146
Project Mgmt XIV	\$146
Project Mgmt XV	\$146
Project Mgmt XVI	\$146
Project Mgmt XVII	\$146
Project Mgmt XVIII	\$146
Project Mgmt XIX	\$146
Project Mgmt XX	\$146
Project Mgmt XXI	\$146
Project Mgmt XXII	\$146
Project Mgmt XXIII	\$146
Project Mgmt XXIV	\$146
Project Mgmt XXV	\$146
Project Mgmt XXVI	\$146
Project Mgmt XXVII	\$146
Project Mgmt XXVIII	\$146
Project Mgmt XXIX	\$146
Project Mgmt XXX	\$146

## LAN CARDS

LAN Card	\$146
LAN Card II	\$146
LAN Card III	\$146
LAN Card IV	\$146
LAN Card V	\$146
LAN Card VI	\$146
LAN Card VII	\$146
LAN Card VIII	\$146
LAN Card IX	\$146
LAN Card X	\$146
LAN Card XI	\$146
LAN Card XII	\$146
LAN Card XIII	\$146
LAN Card XIV	\$146
LAN Card XV	\$146
LAN Card XVI	\$146
LAN Card XVII	\$146
LAN Card XVIII	\$146
LAN Card XIX	\$146
LAN Card XX	\$146
LAN Card XXI	\$146
LAN Card XXII	\$146
LAN Card XXIII	\$146
LAN Card XXIV	\$146
LAN Card XXV	\$146
LAN Card XXVI	\$146
LAN Card XXVII	\$146
LAN Card XXVIII	\$146
LAN Card XXIX	\$146
LAN Card XXX	\$146

# POCKET COMPUTERS \$199

Commodore 64	\$199
Commodore 64 II	\$199
Commodore 64 III	\$199
Commodore 64 IV	\$199
Commodore 64 V	\$199
Commodore 64 VI	\$199
Commodore 64 VII	\$199
Commodore 64 VIII	\$199
Commodore 64 IX	\$199
Commodore 64 X	\$199
Commodore 64 XI	\$199
Commodore 64 XII	\$199
Commodore 64 XIII	\$199
Commodore 64 XIV	\$199
Commodore 64 XV	\$199
Commodore 64 XVI	\$199
Commodore 64 XVII	\$199
Commodore 64 XVIII	\$199
Commodore 64 XIX	\$199
Commodore 64 XX	\$199
Commodore 64 XXI	\$199
Commodore 64 XXII	\$199
Commodore 64 XXIII	\$199
Commodore 64 XXIV	\$199
Commodore 64 XXV	\$199
Commodore 64 XXVI	\$199
Commodore 64 XXVII	\$199
Commodore 64 XXVIII	\$199
Commodore 64 XXIX	\$199
Commodore 64 XXX	\$199

## BACKLIT NOTEBOOK

\* 9.5 Mhz-20MB \$1295 \$34 mo only 6lbs  
**POEET** \$Call\$  
**ATARI Portfolio** \$359-\$15/mo

**PALMTOP 80C88**, MS DOS compatible, Lotus 123 file compatible. Word Processor, Address Book, Appointment Diary, Phone Dialer, Up Download thru parallel port to printers: PC/XT/AT 386.0.

**SHARP Notebook**  
**PC 6220** \$79/mo  
 \* 286-12Mhz  
 \* 20MB hard drive  
 \* Backlit super twist VGA-LCD  
 \* Weighs 4.4 lbs. - 11"x8.5"x14"

**MONITORS**  
 \$12  
 Hyundai VGA 720x420 \$299  
 Monitor 13" \$110  
 Parascan 13" \$110  
 Sony 13" Multiscan \$159  
 Sony 13" Color \$159  
 NEC Multi 30 2A \$159  
 NEC 30 \$159  
 NEC 30 \$159  
 Packard Bell 12" \$89  
 Packard Bell 12" \$89  
 VGA (white) \$149  
 Mitsu 13" Multiscan \$399  
 Mitsu 13" Multiscan \$399  
 IBM 13" 12 mono \$199  
 IBM 13" 12 mono \$199  
 IBM 13" 12 color \$146  
 IBM 13" 12 \$1169

## XENIX

Xenix	\$146
Xenix II	\$146
Xenix III	\$146
Xenix IV	\$146
Xenix V	\$146
Xenix VI	\$146
Xenix VII	\$146
Xenix VIII	\$146
Xenix IX	\$146
Xenix X	\$146
Xenix XI	\$146
Xenix XII	\$146
Xenix XIII	\$146
Xenix XIV	\$146
Xenix XV	\$146
Xenix XVI	\$146
Xenix XVII	\$146
Xenix XVIII	\$146
Xenix XIX	\$146
Xenix XX	\$146
Xenix XXI	\$146
Xenix XXII	\$146
Xenix XXIII	\$146
Xenix XXIV	\$146
Xenix XXV	\$146
Xenix XXVI	\$146
Xenix XXVII	\$146
Xenix XXVIII	\$146
Xenix XXIX	\$146
Xenix XXX	\$146

## COMMUNICAT

Communicat	\$146
Communicat II	\$146
Communicat III	\$146
Communicat IV	\$146
Communicat V	\$146
Communicat VI	\$146
Communicat VII	\$146
Communicat VIII	\$146
Communicat IX	\$146
Communicat X	\$146
Communicat XI	\$146
Communicat XII	\$146
Communicat XIII	\$146
Communicat XIV	\$146
Communicat XV	\$146
Communicat XVI	\$146
Communicat XVII	\$146
Communicat XVIII	\$146
Communicat XIX	\$146
Communicat XX	\$146
Communicat XXI	\$146
Communicat XXII	\$146
Communicat XXIII	\$146
Communicat XXIV	\$146
Communicat XXV	\$146
Communicat XXVI	\$146
Communicat XXVII	\$146
Communicat XXVIII	\$146
Communicat XXIX	\$146
Communicat XXX	\$146

## LAN & NETWRK

LAN & Netwrk	\$146
LAN & Netwrk II	\$146
LAN & Netwrk III	\$146
LAN & Netwrk IV	\$146
LAN & Netwrk V	\$146
LAN & Netwrk VI	\$146
LAN & Netwrk VII	\$146
LAN & Netwrk VIII	\$146
LAN & Netwrk IX	\$146
LAN & Netwrk X	\$146
LAN & Netwrk XI	\$146
LAN & Netwrk XII	\$146
LAN & Netwrk XIII	\$146
LAN & Netwrk XIV	\$146
LAN & Netwrk XV	\$146
LAN & Netwrk XVI	\$146
LAN & Netwrk XVII	\$146
LAN & Netwrk XVIII	\$146
LAN & Netwrk XIX	\$146
LAN & Netwrk XX	\$146
LAN & Netwrk XXI	\$146
LAN & Netwrk XXII	\$146
LAN & Netwrk XXIII	\$146
LAN & Netwrk XXIV	\$146
LAN & Netwrk XXV	\$146
LAN & Netwrk XXVI	\$146
LAN & Netwrk XXVII	\$146
LAN & Netwrk XXVIII	\$146
LAN & Netwrk XXIX	\$146
LAN & Netwrk XXX	\$146

## UTILITIES

Utilities	\$146
Utilities II	\$146
Utilities III	\$146
Utilities IV	\$146
Utilities V	\$146
Utilities VI	\$146
Utilities VII	\$146
Utilities VIII	\$146
Utilities IX	\$146
Utilities X	\$146
Utilities XI	\$146
Utilities XII	\$146
Utilities XIII	\$146
Utilities XIV	\$146
Utilities XV	\$146
Utilities XVI	\$146
Utilities XVII	\$146
Utilities XVIII	\$146
Utilities XIX	\$146
Utilities XX	\$146
Utilities XXI	\$146
Utilities XXII	\$146
Utilities XXIII	\$146
Utilities XXIV	\$146
Utilities XXV	\$146
Utilities XXVI	\$146
Utilities XXVII	\$146
Utilities XXVIII	\$146
Utilities XXIX	\$146
Utilities XXX	\$146

## HP LaserJet

HP LaserJet	\$146
HP LaserJet II	\$146
HP LaserJet III	\$146
HP LaserJet IV	\$146
HP LaserJet V	\$146
HP LaserJet VI	\$146
HP LaserJet VII	\$146
HP LaserJet VIII	\$146
HP LaserJet IX	\$146
HP LaserJet X	\$146
HP LaserJet XI	\$146
HP LaserJet XII	\$146
HP LaserJet XIII	\$146
HP LaserJet XIV	\$146
HP LaserJet XV	\$146
HP LaserJet XVI	\$146
HP LaserJet XVII	\$146
HP LaserJet XVIII	\$146
HP LaserJet XIX	\$146
HP LaserJet XX	\$146
HP LaserJet XXI	\$146
HP LaserJet XXII	\$146
HP LaserJet XXIII	\$146
HP LaserJet XXIV	\$146
HP LaserJet XXV	\$146
HP LaserJet XXVI	\$146
HP LaserJet XXVII	\$146
HP LaserJet XXVIII	\$146
HP LaserJet XXIX	\$146
HP LaserJet XXX	\$146

## MATH COs

Math Co	\$146
Math Co II	\$146
Math Co III	\$146
Math Co IV	\$146
Math Co V	\$146
Math Co VI	\$146
Math Co VII	\$146
Math Co VIII	\$146
Math Co IX	\$146
Math Co X	\$146
Math Co XI	\$146
Math Co XII	\$146
Math Co XIII	\$146
Math Co XIV	\$146
Math Co XV	\$146
Math Co XVI	\$146
Math Co XVII	\$146
Math Co XVIII	\$146
Math Co XIX	\$146
Math Co XX	\$146
Math Co XXI	\$146
Math Co XXII	\$146
Math Co XXIII	\$146
Math Co XXIV	\$146
Math Co XXV	\$146
Math Co XXVI	\$146
Math Co XXVII	\$146
Math Co XXVIII	\$146
Math Co XXIX	\$146
Math Co XXX	\$146

## SCANNERS

Scanner	\$146
Scanner II	\$146
Scanner III	\$146
Scanner IV	\$146
Scanner V	\$146
Scanner VI	\$146
Scanner VII	\$146
Scanner VIII	\$146
Scanner IX	\$146
Scanner X	\$146
Scanner XI	\$146
Scanner XII	\$146
Scanner XIII	\$146
Scanner XIV	\$146
Scanner XV	\$146
Scanner XVI	\$146
Scanner XVII	\$146
Scanner XVIII	\$146
Scanner XIX	\$146
Scanner XX	\$146
Scanner XXI	\$146
Scanner XXII	\$146
Scanner XXIII	\$146
Scanner XXIV	\$146
Scanner XXV	\$146
Scanner XXVI	\$146
Scanner XXVII	\$146
Scanner XXVIII	\$146
Scanner XXIX	\$146

# YEAR END CLEARANCE — EVERYTHING GOES

Full Page Scanner . \$269.00

Letter Quality Daisy Wheel Printer . \$119.00

200Meg Drive . \$849.00

**"We guarantee lowest pricing \* on Seagate, Everex, Panasonic, DTK Systems, Samsung, all memory expansions, and many more name brand products. Also, NEVADA COMPUTER specializes in over stock, discontinued, excess, liquidation, bankrupt, etc. INVENTORIES, of which we purchase large quantities under dealer cost and offer to you at a fraction of everybody elses pricing. Savings up to 90% off! All new with at least 90 day warranties."**

## COMPAQ

Description	Equiv. Compaq Part #	For Model #	Your Low Price
1MB Add-on Module	113131-001	386/20/25/20e/286E	179 <sup>00</sup>
1MB Add-on Module	113646-001	Deskpro 386S	189 <sup>00</sup>
4MB Add-on Module	113132-001	386/20/25/20E/286E	359 <sup>00</sup>
4MB Add-on Module	112534-001	Deskpro 386S	499 <sup>00</sup>
1MB Memory Exp. Bd	113644-001	Deskpro 386/20e	299 <sup>00</sup>
1MB Memory Exp. Bd	113633-001	Deskpro 386S	309 <sup>00</sup>
4MB Memory Exp. Bd	113645-001	Deskpro 386/20e	799 <sup>00</sup>
4MB Memory Exp. Bd	113634-001	Deskpro 386S	799 <sup>00</sup>
1MB Memory Exp. Bd	117428-001	286E	469 <sup>00</sup>
4MB Memory Exp. Bd	117429-001	286E	1299 <sup>00</sup>
1MB Upgrade Bd	110235-001	SLT/286	399 <sup>00</sup>
4MB Upgrade Bd	108070-001	386/16	1299 <sup>00</sup>

## HP LASER JET II, IID, IIP & III

1Meg	119 <sup>00</sup>	2Meg	179 <sup>00</sup>	4Meg	299 <sup>00</sup>
HP IIP	1049 <sup>00</sup>	HP LASER JET II	1499 <sup>00</sup>	HP III	1799 <sup>00</sup>

All memory boards expandable to 4 Meg. Specify Machine Type

## EVEREX

**RAM 3000 DELUXE** Up to 3 Meg. (EMS) 4.0 OS/2. Back up base memory and expanded and/or extended memory. Uses 256K D-RAM **99<sup>00</sup>**

**RAM 8000** Up to 8MG capacity/support to base extended or expanded memory in any combination. Fully compatible with Lotus, Intel, Microsoft, EMS 4.0, EFMS. Supports Multi-Tasking and DMA Multi-Tasking in hardware software configurable (no dip switches tc set) Full 16MG window for future expansion. Zero wait state. uses 1MG D-RAM **199<sup>00</sup>**

**RAM 10000** Up to 10 MB extended or expanded memory. Compatible with Lotus, Intel, Microsoft, EMS 4.0 Uses 1 MB D-RAM. **179<sup>00</sup>**

## MEMORIES...

### SIMM MODULES

Description	120NS	100NS	80NS	60NS
256 x 9 IBM	199 <sup>00</sup>	299 <sup>00</sup>	339 <sup>00</sup>	599 <sup>00</sup>
1Meg x 8 Apple	85 <sup>00</sup>	95 <sup>00</sup>	99 <sup>00</sup>	—
1Meg x 9 IBM	—	64 <sup>00</sup>	69 <sup>00</sup>	99 <sup>00</sup>
4Meg x 9 IBM	—	—	399 <sup>00</sup>	499 <sup>00</sup>

### INTEL COPROCESSORS

	8 Bit	32 Bit		
8087	5MHz or less	88 <sup>00</sup>	80807-16	16MHz
8087-2	8MHz	118 <sup>00</sup>	80837-20	20MHz
8087-1	10MHz or less	149 <sup>00</sup>	80387-25	25MHz
	16 Bit			
80287	6MHz	149 <sup>00</sup>	80387-33	33MHz
80287-B	8MHz	189 <sup>00</sup>	80387-SX	—
80287-10	10MHz	218 <sup>00</sup>	80287-XL	228 <sup>00</sup>
80C287-12	Laptop	278 <sup>00</sup>		

### BOCA AT PLUS

**16 BIT MEMORY BOARD FOR 286, 386 AT**  
OK-8Meg Board • 4.0 LIM Compatible • New 5 Year Warranty

- Conventional, Expanded and Extended Memory
- Supports DOS OS/2 LIM/EMS & EEMS
- Operates with CPU Speeds to 33 MHz

OK — 129<sup>00</sup> 2 Meg — 246<sup>00</sup>  
4 Meg — 353<sup>00</sup> 8 Meg — 577<sup>00</sup>

### ZENITH

386/25/33	1 Meg	109 <sup>00</sup>	Super	1 Meg	359 <sup>00</sup>
	2 Meg	299 <sup>00</sup>	Super 286	4 Meg	1159 <sup>00</sup>

## IBM PS2 (BOARDS & MODULES)

Description	Equiv. IBMPS2 Part #	For Model #	Your Low Price
512K Upgrade	30F 5348	30/286	59 <sup>00</sup>
2MB Upgrade	30F 5360	30/286	189 <sup>00</sup>
1MB Module	6450603	70-E61 & 121	104 <sup>00</sup>
2MB Module	6450604	70-E61 & 121	189 <sup>00</sup>
2MB Module	6450608	70-A21	209 <sup>00</sup>
1MB Mem. Board	6450375	80-041	149 <sup>00</sup>
2MB Mem. Board	6450379	80-111 & 311	319 <sup>00</sup>
2MB Exp. 8MB	6450605	70/80	599 <sup>00</sup>
4MB Module	34F 2933	70/80	599 <sup>00</sup>
2MG Module	6450572	70 & 80	449 <sup>00</sup>
4MG Board	6451060	80-A21 & A31	699 <sup>00</sup>
2-8MG Board	1497259	50-55 & 60	499 <sup>00</sup>

## RAM CHIPS

Description	150NS	120NS	100NS	80NS	70NS
64 x 1	120	180	240	—	—
64 x 4	245	295	345	395	—
256 x 1	175	195	235	245	485
256 x 4	—	800	900	1000	1345
1 Meg x 1	—	485	545	585	685

Thousands in Stock Call For Qty Dis

## TOSHIBA

2MG Card Toshiba Portable T1600	298 <sup>00</sup>
2MG Card Toshiba Portable T3100SX	298 <sup>00</sup>
4MG Card Toshiba Portable T3100SX	788 <sup>00</sup>
512K Card Toshiba Portable T3100e	148 <sup>00</sup>
2MG Card Toshiba Portable T3100e	298 <sup>00</sup>
2MG Card Toshiba Portable T3200SX	298 <sup>00</sup>
4MG Card Toshiba Portable T3200SX	698 <sup>00</sup>
3MG Card Toshiba Portable T3200	498 <sup>00</sup>
3MG Card Toshiba Portable T5100	298 <sup>00</sup>
2MG Module Toshiba Portable T5200	298 <sup>00</sup>
3MG Module Toshiba Desktop T8500	348 <sup>00</sup>

## CANON FLATBED SCANNER IX-12F

- 300 DPI • 16 Secs per page • 32 Level Gray Scale
- 1 year warranty • Ready to go Interface card and cable included

List 1595 Your Price 499<sup>00</sup>

OPTIONS: OCR 199<sup>00</sup> PC Paint by Z-Soft 165 79<sup>00</sup>  
Sheet Feeder (also works with HP) 299<sup>00</sup>

## YEAR END CLEARANCE

WHILE SUPPLIES LAST — WITH 1 YEAR WARRANTY



## FAX MODEM CARD by Xerox

- Automatic Group III Digital Fax • Background operation
- Send & receive, screen images, scanned pages
- 1200 Baud modem built on • Fax 9600/7200/4800/2400
- Software - telephone cord • New, factory sealed

List 695 Your Price 149<sup>00</sup>

## WANGTEK TAPE BACKUPS

- 65MB per minute
- Wangtec 5099EN24 drive
- Wangtec 8 bit Qic60 controller
- Software • Menu driven
- DC600 cartridge • Easy installation

List 999<sup>00</sup> Your Price 399<sup>00</sup>

40MB backup works off floppy controller 189<sup>00</sup>

## DAISY WHEEL PRINTER

- 14CPS Letter Quality
- Manufactured by Silver Reed
- IBM Centronics Parallel Interface
- New 90 day warranty



List 1149<sup>00</sup> Your Price 149<sup>00</sup>

12 CPS version for 119<sup>00</sup>

## FULL PAGE SCANNER BY AT&T

- IBM Interface & Cable
- PagePower Software. A complete draw. Scan, fax packages
- 200DPI • Automatic Sheet Feeder

OCR Software 199<sup>00</sup> List 999<sup>00</sup> Your Price 269<sup>00</sup>

## MODEMS

MANUFACTURED BY ZOOM PC 2400 HC INTERNAL MODEM

- Fully Hayes Compatible • Monitor Speaker with Volume Control
- 2400/300 Baud Transmission Rate • Addressable COM 1,2,3,4
- Compatible with IBM PC, XT, AT and Compatibles
- Fully Duplex Operation • Complete with ProCom Software
- Two Year Manufacturer's Warranty • Auto Dial/Auto Answer

List 199<sup>00</sup> Your Price 79<sup>00</sup> Each

2400 BAUD EXTERNAL MODEM List 299<sup>00</sup> Your Price 99<sup>00</sup>

## EVEREX MODEMS

EV-923 EverCom 12 300/1200 bps Bitcom Software 69<sup>00</sup>

EV-941 EverCom 24 2400 Baud Int. Bitcom Software 139<sup>00</sup>

EV-945 External 2400 Baud 199<sup>00</sup>

EV-942 2400 PS2 199<sup>00</sup> Level 5 MNP Add 39<sup>00</sup>

## FLOPPY DRIVES

MITSUBI

360K 1/2 Ht 5 1/4 59<sup>00</sup>

1.2 Meg 5 1/4 79<sup>00</sup>

720K 3 1/2" Drive w/5 1/4" mounting 69<sup>00</sup>

1.44 Meg 3 1/2" Drive w/5 1/4" mounting 89<sup>00</sup>

360K Tandon TM100-2 Full HT (The original IBM) 89<sup>00</sup>

We also carry Sony, Teac & others. Please Call

## POWER SUPPLIES

IBM DIRECT REPLACEMENT

150 WATT XT Comp • UL Appr • 110/220V input switch • 4 drives 49<sup>00</sup>

200 WATT AT comp • UL Appr • 110/220V input switch 69<sup>00</sup>

## SAMSUNG MONITORS

12" Amber w/Tilt & Swivel Base 89<sup>00</sup>

14" Color 640 x 200, 16 colors 209<sup>00</sup>

14" EGA 640 x 350, 64 colors/31 369<sup>00</sup>

VGA 800 x 600 Multisync Compatible 449<sup>00</sup>

14" VGA Demo looks new. 31 Dot Pitch 284<sup>00</sup>

## EVEREX VIDEO CARDS

EGA EV659 640 x 350 Auto Switch 99<sup>00</sup>

VGA Viewpoint 16 Bit 256 Exp 512k 179<sup>00</sup>

## NCC VIDEO CARDS...

MonoGraphics (Hercules Compatible) with Par Port 29<sup>00</sup>

Color Graphics (Hercules Compatible) with Par Port 39<sup>00</sup>

Mono Card Text Only 9<sup>00</sup>

VGA Card 1024 x 768 (256K Exp 512K) 109<sup>00</sup>

STB mono/color card 29<sup>00</sup>

## SEAGATE HARDDRIVE

	AT KIT	XT KIT
ST125-0	20mB 40msec 3.5"	\$249
ST125-1	20mB 28msec 3.5"	\$269
ST138-0	30mB 40msec 3.5"	\$289
ST138-1	30mB 28msec 3.5"	\$309
ST225	20mB 65msec	\$199
ST238R (RLI)	30mB 65msec	\$219
ST251-1	42mB 28msec	\$269
ST227R-1 (RLI)	65mB 28msec	\$339
ST4096	80mB 28msec	\$549
ST4144 (RLI)	120mB 28msec	\$659

XT kits include cables, software (over 32MB) controller  
AT kits include cables, rails, software (over 32MB)

## CONNER HARDDRIVE

40 Meg 18 Mil. Sec.	399 <sup>00</sup>	100 Meg 18 Mil. Sec.	549 <sup>00</sup>
200 Meg 18 Mil. Sec.	849 <sup>00</sup>		

## CONTROLLERS

FOR HARDDRIVES		
IDE Controller	39 <sup>00</sup>	8 Bit WD Controller 59 <sup>00</sup>
16 Bit WD Controller 2 1	109 <sup>00</sup>	16 Bit Everex HD/Floppy 1.1 99 <sup>00</sup>
FOR FLOPPYS		
Super Floppy Controls 1,2, 360K 720K & 1.44 Drives		69 <sup>00</sup>

ORDERS ONLY

**800-654-7762**

TECHNICAL / CUSTOMER SERVICE / ORDER STATUS:

702-294-0204

FAX 702-294-1168

Trademarks are Registered with their respective Co.s Prices Subject to Change

All Products 90 Day Warranty unless stated otherwise.

- WE ACCEPT INTERNATIONAL ORDERS
- WE ALSO PURCHASE EXCESS INVENTORY—FAX OR CALL
- NO SOFTWARE RETURNS

\*APPLIES TO ADVERTISED PRICES IN THIS MAGAZINE ONLY!

NO SURCHARGE FOR MC/VISA/AE

TERMS:

MC • VISA • CDD CASH • NET  
Purchase Orders from Qualified Firms  
Personal Checks • COD add \$5.00  
20% Restocking Fee on Returns Within 15 Days  
No Refunds After 30 Days  
ALL PRICES FINAL



1000 Nevada Hwy. • Unit 101  
Boulder City, NV 89005

SE HABLE ESPANOL



SHIPPING: (min. 8%) UPS

**NEW UNIQUE POWERFUL!**

INTRODUCING...

**NETFAX<sup>®</sup>**

NETWORK FAX SYSTEM



- Send from within WordPerfect
- Automatic inward routing via TTI/CSID
- Uses no TSR Memory
- Includes facsimile modem & network software
- Send FAX messages from any workstation
- Merge text and graphics
- Automatic personalized cover sheets
- Can both send and receive
- Secure Journal to Users

**\$995**

**Get FAX Power Today!**

**ALL THE FAX<sup>®</sup> 1-800-289-3329**

Circle 15 on Reader Service Card

**IEEE 488**

**Easiest to use,  
GUARANTEED!**

- IBM PC, PS/2, Macintosh, IIP, Sun, DEC
- IEEE device drivers for DOS, UNIX, Lotus 1-2-3, VMS, XENIX & Macintosh
- Menu or icon-driven acquisition software
- IEEE analyzers, expanders, extenders, buffers
- Analog I/O, digital I/O, RS-232, RS-422, SCSI, modem & Centronics converters to IEEE 488

Free Catalog & Demo Disks  
(216) 439-4091

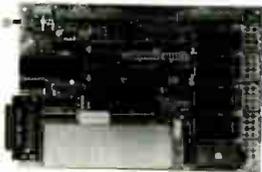


25971 Cannon Rd. • Cleveland, OH 44146

Circle 182 on Reader Service Card

New, Improved!

**SIBEC-II**



- Intel 8052AH-BASIC CPU
- PROM programmer
- Now requires 5V supply only
- Enhanced memory mapping; Supports 2K-64K devices to a total of 128K.

Still only \$228.00 QTY 1  
Call Now! (603) 469-3232

Inquire about our PKD51 8051-8052 product development kit for the IBM PC/XT/AT \$595, and 8051/8052 BASIC compiler. \$295

Binary Technology, Inc.  
Mail: 51 • P.O. Box 67 • Meriden, CT 03770

New, Improved!

**8051/8052  
BASIC  
COMPILER!**

Now with integer, byte and bit extensions.  
Fully compatible with MCS BASIC 52  
Runs on IBM-PC or compatible

**\$295.00**

Call Now! 603-469-3232



Binary Technology, Inc.

Main Street • P.O. Box 67 • Meriden, CT 03770

**MEMORY UPGRADES**

IBM PS/2, APPLE  
AST, COMPAQ  
HEWLETT PACKARD  
ZENITH, SUN MICRO  
STANDARD SIMMS

LAPTOP MEMORY  
(NEC, TOSHIBA, APPLE, COMPAQ)  
LASER PRINTER MEMORY  
(HP, CANON, TEC ENGINE)  
NO RISK, BEST PRICE, BEST QUALITY



A DIVISION OF ROHM CORPORATION  
433 N. MATHYLA AVE. SUNNYVALE, CA 94088  
TEL (408) 746-1590 FAX (408) 746-1593

1-800-292-7771

Circle 13 on Reader Service Card

**UNIPRO,**

the PC/XT/AT/386 based universal program-  
tester programs PROMs, EPROMs, EEPROMs up to 4MB and 32-bit wide, PALs, PLDs, GALs, EPLDs, PEELs, and Micro Controllers. JEDEC file compatibility and Test Vector verification allow the use of most popular PLD compilers. The unit also tests TTL/CMOS Logic ICs and Dynamic/Static RAMs. 40-pin Gold ZIF socket, built-in protection for short circuit and over current, high speed parallel interface to the PC, and menu-driven software are included at \$585.



XELTEK

764 San Aleso Ave.  
Sunnyvale, CA 94086  
TEL: (408) 727-6995 • FAX: (408) 727-6996

Circle 375 on Reader Service Card



DS-DD 499 PER BOX	Foreign Enquiries Welcome	DS-HD 929 PER BOX
769 PER BOX	5.25" 3M Brand Diskettes	1439 PER BOX
	3.50" 3M Brand Diskettes	

**3M DATA CARTRIDGES**

DC-2000	13.95	DC-600A	18.99
DC-300XLP	17.39	DC-6150XTD	19.99

**3M COMPUTER TAPES**

777-1/2"-2400'-C55	11.45	700-1/2"-2400'-C55	12.55
777-1/2"-1200'-C55	8.95	700-1/2"-2400'-C143	13.45
DEC-TK-50	25.95	DEC-TK-52	37.95
IBM-3480	4.95	Opt. Rewrite Disks	169.00

**3M HIGHLAND DISKETTES**

5.25" DS-DD 389 PER BOX	3M Highland	5.25" DS-HD 649 PER BOX
689 PER BOX	3.50" BRAND NAME	1249 PER BOX



**BASF**



DS-DD 449 PER BOX	Quantity Discounts Available	DS-HD 749 PER BOX
695 PER BOX	5.25" BASF Brand Diskettes	1249 PER BOX
	3.50" BASF Brand Diskettes	

.32	BASF 5.25" DS-DD No-Logo Bulk		
	with sleeves, labels & W/P tabs		
2400' w/tape seal	10.95	600' w/tape seal	6.95
1200' w/tape seal	7.95	300' w/tape seal	5.45

**Verbatim DataLifePlus**  
Teflon/Preformatted

DS-DD 549* PER BOX	Quantity Discounts Available	DS-HD 949* PER BOX
749 PER BOX	5.25" DataLife Plus Diskettes	1395 PER BOX
	3.50" DataLife Diskettes	

**maxell.**

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
5.59	9.69	7.99	14.39

**KAO BULK**

DS-DD .39	"No-Logo"	DS-HD .69
.69	5.25" Color-Bulk	1.09
	3.50" Color-Bulk	

**BULK DISKETTES**

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
.25*	.46*	.45	.99

\*WITH SLEEVES, LABELS AND W/P TABS

**HEWLETT PACKARD Original Toner Cartridges**

Laserjet Series I P/N 92285A	75.95
Laserjet Series II P/N 92295A	75.95
Laserjet Series IIP P/N 902275A	63.95

Dysan	5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
539	969	795	1495	
	PER BOX	PER BOX	PER BOX	

**WE BEAT ANY PRICE!!**

**TERMS:** No surcharge on VISA, Mastercard or AMEX. Order packaging and processing = \$2.95 per order. COD orders add \$3.95. PO's accepted from recognized institutions on Net 30 days. L/C, T/T and Bank Draft acceptable. Price quoted for case (100 disks or 10 cartridges). For quantities less than 1 case add 10%. **SHIPPING:** UPS surface \$1.95/5 cartridges; \$0.95/50 diskettes (Prices subject to change without notice. Errors and omissions not accepted. All warranties are from manufacturers.)

Toll Free Order Line: **1-800-523-9681**  
Information Line: **1-801-255-0080**  
TLX-9102404712 FAX-801-572-3327

**DISKOTECH**

213 Cottage Avenue  
P.O. Box 1339 Sandy, Utah 84091

# KNAPCO

MASTER DISTRIBUTORS

## EMERSON UPS

YES !!!  
KNAPCO  
DELIVERS  
EMERSON  
POWER !!!



### EMERSON MODELS

- Model 10 150Va. \$ 149.
- Model 20 300Va. \$ 219.
- Model 30 500Va. \$ 309.
- Model 40 800Va. \$ 539.
- Model 50 1400Va. \$ 739.
- UPS 600 \$798. \$ 499.
- UPS 1250 \$1398. \$ 769.
- UPS 1500 \$1798. \$ 995.
- TRUE ON LINE MODELS
- PC ET \$798. \$479.
- AP 1.5KVA \$3217. \$1850.
- AP 3KVA \$5550. \$3799.
- AP 5KVA \$9499. \$5999.

AccuCard NOW \$199.

ORDER HOT LINE

800-827-4718

### EMERSON UPS

**\$479**  
retail \$798

**\$439**  
retail \$688

true SINEWAVE or ONLINE  
KNAPCO DELIVERS THE BEST PRICES !!!!

### INTERNATIONAL TRANSFORMERS

220v. / 110v. step up / down

- 100 WATT. TRANSF. \$ 28.
- 300 WATT. TRANSF. \$ 40.
- 500 WATT. TRANSF. \$ 59.
- 1000 WATT. TRANSF. \$ 89.
- 1300 WATT. TRANSF. \$ 98.
- \*2000 WATT. TRANSF. \$116.
- \*3000 WATT. TRANSF. \$197.

... Selectable Voltage Taps

### VOLTAGE REGULATORS & CONDITIONERS

- TYR 500 500 WATT 110 / 220v. \$259. \$128.
- TYR1000 1000 WAT 110 / 220v. \$349. \$196.
- MY 2K 2000 WATT 220v. ONLY \$429. \$259.
- VR2K 2000 WATT 110 / 220v. \$649. \$379.

### 110 VOLT VOLTAGE REGULATORS

- MV 500 500 WATT \$119.
- UPS BATTERIES FOR QUICK SHIP

813 - 449 - 0019  
FAX 813 - 449 - 0701 P-22

# KNAPCO

QUALITY DISTRIBUTION FOR 45 YEARS

1201 HAMLET AVE.  
CLEARWATER FL. 34616



Sure  
it's  
insured?

SAFEWARE® Insurance provides full replacement of hardware, media and purchased software. As little as \$49/yr. covers:

- Fire • Theft • Power Surges
- Water Damage • Auto Accident

For information or immediate coverage call:

1-800-848-3469

Local 1-614-262-0559

Subject to underwriting and availability by state.  
On CompuServe. GO SAF On Genie. SAFEWARE



SAFEWARE, The Insurance Agency Inc.  
2929 N. High St., P.O. Box 02211  
Columbus, OH 43202

Circle 305 on Reader Service Card

## 80C51 BASIC-52 BOARD

FOR DISTRIBUTED DATA ACQUISITION

\$220 US includes:

- Intel 80C51FA, new PWM array
- RS422/485, auto RX/TX flow
- RS232, auto override select
- 64K static RAM, battery back up
- 32K CMOS EPROM, 8K Basic-52
- Battery operated & NiCd charge
- On board power supply, 300ma
- Hitachi LMxx LCD driver port
- PC communication software

\*\*\* OPTIONS \*\*\*

- Prototyping Board (Dig.+Analog) . . \$39US
- PC/RS232 ← RS422/485 . . . \$44US
- 80C51 Kit form . . . . . \$99US

### BINARY DATA ACQUISITION CORP.

1735 Bayly Street, Pickering, Ontario L1W 3G7  
Canada, Phone (416) 420-8029 Fax (416) 831-0510  
Cashiers Cheque or Visa

Circle 47 on Reader Service Card

## ICs PROMPT DELIVERY!!!

SAME DAY SHIPPING (USUALLY)  
QUANTITY ONE PRICES SHOWN FOR SEPT. 30, 1990

OUTSIDE OKLAHOMA NO SALES TAX

DYNAMIC RAM		
4M Board for hp LJs w/2MB		\$173.00
SIMM 2M IBM PS/2 Model 70		185.00
SIMM 1M AST Prem 386 33MHz		135.00
SIMM 1Mx9	80 ns	59.00
SIMM 256Kx9	100 ns	20.00
1Mbit	1Mx1 60 ns	11.95
1Mbit	1Mx1 80 ns	6.15
41256	256Kx1 80 ns	2.90
41256	256Kx1 100 ns	2.10
41256	256Kx1 120 ns	1.95
4464	64Kx4 100 ns	2.20
41264*	64Kx4 100 ns	5.95
EPROM		
27C1000	128Kx8 200 ns	\$15.00
27512	64Kx8 200 ns	7.10
27256	32Kx8 200 ns	5.40
27128	16Kx8 250 ns	3.75
STATIC RAM		
62256P-10	32Kx8 100 ns	\$6.50
6264P-12	8Kx8 120 ns	4.25

OPEN 6 DAYS, 7:30 AM - 10 PM SHIP VIA FED-EX ON SAT.

SAT DEL ON FED-EX ORDERS RECEIVED BY: 11:59 AM EST  
MasterCard VISA or UPS CASH COD  
MICROPROCESSORS UNLIMITED, INC.  
24,000 S. Peoria Ave. (918) 267-4961  
BEGGS, OK 74421  
No minimum order. Please note price subject to change.  
Shipping, handling extra. up to \$1 for packing materials.

Circle 226 on Reader Service Card

# BLAST YOUR MESSAGE THRU!

**VOICE MAIL • TELEMARKETING CALL PROCESSING**

Let Powerline transform your PCXT/AT/386 into a multi-line voice processing command center. Have your computer intelligently process your sales, inquiries and messages. Complete package.

Single Line (Bgn/Out) . . . \$295.00  
Multi-Line . . . . . \$895.00  
(Developer/OEM packages available)  
VISA - MC - AMEX - COD

Call: (415) 522-3800  
FAX: (415) 522-5556

TALKING TECHNOLOGY, INC.

1125 ATLANTIC AVE., ALAMEDA, CA 94501  
See us at COMDEX, Booth #H7067

Circle 334 on Reader Service Card

## Write COBOL Applications for DOS, UNIX, VMS, Novell and BOS with one compiler.

- Multi-user
- DBMS Tools
- Screen Builder
- Report Writer
- Text Editor
- Debugger
- Multi-platform
- Transportable Library
- Subroutine Library
- Utility Toolkit
- Terminal-independent
- Many more features

Call or write for complete information.

BOS National, Inc.  
2607 Walnut Hill Lane  
Dallas, TX 75229  
(214) 956-7722



Special Offer Available Now!

Money Back Guarantee

Circle 55 on Reader Service Card

## AVT 286-12 40MB Mono System

- INTEL 80286 12 MHz, 0 Watt
- 1MB RAM Expandable to 4MB
- 40MB Hard Drive
- 1.2MB or 1.44MB Floppy Drive
- 101 Key Extended Keyboard
- Monochrome Monitor with Herc. Graphics
- Parallel, Serial, Real Time Clock
- Choice of Slimline, Desktop or Mini Tower Case
- One Year Warranty

\$895

Same Configuration as above with	VGA Color	Options
386SX-16	\$1095	65MB HD Add \$350
386SX-20	\$1175	80MB HD Add \$250
386-25	\$1545	Second Floppy Add \$89
386-33	\$1845	All other upgrades CALL

### MOTHERBOARD SPECIAL

- 80286-12 0 Watt, Exp to 4MB, AMI BIOS, OK \$129
- 80386SX-16 16MHz, Exp to 8MB, AMI BIOS, OK \$319
- 80386SX-20 New 20MHz, Exp to 8MB, AMI BIOS, OK \$399
- 80386-25 0 Watt, AMI BIOS, Exp to 8MB, OK \$749
- 80386-33 64K Cache, 0 Watt, AMI BIOS, OK \$1049
- Special !! 80486-25 128K Cache, 0 Watt CALL

Avantech Solutions, Inc.  
3 W. Columbia Ave.  
Palisades Park, NJ 07650  
(201) 941 - 1961

Circle 38 on Reader Service Card



PS/2 model 30/286-30 meg	1795
PS/2 model 50Z/286-60 meg	2395
PS/2 model 55SX/386SX-60 meg	2875
PS/2 model 70/386-120 meg	5595
PS/2 model 80/121-120 meg	NEW

\*\*\* Monitor Extra \*\*\*



Compaq 286E-40 meg	2150
Compaq 386/20E-100 meg	4150
Compaq 386S-100 meg	3595
Other Models	CALL

\*\*\* Monitor Extra \*\*\*

### Macintosh

Mac SE/30-40 meg	3195
Mac IICX-80 meg	4595
Mac Portable-40 meg	4795
Other Models	CALL

\*\*\* Keyboard & Monitor Extra \*\*\*

# LOW PRICE LEADER

SINCE 1983

## LAPTOP

Texas Instruments TM2000	2595
Compaq LTE/286-40	2975
Sharp 622C	2595

CALL FOR OTHER BRANDS

## LAPTOP ACCESSORIES

Memory	
1 meg Toshiba 1000SE	210
2 meg Toshiba 3100SX	230
2 meg Toshiba 3200SX	230
2 meg Toshiba 5200	225
1 meg Compaq SLT	310



### Everex System 1 1995

Everex Step 286/12 - 1meg  
40 meg VGA card and monitor

### Everex System II 2495

Everex Step 386SX - 2 meg  
40 meg VGA card and monitor

### Everex System III 5395

Everex Step 386/33 - 4 meg  
150 meg VGA card and monitor

\* CALL FOR MODELS & CONFIG \*

## AGI Computer

AGI 386SX-1 meg 1695  
40 meg VGA card and monitor



AST 386SX - 2 meg 2395  
40 meg VGA card and monitor

CALL FOR OTHER MODELS

### DISKS

DYSAN 5 1/4 HD / 3 1/2 HD	13/26
MAXELL 5 1/4 HD / 3 1/2 HD	12/25
Min. 10 Boxes Order	

### WE STOCK

CITIZEN  
OKIDATA  
EVEREX  
GOLD STAR

TOSHIBA  
NEC  
WYSE  
HITACHI

PRINCETON GRAPHICS  
SONY  
ACER  
HOUSTON INSTRUMENTS

AMDEK  
HAYES  
SAMSUNG  
CALCOMP

PC MOUSE  
MICROSOFT MICE  
LOGITECH  
MITSUBISHI

IRWIN & ARCHIVE  
TAPE BACK  
TAXAN  
MAGNOVOX

<b>Intel Coprocessors</b>	
8087-3	105
8087-2	145
80287-8	225
80287-10	249
80387-16	395
80387-20	425
80387-25	495
80387-33	599

<b>SOFTWARE SPECIALS</b>	
dBase IV	455
Wordperfect 5.1	260
Aldus Pagemaker	495
Ventura Publisher	525
Clipper	435
WordStar 5.5	150
EasyExtra	40



**NOVELL**  
Authorized Dealer

<b>SPECIALS</b>	
HP Scan Jet	1425
HP Paint Jet	965
Lotus Ver. 3.0	355
Kodak 150P	370
Complete Fax Board	499
Okidata 391	625
Epson LQ1050	660
Panasonic 1124	319
HP-7475 Plotter	1595
SummaGraphic	365

<b>LASER PRINTERS</b>	
HP Laser IIID	2650
HP Laser 2P	995
HP Laser III	1695
Panasonic 4450	1395
Brother HL-8-E	1895
Nec LC 890	3195
Toshiba Laser 6	1095

<b>MONITORS</b>	
Nec Multisync IIA	499
Nec Multisync 3D	599
Magnavox EGA	339
Nec Multisync 5D	2350
Samsung EGA	359
Sony 1302	619

<b>PACIFIC DATA PRODUCTS</b>	
P. Page II	395
P. Page IIP	365
P. 1-2-4 Mem II	159
P. One Meg IIP	180
P. 25 in One III	275
P. Headlines	245

<b>LAN BOARDS</b>	
8 bit Arcnet	110
16 bit Arcnet	220
8 bit Ethernet	190
16 bit Ethernet	275
8 port Active Hub	325
Token Ring Card	399
Tokenhub 4-port	355
Call for other LAN Accessories	

<b>MODEMS</b>	
Everex 2400 Int/Mnp	179
Hayes 2400B	315
Hayes 9600B	875
USRobotics Hst/Dual	1150
More in Stock	Call

ALL QUOTED PRICES ARE CASH PRICES ONLY.  
Visa and MasterCard 3% higher, American Express 5% higher

**EXPORTS Available**

# COMPUTERLANE

HOURS:  
M-F 9-6  
S 10-6

**1-800-526-3482 (Outside CA)**  
**(818) 884-8644 (In CA)**  
**(818) 884-8253 (FAX)**

22107 ROSCOE BLVD.  
CANOGA PARK  
1/2 BLOCK W. OF TOPANGA  
CA 91304

CORPORATE ACCOUNTS WELCOME  
CALL FOR VOLUME DISCOUNTS  
CONSULTANTS CALL FOR PRICING

Prices subject to change without notice  
\* Quantities are limited

Compaq is a Registered Trademark of Compaq  
IBM is a Registered Trademark of International Business Machines



# AT&T FULL PAGE SCANNER \$298

Includes FREE Microsoft Software:  
Windows 2.0, Scan, Draw, Fonts, Lan, Modem & Fax

- PC/AT Compatible
- Contrast Adjustment
- 200 Dots Per Inch
- Writes Images to Your Hard Drive (Required)
- Automatic Sheet Feed

Deluxe OCR Software...\$198

List Price \$1295

## JADE COMPUTER



### Ultra 486

# \$3698

Double The Power,  
Twice The Speed

Landmark—113.4 MHz  
Power Meter—11.03 MIPS

- Monitor Optional
- True 25 MHz, 80486 CPU
  - 1 MB of 32 BIT RAM
  - Expands to 8+ MB
  - Built in High Speed Cache
  - 100% Novell & IBM Compatible
  - 1.2 MB 5 1/4" Disk Drive
  - Fast 1:1 Interleave Dual Hard Disk/Dual Floppy Disk Controller
  - Wetek 3167 FPP Socket
  - Full Size Professional Case
  - 101 Key Enhanced Keyboard
  - 200 Watt Power Supply
  - Built-in Clock/Calendar
  - Assembled & Tested in U.S.A.
  - One Year Warranty

### Monitor & Hard Drive Options

40 MB System	80 MB System	600 MB System
Complete Monographics System		
\$4198	\$4298	\$6698
Complete VGA System		
\$4498	\$4698	\$6998

## MEMORY UPGRADES

TOSHIBA	
1000SE 2 MB card	\$428
1600 2 MB card	\$298
3100e 2 MB card	\$298
3100SX 2 MB card	\$298
3100SX 4 MB card	\$698
3200SX 2 MB card	\$298
3200SX 4 MB card	\$698
3200 3 MB card	\$468
5100 2 MB card	\$298
5200 2 MB card	\$298
5200 8 MB card	\$1198

COMPAQ	
LTE 1 MB	\$218
486/25 SystemPro 8 MB	\$398
DeskPro upgrades as low as	\$144

IBM	
PS/2 MDL 30/286	512K \$178
PS/2 MDL 70	1 MB \$118
PS/2 MDL 80	1 MB \$168
PS/2 MDL 80-A21, A31	1 MB \$128
Laser Printer	1 MB \$258
	2 MB \$238
	3.5 MB \$398

AST	
486 2 MB upgrade	Call
All other models available	Call

See bottom portion of ad for pricing information.

APPLE	
MAC Portable 1 MB card	\$388
All other models available	Call

ZENITH	
SuperSport 286 1 MB	\$288
386-20/25/33 1 MB	\$108
	2 MB \$238
	4 MB \$798

## JADE COMPUTER



### Super-386

### 16 MHz (SX)

# \$798

1 MB expands to 8 MB

Monitor Optional

### 25 MHz Cache

# \$1398

1 MB expands to 32 MB  
64K Cache expands to 128K

### 33 MHz Cache

# \$1498

1 MB expands to 8 MB  
64K Cache not expandable

- 80386 processor running at 16 MHz (SX), 25 MHz or 33 MHz
- 384K Shadow RAM
- 1.2 MB or 1.44 MB Drive
- 1:1 interleave hard disk/floppy disk controller
- 80387 socket
- Full size case
- One 32-bit, Five 16-bit, Two 8 bit slots
- 102 key enhanced keyboard
- 200 watt power supply
- Clock/calendar

Monitor & Hard Drive Options (16 MHz SX)

Floppy Only	40 Megabyte	80 Megabyte
Complete Monographics System		

# \$948 | \$1348 | \$1598

Complete VGA System

# \$1298 | \$1698 | \$1898

For 25 MHz Cache add \$598  
For 33 MHz Cache add \$698

## EPSON

LX-810	\$178
FX-850	Call
FX-1050	Call
LQ-510	\$289
LQ-850	Call
LQ-950	Call
LQ-1010	Call
LQ-1050	Call
LQ-2550	Call
EPL-6000	Call

## Panasonic

KX-1180	\$169
KX-1191	\$238
KX-1124	\$289
KX-1624	\$428



8087	\$88	80287-12	\$278
8087-2	\$118	80387-SX	\$318
8087-1	\$158	80387-16	\$348
80287	\$128	80387-20	\$388
80287-8	\$198	80387-25	\$488
80287-10	\$228	80387-33	\$598
80287 XL	\$228		

## ITT Co-Processors

2C87-8	\$198	2C87 12	\$268
2C87-10	\$228	2C87-20	\$328

## VGA Package

Card \$148

Monitor \$298



640 x 480 Hi-Res Card

Accessories for Your		HEWLETT PACKARD	
Pacific Page PostScript LJ IIP/III	\$398		
Pacific Page PostScript LJ II	\$498		
PDP 25 in 1 (172 Fonts) LJ II/IIP	\$278		
PDP 25 in 1 (172 Fonts) LJ III	\$398		
PDP Plotter in a Cartridge IIP/II/III	\$248		
4 MB Memory Card for LJ II/IID			
Without RAM	\$98	2 MB	\$198
1 MB	\$148	4 MB	\$398
New! Memory Card for LJ IIP/III			
Without RAM	\$98	2 MB	\$198
1 MB	\$148	4 MB	\$398

## Microsoft DOS

3.3 — \$78  
4.01 — \$88

## 2400 Baud Internal Modem w/Software \$74

1200 internal w/software	\$44
1200 baud external	\$88
2400 baud external	\$128
2400 PS/2 internal	\$198

Roland Plotters  
DXY-1100 \$798  
All Roland Models Available

## JADE COMPUTER Technicon 5102 Printer \$128

- 120 CPS, 9 PIN Printer
- Near Letter Quality Printing - Four Print Styles
- EPSON/IBM Compatible
- One Year Warranty
- International Character Set

Tape Back-up	
40 MB Internal	\$268
150 MB Internal	\$628
250 MB Internal	\$728
For External Add	\$128

## Trackballs

Logitech Trackman Serial	\$98
Logitech Trackman BUS	\$108
MicroSpeed PC-Trac Serial	\$88
MicroSpeed PC-Trac BUS	\$98
MicroSpeed FastTrap Serial	\$108
MicroSpeed FastTrap BUS	\$118

## Panasonic VGA \$468

PanaSync Monitor  
1024 x 768  
14" 28 Dot Pch

Logitech  
LogiMouse Hi-Rez. Bus \$88  
LogiMouse Hi-Rez. Serial \$98

## Microsoft BUS Mouse \$48

200 DPI  
w/Drivers Software

Scanner  
Diamond Flower HS-3000 Plus \$198  
OCR Software for HS-3000 \$88

Keyboard  
102 enhanced click \$68  
Keyboard Drawer \$34

No Surcharge  
for Credit Cards!



California

Torrance, Costa Mesa, Woodland Hills  
Kearny Mesa, Sunnyvale

Texas Georgia Arizona  
Addison, Houston Smyrna Phoenix

Not all items in stock at our nine retail locations.



MEMBER  
MICRO-COMPUTER  
MARKETING COUNCIL

4901 W. Rosecrans Ave. Box 5046, Hawthorne, California 90251-5046 213-973-7707  
Continental U.S.A. 1-800-421-5500 Inside California 1-800-262-1710

10 Day Money Back Guarantee

We accept checks, credit cards (or purchase orders from qualified firms and institutions.) No surcharge on credit card orders. CA, TX, GA, & AZ. residents add sales tax. Prices and availability subject to change without notice. \$4.00 minimum shipping and handling charge.

Circle 189 on Reader Service Card

**ARC TANGENT PROFESSIONAL MAIL** \$695  
 Complete Mailing List Management Software

The most advanced, professional-level mailing list management system available for IBM and compatible microcomputers. Save thousands of dollars on postage, printing, and processing costs.

- Unlimited number of names and addresses
- Sophisticated merge/purge duplicate detection
- Complete postal presorting and barcoding
- Custom letters, labels, reports
- Convert data from dBase, ASCII, other formats

Arc Tangent, Inc.  
 121 Gray Avenue  
 Santa Barbara, CA 93101-1831  
 (805) 965-7277

Circle 30 on Reader Service Card  
 (RESELLERS: 31)

**PLD Design Software**  
 Get Started with CUPL™ for only \$149.95



Now you can have a PLD Starter Kit that gives you all the horsepower that the CUPL PLD compiler offers, at a fraction of the cost. For more information, call 1-800-331-7766 or 305-974-0967.

**LOGICAL DEVICES, INC.**

Circle 202 on Reader Service Card  
 (RESELLERS: 203)

**486/33**

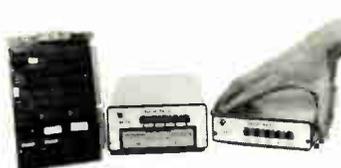
33Mhz Intel i486 microprocessor.  
 128K high speed cache one board.  
 4Mb of 70ns dynamic ram.  
 1.2 Mb 5¼ and 1.44 Mb 3½ drives.  
 150 Mb NEC ESDI hard disk.  
 Super VGA. 16 bit, 512 Kb card.  
 14 inch Super VGA monitor.  
 2 serial, 1 parallel and 1 game port.  
 Keyboard and MS compatible mouse.  
 DOS version 4.01 or 3.3 included.  
 Deluxe 6 bay Tower or AT case.  
 Burned in and tested. 1 yr. warranty.  
 25Mhz version available.  
 386/25 and 386/33 available.

No Flash, No Hype.  
 Just a good deal!  
**\$5995.00**

AME PRODUCTS • PO BOX 8207  
 MISSION HILLS • CA, 91346 • (818) 892-9671

Circle 20 on Reader Service Card

**GET the PC BUS**



**Single Board Computers**

- DOS & .EXE on ROM in ten easy steps!
- PC/AT Bus Expansion
- Complete Systems \* Cards \$299

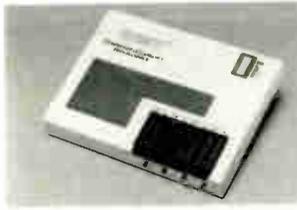
V50 uP, 10mhz, CMOS, AT Code Compatible  
 5 Serial Ports, 1 Meg RAM, 256K ROM.  
 Piggyback: Floppy, Keyboard, SCSI, Printer,  
 BIOS with Utilities and Monitor

**Kila SYSTEMS**  
 655 Hawthorn, Boulder CO, 80304 FAX (303) 786-9983

Call!  
 (303) 444-7737

Circle 195 on Reader Service Card

**Program Your Chips**  
 In Sets of 4 for \$695.00



**Special offer Now Includes:**  
 Free UV eraser, CUPL starter Kit and  
 a \$300.00 Factory Rebate with the  
 PDT-1 EPROM, EPLD, Micro  
 Programmer. **1-800-331-7766**

**LOGICAL DEVICES, INC.**

Circle 204 on Reader Service Card  
 (RESELLERS: 205)

**Write us . . . so they won't call you**

Many people enjoy receiving information about products or services in their homes by telephone.

But if you want fewer phone calls from national advertisers, we can help. Telephone Preference Service can effectively reduce phone calls from national advertisers. And, it's absolutely FREE. Just send us your name, full address, area code and phone number. We'll tell participating national advertisers to remove your name from their calling lists.

After all, they only want to talk to people who want to listen.

**Telephone Preference Service**

Direct Marketing Association  
 11 West 42 Street, P.O. Box 3861  
 New York City, NY 10163-3861



**Nashua**

3½" DS 6<sup>95</sup> per box  
 3½" HD 15<sup>95</sup> per box  
 5¼" DS 3<sup>95</sup> per box  
 5¼" HD 6<sup>50</sup> per box

**3M**

Authorized Distributor Magnetic Media Division

5¼" DD 5<sup>95</sup> PER BOX  
 5¼" HD 10<sup>95</sup> PER BOX  
 3½" DS 8<sup>95</sup> PER BOX  
 3½" HD 17<sup>95</sup> PER BOX

**Canon LBP-4**  
 LASER BEAM PRINTER

OUR PRICE IS SO LOW THAT THE MANUFACTURER WOULD BE VERY UPSET IF WE WERE TO PUBLISH IT. SO WE CAN ONLY SAY "THE PRICE IS LOW & INCLUDES ONE TONER CARTRIDGE & UPS TWO DAY AIR DELIVERY"

**CALL FOR PRICE**

**Diskette Connection**  
 NORTHWEST & CANADA  
 1-800-451-1849  
 PO BOX 10247 WILMINGTON DE 19850

SOUTHEAST  
 1-800-940-4600  
 PO BOX 4183 DEERFIELD BEACH FL 33442

MIDWEST  
 1-800-654-4058  
 PO BOX 1674 BETHANY OK 73008

WEST - HAWAII & ALASKA  
 1-800-621-6221  
 PO BOX 12396 LAS VEGAS NV 89112

Minimum Order \$20.00 NO SURCHARGE on VISA / MC  
 COO orders add \$3.50 Shipping charges determined by items and delivery method required by customer.  
 (Prices are subject to change without notice)

FAX (405) 495-4598



# SHIPPING NOW

## INCREIBLE PRICES

### 3M REWRITABLE OPTICAL DISKS

600 to 650 Mbyte Erasable, Removable Data Storage

\$179<sup>00</sup> each

\$161 if 10 or more. Quantities above 25 contact BOW IND. 800-877-0701



### R-50 SERIES MAGNETO OPTICAL STORAGE SUB-SYSTEM

Plug & Play. Optical Disk Drive w/power supply, SCSI cable, software interface, documentation.

\$3199<sup>00</sup> each

IBM and Compatible.

\$3124 Mac version. (DOES NOT INCLUDE DISK) 800-877-0701



The Little Big LAN

### AMAZING \$75 NETWORK

Compatible with Twisted Pair or COAX (Arcnet and Ethernet compatible) networks. 800-877-0701

VISA, MC, C.O.D.  
**FAX ORDERS 703-631-0708**  
 Next Day or 2nd Day Delivery if order received before 2pm E.S.T.  
**1-800-877-0701**



4116 B Walney Road  
 Chantilly, VA 22021  
 Ph 703-631-0700 FAX 703-631-0708

Authorized Integrator  
 Optical Recording Department



### 9-Track Tape For Your IBM PC/XT/AT/PS-2™

Read 1600 bpi 9-track tapes from a micro, mini or mainframe in EBCDIC or ASCII as mirror image or by individual files.

Use the 2000 PC™ for disk backup, data interchange or archival storage.

PC/XT/AT/PS-2 are trademarks of IBM. 2000 PC is a trademark of Digi-Data.



DIGI-DATA CORPORATION  
 8580 Dorsey Run Road  
 Jessup, MD 20794-9990  
 (301) 498-0200  
 800-782-6395  
 FAX (301) 498-0771  
 First in Value

Circle 111 on Reader Service Card

X.25 SDLC  
 QLLC HDLC  
 ADCCP PAD

- C source code
- ROM-able
- Full porting provided
- No OS required



GCOM, Inc.  
 41 E. University  
 Champaign IL 61820  
 (217) 352-4266

Specialists in Computer Communications  
 FAX 217-352-2215

Circle 142 on Reader Service Card

### DATA ACQUISITION

- Systems for Lab, Factory & Field
- PC Software Included
- Serial, Modem, & Bus
- Stand Alone Ability
- Laptop & Handheld
- PC & MAC Cards
- Inexpensive
- OEM & VAR
- RTU's



**FREE CATALOG & DEMO DISK!**  
 Manufacturers of Measurement & Control systems for Laboratory, Industrial, & Field applications. Specialists in Battery-Powered systems.



Call for applications info (201) 299-1615  
 P.O. Box 246 Morris Plains NJ 07950 U.S.A.



Circle 124 on Reader Service Card

### Real Time Waveform Display.

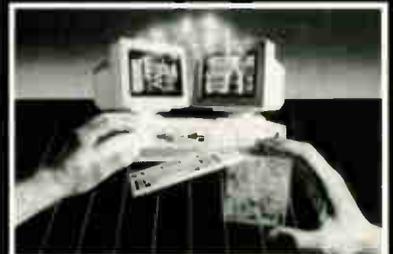
Only CODAS waveform recording systems offer true real time waveform display.

- For IBM AT, PS/2 Micro Channel\*, and compatibles.
  - Record up to 16 waveforms to disk in real time at up to 50,000 samples per second for instant playback, analysis, and manipulation.
  - Includes all necessary hardware and software for fast, turnkey startup.
  - Includes Microsoft C-compatible library of function calls for customization.
- For a **FREE Evaluation Package**, call: 1-800-553-9006. In Ohio, 1-216-434-4284.

**DATAQ INSTRUMENTS, INC.**  
 825 Sweitzer Ave., Akron, OH 44311

\*IBM, AT, PS-2 and Micro Channel are trademarks or registered trademarks of IBM Corp. Microsoft C is a trademark of Microsoft Corp.

Circle 101 on Reader Service Card



**New, Gridless, 100% Autorouting**  
 Create schematics and PCBs quickly and simply with **HiWIRE-Plus®** and your IBM PC. With the new, gridless, multilayer autorouter (AR) for HiWIRE-Plus, creating printed-circuit layouts is even faster. AR and HiWIRE-Plus are each \$895 and come with 30-day money-back guarantees. Credit cards welcome.



Corporation  
 1801 South St., Lafayette, IN 47904  
 (800) 742-6809 or (317) 742-8428

Circle 374 on Reader Service Card



### CROSS-32 V2.0 META ASSEMBLER

- Table based absolute macro cross-assembler using the manufacturer's assembly mnemonics.
  - Includes manual and MS-DOS assembler disk with tables for ALL of the following processors:
- |        |        |       |      |         |         |
|--------|--------|-------|------|---------|---------|
| 1802   | 64180  | 6801  | 8048 | TMS320  | Z8      |
| 37700  | 6502   | 6805  | 8051 | TMS340  | Z80     |
| 50740  | 65816  | 6809  | 8085 | TMS370  | Z180    |
| 7500   | COP400 | 6811  | 8086 | TMS7000 | Z280    |
| SUPER8 | COP800 | 68000 | 8096 | TMS9000 | MORE... |
- Users can create tables for other processors or ask us, we have many more!
  - Generates listing, symbol table and binary, Intel, and Motorola hexcode.
  - Free worldwide airmail shipping & handling.

US\$199.00 CDN\$239.00

UNIVERSAL CROSS-ASSEMBLERS

P.O. Box 6158  
 Saint John, N.B.,  
 E2L 4R6 Canada  
 Voice/Fax: (506)847-0681



Circle 362 on Reader Service Card

# MEMORY UPGRADES!

WE ACCEPT PURCHASE ORDERS FROM UNIVERSITIES,  
QUALIFIED FIRMS AND GOVERNMENT AGENCIES.

WE ACCEPT INTERNATIONAL ORDERS  
3 day International delivery available via Federal Express or DHL!  
OR FAX  
CALL (714) 588-9866 24-HOURS-A-DAY FAX (714) 588-9872



## WE WILL BEAT ANY ADVERTISED PRICE

### IBM PS/2 MEMORY

Models 30-286, Exp. Board 1497259	
512K Kit 30F5348	\$54.00
2M Kit 30F5360	\$179.00
Models 70-E61 121,55SX,65SX	
1MB 6450013	\$89.00
Models 70-E61/121,50Z,55SX,65SX	
2MB 6450004	\$169.00
Models 55SX, 65SX, 34F3077 & 34F3011	
4MB 34F2933	\$499.00
Model 70-A21	
2MB 6450608	\$169.00
Model 80-141	
1MB 6450375	\$145.00
Models 80-111/311	
2MB 6450379	\$259.00
Models 80-A21 A31	
4MB 6451060	\$659.00
All Models 70 and 80	
2 8MB Board w/2M	
6450605	\$499.00
2 14MB Board w/2M	
34F3077	\$599.00
4 15MB Board w/4M	
34F3011	\$999.00
Models 50,50Z,55SX & 60	
2 8MB Board w/2MB	
1497259	\$599.00
Models 50, 55Z, 60 & 65SX	
2 15MB Board w/2MB	
6450609	\$625.00

### LASER PRINTER MEMORY

<b>Hewlett-Packard LaserJet IIP &amp; III</b>	
1MB 33474B	\$99.00
2MB 33475B	\$169.00
4MB 33477B	\$299.00
<b>Hewlett-Packard LaserJet II &amp; IID</b>	
1MB 33443B	\$99.00
2MB 33444B	\$169.00
4MB 33445B	\$299.00
<b>Apple Laserwriter II and II/NTX</b>	
1MB M6005	\$89.00
4MB M6006	\$349.00
<b>IBM Laser 4019 and 4019e</b>	
1MB 1039136	\$209.00
2MB 1039137	\$375.00
3 8MB 1038675	\$489.00
<b>Canon LBP-8II, 8IIR, 8IIT</b>	
1MB 563 1300	\$129.00
2MB 563 1880	\$189.00
4MB Part # N/A	\$345.00
<b>Epson EPL6000</b>	
2MB IBS401	\$375.00
4MB Part # N/A	\$745.00

### APPLE MEMORY

<b>Apple Macintosh SE, SE30, II, IIfx and Iix</b>	
1MB Kit MO218	\$95.00
2MB Kit MO219	\$145.00
<b>Apple Macintosh IIfx</b>	
4MB Kit MO292LL A	\$285.00
16MB Kit Part # N/A	\$1445.00
<b>Apple Macintosh IIfx</b>	
4MB Kit MO376LL A	\$319.00
16MB Kit Part # N/A	\$1450.00

### COMPAQ MEMORY

<b>DeskPro 286-E,386-20 20E 25</b>	
1MB 113131 001	\$139.00
4MB 112334 001	\$349.00
113132-001	\$349.00
<b>DeskPro 386S 16</b>	
1MB 113646 001	\$139.00
4MB 112334 001	\$349.00
<b>DeskPro 286N, 386N and 386SX and 20</b>	
1MB 118688 001	\$99.00
4MB 118690 001	\$499.00
<b>DeskPro 386N, 386SX and 20</b>	
2MB 118689 001	\$169.00
<b>DeskPro 386-33, 486-33 &amp; SystemPro</b>	
2MB 115344 001	\$200.00
8MB 116561 001	\$1899.00
<b>DeskPro 386-20e and 25e</b>	
1MB Board 113644 001	\$225.00
4MB Board 113645 001	\$569.00
<b>DeskPro 386S</b>	
1MB Board 113633 001	\$225.00
4MB Board 113634 001	\$569.00
<b>DeskPro 386/16 (Populate In this order)</b>	
1MB Kit 108071 001	\$165.00
1MB Board 108069 001	\$369.00
2MB Board 108069 71 001	\$579.00
4MB Board 108070 001	\$1049.00
8MB Board 108070 72-001	\$1499.00

### AST MEMORY

<b>Premium Workstation 286/386SX, Bravo 286</b>	
512K Kit 500510 010	\$59.00
2MB Kit 500510 002	\$169.00
<b>Premium 386C and 386-16</b>	
1MB Kit 5005 0 007	\$95.00
4MB Kit 5005 0 008	\$349.00
<b>Premium 386-20</b>	
1MB Kit 500510 003	\$129.00
4MB Kit 500510 004	\$369.00
<b>Bravo 386-SX</b>	
2MB Kit 5005 0 002	\$179.00
4MB Kit 5005 0 008	\$349.00
<b>Premium 386-SX/16/25/33 &amp; 486-33</b>	
1MB 5007 18 002	\$95.00
<b>Premium 486</b>	
2MB 5007 8 004	\$342.00

### ZENITH MEMORY

<b>Zenith Z-386-20 25/33 &amp; 33E</b>	
1MB ZA163800ME	\$89.00
4MB ZA3800MK	\$499.00
<b>Zenith Z-386-20 25 &amp; 33</b>	
2MB ZA3600MG	\$169.00
<b>Zenith Z-386 SX</b>	
2MB Z 605 1	\$267.00

### HEWLETT-PACKARD MEMORY

<b>Vectra QS 16S and ES/12PC</b>	
1MB Kit D1540A	\$99.00
2MB Kit D1354A	\$175.00
4MB Kit D1542A	\$349.00
<b>Vectra QS 20PC, RS 25PC, 20C and 25C</b>	
1MB Kit D1640A	\$105.00
4MB Kit D1642A	\$349.00
<b>Vectra 486 PC</b>	
1MB Kit D2150A	\$89.00
4MB Kit D2151A	\$499.00
<b>Vectra 486PC and 386/25 PC</b>	
8MB Kit D2152A	\$999.00
<b>Vectra 386 25 PC</b>	
2MB Kit D23F1A	\$266.00

### LAPTOP MEMORY

#### TOSHIBA

<b>Model 1000SE XE</b>	
1MB	\$289.00
2MB	\$399.00
<b>Model T1200XE</b>	
1MB	\$249.00
<b>Model T1600</b>	
1MB	\$249.00
<b>Model T3100E</b>	
1MB	\$249.00
<b>Model T3100SX</b>	
1MB	\$249.00
2MB	\$689.00
<b>Model T3200SX</b>	
1MB	\$249.00
2MB	\$689.00
<b>Model T5100</b>	
1MB	\$249.00
<b>Model T5200,T8500</b>	
1MB	\$249.00
2MB	\$1300.00

#### COMPAQ

<b>Portable 386</b>	
1MB Kit	\$325.00
1MB Extension Brd	\$1049.00
1MB Expansion Brd	\$1049.00
<b>Portable III</b>	
512K Kit	\$69.00
2MB Kit	\$325.00
<b>Portable LTE 286</b>	
1MB	\$189.00
2MB	\$269.00
<b>SLT-286</b>	
1MB	\$239.00
4MB	\$1325.00
<b>SLT-386</b>	
1MB	\$325.00
2MB	\$495.00

#### ZENITH

<b>SuperSport 286 &amp; 286E</b>	
1MB	\$189.00
<b>SuperSport SX &amp; 286E</b>	
2MB	\$449.00
<b>SuperSport SX</b>	
2MB Alpha	\$549.00
2MB Beta	\$549.00

#### NEC

<b>ProSpeed 286</b>	
1MB	\$289.00
4MB	\$900.00
<b>ProSpeed 386</b>	
2MB	\$450.00
4MB	\$900.00

#### APPLE

<b>Apple Macintosh Portable</b>	
1MB	\$279.00
2MB	\$850.00
3MB	\$1136.00
4MB	\$1564.00

FIRST SOURCE INTERNATIONAL  
WILL NOT BE UNDERSOLD ON  
LAPTOP MEMORY!

### COMDEX SPECIALS!

IBM PS/2	1MB	2MB	4MB
50Z,55SX,65SX,70	89	169	499
<b>COMPAQ</b>			
286N,366N,386SX&20	89	169	499
<b>ZENITH</b>			
Z-386/20/25/33&33E	89	169	499
<b>HEWLETT-PACKARD</b>			
LaserJet IIP&III	99	169	299
LaserJet IIP&IID	99	169	299
Vectra 486PC	89	499	999

Prices are valid only thru November 1990

### EXPANSION BOARDS

All BocaRam Boards include  
PrintSpooler and Ram Disk software.

#### BocaRam/XT

Up to 2MB of expanded memory for any IBM PC  
XT AT and 8 bit PC bus compatibles running at CPU  
speeds up to 12MHz. LIM/EMS 4.0 compatible  
Uses 256Kx1 Dram

Order Now: SIMXT00 ..... \$119.00  
with 2MB: SIMXT02 ..... \$279.00

#### BocaRam/AT Plus

Up to 8MB for any AT or 16 bit compatible machines  
running up to 33MHz. Offers conventional,  
expanded and/or extended memory, provides a  
maximum of 8MB LIM/EMS 4.0 Uses 1x1 Dram

Order Now: SIMAT80 ..... \$139.00  
with 2MB: SIMAT82 ..... \$279.00

#### BocaRam 50Z

Up to 2MB zero wait-state expanded and/or  
extended memory board designed for IBM PS/2  
Models 50, 50Z, 60, and true MCA compatibles  
Uses 1x1Dram. OS/2 compatible

Order Now: SIMMC20 ..... \$155.00  
with 2MB: SIMMC22 ..... \$290.00

#### SIMMS

<b>IBM TYPE</b>		<b>1MX1</b>	
4Mx9-80	\$410.00	1MX1-12	\$6.50
1Mx9-12	\$69.00	1MX1-10	\$7.00
1Mx9-10	\$73.50	1MX1-80	\$7.50
1Mx9-80	\$79.00	1MX1-70	\$8.00
1Mx9-70	\$89.00	1MX1-60	\$8.50

#### APPLE-MAC

<b>256KX4</b>		<b>256KX1</b>	
256x9-12	\$20.00	256KX4-12	\$6.85
256x9-10	\$23.50	256KX4-10	\$7.00
256x9-80	\$26.00	245KX4-80	\$7.20
256x9-60	\$35.00		

#### SIPPS AND STATIC COLUMN AVAILABLE

<b>64KX4</b>		<b>64KX1</b>	
4Mx8-80	\$335.00	256KX1-12	\$1.85
1Mx8-12	\$61.00	256KX1-10	\$2.00
1Mx8-10	\$65.00	256KX1-80	\$2.20
1Mx8-80	\$68.00	256KX1-70	\$2.50
256x8-12	\$23.40	256KX1-60	\$3.50
256x8-10	\$24.00		
256x8-80	\$24.70		

CALL TOLL FREE FROM ANYWHERE IN THE U.S. OR CANADA!

# ORDER NOW: 1-800-535-5892

### TERMS AND CONDITIONS

- NO SURCHARGE ON MC OR VISA
- Terms: Mt. Visa, AmEx (AE-4%), COD, Cash
- Not 30 on purchase orders from qualified firms
- 20% Restocking fee on all non-defective returns & returned orders. RMA if required
- Manufacturers part numbers are for your convenience; all products third party
- PRICES AND AVAILABILITY SUBJECT TO CHANGE.

### First Source International, Inc.

36 Argonaut, Suite 140  
Aliso Viejo, California 92656  
Tel. (714) 588-9866  
FAX (714) 588-9872  
"The Only Source"

Order Desk Hours:  
Monday thru Friday 8:00-5:00  
Saturday 10:00-3:00  
Use our 24 hour-a-day voice mail or FAX!

PLEASE SEND ALL P.O.'S AND MAIL ORDERS TO:  
First Source International, Inc.  
P.O. Box 3676  
Laguna Hills, CA 92653

### WHY SHOULD YOU BUY FROM F.S.I.?

- We will meet or beat any advertised price!
- Limited Lifetime Warranty available
- All products guaranteed 100% compatible in form, fit and function or your money back
- No surcharge on Visa or Mastercard
- Most orders shipped Same Day!
- WE ARE "THE ONLY SOURCE!"

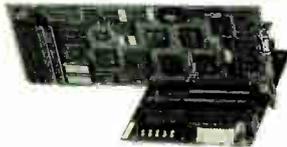
## FIRST SOURCE IS "THE ONLY SOURCE" FOR MEMORY

Circle 135 on Reader Service Card (RESELLERS: 136)

NOVEMBER 1990 • B Y T E 449

Industrial & Lab Automation with PCs

# ADVANTECH



**All-in-One 80286-12 CPU Card**

PCA-6125 **\$395**

- 12MHz 80286 microprocessor
- Socket for 80287 math coprocessor
- AMI BIOS assures compatibility
- Memory configuration: 512K, 1M, 2M & 4M
- Built-in interface for 2 IDE H/D and 2 F/D
- On-board: 1 parallel/2 serial ports
- VLSI CMOS for low power consumption

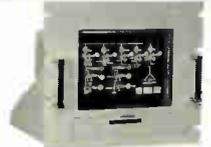
**408-293-6786**

1340 Tully Rd., #314, San Jose, CA 95122 FAX 408-293-4697

Circle 21 on Reader Service Card

Industrial & Lab Automation with PCs

# ADVANTECH



**19" Rack Mounted Multi-Sync Monitor**

IPC-650/651M **\$895**

- 14" Multi-sync monitor
- Fully compatible thru Super VGA & 8514/A
- 1024 dots x 768 lines with .31mm dot pitch
- 19" EIA RS-310C standard rack
- Nickel coated aluminum housing
- Lexan overlay protects CRT screen

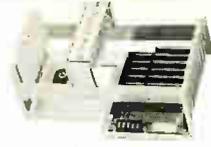
USA & Canada: San Jose, CA  
Tel: 408-293-6786 Fax: 408-293-4697

Europe & Asia: Taipei, Taiwan  
Tel: 886-2-9184567 Fax: 9184566

Circle 21 on Reader Service Card

Industrial & Lab Automation with PCs

# ADVANTECH



**Industrial PC Card Cage with 8 Slot Backplane**

IPC-6010 **\$195**

- Open-style framework for flexible installation in a custom enclosure
- 8 slot backplane with LED power indicators
- 4 layer PCB with dedicated power & ground planes
- Supports both standard PC power connection and industrial screw terminal connection
- Special hold-down clamp protects plug-in cards

**408-293-6786**

1340 Tully Rd., #314, San Jose, CA 95122 FAX 408-293-4697

Circle 21 on Reader Service Card

Advertise your computer products through

## BYTE BITS

(2" x 3" ads)

For more information call Mark Stone at **603-924-2695**

BYTE  
One Phoenix Mill Lane  
Peterborough, NH 03458

Circle 59 on Reader Service Card

## EZ-ROUTE VERSION II



**SCHEMATIC TO PCLAYOUT \$500 INCLUDES AUTO ROUTER**

EZ-ROUTE Version II from AMS for IBM PC, PS/2 and Compatibles is an integrated CAE System which supports 256 layers, trace width from 0.001 inch to 0.255 inch, flexible grid, SMD components and outputs on Penplotters as well as Photo plotters and printers.

Schematic Capture \$100, PCB Layout \$250, Auto Router \$250.

**FREE EVALUATION PACKAGE**  
**30 DAYS MONEY BACK GUARANTEE**  
1-800-972-3733 or (305) 975-9515

**ADVANCED MICROCOMPUTER SYSTEMS, INC.**  
1321 N.W. 65 Place - Ft. Lauderdale, FL 33309

Circle 39 on Reader Service Card

## Terminal Emulation

### TEK 4105/4010

- Tektronix 4105
- Tektronix 4010/4014
- VT320, VT220, VT102
- Picture files
- VGA and EGA support
- High resolution hardcopy

### VT320

- VT320, VT220, VT102 emulation
- File transfer
- 132 column modes
- Color support
- Hot key
- Extensive network support

■ ■ **Diversified Computer Systems, Inc.**  
3775 Iris Avenue, Suite 1B  
Boulder, CO 80301 (303) 447-9251  
FAX 303-447-1406

Trademarks: VT102, VT220 — DEC; Tektronix — Tektronics Inc.

Circle 118 on Reader Service Card

# 486

Made in U.S.A.

## JC GOLD CARD

The JCS 486, the New Performance Leader in Personal 486 Systemboards

- Intel 80486/25 (85) CPU
- 8KB Cache integrated in CPU
- Math Coprocessor integrated in CPU
- Shadow RAM for Video & System BIOS
- Second Level Cache Memory expandable to 512KB
- Welltek 4167 numeric coprocessor socket
- 30 DAY MONEY BACK GUARANTEE

**486 Complete System . . . . \$3595**  
Include 4MB Memory, 160MB ESDI HDD, ESDI Cache Controller, 12 or 1.44MB FDD, MS DOS, AT IO, 101 Keyboard

80386/20 CPU Bd, C&T chipset \$ 590  
80386/25 CPU Bd, C&T chipset \$ 695  
80386/25 Cache Bd, C&T chipset \$1095

Dealer inquiries welcome  
Jemini Electronics (408)727-9986  
3400 De La Cruz Blvd, Unit T  
Santa Clara Ca, 95054 (408)727-7687

11.1 MIPS

Circle 192 on Reader Service Card

## How to Protect Your Computer



### And Make It Last Longer

FREE money-making literature. What you need to know about UPS — uninterruptible power systems. How to get complete protection from power line problems. 500 VA to 18 KVA models from the world's largest manufacturer of single-phase UPS.

**Best Power Technology, Inc.**  
P.O. Box 280, Necedah, WI 54646  
**Toll-Free (800) 356-5794, ext. 3871**  
(608) 565-7200, ext. 3871  
See us at COMDEX, Booth #N4472

Circle 46 on Reader Service Card

## FREE CATALOG

### RS-232C INTERFACE & MONITORING EQUIPMENT CATALOG

WRITE or CALL for YOUR FREE COMPREHENSIVE B & B ELECTRONICS CATALOG TODAY! Pages and pages of photographs and illustrated, descriptive text for B&B's complete line of RS-232C converters, RS-422 converters, current loop converters, adapters, break-out boxes, data switches, data splitters, short haul modems, surge protectors, and much, much more. Most products meet FCC Part 15J. Your RS-232 needs for quality, service and competitive prices will be more than met by B&B ELECTRONICS. Manufacturer to you, no middleman! Money-back guarantee! Same-day shipment! One-year warranty on products! Technical support is available.

**Order direct from manufacturer TODAY & SAVE!**

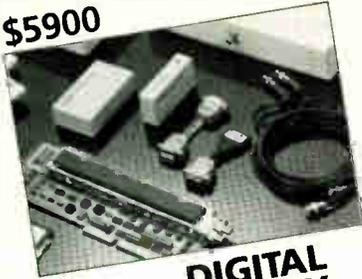
**Write For Your FREE Catalog Today!**

## B&B Electronics

MANUFACTURING COMPANY  
4002L Baker Road P.O. Box 1040 • Ottawa, IL 61350  
Phone: 815-434-0846

Circle 40 on Reader Service Card

\$5900



### DIGITAL FM TELEMETRY

Ideal for ECG, physiology, etc. 6 channels, for PC/AT compatible. Adaptable interface. Dual antennae, digital error check.

**CMETelex**

554 Parkside Dr., Waterloo, Ont. 519-886-8440 Fax 519-886-8442

Circle 71 on Reader Service Card

## LOOKING FOR SUPPLIERS

GIKEN SHOJI CO., LTD. is a leading distributor of computer peripheral products in Japan.

To correct Japan's enormous trade surplus, Japanese users are being encouraged to purchase foreign products, generating demand for software, programming tools, utilities, and application software.

We are offering you the opportunity to introduce yourself and your products to the enormous Japanese market through GIKEN SHOJI.

Please contact us by FAX now.

**GEKEN SHOJI CO., LTD.**

FAX: 81-52-251-0229  
2nd Floor, Marukoshi Bldg,  
6-5, 4-Chome, Sakae, Naka-ku,  
Nagoya, Japan.

Circle 397 on Reader Service Card

**MULTI-SPEED !!!**  
9 TRACK TAPE SUBSYSTEM  
for IBM PC/AT/386

**1 YEAR WARRANTY**



- IBM/ANSI compatible at 800\*/1600/3200 bpi
- Controller, cables and software included
- Interfaces for PS/2\*, Xenix\* and DEC\*
- SCSI\*, AT or MCA\* Bus I/O at 25/50/100 ips

**AKSystems Inc**  
20741 Marilla St. Chatsworth CA 91311  
TEL: 818/709-8100 FAX: 818/407-5889

Circle 14 on Reader Service Card

## Special Offer

Introduction of new transputer products  
CD-TB10/AT 10 slot TRAM motherboard. Onboard root transputer with 1-20 MB memory, FIFO, C004 and T222. High speed 16-bit AT bus interface. B008 compatible. Entry level price . . . US\$ 2,700

Size 2 TRAM's with T800-20  
CD-TRAM2-1, 1MB RAM US\$ 1,040  
CD-TRAM2-2, 2MB RAM US\$ 1,320  
CD-TRAM2-4, 4MB RAM US\$ 2,240  
CD-TRAM2-8, 8MB RAM US\$ 3,590

Cresco Data A/S, 148, Oeresundsvej  
DK-2300 Copenhagen S., Denmark  
Phone +45 31 55 42 70  
Fax +45 31 55 01 53

Circle 85 on Reader Service Card

## There is a Difference. Lifetime Free Updates

**EP-1  
\$349**



A programmer is not just another programmer. That is why BP Microsystems is committed to bringing our customers the highest quality programmers at an affordable price. A good example of this commitment is the EP-1 EPROM Programmer. The EP-1 supports virtually every 24- or 28-pin E/EPROM. And, all of our programmers include lifetime free software updates and an unconditional money back guarantee.

**BP MICROSYSTEMS**

1-800-225-2102  
(713) 481-0430

Circle 57 on Reader Service Card

**Cross-Assemblers** from \$50.00

**Simulators** from \$100.00

**Cross-Disassemblers** from \$100.00

**Developer Packages**

from \$200.00 (a \$50.00 Savings)

**Make Programming Easy**

Our Macro Cross-assemblers are easy to use. With powerful conditional assembly and unlimited include files.

**Get It Debugged--FAST**

Don't wait until the hardware is finished. Debug your software with our Simulators.

**Recover Lost Source!**

Our line of disassemblers can help you re-create the original assembly language source.

**Thousands of Satisfied Customers Worldwide**

PseudoCorp has been providing quality solutions for microprocessor problems since 1985.

**Processors**

Intel 8048	PCA 1502.05	Intel 8051	Intel 8026 1996c
Motorola 6800	Motorola 6801	Motorola 68HC11	Motorola 6805
Hitachi 6301	Motorola 6809	MOS Tech 6502	WDC 65C02
Rockwell 65C02	Intel 8080 85	Zilog Z80	80C 800
Hitachi HD64180	Mel 68k 810	Zilog Z8	Zilog Super 8

\* All products require an IBM PC or compatible.

For Information Or To Order Call:

**PseudoCorp**

716 Thimble Shoals Blvd, Suite E

Newport News, VA 23606

(804) 873-1947

FAX: (804) 873-2154

Circle 293 on Reader Service Card

Circle 61 on Reader Service Card

**LOW COST  
INTERFACE  
CARDS FOR  
PC/XT/AT**



**RS-485/422 Card [PC485] \$95/125**

- Serial Async. Communication up to 4,000ft; 2 or 4 wires; NS16450 UART;
- Can be configured as COM1-COM4; Maximum Baud Rate 56KB.
- Flexible configuration options; RTS or DTR control of transmission direction.
- Full/Half duplex operation; Supports hardware handshaking (RTS,CTS).
- Dual driver/receivers; Handles 64 devices; Compatible with most comm. software.
- High speed version available (supports baud rates up to 256KB) - \$165

**Dual-Port RS-485/422 [PCL743] \$175**

- Two independent channels - UAR1s; 2 or 4 wire operation; Max. Baud 56KB
- Dipswitch configurable as COM1-4 (IRQ2-7). On board terminator resistor.

**IEEE-488 Card [PC488A] \$145**

- Includes DOS Device Driver and sample Communication program in BASIC.
- Additional libraries for C, Pascal, FORTRAN, Assembly - \$50 (all)
- Full range of Talker, Listener, Controller, Serial/Parallel I/O, SRQ, etc..
- Powerful menu-driven **BUS ANALYZER** can be run in the background while 488 programs or commands are executed; Features Program Stepping, Break points, Real Time Bus Data Capture (4K buffer), Instant Screen Toggling.
- Complete Controller / Talker / Listener capability. Based on NEC-7210.
- Memory-resident Printer Port Emulation Utility included (LPT1-3).
- Compatible with NI's GPIB-PC11.

**IEEE-488 Card [PC488C] With Built-In Bus Analyzer \$445**

- Software Support for BASIC, QuickBASIC and GWBASIC.
- Additional libraries for C, Pascal, FORTRAN, Assembly - \$50 (all)
- Full range of Talker, Listener, Controller, Serial/Parallel I/O, SRQ, etc..
- Powerful menu-driven **BUS ANALYZER** can be run in the background while 488 programs or commands are executed; Features Program Stepping, Break points, Real Time Bus Data Capture (4K buffer), Instant Screen Toggling.
- Complete Controller / Talker / Listener capability. Based on NEC-7210.
- Memory-resident Printer Port Emulation Utility included (LPT1-3).
- Compatible with NI's GPIB-PC11.

**DIGITAL I/O Card [PCL720] \$175**

- Input: 32 TTL compatible channels; Input load is 0.2 mA at 0.4V.
- Output: 32 TTL compatible channels; Sinks 24mA (0.5V); Sources 15mA (2.0V)
- Counter/Timer: DC to 2.6MHz; 3 channels; 16 bit counters; 6 counting modes.
- Breadboard area for prototyping. Dipswitch I/O port selection (200-378 hex).

**LOW COST  
DATA  
ACQUISITION  
& CONTROL  
CARDS  
FOR PC/XT/AT**



**12 BIT A/D & D/A [PCL711s] \$295**

- A/D converter: 8 single-ended channels; Device: AD574; Conversion time less than 25µsec; Input range: ±5V; Software Trigger; Mode only.
- D/A converter: 1 channel; 12 bit resolution; 0 to +5V/10V Output Range.
- Digital I/O: 16 Input / 16 Output channels; All I/Os TTL compatible.
- External Wiring Terminal Board with mounting accessories included.
- Utility Routines and Demo/Sample Programs for BASIC and Quick-BASIC.

**12 BIT A/D & D/A [PCL812] \$395**

- A/D converter: 16 single ended inputs; Device: AD574; Conversion time less than 25µsec; Built-in programmable pacer; Input ranges: ±10V, ±5V, ±1V.
- D/A converter: 2 channels; 12 bit resolution; Output Range 0-5V.
- Digital I/O: 16 Input / 16 Output channels; All I/Os TTL compatible.
- Counter: 1 channel programmable interval counter/timer; Uses Intel 8254.
- DMA and interrupt capability. Utility software for Basic included.

**FAST 12BIT A/D/A [PCL718] \$795**

- A/D converter: 16 single ended or 8 differential channels; 12 bit resolution; Programmable scan rate; Built-in Interrupt and DMA control circuitry.
- Conversion speed 60,000 samples/sec (standard), 100,000 samples/sec (optional).
- Input ranges: Bipolar ±10V, ±5V, ±2.5V, ±1V, ±0.5V; Unipolar 10,5,2,1V.
- D/A converter: 2 channels; Resolution: 12 bits res; Settling time: 5µsec; ±5V
- Digital I/O: 16 OUT, 16 IN; TTL compatible; All I/Os TTL compatible.
- Counter: 16 bit prog. interval counter/timer; Uses Intel 8254; Pacer clock;
- Software: Utility software for BASIC and QuickBASIC included.

**6 Channel 12 bit D/A [PCL726] \$495**

- Output Ranges: 0 to +5V, 0 to +10V, ±5V, ±10V or sink +20mA.
- Settling time: 70µs. Linearity: ±1/2bit Voltage output driving capacity: ±5mA
- Digital I/O: 16 digital inputs and 16 digital outputs; TTL compatible.

**STEPPER MOTOR CARD \$395**

- Capable of independent and simultaneous control of up to 3 stepper motors.
- Speed: Programmable from 3.3 PPS to 3410 PPS; Built-in acceleration control.
- Output Mode: One clock (Pulse, Direction) or two clock (CW, CCW pulses)
- Step position: Read-back; Opto-isolated outputs; Crystal based timing.
- Includes 8 bit digital input/output port. Order P/N [PCL-738H]

MC / VISA / AMEX

Call today for datasheets!

Circle 62 on Reader Service Card

**B&C MICROSYSTEMS INC.**

750 N. PASTORIA AVE., SUNNYVALE, CA 94086 USA  
TEL: (408) 730-5511 FAX: (408) 730-5521 BBS: (408) 730-2317



NOVEMBER 1990 • B Y T E 451

## 33 MHz 80486 Motherboard

Faster than the Everex Step™ & ALR  
15 MIPS! \$2,990 Qty 1 (Ok)



### Features:

- 64K or 256K Write Back Cache
- True 32-Bit Memory Exp. to 16 MB
- 8K Internal Cache
- Support Waittek
- Dual Read/Write Cache
- UNIX, OS/2 & Novell Compatible
- Transparent Refresh
- 1 Year Full Warranty
- UL/FCC B Available
- Complete Documentation

	MIPS	Cache	0k	4M
486/33	15.2	64K	2990	3290
486/25	11.4	64K	2599	2899
386/33	8.3	64K	1429	1729
386/25	6.2	64K	1229	1529

Technology Power Enterprises, Inc.  
47273 Fremont Blvd, Fremont CA 94538  
Tel (415) 623-9162 FAX (415) 623-9462

Circle 338 on Reader Service Card

# MARYMAC®



of discounting  
Tandy® computers,  
Fax and Radio  
Shack® products

## Radio Shack® Tandy®

We will meet or beat...  
**GUARANTEED LOWEST PRICES**

MARYMAC INDUSTRIES INC.  
22511 Katy Fwy.  
Katy (Houston), TX 77450  
1-713-392-0747 FAX (713) 574-4567  
Toll Free 800-231-3680

Circle 214 on Reader Service Card

## Data Acquisition Processor™



- Onboard Intelligence For IBM PC/XT/AT/386
- 16 MHz 80C186 for general processing
  - 20 MHz DSP56001 for digital signal processing
  - Sustained digital signal processing of 10 MIPS
  - FFT and FIR filtering without programming
  - Acquires analog and digital inputs to 235K s/s
  - Buffers and processes input data as required
  - Updates analog or digital outputs to 250K s/s
  - Over 100 commands without programming
  - Custom commands may be written in C

Call for FREE Demo Diskette

MICROSTAR (206) 881-4286  
2863 152 Ave. N.E.  
LABORATORIES Redmond, WA 98052  
FAX (206) 881-5494

Circle 227 on Reader Service Card

## COMPUTER AIDED INSTRUCTION

PROFESSIONAL QUALITY SOUND for:

HYPERTEXT, LAN NETWORKS,  
LANGUAGE TRAINING, SHOWS,  
DEMO DISKS

Low-Cost Digital Audio for Windows 3.0  
Protected / Real Modes

IBM-PC DIGITAL VOICE / SOUND  
from \$20 (player module) to \$640 (Developer's Kit)

Quality Software / Hardware  
- in use worldwide!

- 30 Day Money-Back Guarantee if not Satisfied
- JUST LIKE HAVING A DAT TAPE RECORDER IN A PC.
- Fastest, easiest Editors with the most features for the price.
- Quick, simple hardware / software installation.
- Use for Foreign Language training / communications.
- For Business: Training, Slide Shows, with Graph, ShowPartner FX.
- For Engineering: Function Gen., Clear Voice Alarms, Storage Scope.
- For Fun: Create Your Own Mac-like Boot-up Sounds, Alter Your Voice.

Orders: 800-969-4411 by Silicon Shack FAX: 408-374-4412  
5120 Campbell Ave. # 112, San Jose, CA 95130.

Technical: 408-446-4521

Ask for FREE PRODUCT CATALOG of IBM-PC sound products.  
Oevelopers: Ask about TurboSound - PC voice sound engine.

Circle 315 on Reader Service Card

## For OZ-Wizard/ IQ-Electronic Organizer



128 KB RAM CARD  
for OZ-Wizard/IQ-Electronic Organizer Series.  
Trader request desired!



RMS GmbH  
Bauerlandstraße 99  
2390 Flensburg  
West-Germany  
Tel. -49-4 61-4 20 39  
Fax -49-4 61-4 50 26

Circle 28 on Reader Service Card

## FACTORY SALE

### AST RamPage Plus 286

Expanded Memory Board  
For  
IBM XT /286 AT and compatibles  
Up to 8Mb of EMS 4.0 Expanded Memory

#### Configurations

0Kb	\$230.00
512Kb	\$275.00
2Mb	\$350.00
8Mb	\$675.00

- \* Two Year Factory Warranty
- \* FREE Shipping on PrePaid Orders
- \* Immediate Delivery
- \* Dealer Inquiries Welcome

Galaxy Electronics Inc.  
33 Freeman Street  
Newark, NJ 07105  
201 344-5812 FAX 516 374-4170

Circle 396 on Reader Service Card

## A MUST for Computers

# VIZIFLEX SEELS



### The Ideal Keyboard Cover!

Protect your computer and eliminate down-time caused by liquid spills, contaminants, environmental hazards, etc. with VIZIFLEX SEELS - the only keyboard cover that:

- Remains securely in-place during the operation of the keyboard and will not interfere with computer performance in any way.
- Is designed to "form-fit" to the exact contours of the keyboard to provide superior tactile sensitivity & feel for individual keys.
- Consists of UltraFlex™ material, a transparent, flexible "film" which allows all "markings" to be clearly visible.

VIZIFLEX SEELS are the only keyboard covers for your computer!

VIZIFLEX SEELS, INC.  
16 E. Lafayette St., Hackensack, NJ 07601 (201) 487-8080

Circle 371 on Reader Service Card

## SAME DAY SHIPPING

### R & R Electronics

6050-X, McDonough Drive, Norcross, GA 30093  
(404) 368-1777 • Fax (404) 368-9659

Prices subject to change without notice

#### SIMMs

PS/2, AST etc. Call	256Kx9-80	\$18
1Mx9-70	256Kx9-100	\$17
1Mx9-80	1Mx8-80	\$50
1Mx9-100	Other Cards	Call

#### D-RAMS

256K-70	\$2.50	64x1-100	\$1.80
256K-80	\$2.30	64x4-100	\$2.75
256K-100	\$2.20	256x4-100	\$6.00
256K-120	\$2.10	1Mx1-80	\$5.25
256K-150	\$2.00	1Mx1-100	\$5.15

#### INTEL - HIT - CYRIX - WEITEK

8087	\$ 88	80287-12	\$275
8087-2	\$115	80387-SX	\$288
8087-1	\$165	80387-16	\$315
80287-6	\$135	80387-20	\$355
80287-8	\$185	80387-25	\$445
80287-10	\$210	80387-33	\$548

800-736-3644

Circle 296 on Reader Service Card

## VIDEO FRAME GRABBERS



MODEL	RESOLUTION	
HRT 256-4	256 x 256 x 4	495
HRT 256-8	256 x 256 x 8	795
HRT 512-8	512 x 512 x 8	995
HRT 512-24	512 x 512 x 24	1995

- IBM PC/XT/AT COMPATIBLE
- DIGITALIZE IN REAL TIME
- COMPOSITE VIDEO IN
- 24 BIT RGB OUT except model HRT 256-4
- 16 level gray scale out
- SOFTWARE LIBRARY OF IMAGE ANALYSIS ROUTINES
- FREE SOFTWARE UPGRADES TO REGISTERED OWNERS
- FULL CREDIT ON UPGRADE PURCHASE IN FIRST YEAR
- RETURN OLD BOARD AND JUST PAY DIFFERENCE

HRT HIGH RES TECHNOLOGIES  
P.O. BOX 76  
LEWISTON, N.Y. 14092  
PHONE 416-497-6493 FAX 416-497-1988

Circle 161 on Reader Service Card

Arlington Electronics  
**386-SX-16**  
**\$1198**

286-12 40Mb \$ 989  
 386-25 40Mb \$1549  
 386-33 40Mb \$1889  
 64K Hi speed cache

*All systems include:*

- Mono graphics monitor
- 40 Mb Teac IDE HDD
- 1.2 or 1.44 Mb Teac FDD
- 1 Mb 80ns main memory
- 101 Keytronic keyboard
- MS-DOS™ 3.3 or 4.01
- Choice of 3 case designs
- 1 year warranty

3% Shipping charge    Visa    MasterCard  
 AMEX

**1-800 833-3590**

Circle 33 on Reader Service Card

**DYNAMIC RAMS**

4Mx9	80ns	\$295.00
PS2 2M	604.608	\$135.00
1Mx9	80ns	\$ 51.00
1Mx8	80ns	\$ 47.00
256x4	100ns	\$ 5.25
1Mx1	100ns	<b>\$ 4.95</b>
41464	100ns	\$ 2.75
41256	120ns	<b>\$ 2.10</b>
51258	80ns	\$ 3.45
4164	120ns	\$ 1.85

\* For quantity discounts, high speed parts, SIPP. Please Call!

MATH COPROCESSORS	3C87	117 C/RIX	\$ CALL		
80387-33	33MHz	5540.00	20MHz	\$245.00	
80387-25	25MHz	\$435.00	2C87-12	12MHz	\$185.00
80387-20	20MHz	\$350.00	2C87-10	10MHz	\$175.00
80387-16	16MHz	\$305.00	8087-1	10MHz	\$155.00
80387SX	16MHz	\$275.00	V-20	8-10MHz	\$8.5/15

**I.C. EXPRESS**

15140 Valley Blvd. City of Industry, CA 91744  
 Customer Service: (818) 333-8880 FAX: (818) 338-1236

**ORDER: (800) 877-8188** (Mon-Fri 8-5 PST)  
 CALL FOR CURRENT PRICES & VOLUME DISCOUNTS

Prices shown for cash. Minimum 30 day order. Please allow additional shipping. Minimum order: \$10.00. Shipping & Handling: UPS Ground \$5.00. Air \$7.00 (1 lb). ALL MERCHANDISE IS 100% GUARANTEED WITH PROMPT DELIVERY.

Circle 188 on Reader Service Card

**UNIVERSAL PROGRAMMER & TESTER**

MODEL: ALL-03    FOR PC XT/AT/386

**\$695**

INCLUDES:

- Main Module
- SAC-201 Card
- D-25 Cable
- Software
- Manual & Device List

- E(E)PROMS general
- NMOS & CMOS (16k to 512k, 1M to 4M BITS)
- BIPOLAR PROMS
- PAL, CMOS PAL, GAL, PEEL, EPLD, FPL
- Microcomputer (8748, 8751, 87C51 & Z8 series)
- IC TEST (TTL 74/54 & 40/45 series)
- MEMORY TEST
- HEX TO BINARY code converter for INTEL 80/86 HEX
- MOTOROLA S1/S2 HEX and TEKTRONIX HEX
- HIGH SPEED
- 40 PIN test socket with 40 sets of software controlled circuit. 40 sets of programmable
- "GO" KEY & "GOOD" —LED permit stand alone machine operation
- 4 SOCKET ADAPTER (OPTION)

1 Year Warranty & 30 Days Money Back Guarantee —

**ORDER TOLL FREE 1-800-633-3449**  
 IN CALIF (Tel) 408-748-8491 (FAX) 408-748-8492

**C&J MICRONICS**  
 1400 Coleman Ave., #D-13, Santa Clara, CA 95050

Circle 96 on Reader Service Card

**16-BIT RESOLUTION ANALOG-TO-DIGITAL CONVERTER**

**12,000 SAMPLES/SEC**

**for IBM PC, XT & AT**

**SINGLE PIECE PRICE \$475**

We manufacture a broad line of data acquisition and control hardware and software for Apple and IBM computers.

Call for quotes on custom hardware or complete systems.

**LAWSON LABS, INC.**

74 4th AVE. W.N.  
 KALISPELL, MT 59901  
 800 321-5355 or 406 257-5355  
 FAX 406 257-5572

Circle 200 on Reader Service Card

**Intelligent Solutions**  
 NetWare, DOS, OS/2 & Xenix

**SCSI CONTROLLERS FOR ISA & MCA**

Novell tested under NetWare 286

Use with NetWare 286 or 386

Use any size SCSI disk drive

Handle large SCSI hard drives and erasable opticals

NOVELL LABS AUTHORIZED  
**TESTED AND APPROVED**  
 NetWare Compatible

**PROCOMP**

Phone: (216) 234-6387  
 FAX: (216) 234-2233

The SCSI Professionals  
 6801 ENGLE ROAD, CLEVELAND, OH 44130

Circle 287 on Reader Service Card

**T-10 UNIVERSAL PROGRAMMER**

**EPROM ■ PLD ■ Bipolar PROM**

- Built-in LCC & SMT ZIF sockets to 44 pins
- Individual pin driving
- Point & shoot menus, with MOUSE support
- Device updates on disk & BBS
- Built-in margin testing
- Vector testing
- User definable test parameters
- Full screen editing in 2: formats
- Intelligent identifier

**SUNRISE ELECTRONICS, INC.**  
 524 S. Vermont Ave. ■ Glendora, CA 91740  
**(818) 914-1926**

Circle 331 on Reader Service Card

**Made in USA!**



**PC BASED UNIVERSAL DEVICE PROGRAMMER \$695/895**

- Programs EPROMS, MICROS, BIPOLARS, PALs, GALs, EP1Ds, PEELs (current libraries support over 800 devices by over 35 manufacturers)
- Software driven pin drivers. DIA generated programming voltages (8 bit DACs used to generate voltages from 0.1V resolution for all pins).
- Fast device programming/verify (read via dedicated parallel interface).
- Upgradeable for virtually any future programmable devices up to 40 pins.
- Self-sustained operation. No additional modules or plug-in adapters required.
- Includes user friendly MEMORY BUFFER FULL SCREEN EDITOR. Commands include: Fill, Move, Insert, Delete, Search. Data entry can be done in ASCII or HEX form. FUSEMAP EDITOR for Logic devices.
- Friendly Menu-Driven Interface. Device selection by PIN and Manufacturer
- Supports 816/32 bit data word formats.
- Programming algorithms: Normal, Intelligent I & II, Quick Pulse Programming. Automatic selection of fastest algorithm for any given part.
- Verify operation performed at normal & worst case operating voltage.
- Friendly test: JEDEC standard functional testing for logic devices. TTL Logic functional test for 74xx/54xx series devices and memory devices. Test library can be updated by the user. User definable test pattern generation
- File formats accepted: JEDEC (full), JEDEC (kernel), Binary, MOS Technology, Motorola Hex, Intel Hex, Tektronix Hex.
- Base price (\$695) includes Interface card, cable, Memory + Micro + Bipolar library. TTL CMOS/MEMORY device test capability, one year free updates
- Complete price (\$895) includes all of the above plus Logic Device 1 library.
- Library updates can be received via floppy or B&C Customer Support BBS.
- Full 1 year warranty. Customer support via voice line, Fax & dedicated BBS.

**Made in USA!**



**UNIVERSAL RS-232 PROGRAMMER \$345/495**

- Programs EPROMs, ZPROMs, Intel Micros, Flash EPROMs, Memory Cards.
- Stand-Alone Mode for EPROM and Memory Card Duplication / Verify.
- All 2428/32 pin EPROMs to 4 MBits (upgradeable to 32 megabits).
- Micros: 8741A, 72A, 4, 8, 9, 51, CS1, CS1FA/B, 52, 53, 55, CS21, CS41, 9761.
- Model UP100 (\$345), Model UP200 (\$495) accepts dedicated modules.
- Memory Cards Programming Module (Seiko/Epson, Fujitsu) - \$145.
- GANG Programming Module (4 sockets) - \$145.
- Optional built-in Eraser/Timer module - \$50; Conductive foam pad.
- On Board Programming capability; Custom interface modules available.
- User friend. Menu-Driven Interface Program for IBM-PC and Macintosh.
- Can be operated with any computer containing an RS-232 serial port.
- OEM open board programmer configurations available (from \$245).
- One year free software updates and Customer Support.
- Customer support via voice line, dedicated BBS or fax; Full 1 year warranty.

**Made in USA!**



**INTELLIGENT ROM EMULATOR \$395**

- Emulates 2716 through 27512 EPROMs (2k to 64k bytes) with a single unit.
- Megabit parts can be emulated with multiple units (Mega adapter required).
- Connects to the standard parallel printer port. Uses standard printer cable.
- FAST data loading via parallel printer port (64k bytes in less than 10 seconds).
- Intelligent "In-Circuit-Emulator" type features include: Address Compare (with HALT output), Address Snapshot (for target addr. bus monitoring), Trigger Input (for external events monitoring), Programmable Reset Output.
- Powerful Memory buffer editor. Selectable word sizes (8, 16, 32).
- User friendly software. Command set includes: Load, Write, Display, Run, Type, Edit, Fill, Run-Command-File, Monitor, Port, Reset, Help, Calculator.
- Cascadable to 8 units. Includes target cable with Trigger, Halt & Reset clips.
- CMOS model with NiCad rechargeable 9V battery backup - \$495. (Can be used in stand-alone mode; Built-in battery recharging circuitry.)
- File formats accepted: Binary, Intel Hex, Motorola S.

MC / VISA / AMEX    Call today for datasheets!

**B&C MICROSYSTEMS INC.**

750 N. PASTORIA AVE., SUNNYVALE, CA 94086 USA  
 TEL: (408)730-5511 FAX: (408)730-5521 BBS:(408)730-2317

NOVEMBER 1990 • B Y T E 453

# EDITORIAL INDEX BY COMPANY

Index of companies covered in articles, columns, or news stories in this issue  
Each reference is to the first page of the article or section in which the company name appears

Company, Page #	Inquiry #		
<b>A</b>			
Adac, 48	1299	Easy Automation Systems, 66	1278
Adaptec, 172	1111	Energy Conversion Devices, 289, 338	1233
Adaptive Solutions, 342	1003	Entropy Engineering, 73	1158
Adobe Systems, 107		Epson America, 119	
Advanced Hardware Architectures, 331		Eugene Amazon, 73	1146
Advanced Logic Research, 162, 268	1075	Everex Systems, 19, 186	1110
Advanced Micro Devices, 19, 194	1061	Exabyte, 323, 338	1234
Apple Computer, 107, 146	1080	<b>F</b>	
Applied Concepts, 52	1307	F-Chart Software, 70	1285
Archive, 323, 331, 338	1226	FlexStar, 172	1114
Asahi, 275		Fresh Technology Group, 58	1317
Ashton-Tate, 165		Fuji, 275	
AST Research, 186	1108	Fujitsu, 19	
AT&T, 19		Fujitsu America, 172, 338	1115
Atari, 311		Future Domain, 172	1235
Autodesk, 73	1147	FWB, 172	1117
<b>B</b>			
Bellcore, 342	1004	<b>G</b>	
Benchmark Associates, 89	1222	GateWaze, 66, 70	1279
Borland International, 156, 403		Gigatek, 338	1236
British Aerospace, 19		GigaTrend, 323, 338	1237
<b>C</b>			
California Scientific Software, 342	1005	GfRiD Systems, 46	1290
California Software Design, 338	1227	Grolier Electronic Publishing, 73	1149
Cana Group, 48	1300	<b>H</b>	
Canon U.S.A., 235, 338	1228	Harris Semiconductors, 342	1007
Carlisle Memory Products, 338	1229	Hewlett-Packard, 119, 132, 275, 323, 331, 338	1162
cc:Mail, 89	1221	Hitachi America, 323, 338	1239
Cipher Data Products, 338	1230	Holder, Egan, 62	1273
Club American Technologies, 186	1109	HSD Microcomputer U.S., 47	1296
CMC Research, 73	1151	<b>I</b>	
CMS Enhancements, 172	1112	IBM, 19, 97, 275, 338, 395	1240
Colorado Memory Systems, 331, 338	1231	IBM Magnetic Recording Institute, 301	
Compaq Computer, 127, 140, 338	1232	InfoChip Systems, 331, 338	1241
CompuAdd, 46	1292	Informix Software, 221	1226
CompuServe, 107		Innovative Communications Systems, 72	1286
Computer Cowboys, 342	1006	Integrated Information Technology, 19, 194	1064
Computer Virus Industry Association, 466		Intel, 19, 165, 194, 338, 342	1008
Connect, 107		International Data, 395	
Core International, 172	1113	International Standards Organization, 97	
Cyrix, 194	1063	InterNet, 466	
<b>D</b>			
Dariana Technology, 132	1163	IOcomm, 47	1298
Data Access, 89	1224	Iomega, 47	1297
Datacap, 72	1288	Irma Research, 251	1077
Defense Advanced Research Projects Agency, 342		<b>J</b>	
Dell Computer, 19		JVC Information Products, 323, 338	1243
Digital Equipment, 19, 119, 385		<b>L</b>	
Disctec, 266		La Cie, 172	1118
Distributed Processing Technology, 205	1105	Laser Magnetic Storage International, 275, 338	1244
Dolphin Software, 54	1311	LaserGo, 48	1301
<b>E</b>			
<b>J</b>			
<b>K</b>			
<b>L</b>			
<b>M</b>			
<b>N</b>			
<b>O</b>			
<b>P</b>			
<b>Q</b>			
<b>R</b>			
<b>S</b>			

<b>T</b>		<b>U</b>		<b>W</b>		<b>X</b>	
Tandberg Data, 331		UDS, 58	1313	Walt Disney Software, 73	1156	Xeltek, 52	1308
Tandy, 10, 46	1291	UniPress, 227	1018	Wang/Informatics, 251	1076	Xerox, 395	
Teac America, 323, 338	1421	University of California, 342	1014	WangDAT, 323, 338	1425	Xerox Palo Alto Research Center, 385	
Teraplex, 19		University of Tokyo, 342		Wangtek, 323, 338	1426		
Texas Instruments, 19, 262, 342	1012	Upsonic, 258	1106	Weitek, 194	1065		
	1078			Western Digital, 172	1127		
Texas MacExpress, 19		<b>V</b>		Willow Peripherals, 73	1148	<b>Z</b>	
3Com, 97		Velox Computer, 19		WordPerfect, 132	1164	Zenith Data Systems, 301, 338	1427
3M, 275, 338	1422	Ventura Software, 132	1160			Zero Surge, 73	1155
Togai InfraLogic, 342	1013	Vision Software, 70	1282			Zinc Software, 62	1272
Toshiba, 19, 107, 266, 301, 311		Visionary Electronics, 58	1314			Zirco, 52	1304
Toshiba America Information Systems, 338	1423	Visix Software, 227	1019				
Toshiba Semiconductor, 338	1424						
Toyogo, 73	1152						

### BYTE ADVERTISING SALES STAFF:

Steven M. Vito, Associate Publisher/V.P. of Marketing, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281  
 Arthur Kossack, Eastern Advertising Director, Two Prudential Plaza, 180 North Stetson Ave., Chicago, IL 60601, tel. (312) 616-3341  
 Jennifer L. Bartel, Western Advertising Director, 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  
 Dan Savage (617) 860-6344  
 Scott Gagnon (603) 924-2651  
 McGraw-Hill Publications  
 29 Hartwell Avenue  
 Lexington, MA 02173  
 FAX: (617) 860-6999

**EAST COAST**  
 NY, NYC, NJ, DE, PA  
 Kim Norris (212) 512-2645  
 Ariane Casey (212) 512-2368  
 Patricia Payne (603) 924-2654  
 McGraw-Hill Publications  
 1221 Avenue of the Americas—  
 28th Floor  
 New York, NY 10020  
 FAX: (212) 512-2075

**SOUTHEAST**  
 NC, SC, GA, FL, AL, TN, VA,  
 MS, AR, LA, DC, MD, WV, KY  
 John Y. Schilin (404) 843-4782  
 Patricia Payne (603) 924-2654  
 McGraw-Hill Publications  
 4170 Ashford-Dunwoody Road  
 Suite 520  
 Atlanta, GA 30319  
 FAX: (404) 252-4056

**MIDWEST**  
 IL, MO, KS, IA, ND, SD, MN,  
 WI, NE, IN, MI, OH  
 Kurt Kclley (312) 616-3328  
 Mary Ann Goulding (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  
 Alison Keenan (214) 701-8496  
 Patricia Payne (603) 924-2654  
 McGraw-Hill Publications  
 14850 Quorum Drive  
 Suite 380  
 Dallas, TX 75240  
 FAX: (214) 991-6208

**NORTH PACIFIC: San Francisco, CA**  
**NORTHERN CA, OR, ID, MT,  
 WY, NORTHERN NV**  
 Roy J. Kops (415) 954-9728  
 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  
 Leslie Hupp (408) 879-0381  
 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 COUNTY,  
 SAN DIEGO COUNTY, UT**  
 Ron Cordeck (714) 557-6292  
 Jonathan Sawyer (603) 924-2665  
 McGraw-Hill Publications  
 3001 Red Hill Ave.  
 Building #1—Suite 222  
 Costa Mesa, CA 92626  
 FAX: (714) 557-2219

**BYTE BITS (2x3)**  
 Mark Stone (603) 924-6830  
 BYTE Publications  
 One Phoenix Mill Lane  
 Peterborough, NH 03458

**The Buyer's Mart (1x2)**  
 Brian Higgins (603) 924-3754  
 BYTE Publications  
 One Phoenix Mill Lane  
 Peterborough, NH 03458

**Regional Advertising**  
 James Bail (603) 924-2533  
 Barry Echavarria (603) 924-2574  
 Larry Levine (603) 924-2637  
 BYTE Publications  
 One Phoenix Mill Lane  
 Peterborough, NH 03458

**BYTE Deck**  
 Ed Ware (603) 924-2596  
 BYTE Publications  
 One Phoenix Mill Lane  
 Peterborough, NH 03458

**Catalog Showcase**  
**BYTE Inter national Direct  
 Response Postcards**  
 Ellen Perham (603) 924-2598  
 BYTE Publications  
 One Phoenix Mill Lane  
 Peterborough, NH 03458

**Peterborough, NH Office**  
 Inside Sales FAX: 603-924-2683  
 Advertising FAX: 603-924-7507

### International Advertising Sales Staff:

Uwe Kretzschmar, European Advertising and Marketing Manager, BYTE Publications,  
 McGraw-Hill Publishing Co., Wimbledon Bridge House, One Hartfield Road, Wimbledon, London, SW19 3RU, England, Tel: 44 81 543 1234, Fax: 44 81 540 3833

**GERMANY, SWITZERLAND,  
 AUSTRIA**  
 Uwe Kretzschmar (44-81-545-6268)  
**UNITED KINGDOM**  
 Roz Weyman (44-81-545-6269)  
 McGraw-Hill Publishing Co.  
 Wimbledon Bridge House  
 One Hartfield Road  
 Wimbledon, London SW19 3RU  
 England  
 Tel: 44 81 543 1234  
 FAX: 44 81 540 3833  
 TELEX: 892191

**BENELUX**  
 Ellen Pardede  
 Batenburg 103  
 3437 AB Nieuwegein  
 The Netherlands  
 Tel: 31 34 02 49496  
 FAX: 31 34 02 37944

**FRANCE, ITALY**  
 Zena Coupe, Amanda Blaskett  
 A-Z International Sales Ltd.  
 4 Ashmourt Road, Hornsey Lane  
 Highgate, London N19 3BH  
 England  
 Tel: 44 71 281 4116  
 FAX: 44 71 281 8224

**ISRAEL**  
 Dan Ehrlich  
 Ehrlich Communication International  
 P.O. Box 11297  
 Tel Aviv 61112  
 Israel  
 Tel: (972) 3 449823  
 FAX: (972) 3 5468168

**JAPAN**  
 Masaki Mori  
 McGraw-Hill Publishing Co.  
 Overseas Corp.  
 Room 1528  
 Kasumigaseki Bldg.  
 3-2-5 Kasumigaseki,  
 Chiyoda-Ku  
 Tokyo 100, Japan  
 Tel: 81 3 581 9811  
 FAX: 81 3 581 4018

**SWEDEN**  
 Media Marketing AB  
 Karlbergsvagen 89A  
 S-10031 Stockholm  
 Sweden  
 Tel: 46 8 301280

**HONG KONG**  
 Stephen Marcopoto  
 Seavex Ltd.  
 303 Wilson House  
 19-27 Wyndham St.  
 Central, Hong Kong  
 Tel: 852-868-2010  
 Telex: 60904 SEVEX HX  
 FAX: 852 810 1283

**SINGAPORE**  
 Jocelyn Domingo  
 Seavex Ltd.  
 400 Orchard Road, #10-01  
 Singapore 0923  
 Republic of Singapore  
 Tel: 65 734 9790  
 Telex: RS35539 SEAVEX  
 FAX: 65 732 5129

**TAIWAN**  
 Anita Chen  
 Acer TWP  
 977 Min Shen E. Road, 1-4 Flr.  
 Taipei 10581, Taiwan ROC  
 Tel: 886 2 763 0052  
 Fax: 886 2 765 6874

# READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

## Alphabetical Index to Advertisers

Inquiry No.	Page No.						
8	197	107	104A-8	218	327	320	124,125
9	197	108	184	218	327	321	87
10	380	108	90	218	327	322	398
11	380	108	389	218	357	323	398
12	283	109	29	221	390	324	207
13	443	110	318	222	368	325	207
14	451	111	448	223	319	326	223
15	443	112	443	226	44	327	223
16	437	113	447		6,9	328	223
17	2,3	113	443		21	329	94,95
18	2,3	114	421		68,69	331	453
19	204	115	421		129	332	349
20	447	116	253		130,131	333	444
21	450	118	450		232,233	334	452
22	450	119	291		313	335	179
23	383	120	391		317	336	399
24	99	121	196		315	337	399
25	99	122	198		452	338	452
26	300	123	411		192C	339	202,203
27	300	124	448		347	340	202,203
28	450	125	448		415	341	441
29	452	126	319		420	342	452
30	222	127	22,23		329	343	452
31	420	127	137		329	344	421
32	420	128	138A-B		287	345	421
33	447	129	256,257		420	346	351
34	447	129	420		205	347	351
35	86	130	420		118	348	333
36	453	131	226		252	349	333
37	56,57	132	183		314	350	82,83
38	56,57	135	448		238	351	82,83
39	33	136	274		302	352	74
40	444	137	53		403	353	79
41	450	138	372		321	354	435
42	450	139	372		252	355	18
43	187	140	372		110	356	383
44	187	141	452		248,249	357	368
45	237	396	32A-B		12,13	358	368
46	248,249	142	448		84,85	359	17
47	450	143	451		442	360	436,439
48	450	144	30,31		206	361	448
49	444	145	30,31		258	362	189
50	443	146	120		210,211	363	448
51	378,379	147	394		212,213	364	189
52	295	148	76		214,215	365	316
53	414,434	149	421		216,217	366	122
54	6	150	408		218,219	367	35
55	407	151	200		220	368	411
56	420	152	234		242,243	369	402
57	11	153	224		310	370	420
58	11	154	224		111	371	452
59	444	155	224		315	372	336
60	448	156	224		151	373	296
61	451	157	224		201	374	448
62	259	158	98		201	375	443
63	421	161	136,139		201	376	91
64	422-432	162	452		201	377	208
65	434	163	382		35-38	378	108
66	448	164	67		15	379	108
67	320,321	165	270,271		81	380	440
68	432	166	270,271		90	381	440
69	392	167	16,17		112-114	401	IS-74
70	375	168	283		115,116	402	IS-59
71	410	169	295		117	403	IS-69
72	451	170	295		101	404	IS-49
73	451	171	153		435	405	IS-44
74	453	172	153		240	406	IS-44
75	285	173	103		109	407	IS-40,41
76	285	174	100		165	408	IS-72
77	25	175	100		361	409	IS-72
78	25	176	26,27		123	410	IS-56
79	84	177	26,27		28A-B	411	IS-38
80	85	178	169		453	412	IS-38
81	386	179	169		420	413	IS-39
82	199	180	170,171		59-61	414	IS-39
83	451	181	421		158-161	415	IS-73
84	390	182	443		158-181	416	IS-46
85	154,155	183	144,145		135	417	IS-52
86	98A-D	184	144,145		451	418	IS-56
87	184A-D	185	308,309		135	419	IS-73
88	380	186	440		451	420	IS-73
89	383	187	362,363		418	421	IS-46
90	282	188	453		418	422	IS-52
91	225	189	446		418	423	IS-56
92	225	190	340,341		418	424	IS-72
93	328	191	420		418	425	IS-74
94	250	192	420		418	426	IS-55
95	445	193	420		418	427	IS-47
96	434	194	285		418	428	IS-13
97	230,231	195	126		418	429	IS-9
98	208	196	444		418	430	IS-7
99	433	197	413		418	431	IS-64
100	433	198	440		418	432	IS-64
101	451	199	184		418	433	IS-28
102	280,281	200	453		418	434	IS-28
103	280,281	201	453		418	435	IS-20
104	280,281	202	433		418	436	IS-20
105	330	203	447		418	437	IS-30
106	330	204	447		418	438	IS-65
107	380	205	447		418	439	IS-64
108	352	206	447		418	440	IS-64
109	352	207	50,51		418	441	IS-64
110	453	208	297		418	442	IS-62
111	409	209	297		418	443	IS-62
112	440	210	229		418	444	IS-7
113	121	211	77		418	445	IS-20
114	192B	212	416		418	446	IS-20
115	192B	213	416		418	447	IS-62
116	192B	214	75		418	448	IS-62
117	448	215	416		418	449	IS-7
118	421	216	416		418	450	IS-7
119	448	217	294		418	451	IS-7
120	421	218	75		418	452	IS-7
121	448	219	452		418	453	IS-7
122	448	220	452		418	454	IS-7
123	448	221	452		418	455	IS-7
124	448	222	452		418	456	IS-7
125	448	223	452		418	457	IS-7
126	448	224	452		418	458	IS-7
127	448	225	452		418	459	IS-7
128	448	226	452		418	460	IS-7
129	448	227	452		418	461	IS-7
130	448	228	452		418	462	IS-7
131	448	229	452		418	463	IS-7
132	448	230	452		418	464	IS-7
133	448	231	452		418	465	IS-7
134	448	232	452		418	466	IS-7
135	448	233	452		418	467	IS-7
136	448	234	452		418	468	IS-7
137	448	235	452		418	469	IS-7
138	448	236	452		418	470	IS-7
139	448	237	452		418	471	IS-7
140	448	238	452		418	472	IS-7
141	448	239	452		418	473	IS-7
142	448	240	452		418	474	IS-7
143	448	241	452		418	475	IS-7
144	448	242	452		418	476	IS-7
145	448	243	452		418	477	IS-7
146	448	244	452		418	478	IS-7
147	448	245	452		418	479	IS-7
148	448	246	452		418	480	IS-7
149	448	247	452		418	481	IS-7
150	448	248	452		418	482	IS-7
151	448	249	452		418	483	IS-7
152	448	250	452		418	484	IS-7
153	448	251	452		418	485	IS-7
154	448	252	452		418	486	IS-7
155	448	253	452		418	487	IS-7
156	448	254	452		418	488	IS-7
157	448	255	452		418	489	IS-7
158	448	256	452		418	490	IS-7
159	448	257	452		418	491	IS-7
160	448	258	452		418	492	IS-7
161	448	259	452		418	493	IS-7
162	448	260	452		418	494	IS-7
163	448	261	452		418	495	IS-7
164	448	262	452		418	496	IS-7
165	448	263	452		418	497	IS-7
166	448	264	452		418	498	IS-7
167							

# READER SERVICE

\* Correspond directly with company.

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
445 IQ ENGINEERING	IS-15	<b>REGIONAL SECTIONS</b>		587 H.CO COMPUTER PRODUCTS	NE-20	672 MICA COMPUTER	PC-23
446 IQ ENGINEERING	IS-15			588 IME COMPUTERS	NE-2	673 MICA COMPUTER	PC-23
447 IC INFO SYSTEMS	IS-35			589 IME COMPUTERS	NE-2	674 MICRO DESIGNS	PC-4
448 LASERMASTER CORP	IS-75			570 INTERFACE GROUP	NE-7	675 MICRO DESIGNS	PC-4
449 LASERMASTER CORP	IS-75			571 INTERFACE GROUP	NE-7	676 MICROSPEED COMPUTERS	PC-16
451 LOGIDATA TECH	IS-51			572 INTRA ELECTRONICS	NE-32	677 MICROSPEED COMPUTERS	PC-16
452 MASHOV (MSE) LTD	IS-67			573 MANCHESTER EQUIPMENT	NE-1	678 MICROCOM COMPUTERS	PC-24
453 MAXIT DEVELOPMENT/OSBORNE	IS-78			574 MANCHESTER EQUIPMENT	NE-72A-B	679 MICROCOMPUTER MKTG.CNCL	PC-17
454 MAXIT DEVELOPMENT/OSBORNE	IS-78			575 MICRO DESIGNS	NE-4	680 MYODA,INC	PC-17
455 MAYFAIR MICROS	IS-14			576 MICRO DESIGNS	NE-4	681 MYODA,INC	PC-14
456 MEGADATA	IS-36			577 MICROSPEED COMPUTERS	NE-13	682 OPTICAL PUBLISHING,INC	PC-14
457 MEGADATA	IS-36			578 MICROSPEED COMPUTERS	NE-13	683 OPTICAL PUBLISHING,INC	PC-2
458 MICROGRAFX	IS-43			579 MYODA,INC	NE-23	684 PROSPERO SOFTWARE,INC	PC-2
459 MINOLTA GMBH	IS-23			580 MYODA,INC	NE-23	685 PROSPERO SOFTWARE,INC	PC-2
461 PHILIPS	IS-27			581 MYODA,INC	NE-23	686 SAMPO TECHNOLOGY CORP	PC-30
462 PROGRAMMERS ODYSSEY	IS-12			582 REASON TECHNOLOGIES	NE-9	687 THE PRINTER WORKS	PC-10,11
463 PROLOG DEVELOPMENT CTR	IS-80			583 SAMPO TECHNOLOGY CORP	NE-26	688 THE PRINTER WORKS	PC-10,11
464 SAGE/POLYTRON	IS-24			* SCAN SYMPOSIUM	NE-22	689 UNITED INNOVATIONS	PC-20
465 SMART SOFTWARE	IS-48			584 C.E.T.D.C.	NE-15	690 ZERICON	PC-15
* SOFTLINE CORP	IS-45						
466 SOFTWARE CONSTRUCTION CO.	IS-57						
467 SOFTWARE DEVELOPMENT SYS	IS-33						
468 SOFTWARE DMI	IS-16						
469 SUN'S ELECTRONICS CO. LTD	IS-54						
470 SURAH,INC.	IS-74						
470 TATUNG	IS-37						
471 TEAC	IS-10						
480 TP ENTERPRISE LTD	IS-68						
473 TRIANGLE DIGITAL SERVICES	IS-72						
474 TRIGEM	IS-2						
475 TWINHEAD	IS-18,19						
476 UNIVERSAL DATA SYSTEMS	IS-31						
477 UNIVERSAL DATA SYSTEMS	IS-31						
478 USA SOFTWARE	IS-29						
479 VIKING SOFTWARE SERVICE	IS-52						
<b>INT'L DIRECT RESPONSE POSTCARDS</b>							
* BYTEWEEK	IS						
* C USERS JOURNAL	IS						
* COMPUTER SOLUTIONS	IS						
* COMPUTER SOLUTIONS,N.W.	IS						
* DIGIBOARD	IS						
* GATEWAY 2000	IS						
* KEITHLEY/METRAYTE	IS						
* MBP	IS						
* MGRAPH,INC	IS						
* PROGRAMMER'S JOURNAL	IS						
* REASONABLE SOLUTIONS	IS						
* TECH SPECIALIST	IS						
<b>Midwest</b> 72 MW1-24							
588 ADI CORPORATION	MW-21						
589 BSI	MW-5						
590 BSI	MW-5						
591 CAF COMPUTER CORP	MW-23						
592 C.E.T.D.C.	MW-22						
593 CHUN YUN ELECTRONICS	MW-19						
594 DERBYTECH COMPUTERS	MW-1						
595 DERBYTECH COMPUTERS	MW-1						
596 IME COMPUTERS	MW-2						
597 IME COMPUTERS	MW-2						
598 INTERFACE GROUP	MW-3						
599 INTERFACE GROUP	MW-3						
600 INTRA ELECTRONICS	MW-24						
601 IRIS SOFTWARE	MW-11						
602 IRIS SOFTWARE	MW-11						
603 MICRO DESIGNS	MW-4						
604 MICRO DESIGNS	MW-4						
605 MICROSPEED COMPTERS	MW-9						
606 MICROSPEED COMPTERS	MW-9						
607 MICROCOM COMPUTERS	MW-13						
608 MYODA,INC	MW-15						
609 MYODA,INC	MW-15						
610 REASON TECHNOLOGY	MW-9,7						
611 SAMPO TECHNOLOGY CORP	MW-18						
612 SOFT & MORE	MW-16						
<b>Northeast</b> 72 NE1-32							
551 ADI CORPORATION	NE-29						
552 BITWISE DESIGNS,INC	NE-12						
553 BITWISE DESIGNS,INC	NE-12						
554 BRIGHTBILL-ROBERTS	NE-5						
555 BSI	NE-16						
556 BSI	NE-18						
557 CAF COMPUTER CORP	NE-31						
558 C.E.T.D.C.	NE-30						
559 CHUN YUN ELECTRONICS	NE-27						
560 COMPLYNYK	NE-3						
561 COMPLYNYK	NE-3						
* COMP. GRAPHICS SHOW '91	NE-24						
562 COMP. SALES PROFESSIONAL	NE-11						
563 COMP. SALES PROFESSIONAL	NE-11						
564 DERBYTECH COMPUTERS	NE-17						
565 DERBYTECH COMPUTERS	NE-17						
566 H.CO COMPUTER PRODUCTS	NE-20						
<b>Pacific Coast</b> 72 PC1-36							
645 ADI CORPORATION	PC-33						
646 AYDIN CONTROLS	PC-26						
647 AYDIN CONTROLS	PC-26						
648 BOFFIN LTD	PC-7						
649 BOFFIN LTD	PC-7						
650 BRIGHTBILL-ROBERTS	PC-6						
651 BSI	PC-28						
652 BSI	PC-28						
653 CAF COMPUTER CORP	PC-35						
654 C.E.T.D.C.	PC-34						
655 CHUN YUN ELECTRONICS	PC-31						
656 CONVEX	PC-9						
657 DERBYTECH COMPUTERS	PC-1						
658 DERBYTECH COMPUTERS	PC-1						
659 MICRO WEST 90	PC-5						
660 EASY NETWORK	PC-19						
661 EASY NETWORK	PC-19						
662 H.CO COMPUTER PRODUCTS	PC-21						
663 H.CO COMPUTER PRODUCTS	PC-21						
664 IME COMPUTERS	PC-14						
665 IME COMPUTERS	PC-14						
666 INTERFACE GROUP	PC-3						
667 INTERFACE GROUP	PC-3						
668 INTRA ELECTRONICS	PC-36						
669 IRIS SOFTWARE	PC-13						
670 IRIS SOFTWARE	PC-13						
671 METAWARE	PC-25						
<b>South</b> 72 SO1-24							
615 ADI CORPORATION	SO-21						
616 BOFFIN LTD	SO-13						
617 BOFFIN LTD	SO-13						
618 BSI	SO-5						
619 BSI	SO-5						
620 BUSINESS COMPUTER SYS	SO-9						
621 BUSINESS COMPUTER SYS	SO-9						
* BYTE CARD DECK	SO-9						
622 CAF COMPUTER CORP	SO-23						
623 C.E.T.D.C.	SO-22						
624 CHUN YUN ELECTRONICS	SO-19						
625 DERBYTECH COMPUTERS	SO-7						
626 DERBYTECH COMPUTERS	SO-7						
627 IME COMPUTERS	SO-2						
628 IME COMPUTERS	SO-2						
629 INTERFACE GROUP	SO-3						
630 INTERFACE GROUP	SO-3						
631 INTRA ELECTRONICS	SO-24						
632 MICRO DESIGNS	SO-4						
633 MICRO DESIGNS	SO-4						
634 MICROSPEED COMPUTERS	SO-16						
635 MICROSPEED COMPUTERS	SO-16						
636 MICROCOM COMPUTERS	SO-11						
637 MYODA,INC	SO-1						
638 MYODA,INC	SO-1						
639 SAMPO TECHNOLOGY CORP	SO-18						
640 SOFT & MORE	SO-15						

## BYTE ADVERTISING SALES STAFF:

Steven M. Vito, Associate Publisher/V.P. of Marketing, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281  
 Arthur Kossack, Eastern Advertising Director, Two Prudential Plaza, 180 North Stetson Ave., Chicago, IL 60601, tel. (312) 616-3341  
 Jennifer L. Bartel, Western Advertising Director, 14850 Quorum Drive, Suite 380, Dallas, TX 75240, tel. (214) 701-8496  
 Liz Coymann, 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  
 Dan Savage (617) 860-6344  
 Scott Gagnon (603) 924-2651  
 McGraw-Hill Publications  
 29 Hartwell Avenue  
 Lexington, MA 02173  
 FAX: (617) 860-6999

**EAST COAST**  
 NY, NJ, DE, PA  
 Kim Norris (212) 512-2645  
 Ariane Casey (212) 512-2368  
 Patricia Payne (603) 924-2654  
 McGraw-Hill Publications  
 1221 Avenue of the Americas—  
 28th Floor  
 New York, NY 10020  
 FAX: (212) 512-2075

**SOUTHEAST**  
 NC, SC, GA, FL, AL, TN, VA,  
 MS, AR, LA, DC, MD, WV, KY  
 John Y. Schilin (404) 843-4782  
 Patricia Payne (603) 924-2654  
 McGraw-Hill Publications  
 4170 Ashford-Dunwoody Road  
 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  
 Mary Ann Goulding (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,  
 Alison Keenan (214) 701-8496  
 Patricia Payne (603) 924-2654  
 McGraw-Hill Publications  
 14850 Quorum Drive  
 Suite 380  
 Dallas, TX 75240  
 FAX: (214) 991-6208

**NORTH PACIFIC:** San Francisco, CA  
**NORTHERN CA, OR, ID, MT,  
 WY, NORTHERN NV**  
 Roy J. Kops (415) 954-9728  
 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  
 Leslie Hupp (408) 879-0381  
 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 COUNTY,  
 SAN DIEGO COUNTY, UT**  
 Ron Cordek (714) 557-6292  
 Jonathan Sawyer (603) 924-2665  
 McGraw-Hill Publications  
 3001 Red Hill Ave.  
 Building #1—Suite 222  
 Costa Mesa, CA 92626  
 FAX: (714) 557-2219

**BYTE BITS (2x3)**  
 Mark Stone (603) 924-6830  
 BYTE Publications  
 One Phoenix Mill Lane  
 Peterborough, NH 03458

**The Buyer's Mart (1x2)**  
 Brian Higgins (603) 924-3754  
 BYTE Publications  
 One Phoenix Mill Lane  
 Peterborough, NH 03458

**Regional Advertising**  
 James Bail (603) 924-2533  
 Barry Echavarria (603) 924-2574  
 Larry Levine (603) 924-2637  
 BYTE Publications  
 One Phoenix Mill Lane  
 Peterborough, NH 03458

**BYTE Deck**  
 Ed Ware (603) 924-2596  
 BYTE Publications  
 One Phoenix Mill Lane  
 Peterborough, NH 03458

**Catalog Showcase**  
**BYTE International Direct  
 Response Postcards**  
 Ellen Perham (603) 924-2598  
 BYTE Publications  
 One Phoenix Mill Lane  
 Peterborough, NH 03458

**Peterborough, NH Office**  
 Inside Sales FAX: 603-924-2683  
 Advertising FAX: 603-924-7507

## International Advertising Sales Staff:

Uwe Kretschmar, European Advertising and Marketing Manager, BYTE Publications,  
 McGraw-Hill Publishing Co., Wimbledon Bridge House, One Hartfield Road, Wimbledon, London, SW19 3RU, England, Tel: 44 81 543 1234, Fax: 44 81 540 3833

**GERMANY, SWITZERLAND,  
 AUSTRIA**  
 Uwe Kretschmar (44-81-545-6268)  
**UNITED KINGDOM**  
 Roz Weyman (44-81-545-6269)  
 McGraw-Hill Publishing Co.  
 Wimbledon Bridge House  
 One Hartfield Road  
 Wimbledon, London SW19 3RU  
 England  
 Tel: 44 81 543 1234  
 FAX: 44 81 540 3833  
 TELEX: 892191

**BENELUX**  
 Ellen Pardede  
 Batenburg 103  
 3437 AB Nieuwegein  
 The Netherlands  
 Tel: 31 34 02 49496  
 FAX: 31 34 02 37944

**FRANCE, ITALY**  
 Zena Coupe, Amanda Blaskett  
 A-Z International Sales Ltd.  
 4 Ashmont Road, Hornsey Lane  
 Highgate, London N19 3BH  
 England  
 Tel: 44 71 281 4116  
 FAX: 44 71 281 8224

**ISRAEL**  
 Dan Ehrlich  
 Ehrlich Communication International  
 P.O. Box 11297  
 Tel Aviv 61112  
 Israel  
 Tel: (972) 3 449823  
 FAX: (972) 3 5468168

**JAPAN**  
 Masaki Mori  
 McGraw-Hill Publishing Co.  
 Overseas Corp.  
 Room 1528  
 Kasumigaseki Bldg.  
 3-2-5 Kasumigaseki,  
 Chiyoda-Ku  
 Tokyo 100, Japan  
 Tel: 81 3 581 9811  
 FAX: 81 3 581 4018

**SWEDEN**  
 Media Marketing AB  
 Karlbergsvagen 89A  
 S-10031 Stockholm  
 Sweden  
 Tel: 46 8 301280

**HONG KONG**  
 Stephen Marcopoto  
 Seavex Ltd.  
 503 Wilson House  
 19-27 Wyndham St.  
 Central, Hong Kong  
 Tel: 852-868-2010  
 Telex: 60904 SEVEX HX  
 FAX: 852 810 1283

**SINGAPORE**  
 Jocelyn Domingo  
 Seavex Ltd.  
 400 Orchard Road, #10-01  
 Singapore 0923  
 Republic of Singapore  
 Tel: 65 734 9790  
 Telex: RS35539 SEAVEX  
 FAX: 65 732 5129

**TAIWAN**  
 Anita Chen  
 Acer TWP  
 977 Min Shen E. Road, 1-4 Flr.  
 Taipei 10581, Taiwan ROC  
 Tel: 886 2 763 0052  
 Fax: 886 2 765 6874

# READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

\* Correspond directly with company.

## Index to Advertisers by Product Category

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.			
<b>HARDWARE</b>										
926	ADD INS	930	<b>HARDWARE PROGRAMMERS</b>	451	LOGIDATA TECH	IS-61	646	AYDIN CONTROLS	PC-26	
10	ABTECH, INC.	57	BINARY TECHNOLOGY, INC.	443	456	MEGADATA	IS-38	647	AYDIN CONTROLS	PC-26
11	ABTECH, INC.	96	BP MICROSYSTEMS	451	457	MEGADATA	IS-38	552	BITWISE DESIGNS, INC.	NE-12
21	AMERICAN ADVANTECH	152	C&J MICRONICS	453	398	PRACTICAL PERIPHERALS	123	553	BITWISE DESIGNS, INC.	NE-12
28	AMS GMBH	153	GTEK, INC.	408	350	TOUCHBASE SYSTEMS, INC.	74	616	BOFFIN LTD	SO-13
483	ARGOSY	201	GTEK, INC.	408	476	UNIVERSAL DATA SYSTEMS	IS-31	617	BOFFIN LTD	SO-13
47	BINARY DATA ACQUISITION	204	LINK COMPUTER GRAPHICS	433	477	UNIVERSAL DATA SYSTEMS	IS-31	648	BOFFIN LTD	PC-7
408	BLUE CHIP TECHNOLOGY	205	LOGICAL DEVICES, INC.	447		US ROBOTICS	316	649	BOFFIN LTD	PC-7
64	CACHING TECHNOLOGY	257	NOHAU CORP	397		VERMONT CREATIVE SOFTWARE	35	555	BSI	NE-16
65	CACHING TECHNOLOGY	331	SUNRISE ELECTRONICS, INC.	453				556	BSI	NE-16
68	CAPITAL EQUIPMENT CORP.	375	XELTEK	443	936	<b>MONITORS</b>		589	BSI	MW-5
69	CAPITAL EQUIPMENT CORP.				551	ADI CORPORATION	NE-29	618	BSI	SO-5
	CLEO COMMUNICATIONS, INC.	931	<b>INSTRUMENTATION</b>		588	ADI CORPORATION	MW-21	619	BSI	SO-5
417	COMPEX, INC.	71	CME TELEMETRIX	451	615	ADI CORPORATION	SO-21	651	BSI	PC-28
418	COMPEX, INC.	101	DATAQ INSTRUMENTS, INC.	448	645	ADI CORPORATION	PC-33	652	BSI	PC-28
82	CONTROL CORP.	124	ELEXOR ASSOCIATES, INC.	453	21	AMERICAN ADVANTECH	450	557	CAF COMPUTER CORP.	NE-31
85	CRESOCO DATA A/S	200	LAWSON LABS, INC.	453	559	CHUN YUN ELECTRONICS	NE-27	591	CAF COMPUTER CORP.	MW-23
94	CYRIX	235	MOUSE SYSTEMS	252	583	CHUN YUN ELECTRONICS	MW-19	622	CAF COMPUTER CORP.	SO-23
95	CYRIX	251	NATIONAL INSTRUMENTS	CI/II	625	CHUN YUN ELECTRONICS	SO-19	653	CAF COMPUTER CORP.	PC-35
424	C. T. S. LTD.	932	<b>KEYBOARDS/MICE</b>		656	CHUN YUN ELECTRONICS	PC-31	70	CLUB AMERICAN TECH., INC.	199
98	DATA TRANSLATION	99	DATALUX	192B	91	CTX INTERNATIONAL	330		COMPAQ	154, 155
118	DISTRIBUTED PROCESSING TECH	100	DATALUX	192B	92	CTX INTERNATIONAL	330		COMPAQUAD	88A-D
117	DISTRIBUTED PROCESSING TECH	110	DIGITAL VISION	319	169	IYAMA ELECTRIC CO., LTD.	293		COMPAQUAD	164A-D
119	DSM DIGITAL SERVICE	147	GRAPHTEC	394	443	INTERQUAD LTD.	IS-5	560	COMPLYNKK	NE-3
482	GALAXY MICROGRAFT SYS. COIS-70	436	GTCO	IS-20	236	NANAO USA CORP.	238	561	COMPLYNKK	NE-3
145	GRAPHIC SOFTWARE SYSTEMS 120	437	GTCO	IS-20	237	NANAO USA CORP.	238	562	COMP. SALES PROFESSIONAL	NE-11
146	GRAPHIC SOFTWARE SYSTEMS 120	206	LOGITECH, INC.	50,51	254	NEC HOME ELECT (MONITORS)	12, 13	563	COMP. SALES PROFESSIONAL	NE-11
152	GTEK, INC.	207	LOGITECH, INC.	50,51	276	PANASONIC (MONITORS)	15	93	CURTIS, INC.	380
153	GTEK, INC.	208	LOGITECH, INC.	297	481	PHILLIPS	IS-27		DAK INDUSTRIES	42, 45
160	HERCULES	208	LOGITECH, INC.	297	937	<b>NETWORK HARDWARE</b>		103	DELL COMPUTER CORP.	CH-1
161	HIGH RES TECHNOLOGIES	209	LOGITECH, INC.	297	401	3EST USA	IS-74	104	DELL COMPUTER CORP.	102, 103
175	INTEL CORP.	261	NORTHGATE COMPUTER SYS	214, 215	41	BAY TECHNICAL ASSOCIATES	187	105	DELL COMPUTER CORP.	104, 105
176	INTEL CORP.	282	PERCON	433	42	BAY TECHNICAL ASSOCIATES	187		DELL COMPUTER CORP.	104A-B
177	INTEL CORP.	377	ZENY COMPUTER SYS., INC.	208	43	BAY TECHNICAL ASSOCIATES	237	564	DERBYTECH COMPUTERS	NE-17
178	INTEL CORP.				44	BAY TECHNICAL ASSOCIATES	237	565	DERBYTECH COMPUTERS	NE-17
182	IO TECH	933	<b>MASS STORAGE</b>		399	BUFFALO PRODUCTS	258	594	DERBYTECH COMPUTERS	MW-1
447	JC INFO SYSTEMS	14	AK SYSTEMS	451	82	CONTROL CORP.	230, 231	595	DERBYTECH COMPUTERS	SO-7
200	LAWSON LABS, INC.	67	CANON (OPTICAL CARD)	71	87	CSS LABS	280, 281	625	DERBYTECH COMPUTERS	SO-7
453	MAXIT DEVELOPMENT/OSBORNE	420	COMPUTER CONNECTIONS	IS-53	423	CYBEX	IS-56	657	DERBYTECH COMPUTERS	PC-1
454	MAXIT DEVELOPMENT/OSBORNE	422	COSTGOLD RESEARCH LTD	IS-52	103	DELL COMPUTER CORP.	1, CH		ELONEX	IS-47
226	MICROPROCESSORS UNLTD.	97	DATA STRATEGIES INT'L	440	428	EASY NETWORK	IS-55	127	ERGO COMPUTING	137
227	MICROSTAR LABORATORIES	111	DIGI-DATA	448	429	EASY NETWORK	IS-55	128	EVEREX SYSTEMS	256, 257
	MICROWAY	137	FLAGSTAFF ENGINEERING	274	680	EASY NETWORK	PC-19	132	FALCO DATA PRODUCTS	183
386	MYLEX	181	INWIN DEVELOPMENT, INC.	IS-60	681	EASY NETWORK	PC-19	138	FLYTECH TECHNOLOGIES, INC.	53
387	MYLEX	198	LAGUNA CONVERSION SYS	440		ELONEX	IS-47	431	FORTTRON	IS-9
280	PERCEPTIVE SOLUTIONS, INC.	217	MAYNARD ELECTRONICS	357	131	FAIRCOM CORP.	226	432	FORTTRON	IS-9
281	PERCEPTIVE SOLUTIONS, INC.	218	MAYNARD ELECTRONICS	357	138	FLYTECH TECHNOLOGIES, INC.	53		GATEWAY 2000	32A-H
287	PROCOMP, USA	223	MICRO SOLUTIONS COMP. PROD.	318	344	THE SOFTWARE LINK	332	155	HAUHPAUGE COMPUTER WORKS	234
290	PROMISE TECHNOLOGY, INC.	280	PERCEPTIVE SOLUTIONS, INC.	325	345	THE SOFTWARE LINK	332	566	H.CO COMPUTER PRODUCTS	NE-20
240	QUA TECH, INC.	281	PERCEPTIVE SOLUTIONS, INC.	325	346	THE SOFTWARE LINK	333	567	H.CO COMPUTER PRODUCTS	NE-20
241	QUA TECH, INC.	284	PINNACLE MICRO	109	347	THE SOFTWARE LINK	333	683	H.CO COMPUTER PRODUCTS	PC-21
242	QUA TECH, INC.	285	PLUS DEVELOPMENT	185	938	<b>PRINTERS/PLOTTERS</b>		168	IBM PS/2	16, 17
243	QUA TECH, INC.	286	QUALSTAR CORP.	440		EPSON	22, 23	568	IME COMPUTERS	NE-2
244	QUA TECH, INC.	294	QUALSTAR CORP.	440		HEWLETT-PACKARD PERIP	138, 139	569	IME COMPUTERS	NE-2
245	QUA TECH, INC.	306	SANKYO SEIKI (U.K.) LTD	337	163	HOUSTON INSTRUMENT	67	586	IME COMPUTERS	MW-2
246	QUA TECH, INC.	318	SONY	369	164	HOUSTON INSTRUMENT	67	597	IME COMPUTERS	MW-2
247	QUA TECH, INC.	324	STORAGE DIMENSIONS	207	165	HOUSTON INSTRUMENT	67	627	IME COMPUTERS	SO-2
248	QUA TECH, INC.	325	STORAGE DIMENSIONS	207	448	LASERMASTER CORP.	IS-75	628	IME COMPUTERS	SO-2
468	SUN'S ELECTRONICS CO. LTD	471	TEAC	IS-10	449	LASERMASTER CORP.	IS-75	664	IME COMPUTERS	PC-14
470	TATUNG	372	VOGON ENTERPRISES LTD	338	459	MINOLTA GMBH	IS-23	665	IME COMPUTERS	PC-14
338	TECHNOLOGY POWER ENTER	934	<b>MISCELLANEOUS</b>		274	PANASONIC (LASER PRINTER)	38, 38	600	INTRA ELECTRONICS	NE-32
342	THE PERISCOPE CO	16	ALPHA PRODUCTS	437	278	PENTAX TECHNOLOGIES	181	631	INTRA ELECTRONICS	MW-24
343	THE PERISCOPE CO	21	AMERICAN ADVANTECH	450	489	SURAH, INC.	IS-74	638	INTRA ELECTRONICS	PC-38
400	TP ENTERPRISE LTD.	28	AMS GMBH	452	393	TEKTRONIX	202, 203	187	IVERSON COMPUTER CORP.	382, 383
473	TRIANGLE DIGITAL SERVICES	29	ANNABOOKS	222	394	TEKTRONIX	202, 203	192	JEMINI ELECTRONICS	450
355	TRUEVISION, INC.	63	COVOX, INC.	433	687	THE PRINTER WORKS	PC-10, 11	573	MANCHESTER EQUIPMENT	NE-1
359	UNICORE SOFTWARE	84	COVOX, INC.	433	688	THE PRINTER WORKS	PC-10, 11		MANCHESTER EQUIPMENT	NE-72A-B
927	<b>DRIVES</b>	425	DIETRICH POS-EQUIPMENT	IS-74	689	UNITED INNOVATIONS	PC-20	221	MAGELAT COMPUTER CORP.	390
78	COMPUTER UPGRADE CORP.	439	IQEL	IS-65	690	ZERICON	PC-15	672	MICA COMPUTER	PC-23
79	COMPUTER UPGRADE CORP.	171	INFOCUS, INC.	153	939	<b>PRINTER RIBBONS/SUPPLIES</b>		673	MICA COMPUTER	PC-23
83	CURTIS, INC.	172	INFOCUS, INC.	153	270	PACIFIC DATA PRODUCTS	151	575	MICRO DESIGNS	NE-4
568	IME COMPUTERS	174	INTEGRAND	100	271	PACIFIC DATA PRODUCTS	151	603	MICRO DESIGNS	NE-4
569	IME COMPUTERS	445	IQ ENGINEERING	IS-15	940	<b>SCANNERS/IMAGE PROCESSORS</b>		604	MICRO DESIGNS	MW-4
596	IME COMPUTERS	446	IQ ENGINEERING	IS-15	395	DFI	389	632	MICRO DESIGNS	SO-4
597	IME COMPUTERS	195	KILA SYSTEMS	447		HEWLETT-PACKARD PERIP	270, 271	633	MICRO DESIGNS	SO-4
627	IME COMPUTERS	222	MERRITT COMPUTER PRODUCT	368	941	<b>SOFTWARE SECURITY</b>		674	MICRO DESIGNS	PC-4
628	IME COMPUTERS	226	MICROPROCESSORS UNLTD.	444	404	ALADDIN	IS-49	675	MICRO DESIGNS	PC-4
664	IME COMPUTERS	272	PACIFIC DATA PRODUCTS	201	430	FAST ELECTRONIC	IS-63	676	MICROCOM COMPUTERS	PC-27
685	IME COMPUTERS	273	PACIFIC DATA PRODUCTS	201	291	PROTECH MARKETING	135	577	MICROSPEED COMPUTERS	NE-13
183	IOMEGA	334	PRINCETON PUBL. LABS	288A-B	292	PROTECH MARKETING	135	605	MICROSPEED COMPUTERS	NE-13
184	IOMEGA	373	TALKING TECHNOLOGY, INC.	444	300	RAINBOW	83	634	MICROSPEED COMPUTERS	MW-9
223	MICRO SOLUTIONS COMP. PROD.	368	VIDEX	402	301	RAINBOW	83	678	MICROSPEED COMPUTERS	SO-16
231	MITSUBISHI ELECTRONICS	369	VIDEX	402	942	<b>SYSTEMS</b>		677	MICROSPEED COMPUTERS	PC-16
232	MITSUBISHI ELECTRONICS	371	VIZIFLEX SEELS, INC.	452	402	ACER	IS-59		MICROWAY	192C
269	OVERLAND DATA	373	WIESEMANN & THEIS GMBH	296	12	ACMA	283	229	MIS COMPUTER SYSTEMS	329
474	TRIGEM	380	Z-WORLD ENGINEERING	440	403	AGC	IS-89	579	MYODA, INC.	NE-23
356	TULIN CORPORATION	381	Z-WORLD ENGINEERING	440	17	ALR	2, 3	580	MYODA, INC.	NE-23
357	TULIN CORPORATION				18	ALR	2, 3	608	MYODA, INC.	MW-15
928	<b>FACSIMILE</b>				18	ALR	2, 3	609	MYODA, INC.	MW-15
15	ALL THE FAX	41	BAY TECHNICAL ASSOCIATES	187	19	ALTEC	204	637	MYODA, INC.	SO-1
620	BUSINESS COMPUTER SYS	42	BAY TECHNICAL ASSOCIATES	187	20	AMC PRODUCTS	447	638	MYODA, INC.	SO-1
621	BUSINESS COMPUTER SYS	43	BAY TECHNICAL ASSOCIATES	237	22	AMERICAN MITAC	393	679	MYODA, INC.	PC-17
444	INTERQUAD LTD	44	BAY TECHNICAL ASSOCIATES	237	25	AMERICAN RESEARCH CORP	300	680	MYODA, INC.	PC-17
929	<b>GRAPHICS TABLETS</b>	74	COMPUCOM	433	26	AMERICAN RESEARCH CORP	300	253	NCR EUROPE	246, 249
328	SUMMAGRAPHICS	77	COMPUTER PERIPHERALS	328	30	AMERICAN RESEARCH CORP	300	255	NEC SYSTEMS	64, 65
327	SUMMAGRAPHICS	139	FORVAL AMERICA, INC.	372	33	ARLINGTON ELECTRONICS	453	258	NORTHGATE COMPUTER SYS.	209
328	SUMMAGRAPHICS	140	FORVAL AMERICA, INC.	372	38	AVANTECH SOLUTIONS, INC.	444	259	NORTHGATE COMPUTER SYS.	210, 211



# REQUEST FREE PRODUCT INFORMATION BY FAX

Just fax this page to 1-413-637-4343. Save time because your request for information will be processed *immediately*.

- 1** Circle the numbers below which correspond to the numbers assigned to advertisers and products that interest you.
- 2** Check off the answers to questions "A" through "E".
- 3** Print your name, address, and fax number clearly on the form.
- 4** Remove this page or copy this page clearly and fax it to the number above.

Fill out this coupon carefully. PLEASE PRINT.

Name \_\_\_\_\_  
 Title \_\_\_\_\_  
 Company \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_  
 State/Province \_\_\_\_\_ Zip \_\_\_\_\_  
 Country ( ) \_\_\_\_\_ ( ) \_\_\_\_\_  
 Phone Number \_\_\_\_\_ Fax Number \_\_\_\_\_

- A. What is your primary job function/principal area of responsibility? (Check one.)**  
 MIS/DP  
 Programmer/Systems Analyst  
 Administration/Management  
 Sales/Marketing  
 Engineer/Scientist  
 Other
- B. What is your level of management responsibility?**  
 Senior-level  
 Middle-level  
 Professional
- C. Are you a reseller (VAR, VAD, Dealer, Consultant)?**  
 Yes  No

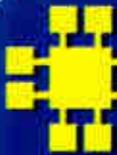
- D. What operating systems are you currently using? (Check all that apply.)**  
 PC/MS-DOS  
 DOS + Windows  
 OS/2  
 UNIX  
 MacOS  
 VAX/VMS
- E. For how many people do you influence the purchase of hardware or software?**  
 1-25  
 26-50  
 51-99  
 100 or more

Inquiry Numbers 1-495

Inquiry Numbers 496-990

Inquiry Numbers 991-1479

1	2	3	4	5	6	7	8	9	10	11	496	497	498	499	500	501	502	503	504	505	506	991	992	993	994	995	996	997	998	999	1000	100
12	13	14	15	16	17	18	19	20	21	22	507	508	509	510	511	512	513	514	515	516	517	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	101
23	24	25	26	27	28	29	30	31	32	33	518	519	520	521	522	523	524	525	526	527	528	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	102
34	35	36	37	38	39	40	41	42	43	44	529	530	531	532	533	534	535	536	537	538	539	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	103
45	46	47	48	49	50	51	52	53	54	55	540	541	542	543	544	545	546	547	548	549	550	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	104
56	57	58	59	60	61	62	63	64	65	66	551	552	553	554	555	556	557	558	559	560	561	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	105
67	68	69	70	71	72	73	74	75	76	77	562	563	564	565	566	567	568	569	570	571	572	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	106
78	79	80	81	82	83	84	85	86	87	88	573	574	575	576	577	578	579	580	581	582	583	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	107
89	90	91	92	93	94	95	96	97	98	99	584	585	586	587	588	589	590	591	592	593	594	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	108
100	101	102	103	104	105	106	107	108	109	110	595	596	597	598	599	600	601	602	603	604	605	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	110
111	112	113	114	115	116	117	118	119	120	121	606	607	608	609	610	611	612	613	614	615	616	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	111
122	123	124	125	126	127	128	129	130	131	132	617	618	619	620	621	622	623	624	625	626	627	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	112
133	134	135	136	137	138	139	140	141	142	143	628	629	630	631	632	633	634	635	636	637	638	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	113
144	145	146	147	148	149	150	151	152	153	154	639	640	641	642	643	644	645	646	647	648	649	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	114
155	156	157	158	159	160	161	162	163	164	165	650	651	652	653	654	655	656	657	658	659	660	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	115
166	167	168	169	170	171	172	173	174	175	176	661	662	663	664	665	666	667	668	669	670	671	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	116
177	178	179	180	181	182	183	184	185	186	187	672	673	674	675	676	677	678	679	680	681	682	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	117
188	189	190	191	192	193	194	195	196	197	198	683	684	685	686	687	688	689	690	691	692	693	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	118
199	200	201	202	203	204	205	206	207	208	209	694	695	696	697	698	699	700	701	702	703	704	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	119
210	211	212	213	214	215	216	217	218	219	220	705	706	707	708	709	710	711	712	713	714	715	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	121
221	222	223	224	225	226	227	228	229	230	231	716	717	718	719	720	721	722	723	724	725	726	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	122
232	233	234	235	236	237	238	239	240	241	242	727	728	729	730	731	732	733	734	735	736	737	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	123
243	244	245	246	247	248	249	250	251	252	253	738	739	740	741	742	743	744	745	746	747	748	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	124
254	255	256	257	258	259	260	261	262	263	264	749	750	751	752	753	754	755	756	757	758	759	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	125
265	266	267	268	269	270	271	272	273	274	275	760	761	762	763	764	765	766	767	768	769	770	1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	126
276	277	278	279	280	281	282	283	284	285	286	771	772	773	774	775	776	777	778	779	780	781	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	127
287	288	289	290	291	292	293	294	295	296	297	782	783	784	785	786	787	788	789	790	791	792	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	128
298	299	300	301	302	303	304	305	306	307	308	793	794	795	796	797	798	799	800	801	802	803	1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	129
309	310	311	312	313	314	315	316	317	318	319	804	805	806	807	808	809	810	811	812	813	814	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	130
320	321	322	323	324	325	326	327	328	329	330	815	816	817	818	819	820	821	822	823	824	825	1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	132
331	332	333	334	335	336	337	338	339	340	341	826	827	828	829	830	831	832	833	834	835	836	1321	1322	1323	1324	1325	1326	1327	1328	1329	1330	133
342	343	344	345	346	347	348	349	350	351	352	837	838	839	840	841	842	843	844	845	846	847	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	134
353	354	355	356	357	358	359	360	361	362	363	848	849	850	851	852	853	854	855	856	857	858	1343	1344	1345	1346	1347	1348	1349	1350	1351	1352	135
364	365	366	367	368	369	370	371	372	373	374	859	860	861	862	863	864	865	866	867	868	869	1354	1355	1356	1357	1358	1359	1360	1361	1362	1363	136
375	376	377	378	379	380	381	382	383	384	385	870	871	872	873	874	875	876	877	878	879	880	1365	1366	1367	1368	1369	1370	1371	1372	1373	1374	137
386	387	388	389	390	391	392	393	394	395	396	881	882	883	884	885	886	887	888	889	890	891	1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	138
397	398	399	400	401	402	403	404	405	406	407	892	893	894	895	896	897	898	899	900	901	902	1387	1388	1389	1390	1391	1392	1393	1394	1395	1396	139
408	409	410	411	412	413	414	415	416	417	418	903	904	905	906	907	908	909	910	911	912	913	1398	1399	1400	1401	1402	1403	1404	1405	1406	1407	140
419	420	421	422	423	424	425	426	427	428	429	914	915	916	917	918	919	920	921	922	923	924	1409	1410	1411	1412	1413	1414	1415	1416	1417	1418	141
430	431	432	433	434	435	436	437	438	439	440	925	926	927	928	929	930	931	932	933	934	935	1420	1421	1422	1423	1424	1425	1426	1427	1428	1429	142
441	442	443	444	445	446	447	448	449	450	451	936	937	938	939	940	941	942	943	944	945	946	1431	1432	1433	1434	1435	1436	1437	1438	1439	1440	143
452	453	454	455	456	457</																											



# JDR Microdevices®

2233 BRANHAM LANE, SAN JOSE CA 95124

- BUY WITH CONFIDENCE FROM JDR!
- 30-DAY MONEY BACK GUARANTEE
- 1 YEAR WARRANTY
- TOLL-FREE TECH SUPPORT

## DYNAMIC RAMS

PART#	SIZE	SPEED	PINS	PRICE
4116-150	16384x1	150ns	16	1.49
4164-150	65536x1	150ns	16	2.49
4164-120	65536x1	120ns	16	2.89
4164-100	65536x1	100ns	16	3.39
TMS4464-12	65536x4	120ns	16	3.95
41256-150	262144x1	150ns	16	2.59
41256-120	262144x1	120ns	16	2.95
41256-100	262144x1	100ns	16	3.15
41256-80	262144x1	80ns	16	3.75
414256-100	262144x4	100ns	20	12.95
414256-80	262144x4	80ns	20	13.45
1MB-120	1048576x1	120ns	18	11.95
1MB-100	1048576x1	100ns	18	12.35
1MB-80	1048576x1	80ns	18	12.95
1MB-70	1048576x1	70ns	18	13.95

## SIMM/SIP MODULES

PART#	SIZE	SPEED	FOR	PRICE
41256A9B-80	256K x 9	80ns	SIMM/PC	49.95
421000A9B-10	1MB x 8	100ns	SIMM/MAC	109.95
421000A9B-10	1MB x 9	100ns	SIMM/PC	113.95
421000A9B-80	1MB x 9	80ns	SIMM/PC	119.95
421000A9B-60	1MB x 9	60ns	SIMM/PC	149.95
256K9SIP-80	256K X 9	80ns	SIP PC	54.95
256K9SIP-60	256K X 9	60ns	SIP PC	64.95
1MBxSIP-10	1MB x 9	100ns	SIP PC	116.95
1MBxSIP-80	1MB x 9	80ns	SIP PC	124.95

## MATH CO-PROCESSORS

8087	5 MHz	89.95
8087-2	8 MHz	129.95
8087-1	10 MHz	169.95
80287-8	8 MHz	209.95
80287-10	10 MHz	239.95
80287-XLT	12MHz	247.95
80287-XL	6.8-10-12 MHz	247.95
80C287	12MHz	299.95
80387-16	16 MHz	359.95
80387-SX	16 MHz	319.95
80387-SX20	20 MHz	399.95
80387-16	16 MHz	359.95
80387-20	20 MHz	399.95
80387-25	25 MHz	499.95
80387-33	33MHz	649.00

**intel**  
5 YEAR WARRANTY  
WITH MANUAL & SOFTWARE GUIDE



\*FOR COMPAQ LITE 286 TANDY 2800  
\*\*FOR ALL OTHER 286 BASED SYSTEMS

## CYRIX CO-PROCESSORS

STATE-OF-THE-ART TO SAVE YOU LONGEVITY WORRIES!  
MANUAL & SOFTWARE GUIDE FULL 5 YEAR WARRANTY!

83D87-16	16 MHz	\$299.95	83D87-33	33MHz	\$49.00
83D87-20	20 MHz	349.95	83S87-16 (SX)	16MHz	269.95
83D87-25	25MHz	439.95	83S87-20 (SX)	20MHz	329.95



## Derick's HIGH-TECH SPOTLIGHT

MODEM STANDARDS

I now feel comfortable publicly recommending CCITT V.32 and MNP communications protocols!

CCITT V.32 is a description of the electrical signals used over phone lines to move data. The CCITT is an international committee that refines the input from many modem industry experts into one accepted standard. Sometimes users or industry experts reject the efforts of standards committees and follow a single industry leader (as was the case with the IBM PC). Here, the committee prevailed.

The Microcom Network Protocol (MNP) is the product of 1 company's efforts to fix data errors and improve transmission efficiency. They've made their protocol available to others for a fee, and have been accepted by users en masse. The committee approach has not worked well in this area.

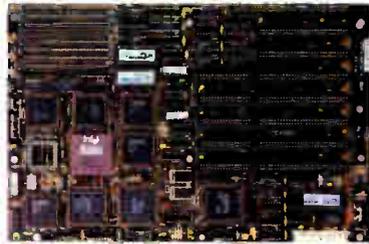
MNP-5 is an implementation of the protocol that insures reliable data transfer and compresses data at a rate of about 2 to 1. Thus, a modem operating at 9600 BPS (bits per second) provides a data transfer rate of approximately 19200 BPS—about 16 times the rate of older 1200 BPS standards!

For we end users, how standards are created is of passing interest—we want solid ones that won't be soon obsolete. CCITT V.32 and MNP-5 will be around for a long, long time.

Derick Moore, Director of Engineering

See JDR's modem selection on the next page

## YOUR MOTHERBOARD CONNECTION!



### MINI 25MHz 386 \$799

• NORTON SI 26.6 • LANDMARK AT SPEED 30.1

"THE FASTEST NON-CACHING MOTHERBOARD THAT WE TESTED."—BYTE MAGAZINE, APRIL 1990.

- MEMORY INTERLEAVING FOR NEAR ZERO WAIT STATES
- SOCKETED FOR 80387 COPROCESSOR
- USES 80NS 256K DR 1MB SIMM/DIP RAMS
- 16MB RAM CAPACITY 8MB ON BOARD, 8MB USING OPTIONAL RAM CARD (OKB INSTALLED)
- ON-BOARD RAM 12MB USING 4 8 256K SIMMS OR 4 8MB USING 4 8 1MB SIMMS • FIVE 16-BIT SLOTS, TWO 8-BIT SLOTS, ONE 32-BIT SLOT FOR PROPRIETARY RAM CARD
- AMI BIOS • SIZE 8.5" X 13"

MCT-M386-25 ..... \$799.00

MCT-M386-M25 PROPRIETARY RAM CARD ..... \$99.95

12MB USING 36-72 256KX1 DRAMS OR 4-8MB USING 36/72 1MBX1 DRAMS

### 33MHz CACHE 386 \$1495

• NORTON SI 45.9 • LANDMARK AT SPEED 50.8

- 33MHz 80386 CPU • 64K ZERO WAIT STATE RAM CACHE
- 12 4 8MB ON BOARD RAM USING 80NS SIMMS (OKB INSTALLED)
- 12MB USING 4 8 256K SIMMS OR 4 8MB USING 4 8 1MB S MMS • SOCKETED FOR 80387 33 MATH CO-PROCESSOR
- 8 EXPANSION SLOTS (ONE 32 BIT SIX 16-BIT, ONE 8-BIT)
- AMI BIOS ASSURES IBM COMPATIBILITY
- 8-33MHz KEYBOARD ADJUSTABLE SPEEDS

MCT-386MBC-33 ..... \$1495.00

MCT-386MBC-25 25MHz VERSION ..... \$999.00

### MINI 25MHz CACHE 386 \$1299

WITH RAM CARD

• NORTON SI 30.5 • LANDMARK AT SPEED 40.7

- 25MHz 80386 • REQUIRE 1 OF THE RAM CARDS BELOW
- SHADOW RAM FOR ROM BIOS
- MEMORY CACHING FOR SUPERIOR PERFORMANCE
- MEMORY INTERLEAVING FOR NEAR 0 WAIT STATE OPERATION (8 BANKS OF MEMORY REQUIRED)
- SOCKETED FOR 80387 DR WEITEK 3167 COPROCESSORS

MCT-C386-25 ..... \$1199.00

RAM CARDS (ONE REQUIRED FOR OPERATION):

1 2 4MB USING 8 16 22 256KX4 DRAMS AND 4 8 16 256KX1 DRAMS (OK INS'ALLED)

MCT-C386-M4 ..... \$99.95

1 2MB USING 36-72 256KX1 DRAMS OR 4-8MB USING 36/72 1MBX1 DRAMS (OK INST)

MCT-C386-M8 ..... \$99.95

1 2 4MB USING 4 8 16 256K SIMMS, 4 8 16MB USING 4 8 16 1MB SIMMS OR 10 1MB USING 8 1MB SIMMS AND 11 256K SIMMS (OK INSTALLED)

MCT-C386-M16 ..... \$99.95

### 486 FROM A.I.R. \$2999

• LANDMARK AT SPEED 113.2

YOUR POWER SOLUTION FOR CAD/CAM/CAE WORKSTATIONS AS WELL AS LAN SERVER APPLICATIONS

- DESIGNED FOR MULTI-TASKING & MULTI-USER APPLICATIONS REQUIRING UNIX OR BENIX • INTEL 80486-CHIP HAS A BUILT IN MATH CO-PROCESSOR & 8K OF RAM CACHE
- INTEL 80486-25 CPU • EXPANDABLE TO 16MB ON BOARD (OK INSTALLED) • SOCKETED FOR A WEITEK 4167 MATH CO-PROCESSOR • SUPPORTS SHADOW RAM WITH INTERNAL CACHE CONTROLLER • EIGHT 16-BIT BUS SLOTS.
- 6 LAYER BOARD DESIGN • COMPATIBLE WITH OS/2, NOVELL, DESQVIEW, UNIX, WINDOWS AND WINDOWS 3.0

AIR-486MB25 ..... \$2,999.00



### 12.5MHz 286 \$199.95

• NORTON SI 14.3 • LANDMARK AT SPEED 16.5

- STANDARD 8088 LAYOUT
- 286 COMPATIBLE • 6/12 5MHz KEYBOARD SELECT SPEEDS
- EXPANDABLE TO 4MB ON BOARD 5 2K 1MB USING 18 36 256KX1 DRAMS, 2 4MB USING 18 36 1MBX1 DRAMS (OKB INSTALLED)
- MEMORY SPEED: 120NS FOR 1 WAIT, 100NS FOR 0 WAIT

MCT-M286-12 ..... \$199.95



### 16MHz MINI 386-SX \$399.95

• NORTON SI 15.3 • LANDMARK AT SPEED 20.8

- USES 16MHz INTEL 80386SX CPU
- EXPANDABLE TO 8MB ON BOARD
- 512K/1MB USING 18/36 256KX1 DRAMS OR 2/4 256K SIPS OR 4/8 256KX4 AND 2/4 256KX1 DRAMS, 3 4MB USING 18/36 1MBX1 DRAMS OR 2/4 1MB SIPS, 6 8MB USING 36 1MBX1 DRAMS AND 2/4 1MB SIPS. AMI BIOS
- CHOOSE FAST 0 WAIT STATE OR 1 WAIT STATE FOR ECONOMICAL USE OF SLOWER RAM
- FIVE 16-BIT & THREE 8-BIT EXPANSION SLOTS
- CHIPS & TECHNOLOGY NEW ENHANCED ADVANCED TECHNOLOGY (NEAT) CHIPSET
- SOCKET FOR 80387SX-16 COPROCESSOR
- 8.5" X 13" SIZE FITS IN MINI-286 AND FULL-SIZE 286 CASES

MCT-386SX ..... \$399.95

### 20MHz 286 \$389.95

• NORTON SI 20.3 • LANDMARK AT SPEED 26.3

- NEAT CHIPSET HAS POWER TO COMPETE WITH 386 SYSTEMS
- EXPANDABLE FROM 512K TO 8MB 512K 1MB USING 18 36 256KX1 DRAMS OR 2/4 256K SIPS, 2 4MB USING 18 36 1MBX1 DRAMS OR 2/4 1MB SIPS, 6 8MB USING 36 1MBX1 DRAMS AND 2/4 1MB SIPS
- 20/10MHz KEYBOARD SELECTABLE SPEEDS • AMI BIOS
- SHADOW RAM AND PAGE INTERLEAVED MEMORY
- FAST 0 WAIT STATE OR 1 WAIT STATE FOR SLOWER RAM
- 8.5" X 13" FITS MOST 8086, MINI-286 & FULL SIZE 286 CASES
- FIVE 16-BIT & THREE 8-BIT SLOTS
- SOCKET FOR 80247-13 MATH CO-PROCESSOR

MCT-M286-20N ..... \$389.95

### 16MHz 286 W/NEAT CHIPSET \$289.95

MCT-M286-16N NORTON SI 16.2 • LANDMARK AT 22.1

12MHz 286 W/NEAT CHIPSET \$269.95

MCT-M286-12N NORTON SI 12.0 • LANDMARK AT 15.5

### 10MHz 8088 NORTON SI 2.1 \$99.95

• 8088 COMPATIBLE OPERATES AT 7.7-10MHz

- KEYBOARD SELECTABLE CLOCK SPEEDS • SOCKET FOR 8087 1 COPROCESSOR • 2 SLOTS • MCT BIOS • 640K RAM CAPAC TY (OKB INSTALLED)

MCT-TURBO-10 ..... \$99.95

**CUSTOMER SERVICE 800-538-5001**  
**TECHNICAL SUPPORT 800-538-5002**

MON-FRI. 7 A.M. TO 5 P.M., SATURDAY, 9 A.M. TO 3 P.M. (PST)  
**ORDER TOLL-FREE 800-538-5000**

KEY CODE #2011

Circle 6 on Reader Service Card (RESELLERS: 7)

NOVEMBER 1990 • BYTE 461

# JDR Microdevices®

ORDER TOLL-FREE 800-538-5000 KEY CODE 10

## MONITORS

**VGA PACKAGE**  
\$499.95

VGA COLOR AND CLARITY AT AN EGA PRICE! • 8-BIT VGA CARD IS FULLY COMPATIBLE WITH IBM VGA • 640 X 480 RESOLUTION IN 16 COLORS • HIGH RESOLUTION ANALOG MONITOR • EGA/CGA/MONO AND HERCULES COMPATIBLE • DRIVERS FOR WINDOWS, GEM, LOTUS 1-2-3, SYMPHONY, AUTOCAD & VENTURA  
VGA-PKG ..... \$499.95

### 16-BIT VGA PACKAGE

16-BIT VERSION INCLUDES MCT-VGA-16  
VGA-PKG-16 ..... \$529.00



### RELISYS MULTISYNC

\$429.95  
• 14" NON-GLARE SCREEN • 800 X 560 MAX RESOLUTION  
• CGA/EGA/VGA COMPATIBLE • TTL/ANALOG MODE  
JDR-MULTI

### RELISYS VGA MONITOR

\$379.95  
• 14" ANALOG VGA MONITOR • GLARE RESISTANT SCREEN  
• 720 X 480 MAXIMUM RESOLUTION • TILT/SWIVEL BASE  
VGA-MONITOR

### EGA MONITOR

\$339.95  
• 14" NON-GLARE SCREEN WITH 640 X 350 MAXIMUM RESOLUTION • DISPLAY 16 COLORS SIMULTANEOUSLY  
EGA-MONITOR

### 14" SCREEN MONO

\$139.95  
• GLARE-RESISTANT 14" SCREEN WITH AMBER DISPLAY  
• 720 X 350 RESOLUTION • TILT/SWIVEL BASE  
GM-1489  
MONO-SAMSUNG SAMSUNG 12" FLAT SCREEN \$129.95  
MONO-VGA PAPERWHITE VGA MONITOR ..... \$139.95  
NEC-MULTI-3D NEC MULTI-3D MULTISYNC ..... \$649.00  
CM-1440 SEIKO DUAL FIXED FREQUENCY ..... \$599.00  
CM-1450 SEIKO 15" DUAL FIXED FREQ. .... \$749.00

**BUY WITH CONFIDENCE FROM JDR!**  
• 30-DAY MONEY BACK GUARANTEE  
• 1 YEAR WARRANTY  
• TOLL-FREE TECH SUPPORT

## Littlefoot™ CASE

\$249.95

• MOUNTS FOR STANDARD FULL SIZE AND MINI-MOTHERBOARDS  
• INCLUDES 250WATT POWER SUPPLY  
• MOUNTS FOR 3 FLOPPY AND 4 HARD DRIVES  
• TURBO AND RESET SWITCHES  
• SPEED DISPLAY, POWER, DISK LEDS  
• MOUNTING HARDWARE, FACEPLATES AND SPEAKER INCL

CASE-100 ..... \$249.95  
CASE-200 "SUPERFOOT"—HOLDS 11 DRIVES ..... \$499.95  
CASE-120 "MINIFOOT" W/200 WATT PS ..... \$199.95  
NOTE: CASES DO NOT INCLUDE DRIVES.



## STANDARD CASES

FULL SIZE SLIDE CASE  
CASE-70 ..... \$89.95  
CASE-50 FOR 8088 OR MINI-86 MOTHERBOARDS ..... \$59.95  
CASE-FLIP FLIP-TOP XT-STYLE CASE ..... \$39.95  
CASE-SLIDE SLIDE TYPE XT-STYLE CASE ..... \$39.95  
CASE-JR ..... \$149.95  
WITH 150W POWER SUPPLY, FOR 8088 OR MINI-286 BOARDS.  
CASE-JR-200 ..... \$189.95  
WITH 200W POWER SUPPLY, FOR 8088 OR MINI-286 BOARDS.



## PC POWER SUPPLIES

PS-135 135 WATT FOR 8088 - U.L. APPROVED ..... \$59.95  
PS-150 150 WATT FOR 8088 - U.L. APPROVED ..... \$69.95  
PS-200X 200 WATT FOR 8088 - U.L. APPROVED ..... \$89.95  
PS-200 200 WATT FOR 286/386 - U.L. APPROVED ..... \$89.95  
PS-250 250 WATT FOR 286/386 ..... \$129.95

## UNINTERRUPTABLE POWER SUPPLIES

CONDITIONED CRITICAL LOAD/BACK-UP DURING BLACKOUT.  
PART NO. VA FREQ. CURRENT BATTERY PRICE  
EMERSON-20 300 60hz 2.50A 10min. \$299.95  
EMERSON-30 500 60hz 4.20A 10min. \$499.95  
EMERSON-40 800 60hz 6.70A 10min. \$699.00

## POST CODE DIAGNOSES SYSTEM PROBLEMS!

TO DIAGNOSE, PLUG IT INTO A CARD SLOT, READ THE INDICATOR DISPLAY & CHECK THE MANUAL FOR THE CORRESPONDING POWER-ON SELF-TEST CODE. SWITCH-LESS AND JUMPERLESS DES'GN. COMPATIBLE W/80286 & 80386-BASED SYSTEMS.  
PCODE ..... \$49.95



## DISPLAY CARDS

### 16-BIT VGA

\$169.95  
• 640 X 480 IN 16 COLORS • 256K VIDEO RAM EXPANDABLE TO 512K • 64 LEVELS OF GRAY SCALE  
MCT-VGA-16 ..... \$149.95  
MCT-VGA-8 8-BIT VERSION ..... \$189.95  
MCT-VGA-1024 1024 X 768 VGA ..... \$249.95  
MCT-VGA-1024+ 1024 X 768 IN 256 COLORS ..... \$189.95  
MCT-VGA VGA WITH TTL SUPPORT

### MONO GRAPHICS/PRINTER

\$49.95  
8088/286 COMPATIBLE • HERCULES COMPATIBLE MONOGRAPHICS • SUPPORTS LOTUS 1-2-3 • 720 X 348 DISPLAY • ADDRESS PARALLEL PRINTER PORT AS LPT1 OR 2  
MCT-MGP

### MORE DISPLAY CARDS

MCT-CGP CGA GRAPHICS FOR RGB MONITOR ..... \$49.95  
MCT-EGA EGA CARD WITH 256K RAM ..... \$149.95

## CABLES AND GENDER CHANGERS

MOLDED; GOLD-PLATED CONTACTS; 100% SHIELDED

CBL-PRNTR-25	25 FT PC PRINTER CABLE	15.95
CBL-PRNTR-RA	RIGHT ANGLE PRINTER CABLE	15.95
CBL-DB25-MM	DB25 MALE-DB25 MALE 6 FT.	9.95
CBL-DB25-MF	DB25 MALE-DB25 FEMALE 6 FT.	9.95
CBL-9-SERIAL	DB9 FEMALE-DB25 MALE 6 FT	6.95
CBL-CNT-MM	36-PIN CENTRONICS -M/M	14.95
GENDER-VGA	DB9-DB15 ADAPTOR	4.95

HUNDREDS MORE AVAILABLE—CALL FOR MORE INFO

## DEVELOPERS' WORLD

JDR caters to the developer with a full line of prototyping and programming products. Here are just a few examples. Request our catalog for our complete line!

## EPROMS

PART#	SIZE	SPEED	Vpp	PINS	PRICE
2716-1	2048x8	350ns	25V	24	3.35
2732A	4096x8	250ns	21V	24	3.35
2764	8192x8	450ns	12.5V	28	3.49
2764-250	8192x8	250ns	12.5V	28	3.69
2764-200	8192x8	200ns	12.5V	28	4.25
27128	16384x8	250ns	12.5V	28	4.25
27128A-200	16384x8	200ns	12.5V	28	5.95
27256	32768x8	250ns	12.5V	28	4.95
27C256	32768x8	250ns	12.5V	28	5.95
27512	65536x8	250ns	12.5V	28	7.95
27C101-20	131072x8	200ns	12.5V	32	19.95

## EPROM PROGRAMMER

\$129.95  
• PROGRAMS 27XX AND 27XXX EPROMS UP TO 27512 • SPLIT OR COMBINE CONTENTS OF SEVERAL DIFFERENT SIZED EPROMS (VARIOUS FORMATS AND VOLTAGES) • READ/WRITE COPY, BLANK CHECK AND VERIFY • HEX AND INTEL HEX FORMATS SOFTWARE  
MOD-EPROM



## DATARASE II EPROM ERASER

\$39.95  
• SMALL SIZE! • ERASES ALL SIZE EPROMS UP TO 4 AT A TIME • MOST IN 3 MINUTES  
• WALL PLUG POWER SUPPLY  
DATARASE II



## JDR'S OWN MODULAR PROGRAMMING SYSTEM

EACH MODULE USES A COMMON HOST ADAPTOR CARD—USE JUST 1 SLOT TO PROGRAM! EPROMS, PROMS, PALS & MORE!

### COMMON HOST ADAPTOR CARD

• UNIVERSAL INTERFACE FOR THE PROGRAMMING MODULES • SELECTABLE ADDRESSES PREVENTS MODULOS  
MOD-MAC ..... \$29.95

### UNIVERSAL MODULE

\$499.95

• PROGRAMS EPROMS, EPROMS PALS, BI-POLAR PROMS, 8748 & 8751 SERIES DEVICES; 16V8 AND 20V8 GALS (GENERIC ARRAY LOGIC) FROM LATTICE, NS, SGS  
• TESTS TTL, CMOS, DYNAMIC & STATIC RAMS  
• LOAD DISK, SAVE DISK, EDIT, BLANK CHECK, PROGRAM, AUTO READ MASTER, VERIFY AND COMPARE  
• TEXT/LOAD SOCKET FOR 3" TO 6" WIDE IC'S (8-40 PINS)

MOD-MUP ..... \$499.95

MOD-MUP-EA 4 UNIT ADAPTOR ..... \$99.95

### EPROM MODULE

\$119.95

• PROGRAMS 24-32 PIN EPROMS, CMOS EPROMS & 16K TO 1024K EPROMS • HEX TO OBJ CONVERTER • AUTO, BLANK CHECK, PROGRAM/VERIFY • VPP 5, 12.5, 12.75, 13, 21 & 25 VOLTS • NORMAL, INTELLIGENT, INTERACTIVE & QUICK PULSE PROGRAMMING ALGORITHMS

MOD-MEP ..... \$119.95

MOD-MEP-4 4 EPROM PROGRAMMER ..... \$169.95

MOD-MEP-8 8 EPROM PROGRAMMER ..... \$259.95

MOD-MEP-16 16 EPROM PROGRAMMER ..... \$499.95

### PAL MODULE

\$249.95

• PROGRAMS MMI, NS, TI 20 & TI 24 PIN DEVICES • BLANK CHECK, PROGRAM, AUTO, READ MASTER, VERIFY & SECURITY FUSE BLOW  
MOD-MPL



new!  
PDS-601

## 8-BIT SOLDERLESS 8088 BREADBOARD WITH DECODE

\$79.95

• INCLUDES ADDRESS DECODING LOGIC, DATA BUFFERING, 2 LSI CIRCUITS FOR PROGRAMMABLE DIGITAL I/O AND COUNTER-TIMER FUNCTIONS • LOGICALLY GROUPED  
• ACCESSES ALL 62 I/O SIGNAL CONNECTIONS • CLEARLY LABELLED BUS LINES • ACCEPTS UP TO 2 FOURTEEN-PIN IC'S • ACCEPTS 9, 15, 19, 25 OR 37-PIN D-SUBS

PDS-601 ..... \$79.95

PDS-600 ABOVE CARD WITHOUT DECODE ..... \$49.95

## 286 BUS BREADBOARD WITH DECODE

\$89.95

• ADDRESS DECODING LOGIC, DATAT BUFFERING, 2 LSI CIRCUITS FOR PROGRAMMABLE DIGITAL I/O AND COUNTER-TIMER FUNCTIONS • ACCESSES ALL 96 I/O SIGNAL CONNECTIONS • LOGICALLY GROUPED • OVER 2,000 PTS.  
• ACCEPTS 9, 15, 19, 25 OR 37-PIN D SUB CONNECTORS

PDS-611 ..... \$89.95

PDS-610 ABOVE CARD WITHOUT DECODE ..... \$59.95

## MORE PROTOTYPE CARDS...

JDR-PR1 8 BIT WITH +5V AND GROUND PLANE 27.95

JDR-PR2 ABOVE WITH I/O DECODING LAYOUT 29.95

JDR-PR2-PK PARTS KIT FOR JDR-PR2 ABOVE 8.95

JDR-PR10 16 BIT WITH I/O DECODING LAYOUT 34.95

JDR-PR10-PK PARTS KIT FOR JDR-PR10 ABOVE 12.95

## MORE PROGRAMMING MODULES...

MOD-MMP MICROPROCESSOR PROGRAMMER ..... \$179.95

MOD-MIC DIGITAL IC & MEMORY TESTER ..... \$129.95

MOD-MBP BI-POLAR PROM PROGRAMMER ..... \$259.95

## PAL DEVELOPMENT SOFTWARE

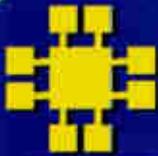
ENTRY-LEVEL PAL DEVELOPMENT FROM CUPL. FULL SUP-PORT FOR 16L8, 16R4, 16R6, 16R8, 20L8, 20R4, 20R8 & 20X3

MOD-MPL-SOFT ..... \$99.95



TERMS: Minimum order \$10.00. For shipping & handling include \$4.00 for ground and \$5.50 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, Littlefoot, Minifoot and Superfoot are trademarks of JDR MICRODEVICES, INC. Copyright 1990 JDR MICRODEVICES.

KEY CODE #1011



# JDR Microdevices®

2233 BRANHAM LANE, SAN JOSE CA 95124

BUY WITH CONFIDENCE FROM JDR!

- 30-DAY MONEY BACK GUARANTEE
- 1 YEAR WARRANTY
- TOLL-FREE TECH SUPPORT



### TI MICROLASER™ —FAST, AFFORDABLE AND EXPANDABLE!

EXPANDABLE PRINTER HAS TEXAS INSTRUMENTS QUALITY AND RELIABILITY IN A COMPACT SIZE! UPGRADEABLE TO 4.5MB AND POSTSCRIPT® - 300 DPI - 6 PPM OUTPUT - 250 SHEET DRAWER

- MANUAL FEED • 40 ENVELOPE AUTO FEED • 5MB RAM BASE UNIT • EMULATES HP LASERJET II

MICROLASER ..... \$1495.00  
MICROLASER-PS ..... \$2495.00  
WITH 35 FONT POSTSCRIPT® AND 1.5MB RAM

### TEFAX—FAX, COPIER, SCANNER, PHONE & PRINTER

- G3/G2 FAX MACHINE • 8.5" SCAN WIDTH • 200 DPI SCANNER • SAME SIZE COPIER • FAX SOFTWARE FOR IBM & MAC • AUTO FAX SEND

TEFAX ..... \$995.00



### CITIZEN 200GX COLOR PRINTER

CITIZEN EXPANDS 9-WIRE TECHNOLOGY TO THE CUTTING EDGE! OPTIONAL COLOR KIT PROVIDES VIVID COLOR OUTPUT UNRIVALLED IN ITS PRICE RANGE!

- 5 RESIDENT FONTS • 240 X 216 DPI • 213 CPS DRAFT MODE; 40 CPS LETTER QUALITY • PARALLEL INTERFACE • 8K PRINT BUFFER

CTZ-200GX-C ..... \$199.95  
CTZ-200GXCOLOR COLOR ON COMMAND KIT ..... \$59.95

### KODAK DICONIX 150+ PORTABLE PRINTER

THE PERFECT COMPANION FOR YOUR LAPTOP OR OUR CARRY-1 PCI WEIGHS 5LBS AND MEASURES JUST 6.5" X 11" X 2"

- QUIET NON-IMPACT INK-JET TECHNOLOGY
- UP TO 180 CPS • DRAFT, NLO, QUALITY AND CONDENSED MODES • USES CUT-SHEET OR CONTINUOUS FORM PAPER
- SUPPORTS EPSON FX-80 & IBM PROPRINTER COMMANDS

DICONIX-150 ..... \$399.95



### FUJITSU COLOR PLOTTER

COMPACT PLOTTER • HP7475A COMPATIBLE • .025MM RES. FPG-315 ..... \$799.00

### INTRODUCING THE MINI-SIZE 286 COMPUTER

**\$599**



HIGH PERFORMANCE IBM/PC COMPATIBLE COMPUTER CAN COMPETE WITH A FULL SIZE PCI STAND IT UPRIGHT. SET IT UNDER A MONITOR—ITS COMPACT SIZE IS THE PERFECT SOLUTION FOR A CROWDED DESK. A COST-CONSCIOUS SCHOOL OR AN EASILY TRANSPORTABLE HOME COMPUTER.

- 12MHZ 80286 CPU WITH 0 WAIT STATE
- AMI BIOS WITH DIAGNOSTICS • 1 MB MEMORY
- TWO SERIAL, ONE PARALLEL PORT
- BUILT-IN CGA/MGA DISPLAY ADAPTOR
- BUILT-IN 3.5" 1.44MB FLOPPY
- 7-1/2" W X 9-1/2" L X 1-3/4" H • WEIGHS JUST OVER 6 LBS.
- WORKS WITH ANY STANDARD KEYBOARD
- INCLUDES CARRY BAG, 30W POWER ADAPTOR, MINI-UPRIGHT STANDS AND MANUAL
- FCC CLASS B APPROVED

- CARRY-1C WITH 1.44MB FLOPPY DRIVE ..... \$599.00
- CARRY-1D WITH 1.44MB FLOPPY & 40MB HD ..... \$899.00
- CARRY-1 8088-BASED VERSION ..... \$299.95
- CARRY-1B ENHANCED 8088 VERSION ..... \$399.95
- INCLUDES 2 FLOPPY DRIVES (720K) AND 640K RAM.
- CARRY-1K 82-KEY CARRY-1 KEYBOARD ..... \$49.95

### ADD 425 FONTS WITH 1 CARTRIDGE!

**\$349.95**

NEW SUPERSET+ HAS THE CAPABILITIES OF THESE CARTRIDGES: PDP'S "25 IN ONE," HP'S MASTERTYPE "PROCOLLECTION," HP'S "MICROSOFT" CARTRIDGE, HEADLINE FONTS & 18 PTS AND JET-WARE'S 12/30 • FOR HP LASERJET SERIES II, IID, IIP, III AND PCL COMPATIBLE • PRINTER DRIVERS FOR WORDPERFECT, MS WORD, MS WINDOWS, EXCEL, PAGEMAKER, WORD, AMI PROFESSIONAL, VENTURA PUBLISHERS, WORDSTAR AND LOTUS 1-2-3.

**new!**

### RAM CARD FOR HP LASERJET

**\$89.95**

- FOR HP LASERJET II PRINTERS • USER EX-ANDABLE TO 1.2-4MB (DK INSTALLED) • USES 1MB 120 NS DRAMS

MCT-RAMJET ..... \$89.95  
MCT-RAMJET-P ..... \$99.95  
1/2/3/4MB FOR IIP, USES 256K X 4 DRAMS

### COLOR HAND SCANNER!

**\$599**

- 400 DPI 16-COLOR DITHER MODE
- 200 DPI 16-SHADE GRAYSCALE
- TRUE 400 DPI MONO MODE
- 3 SWITCH-SELECTABLE 64-SHADE DITHER PATTERNS
- 3 SMSLINE SCAN SPEED
- 7-SEGMENT LED STATUS READOUT
- BRIGHTNESS CONTROL
- HALF LENGTH 16-BIT INTERFACE CARD
- SCAN EXERCISER SOFTWARE CONFIGURES THE SCANNER, SCANS IMAGES IN ANY MODE, LETS YOU VIEW REAL TIME IMAGE, THEN SAVES IN PCX FILE FORMAT
- INCLUDES ZSOFT PAINTBRUSH VI PLUS FOR EDITING AND ENHANCING YOUR IMAGE

**new!**



CHS-4000 ..... \$599.00

### DFI LOW COST ETHERNET CARD

- 100% HARDWARE COMPATIBLE WITH NOVELL NE-1000 ETHERNET CARD
- FOR THICK OR THIN ETHERNET
- 15-PIN ETHERNET CONNECTOR
- BNC CONNECTOR FOR THIN ETHERNET
- DFINET-300 8-BIT VERSION ... \$199.95
- DFINET-400 16-BIT VERSION ..... \$239.95



## NEW PRODUCTS FROM



## PROMETHEUS



### 9600 BAUD V.32 MODEM WITH SEND/RECEIVE FAX **\$699**

THIS NEW EXTERNAL MODEM IS V.32 AND V.42 COMPATIBLE. THE EMERGING 9600 BPS STANDARDS. PLUS IT NOW HAS FULL GROUP 3 FAX SEND AND RECEIVE CAPABILITY. THIS MACHINE TRANSFORMS YOUR PC INTO A COMPLETE PERSONAL INFORMATION CENTER

- 9600/4800/2400/1200 BPS DATA MODEM
- CCITT V.32 V.42 ERROR CORRECTION COMPATIBLE
- MNP-5 ERROR CORRECTION AND DATA COMPRESSION FOR THROUGHPUTS UP TO 19200 BPS
- 9600 BPS GROUP III SEND AND RECEIVE FAX
- INCLUDES PRO-COMM COMMUNICATIONS SOFTWARE
- INCLUDES FAX-IT FAX SOFTWARE
- 2 YEAR WARRANTY

PRO-96EF  
**INTERNAL FAX MODEM \$229.95**

- 2400/1200/300 BPS DATA MODEM
- 9600 BAUD SEND RECEIVE FAX CAPABILITY
- 8088, 286, 386 COMPATIBLE CARD

PRO-MAXI



### MINI 2400 BPS MODEM WITH SEND ONLY FAX **\$139.95**

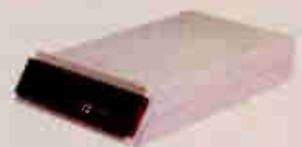
THIS TINY EXTERNAL MODEM PACKS A BIGGER PUNCH THAN YOU'D EXPECT! NOT ONLY IS IT A FULL FUNCTION 2400 BPS DATA MODEM BUT IT ALSO OPERATES AS A SEND-ONLY FAX AT A REMARKABLY LOW PRICE!

- 2400/1200/300 BPS DATA MODEM
- CCITT V.22/V.22BIS, BELL 103/212A COMPATIBLE
- 4800 BPS GROUP III SEND ONLY FAX
- MEASURES JUST 6.25 X 3.8 X 2 INCHES
- 8 STATUS LEDS
- INCLUDES PRO-COMM COMMUNICATIONS SOFTWARE
- INCLUDES FAX-IT FAX SOFTWARE
- 2 YEAR WARRANTY

PRO-EFXM  
MINI-MODEM WITH 9600 BPS FAX SEND SPEED  
PRO-EFXM-96 ..... \$169.95

### 2400BPS MINI MODEM **\$119.95**

AS ABOVE BUT WITHOUT FAX CAPABILITY  
PRO-24E



### 2400 BPS MNP ERROR CORRECTING MODEM **\$249.95**

AN ECONOMICALLY PRICED EXTERNAL MODEM THAT NOW INCLUDES MNP-5 ERROR CORRECTION AND DATA COMPRESSION CAPABILITY

- 2400/1200/300 BPS DATA MODEM
- CCITT V.22/V.22BIS, BELL 103/212A COMPATIBLE
- DATA COMPRESSION BOOSTS THROUGHPUT UP TO 4800 BPS
- 8 STATUS LEDS
- AT COMMAND SET COMPATIBLE
- AUTO DIAL AND AUTO ANSWER
- 2 YEAR WARRANTY

PRO-24EMNP  
PRO-24E EXTERNAL 2400 BAUD MODEM-NO MNP ..... \$149.95

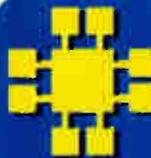
### INTERNAL MNP MODEM **\$189.95**

IPLUG-IN CARD MODEM HAS SAME FEATURES AS ABOVE MODEL. FOR 8088, 286/386 COMPUTERS  
PRO-24MNP  
PRO-24I INTERNAL 2400 BAUD MODEM NO MNP ..... \$99.95

CUSTOMER SERVICE 800-538-5001  
TECHNICAL SUPPORT 800-538-5002  
Copyright 1990 JDR MICRODEVICES.

MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 9 A.M. TO 3 P.M. (PST)  
**ORDER TOLL-FREE 800-538-5000**

KEY CODE #1011



# JDR Microdevices®

2233 BRANHAM LANE, SAN JOSE CA 95124

BUY WITH CONFIDENCE FROM JDR!

- 30-DAY MONEY BACK GUARANTEE
- 1 YEAR WARRANTY
- TOLL-FREE TECH SUPPORT

## HIGH DENSITY HARD DRIVES

### NEW! NEC 153.5MB!

- 153.5MB CAPACITY
- ESDI INTERFACE
- AVG. ACCESS TIME 18MS
- RECORDING: 19.612 BPI BIT, 1.240 TRACK DENSITIES
- 20 SEC. START-STOP TIME
- REQ. DC+5V, +12V POWER
- USES 2-7 RLL METHOD AND NRZ TRANSFER MODE



5655 ..... \$849.00

## MICROPOLIS DRIVES

KITS INCLUDE FLOPPY/HARD CONTROLLER AND CABLE

1355 157 5MB ESDI 23MS	KIT: \$1049	DRIVE: \$949
1375 157 5MB SCSI 23MS	KIT: \$1099	DRIVE: \$899
1558 338 1MB ESDI 18MS	KIT: \$1799	DRIVE: \$1619
1578 338 1MB SCSI 18MS	KIT: \$1799	DRIVE: \$1619
1568 676 8MB ESDI 16MS	DRIVE: \$2499	
1588 676 8MB SCSI 16MS	DRIVE: \$2499	

## Seagate HARD DISKS

21.4MB	\$199	65.5MB	\$389
32.7MB	\$219	80.2MB	\$569
42.8MB	\$339	84.9MB	\$499

## DRIVE KITS

21.4MB	\$249
32.7MB	\$279



KITS INCLUDE HARD DRIVE, DRIVE CONTROLLER, CABLES AND JDR'S DETAILED INSTRUCTION MANUAL

SIZE	MODEL	AVG. SPEED	FORM FACTOR	DRIVE ONLY	XT KIT	AT F/H KIT
21 4MB	ST-225	65MS	5-1/4"	\$199	\$249	\$309
32 7MB RLL	ST-238	65MS	5-1/4"	\$219	\$279	\$379
42 8MB	ST-251-1	28MS	5-1/4"	\$339	\$389	\$449
43 1MB SCSI	ST-251N	40MS	5-1/4"	\$419	-	-
65 5MB RLL	ST-277-1	28MS	5-1/4"	\$389	\$449	\$549
80 2MB	ST-4096	28MS	5-1/4"	\$569	-	\$679
84 9MB SCSI	ST-296N	28MS	5-1/4"	\$499	-	-
122 7MB RLL	ST-4144R	28MS	5-1/4"	\$699	\$759	\$859
21 4MB	ST-125	40MS	3-1/2"	\$259	\$299	\$373
32 1MB RLL	ST-138R	40MS	3-1/2"	\$269	\$339	\$429

\$99<sup>95</sup>

## 1.44MB 3-1/2" DRIVE

- 80 TRACKS • 135 TPI • HIGH DENSITY
- READ/WRITE 720K DISKS, TOO
- INCLUDES ALL NECESSARY MOUNTING HARDWARE

FDD-1.44X BLACK FACEPLATE	\$99.95
FDD-1.44A BEIGE FACEPLATE	\$99.95
FDD-1.44SOFT SOFTWARE DRIVER	\$19.95
MF355A 3-1/2" MITSUBISHI 1.44MB, BEIGE	\$129.95
MF355X 3-1/2" MITSUBISHI 1.44MB, BLACK	\$129.95
FDD-360 5-1/4" DOUBLE SIDED DD 360K	\$69.95
FD-55B 5-1/4" TEAC DOUBLE SIDED DD 360K	\$89.95
FDD-1.2 5-1/4" DOUBLE SIDED HD 1.2M	\$89.95
FD-55GVF 5-1/4" TEAC DOUBLE SIDED HD 1.2M	\$129.95



## MODULAR CIRCUIT TECHNOLOGY

### DRIVE CONTROLLERS

## 1.44MB FLOPPY \$49<sup>95</sup>



• 8088 OR 286 COMPATIBLE • SUPPORTS 2 FLOPPY DRIVES (360K 720K 1.2MB & 1.44MB) • USER SELECTABLE AS A PRIMARY OR SECONDARY (3RD OR 4TH) FLOPPY DRIVE

### HIGH DENSITY 4-FLOPPY CARD \$59.95

• INTERFACES UP TO 4 FLOPPY DRIVES • CABLES FOR 4 INTERNAL DRIVES • BIOS FOR ANY COMBO OF DRIVES

### FLOPPY DISK CONTROLLER \$29.95

• INTERFACES UP TO 4 360K/720K FLOPPY DRIVES • DB37 CONNECTOR FOR EXTERNAL DRIVES

### HARD DISK CONTROLLER \$79.95

• SUPPORTS 16 DRIVE SIZES INCLUDING 10, 20, 30 AND 40MB • CAN DIVIDE 1 LARGE DRIVE INTO 2 LOGICAL DRIVES

### 286/386 FLOPPY/HARD \$149.95

• 1:1 INTERLEAVE FOR IMPROVED PERFORMANCE • CONTROLS 2 HARD & 2 FLOPPY DRIVES (360K/720K/1.2MB, 1.44MB) • CONCURRENTLY USE HARD & FLOPPY DRIVES

### IDE MULTI-IO FLOPPY/HARD \$89.95

• SUPPORTS 2 IDE HARD DRIVES & 2 FLOPPIES • 2 SERIAL & 1 PARALLEL PORT • SUPPORTS COM1 & 2, LPT 1, 2, 3

## INTERFACE CARDS

### MULTIFUNCTION I/O CARDS

#### MULTI I/O CARD \$59.95

• SERIAL PORT • CLOCK/CALENDAR WITH BATTERY • PARALLEL PORT IS ADDRESSABLE AS LPT1 OR LPT2

#### MULTI I/O FLOPPY \$79.95

• SUPPORTS UP TO 2 360K FLOPPIES • SERIAL, PARALLEL GAME PORT AND CLOCK/CALENDAR

#### 286/386 MULTI I/O CARD \$59.95

• SERIAL, PARALLEL AND GAME PORTS • USES 16450 SERIAL SUPPORT CHIPS FOR HIGH SPEED OPERATION

#### NEW! ALL-IN-ONE-CONTROLLER \$129.95

• MONOCHROME GRAPHICS • SUPPORTS 2 IDE HARD DRIVES AND 2 FLOPPIES • 2 SERIAL AND 1 PARALLEL PORT

### MEMORY CARDS

#### 576K RAM CARD \$49.95

• USER SELECTABLE CONFIGURATION TO 576K • USES 64K AND 256K DRAMS (OK INSTALLED)

#### EMS CARD \$129.95

• USER EXPANDABLE TO 2MB USING 1MB DRAMS • CONFORMS FULLY TO LIM EMS 3.2 • RAM DISK SOFTWARE

#### MCT-AEMS \$129.95

#### MCT-AEMS-256 \$129.95

#### MCT-EMS 8088 EMS CARD 2MB CAPACITY \$129.95

#### EEMS CARD \$149.95

• EXPANDABLE TO 4MB USING 256K X 4 DRAMS IN INCREMENTS OF 512K • CONFORMS TO LIM 4.0

## ENHANCED KEYBOARDS

FC-3001 101-KEY, 12 F-KEYS & CALCULATOR	\$74.95
BTC-5339 101-KEY WITH 12 FUNCTION KEYS	\$69.95
BTC-5339R COMPACT 101-KEY, 30% SMALLER	\$79.95
MAX-5339 101-KEY MAXI-SWITCH (286 ONLY)	\$84.95
K103-A AUDIBLE "CLICK" 101-KEY KEYBOARD	\$84.95

## STANDARD KEYBOARDS

BTC-5060 84-KEY WITH 10 FUNCTION KEYS	\$59.95
MAX-5060 MAXI-SWITCH 84-KEY (286 ONLY)	\$64.95

## PC-TRAC \$89<sup>95</sup>

- HIGH RES. (200 PULSE/INCH)
- 2-AXIS POINTING DEVICE (X & Y)
- INCLUDES MAP DEVICE DRIVE WITH BALLISTIC GAIN



PC-TRAC W/RS-232C SERIAL INTERFACE FAST-TRAP THE 3-AXIS MOUSE ALTERNATIVE! \$109.95

## LOGITECH TRACKMAN

- TO 300 DPI RES. • MOUSEWARE UTILITIES, MENUS, MOUSE 2-3 • REQ. 256K MIN MEMORY
- TRACKMAN SERIAL VERSION - NO CARD REQ. \$98.95
- TRACKMAN-B BUS VERSION \$95.95
- W/SHORT CARD FOR 8088, 286, 386 OR PS.2 MODELS 25 & 30



## LOGITECH MICE

3-BUTTON SERIES 9 • 320 DPI RES. • SERIAL PS/2 COMPAT	LOGC9 SERIAL MOUSE \$98.95
LOGC9-C SERIAL MOUSE (NOT PS/2 COMPATIBLE)	\$79.95
LOGC9-P SERIAL MOUSE WITH PAINTSHOW	\$109.95
LOGB9-BUS MOUSE	\$89.95
LOGB9-P-BUS MOUSE WITH PAINTSHOW	\$104.95

## GENISCAN SCANNER \$199<sup>95</sup>

- UP TO 400 DPI • 32 LEVELS OF GRAY SCALE
- W/INTERFACE CARD SCAN-EDIT II AND DR GENIUS
- GS-4500 ..... \$199.95



## 4800/2400 BPS FAX MODEM \$119<sup>95</sup>

- 4800 BAUD GROUP III FAX TRANSMISSION ONLY • 2400 BPS DATA MODEM • W/MENU DRIVEN PROFAX SOFTWARE
- SENDS COS TEXT, PCX & TIFF FILES TO FAX TRANS.

MCT-FAXM	\$119.95
MCT-24I INTERNAL 2400 BAUD DATA MODEM	\$89.95
MCT-12I INTERNAL 1200 BAUD DATA MODEM	\$59.95

## VIVA 2400 BAUD MODEM \$119<sup>95</sup>

- 2400 1200/300 BAUD OPERATION • HAYES AT COMMAND SET COMPAT • EXTENDED S-REGISTER PROGRAMMING • SPEAKER
- 2ND PHONE JACK • AUTO DIAL TONE/REDIAL • STD. RS 232C INTERFACE

VIVA-24E	\$119.95
VIVA-24MNP	\$149.95
ERROR CORRECTING VERSION	



## FAX/PHONE SWITCHER

ROUTES CALLS FROM 1 PHONE LINE TO YOUR FAX, MODEM AND ANSWERING MACHINE! OPERATES ON SINGLE OR MULTI LINE SYSTEMS • AUXILIARY PORT

FAXM-SWITCH ..... \$109.95

## CALL FOR OUR FREE CATALOG!

### BARGAIN HUNTER'S CORNER



## LOGITECH SERIAL MOUSE AND WINDOWS 3.0

LOGITECH'S SERIAL MOUSE REQUIRES NO CARD—JUST A SERIAL PORT, INCL. 9-TO-25-PIN CABLE. WINDOWS 3.0 IS THE 1ST TRUE INTUITIVE G.U.I. (GRAPHICAL USER INTERFACE) FOR YOUR MS-DOS COMPATIBLE PC! ADDRESS UP TO 16MB DIRECTLY! NOW GET BOTH ITEMS AT ONE BARGAIN PRICE! LOGC9-WIN EXPIRES 11/31/90



CUSTOMER SERVICE 800-538-5001

TECHNICAL SUPPORT 800-538-5002

MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 9 A.M. TO 3 P.M. (PST)

# ORDER TOLL-FREE 800-538-5000

KEY CODE #1011

# CHAOS MANOR MAIL

*Jerry Pournelle answers questions about his column  
and related computer topics*

## Expansion Solution

Dear Jerry,

Last November, I wrote to you to ask if you knew of any way that I could add extra slots to an AT in which the existing expansion slots were already full. You replied that you did not know of any available commercial equipment for this. I got similar replies from other sources, as well.

You might be interested to hear how I have solved this problem. An inquiry to Jameco brought the information that the company has an extender card/slot kit, catalog number PCL755C. It consists of a card that plugs into a 16-bit slot and is connected to a second card by three plug-in ribbon cables. The second card has one 16-bit and two 8-bit slots. By simply adding another edge connector, it can easily have a total of two 8-bit and two 16-bit slots. Power for the additional slots can come from the main computer (via the ribbon cables) or from an external source (+5 and +12 volts).

I bought this extender kit, along with an XT flip-top cabinet and an XT power supply. The second extender board (the one with the additional slots) mounts easily in the XT cabinet. I only had to drill six mounting holes and mount the extender board on brass standoffs that were provided with the cabinet, instead of using its own plastic mounting standoffs. The +5- and +12-V cables from the XT power supply had to be extended to reach the power connector on the extender board. The -5- and -12-V (low-current) supplies still come from the main computer. The +5- and +12-V supplies from the main computer to the extender are disconnected by removing two fuses on the extender board that plugs into the computer.

I removed one 8-bit card (which was in a 16-bit slot) from the main computer and replaced it with the first extender board. This card was then put into one of the 8-bit slots in the XT case. I used another slot for a scanner, and I now have two spare 16-bit slots. As soon as I can afford it, I intend to mount a backup tape drive and its controller in the XT cabinet.

The ribbon cables between the two cabinets probably would radiate RFI in excess of FCC requirements. Although this did not bother any electronic equipment in my house, and I am well away from any other houses, I provided some shielding. To do this, I fabricated a metal trough that bolts to both cabinets and fully encloses the cables. A crude solution would be to use grounded aluminum foil.

The extender card kit is rather expensive, especially considering that it is made in Taiwan. It costs \$99.95 plus freight. The total cost was about \$220, including freight, extra connectors, and so on. For this, however, I have been able to add a scanner. I will be able to add an internal tape backup (which is less expensive than an external one) and will still have a spare slot left.

L. D. Thomas  
Georgetown, DE

*Thanks for letting us know!—Jerry*

## Adding Up Bytes

Dear Jerry,

I am writing you to explain the discrepancies that you found with the reports of XTree and the Norton Commander (Computing at Chaos Manor, February).

What you got is not very odd. The total number of files is right: CHKDSK reports three hidden files, one of which is the Volume Label (if you do some peeking around with the Norton Utilities, you'll find it stored in your root directory like any file; it just has a special attribute bit set), and the IO.SYS and MSDOS.SYS system files. Of these three "files," XTree (correctly) counts just the last two. Add two to the 1662 "user files" that CHKDSK reports, and you have the 1664 that XTree reports.

Note that all the figures the Norton Commander gives you for total directory space are exact multiples of your cluster size (2048 bytes). That is all the space allocated to your files, including the slack area at the end of each file. On the other hand, when you select some files, the

Norton Commander adds their "logical" length, without the slack. If you run File-Size in your directory, it will give you both figures. So, your small directory contains three files that use five clusters, even though part of that space (10,240-6128 bytes) is wasted.

The differences in total drive size can also be explained by considering that you could take 1 MB = 1,000,000 instead of the correct value:  $2^{20} = 1,048,576$  bytes.

Neither XTree nor the Norton Commander is wrong; they just do different computations.

Gino Lucrezi  
L'Aquila, Italy

*I confess that I get lazy sometimes in a case like this, since I know I can count on a reader to explain what's going on. Thanks!—Jerry*

## Locating Genius

Dear Jerry,

I just read your comments on Kun Yung Enterprise's Genius Genitizer (Computing at Chaos Manor, August).

I found a U.S. address for KYE International in a database called COMPLIB on CompuServe. That's where I find the names, addresses, and telephone numbers of most manufacturers. KYE International can be reached at 12675 Colony St., China, CA 91710, (800) 456-7593 or (714) 590-3940; fax: (714) 590-1231; BBS: (714) 590-3485.

Andre Mallette  
St.-Leonard, Quebec, Canada

*Thanks. Of course, we good BIX users don't use CompuServe, but. . .*

*I did manage to make contact with the company eventually, and the people there say they'll put the U.S. address in their new stuff.—Jerry ■*

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

# PRINT QUEUE

Hugh Kenner

## Stomping the Nasties

*A field guide through the jungle  
of computer invaders*

**V**iruses—*There Are No Such Things!* That statement appeared in print some three years ago. But there are so such things, as the fracas at InterNet/ARPANET demonstrated late in 1988. That was when, coast to coast, 6200 machines got immobilized by what seems to have been a prank that outran control.

But what, *me* worry? I sit tight at my home machine. Well, no, you needn't worry, not at all, provided only (1) your machine has no modem link to the outer world; (2) you never share floppy disks with anyone; (3) you run no software save what you've written yourself. So runs the considered opinion of John McAfee, coauthor (with reporter Colin Haynes) of *Computer Viruses, Worms, Data Diddlers, Killer Programs, and Other Threats to Your System* (St. Martin's Press, 1989, \$16.95).

McAfee is founding chairman of the Computer Virus Industry Association, which logged over 300,000 virus infections in 1989 alone. And how many went unreported? That's anyone's guess. Users are ready to blame malfunctions on, oh, operator error. It's when linked machines malfunction identically that suspicion begins to stir. And when suspicion stirs in Silicon Valley, it often prompts a call to John McAfee, who climbs into a motor home that is loaded with virus-catching equipment and steers toward the new client's parking lot.

Those of us who lack occasion to call on McAfee can profitably read his book. It does the great service of helping us understand what there is to worry about. And viruses do offer plenty of reasons to worry.

Like "hacker," "virus" is a term misused to the point of utter confusion. First, we are not talking about the antics of crackers, who infiltrate systems to filch credit-card numbers or just leave word that they called. We are talking about a piece of code. Not just such a piece of code as is meant, say, to install an illicit

account in a certain bank's system and gently transfer funds to it. That's a worm. And not just something meant to go berserk on a preset date. That's a logic bomb. (When a Maryland library withheld payment for a bug-riddled system, it discovered that the supplier had installed a logic bomb: "Pay up, or your data vanishes!") Luckily, it was located before it went active.) And not just malign software disguised as something interesting. That's a Trojan horse.

No, a bona fide virus may resemble any of the above, but it has one further and deadly capability. It replicates. That means a single copy can spawn many thousands on many thousand machines. And how does that happen?

Well, somehow or other you've acquired a floppy disk with a virus embedded in one program (its host). Its first act is to separate from its host and make copies of itself that go hunting through your directories for other hosts they can live in. Any new floppy disk you install will be likewise searched; eventually, the virus will be lodged in a program you'll in all innocence pass on to a friend... and so on.

Which so far amounts to very little, save that increasingly numerous programs grow bigger by a few bytes. That was all the famous InterNet virus was meant to do: just spread itself about, to the glee of its perpetrator. Unfortunately, it contained a mild coding error. It should have kept clear of programs it had already infected. It didn't; soon, 6200 interlinked machines were busy at nothing save jamming one another till CPUs saturated and system after system died. (Estimated total damage in lost access time and wasted work: \$98 million.)

McAfee offers fascinating detail on how a virus rolls up its sleeves. Thus, a few, like the Pakistani Brain—toward which virus-catchers genuflect respectfully—concentrate on the boot sector, the handful of bytes that load the



operating system. They move that to a sector they flag "unusable," and then replace it with a customized boot sector that will be in control the next time the machine is turned on.

From now on, Darth Vader is running your machine, on the lookout for opportunities. He can intercept any attempt to modify the boot sector. And if you try to *check* the boot sector, why, he shows you the clean original he first stashed away! And every disk placed in the computer becomes infected instantly. "In some corporations, boot sector viruses have spread to a thousand computers in less than a week," says McAfee. The Pakistani Brain itself "rampaged through the newsroom and bureaus of the *Providence Journal*," apparently after one employee put an infected disk in a home computer.

And so what? Well, the Pakistani Brain is by no means as innocent as the InterNet virus was intended to be. It asks for ransom. Nonpayers find files trashed and systems crashing. No one knows how many copies lie dormant here and there. It was spread from Pakistan on disks with pirated copies of WordStar and Lotus 1-2-3, sold at a fraction of the U.S. makers' prices. The author's motive? Apparently, irritation when programs he himself had written were pirated.

So just avoid bootleg copies? Alas, you cannot be sure. Programs routinely go out for beta testing—massive usage, to find bugs—and who knows what beta testers may have done to the disks they send back? Or not know they have done? An innocent beta tester returned to a Seattle firm a disk he'd worked with on a Macintosh he didn't know was infected. Soon, thousands of distributed copies were carrying disease. (The firm—Aldus—acted responsibly, at heavy cost.) So you'll understand the panic of the man whose newsletter shouted *Viruses—There Are No Such Things*. His business was selling public domain software on disks. Public domain? That's distributed via multiple acts of copying. Who knows who's been meddling with it en route?

And who are these meddlers? In an interview I've read elsewhere, McAfee said he had no idea, except that some of them were pretty smart programmers. The more lurid ideas in the book he has cosigned we may perhaps ascribe to his collaborator, who likes phrases like "operating on the dark side." Chapter 6, "A Walk on the Dark Side of a Subculture," presents isolates who shun "conventional human contact," silicon being so much more dependable. One of them, who'd broken into Digital Equipment's system, shed tears on being accused of "harming a computer." Couple a sensibility like that with "a real or imagined grudge against big business, the government, or the computer community establishment as a whole," and you have (it says here) such a psyche as shoots at random into crowds.

OK, let's buy that to go on with. My problem with all such scenarios is that, accurate or not, they set adrenaline pointlessly flowing. Better to gaze calmly at such gems as the list, on pages 89–91, of just under 400 common passwords. That list was embedded in the InterNet virus, which it served as a skeleton key: "Over 90% of all large systems" have "at least one user" whose password it exhibits. Be sure that key fits no lock of yours. (Some samples: Dog, Batman, Rolex, Carmen, Wisconsin. . .)

Or ponder the fact that you're reading this review (and I hope

**T** here are  
three types of antiviral  
products, all useful,  
none totally safe.

will read the book). But you're a computer-literate reader of *BYTE*. And administrators and law enforcers are apt to be so far from computerdom they either can't begin to comprehend what's been done wrong or else just panic blindly. When PCs at Lehigh University were infected in 1987, Lehigh fired the programmer who'd identified the virus and written an antidote. (If he knew so much, maybe he planted it in the first place?)

Or read the section on antiviral products and how they work. There are three main types, all useful, none totally safe. One type tries to keep viruses out, and it can be confused by things programs do normally; thus, it can emit so many false alarms you stop paying attention. Also, it's vulnerable to the boot sector strategy, which has taken effect *before* the antiviral program—or anything else—is loaded.

A second type tries to find and defuse viruses as they arrive; best, by keeping a "snapshot" of the system status when it's installed and thereafter watching for ominous variations. A third type looks for and cleans up viruses already present; its weakness is that it needs constant updating to insert the fingerprints as new strains get identified.

For a 50-page chapter on 73 known PC viruses—what they do, how to find them, how to zap them—try Richard Levin's *Computer Virus Handbook* (McGraw-Hill, 1990, \$24.95). This big book is meant for serious computer users; the McAfee-Haynes volume trolls for curious bystanders as well.

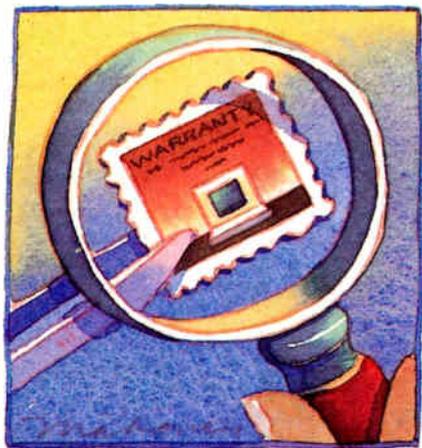
If you don't feel like paying \$16.95 for McAfee-Haynes, you can get it free with a program called Virucide (from Parsons Technology, 375 Collins Rd. NE, Cedar Rapids, IA 52402, (319) 395-9626). Although Virucide is not mentioned in the book, Parsons assures us that McAfee had a hand in it. From the fact that an updating policy is announced, I'll guess that it's mainly type 3. (The manual keeps a *very* low profile and digs itself the usual foxhole: No Warranty of Any Kind.)

Well, Virucide installs easily, runs fast, and tells me that my "preowned" 386 system shows no trace of a virus in any of some 20 megabytes of preowned software. That's a comfort, even though I'm left unsure how much reassurance it may really offer. Next? Well, I'll, yes, run Virucide periodically. And reflect that I can never hope to be in what medical virologists call a sterile environment. ■

---

*Hugh Kenner is a professor of English at Johns Hopkins University. He writes for publications ranging from the New York Times to Art & Antiques. His recent books include Mazes and Historical Fictions. He can be contacted on BIX as "hkenner."*

*Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*



# PROMISES, PROMISES

What's in a warranty?  
Most of the time,  
not much

**W**hen computers first became commercially available, they were bundled with software and sometimes maintenance agreements. Were those sales considered "sales of goods" (and therefore under the purview of the Uniform Commercial Code), or were they "sales of services," controlled by contracts and common law? Was software an intangible or a product? Was a maintenance agreement part of a sales transaction or a service arrangement?

This is just the kind of meaty debate that lawyers who know nothing about technology love. They held tax-deductible meetings in exotic locations, filed lawsuits, and issued proposals. After the expenditure of millions of dollars, it was decided that sometimes a system is a sale of goods, and sometimes it isn't; it all depends.

With those issues clarified, let's move on to how goods are sold. When a salesperson makes promises of vectors per second or immediate rendering, are his or her words legally binding? In most instances, the law will find that whatever a salesperson says is *precatory*. That word would be better spelled *predatory*, but *precatory* is an aspect of caveat emptor—let the buyer beware. A reasonable person should know that the Brooklyn Bridge is

not for sale and that if it is, it needs a lot of repair work and a coat of paint.

On the other hand, what a salesperson says is sometimes considered a warranty, even though the first thing you see when you unbox a new system is a piece of paper saying you have no warranties except for a limited 90-day or one-year warranty. That limited warranty typically says that if you don't follow certain conditions, such as returning the equipment in its original packaging, the warranty is off. Of course, computers and peripherals are packaged in boxes 20 times their size, with foam rubber inserts, molded plastic sidings, and millions of foam peanuts. Saving the packaging eventually means renting space in a warehouse.

The limited warranty then says that the company will replace the failed component with a new one or a used one, at its discretion. This is known as the *law of refurbishment*. One new twist to the law of refurbishment is that used equipment is sometimes refurbished and resold as new. Recycling used equipment has even spawned its own specialists: repackagers who clean equipment, spray it with that smells-like-new odor, rewrap cables in plastic bags, re-shrink-wrap manuals, iron out wrinkles in boxes, and put in blank registration forms. Now you know why they make you return equipment in its original wrappings.

Warranties are covered primarily by the Uniform Commercial Code. The word "uniform" is used to throw off non-lawyers so that they're forced to hire lawyers who understand that uniform means one thing to the public and another to lawyers. This code is not uniform, having been adopted by some of our states with variations. In situations such as this, lawyers use the phrase "the general rule is." The general rule is that just about every warranty (and remedy) can be disclaimed by a seller if the disclaimer is printed in VERY BIG TYPE.

But suppose a salesperson tells you

that a system is capable of performing in a certain manner, and you purchase it relying on that statement. You later find that the system does everything from barking like a seal to waking you up in the morning, but it cannot do that one thing that you bought it for. Then you might have a case for a breach of warranty of fitness for a particular purpose. Of course, getting a judge to pronounce your victory will probably cost you more than the system did.

Then there's the law of disappearing days. Suppose you have a 90-day warranty and you didn't purchase a service plan. The machine breaks down on the tenth day. It takes you four days to retrieve all the foam peanuts, three days to repack the equipment, and 16 days to obtain your authorized return number. Sending the machine back using a ground service will take four to five business days but will cost only a few dollars, or you can use an express service that will deliver the machine in a day or two for what it cost you to purchase the equipment. Inevitably, you'll get the machine back one day after the warranty has expired.

A decent manufacturer (or dealer, or mail-order house) will extend the warranty period to take into account when the machine failed and when it was returned repaired. Some states require the extension. But guess what? In most cases, the burden of an extension is on the purchaser. In other words, you are providing yourself with your own warranties.

That's what democracy is all about: If those manufacturers won't give you a warranty, you are free to pay for one. ■

*Laurens R. Schwartz is a New York attorney and computer consultant. He is the author of numerous articles and books on technology, including the Computer Law Forms Handbook (Clark Boardman Co.) and the forthcoming Computer Art Book (W. W. Norton). He can be reached on BIX c/o "editors."*

*Stop Bit is an open forum for informed opinion on topics related to personal computing. The opinions expressed are those of the author and not necessarily those of BYTE or its staff. Your contributions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

# Put LabWindows to Your Test



## LabWindows® **A+** INSTRUMENTATION SOFTWARE

### Data Acquisition

GPIB  
 Plug-in Boards  
 VXI  
 RS-232

True  False

Industry standard Microsoft C, QuickC, and QuickBASIC development tools for data acquisition and instrument control.  
 Instrument drivers for over 100 GPIB, VXI, and RS-232 instruments.

Integrated support for plug-in data acquisition boards.  
 Powerful analysis library for real-time data processing.  
 Extensive graphics library for creating full-color displays on printers and plotters.

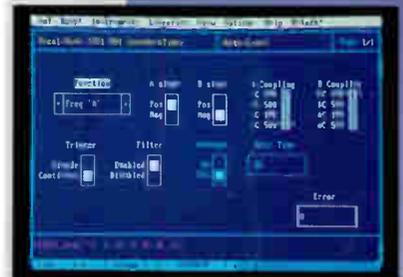
Code generation and debugging tools for faster program development.  
 Software development tools for production test and ATE systems.

### Data Analysis

Digital Signal Processing  
 Statistics  
 Curve Fitting  
 Array Operations

### Data Presentation

File I/O  
 2D Plots  
 Real Time Strip Charts  
 Printer and Plotter Output



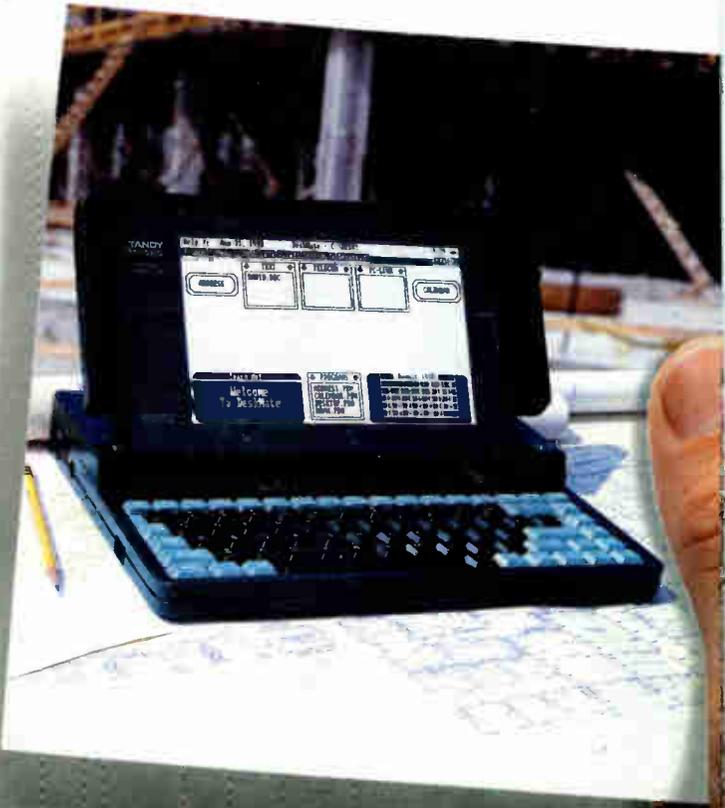
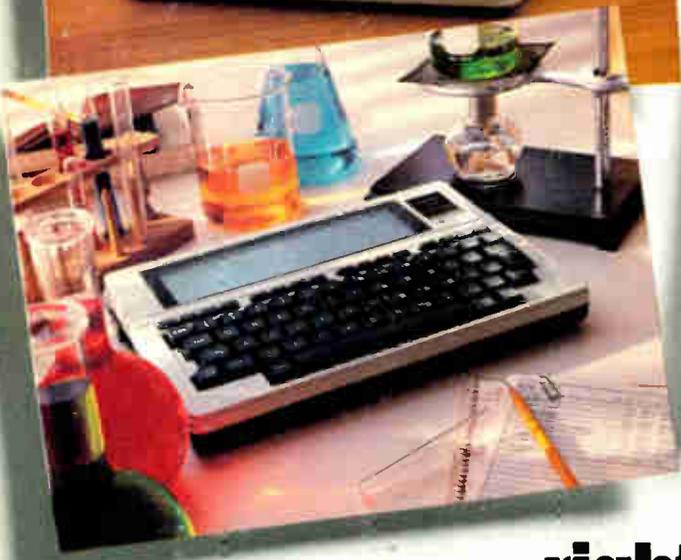
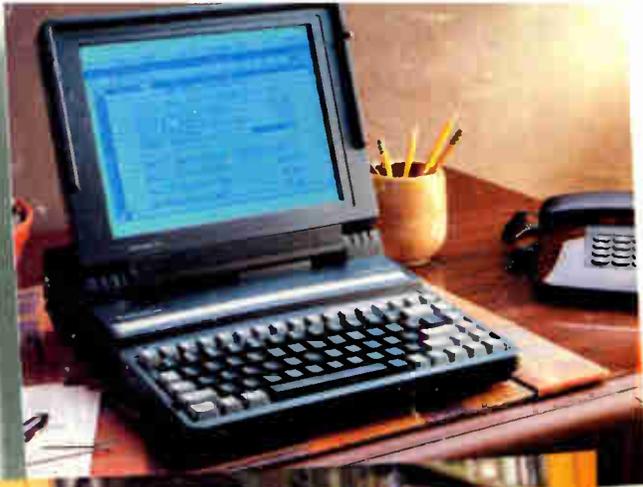
**LabWindows...making industry standard programming languages work for you in data acquisition and instrument control.**


**NATIONAL INSTRUMENTS®**  
*The Software is the Instrument®*  
 6504 Bridge Point Parkway  
 Austin, TX 78730-5039

Circle 251 on Reader Service Card

National Instruments Italy (02) 4830 1892  
 National Instruments France (1) 48 65 33 70  
 National Instruments Switzerland (056) 82 18 27  
 National Instruments United Kingdom (06) 35 523 545  
 Nihon National Instruments K.K. (Japan) (03) 788 1921

**Call for a FREE Demo Disk and Catalog  
 (512) 794-0100 • (800) 433-3488 (U.S. and Canada)**



**With a Tandy<sup>®</sup>  
laptop, PC  
power is always...**

**...right at hand.**

With Tandy's line of powerful laptops, there's no reason to leave your computer behind.

If you like to travel light, pick up the Tandy 1100 FD—the only notebook-size PC with instant-on DeskMate<sup>®</sup> word processing built in. At only 6.2 lbs., the 1100 FD is the ultimate PC compatible for combining portability and affordability.

Or grab the slim, 6-pound Tandy 1500 HD with a 20MB hard drive and DeskMate software. If you demand 286 power, our Tandy 2800 HD is ready to run, with 640 x 400 EGA graphics. Plus, there's the Tandy 102—the 3-pound portable that started the laptop revolution.

Get your hands on a Tandy portable today . . . you'll never have to be without your computer again.

Tandy Computers: Because there is no better value.<sup>SM</sup>

**Radio Shack<sup>®</sup>**  
**COMPUTER CENTERS<sup>®</sup>**  
A DIVISION OF TANDY CORPORATION

Circle 297 on Reader Service Card

World Radio History