

SPECIAL ISSUE

BYTE

THE WORLDWIDE COMPUTING AUTHORITY

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**Fax Software
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FIRST IMPRESSION:

**AST's New
PowerExec**



**Zeos Color
Notebook**



**Compaq LTE
Lite/25**

**Zenith
Z-Sport 325S**

AC 

Caps  Num  Pad  Scrl 

File Edit Format Select Format Options Window Help

Handbook ups

1 2 3 4 5 6 7

FEATURES

- Weight 2.75 Lbs. (HandBook & Battery)
- Dimensions 5.96" x 9.75" x 1.4"
- 4.5 Hr. w/ NiMH Battery, 1.25 Lb. AC Adapter/Charger,
- 5.5" x 2.5" x 1.5"
- Traveling Weight 4.0 Lbs. (HandBook, Battery & Charger)
- CPU Processor, 286-Class Performance
- 1MB RAM Upgradeable to 3MB
- 40MB Hard Drive
- Backlit 7.6" Double-Scan CGA Screen, 640 x 480 Resolution
- Parallel/1 Serial Port
- 28-Key Keyboard, 101-Key Emulation, Inverted T Cursor Pad
- MS DOS 3.0, LapLink XL, MS Works, Central Point Desktop
- & Serial Download Cable
- Carrying Case

Pg 1/1 PIC12

Press Alt to choose commands.

ML <F1=HELP>

GATEWAY2000
HANDBOOK





Try One On For Size!

You can't fully appreciate the amazing little HandBook™ from Gateway 2000 until you've tried one on for size!

Put your fingers on the actual-size keyboard printed here. We've tailored it for comfortable touch typing, even though the HandBook measures less than 6 x 10 inches.

Look at the backlit screen. It's bright, easy to read and easy on your eyes in any setting, with any lighting.

Imagine the HandBook tucked in your briefcase. It leaves plenty of room for important papers, and it doesn't weigh much more than this magazine – just 2.75 pounds, including battery!

Now imagine it seamlessly running all your DOS applications with 286-class performance, and 4.5 hours battery life with power management.

We've sewed up the HandBook with plenty of hard-working PC features, and added a convenient Auto Resume: when you pause in your work, just close the cover to put the HandBook to "sleep." Open the cover and it automatically resumes wherever you left off. No need to close files, quit applications and shut down the system – then open everything up again. Conserve battery power and time!

The HandBook is a one-of-a-kind portable PC – a true designer original that's causing real excitement in the PC industry. In fact, *Popular Science* recently named the HandBook one of the year's top 100 "Best of What's New" achievements!

Do we have you on pins and needles? Then call Gateway 2000 today to try one on for size. It's *definitely* dressing for success!

\$1295

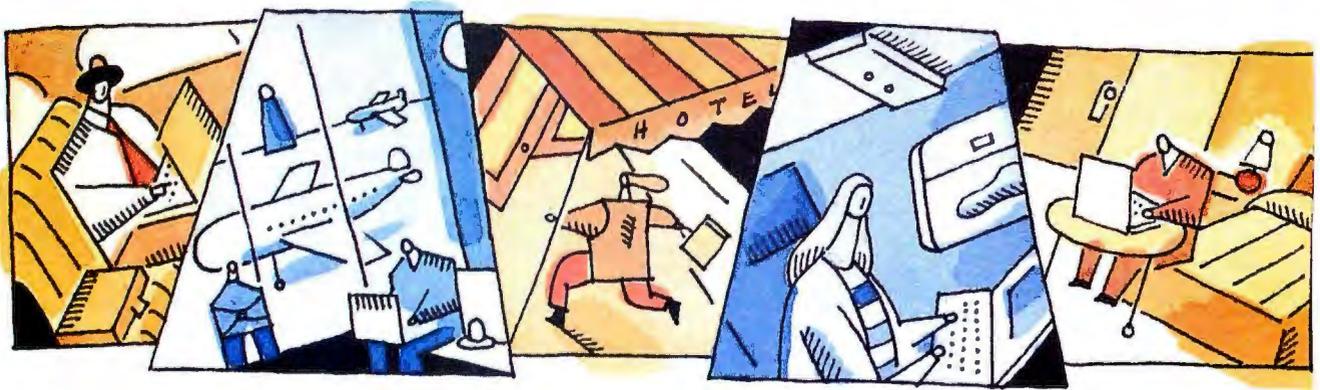
HandBook options include 2400 bps data/9600 bps send-and-receive fax modem, portable printer, extra AC adapter, extra 2.3Ah battery, RAM upgrade to 3MB, combo unit (1.44MB external floppy drive with one parallel and one serial port) and extended VIP warranty.



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

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BYTE's Essential Guide to Portable Computing

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Here.

There.

Everywhere.



The HP DeskJet Portable.
\$599.

Hewlett-Packard presents the DeskJet for the jet set. The new HP DeskJet Portable printer lets you create great-looking documents anywhere you go.

It's small enough to fit in a briefcase and weighs only 4.4 pounds. But the DeskJet Portable prints high-quality 300 dpi black and white text and graphics on plain paper, transparencies or labels.

It's everything you expect from your office printer in a portable package. Compatibility with most major software. A fast print speed of up to three pages per minute. A wide variety of typefaces, sizes and styles. And Hewlett-Packard inkjet technology, so you don't have to sacrifice print quality for portability.

The DeskJet Portable is built tough to take more than the usual amount of jostling. And, to make it even more versatile, an optional rechargeable battery is available, along with a Worldwide Rapid Recharger, a 50-page cut-sheet feeder and a handy carrying case.

To top it off, the DeskJet Portable has a price tag befitting its small size. Just \$599.* Who says you can't take it with you? Call 1-800-552-8500, Ext. 7108,† for the name of the authorized HP dealer nearest you. To receive information by fax call 1-800-333-1917, choose HP FIRST, document #9606.

STAYING PRODUCTIVE AWAY FROM THE OFFICE

HOME:

For one reason or another it's sometimes impossible to avoid having to bring work home. It's usually there simply not enough time in the day to finish all your work while at the office. On the other hand, some find the perfect time and environment of home when working on certain tasks. Whether it's bookkeeping or letter writing, it's important to have the equipment and space you need at home to get work done.



CLIENT:

Business men often find themselves called upon to take care of important details while visiting the client's office. When that occurs, it's best to have immediate access to as many resources as possible. Be sure that someone at your home office is familiar enough with your personal files that they can quickly find anything you need. A portable computer can be a highly effective way to store a wealth of files in a compact unit that can be accessed easily.

HOTEL:

A hotel can be a very peaceful, distraction-free environment for getting work done. And, since many hotels cater almost exclusively to business travelers, you'll find they are usually well prepared to assist you with all your business travel needs. Keep a machine, too, and, in some hotels, personal computers are available to help you get your work done when separated from the conveniences of the home office.

BRANCH OFFICE:

While visiting company offices in different cities, you may find it necessary to set up a separate work space there. If this is not possible, have an assistant from the office you're visiting assigned to you. He or she can help you find the equipment and services you need to stay productive.



HEWLETT
PACKARD

DeskJet Printers
Make it happen.

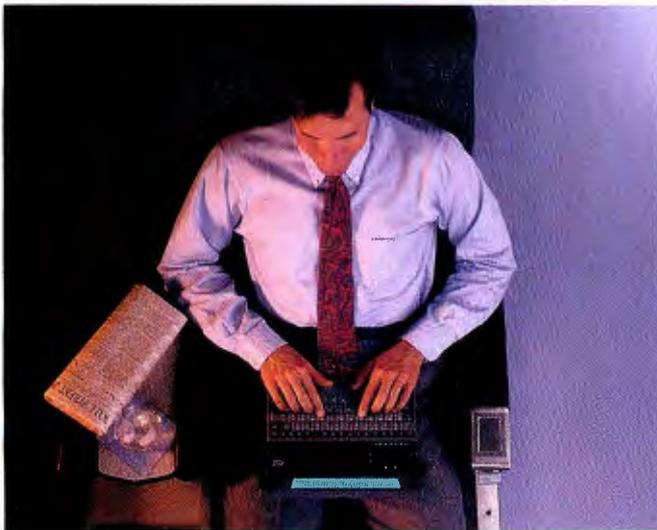
IMAGINE HOW FAR YOU COULD GO WITHOUT LIMITS.



UNLIMITED FUNCTIONALITY. The new PowerExec™ notebook computer gives you freedom to tap into your network, or send information by modem—using credit card-sized PC Cards. It's the first notebook PC with two industry-standard, open-architecture PCMCIA slots. Just slide in a tiny PC card, and you've got incredible functionality. Choose from data and data/FAX modems, LAN adapters, SCSI adapters, and even FlashROM PC Cards.



UNLIMITED USE. Your PowerExec is a great portable computer. But two AST options turn it into a full-featured, affordable desktop PC. AST's PowerStation provides access to two drive bays and two ISA slots, plus desktop I/O ports. Or, choose our convenient EasyPort™. Slide in your notebook, and you have instant access to your PowerExec's ports. Even on its own, the PowerExec delivers desktop PC power and 4 MB of RAM, expandable to 20 MB.

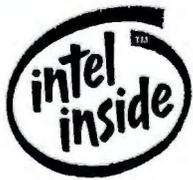


UNLIMITED POWER. You can work coast to coast using just one battery pack in your PowerExec. To give you up to 6.5 hours of battery life, this system is designed with highly sophisticated Intelligent Power Management (IPM). This means the computer constantly monitors the way you work, and automatically tailors its operations specifically to you in order to conserve power. It's the smartest notebook you can find.



UNLIMITED PRODUCTIVITY. AST has broken the barriers between man and machine to deliver unsurpassed productivity. For example, we've positioned the optional SmartPoint™ trackball in the front, so there's no need to move your hands off the keyboard to move the cursor. And we attached the trackball without the usual messy trail of cabling to the back of the system. You can even close the lid completely with the trackball on.

AST DID.



UNLIMITED UPGRADABILITY. AST's new PowerExec is the only fully upgradable notebook PC on the market. You can upgrade the display to vivid passive or active matrix color. The hard drive up to 160 MB. And even the 25 MHz, Intel386™ SL processor board to 486 power.*

*Available Q1 1993

UNLIMITED PORTABILITY. When you're rushing through the airport, the PowerExec won't slow you down. It weighs just 5.9 pounds and measures 11.5" x 8.5" x 1.83". The battery charger weighs under one pound, bringing the PowerExec's total travel weight (with power cord) to just over seven pounds. To get you on your way quickly, the battery pack takes only 90 minutes to charge completely—about the time it takes to go to lunch.



UNLIMITED PEACE OF MIND. No need to worry. Your PowerExec and its contents are protected by an army of hardware and software security features. One of these is unbreakable password protection, which makes your computer virtually worthless to unauthorized users and thieves. But if you forget your password, don't panic. AST provides you with an individualized SmartKey™ to let you back in.



POWEREXEC. Imagine how far you could go with the PowerExec. And if you encounter trouble along the way, AST will repair your system for free within 48 hours.** PowerExec pricing starts at just \$2395.† For information on the PowerExec, call us today at 1-800-876-4AST in the U.S. and Canada.

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crisp and bright screen... Windows, July 1992.

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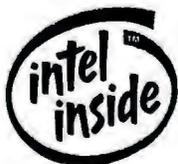
machine we tested... PC World, September 1992.

"OUTSTANDING"

ultra-quiet keyboard... Windows, July 1992.

"SUPERB"

color screen and fast hard disk... PC Magazine, January 14, 1992.



*The experts weren't at a loss for words when they reviewed the NEC UltraLite® SL/25C.
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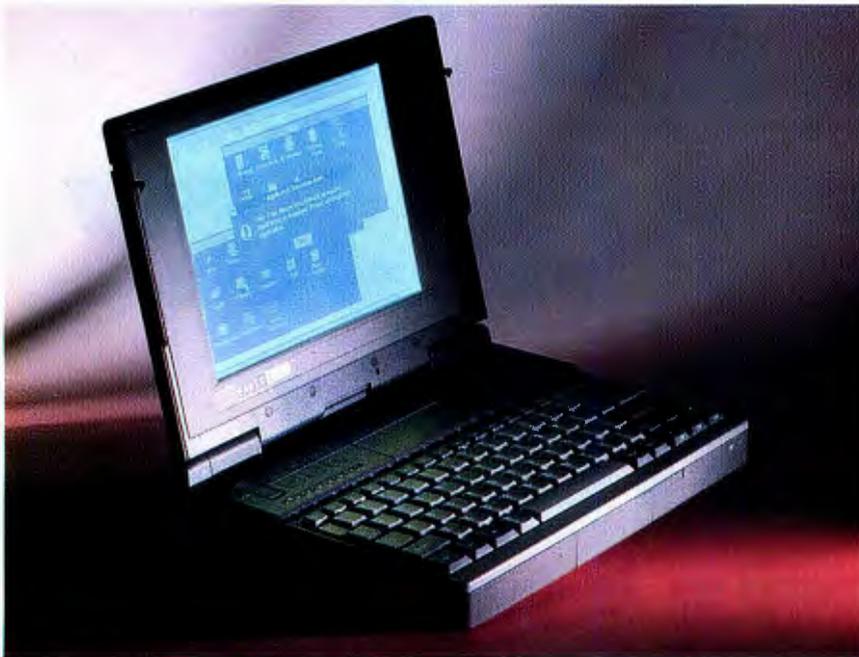


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Because ↑ is the way you want to go.

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AST'S POWEREXEC HERALDS THE NEXT GENERATION



THE FACTS

PowerExec

with 4 MB of RAM, a 60-MB hard drive, a 3½-inch 1.44-MB floppy drive, and an AC adapter: monochrome display, \$2395; passive-color display, \$3395; active-color display, \$4395

AST Research, Inc.

16215 Alton Pkwy.

Irvine, CA 92713

(800) 876-4278

(714) 727-4141

fax: (714) 727-9355

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AST's PowerExec notebook offers expansion and upgradability in a smartly designed package.

FIRST IMPRESSION

GENE SMARTE

The enabling technologies needed to reduce the size and weight and increase the performance of notebook systems are ably represented in the new PowerExec from AST Research. This notebook embodies many of the characteristics that savvy users seek. It is upgradable and expandable (it includes two PCMCIA-compatible slots), and it has improved power management to prolong battery life.

On the outside, the PowerExec appears much like other notebook systems, measuring 8.5 by 11.5 by 1.83 inches. With a NiMH (nickel-metal-hydride) battery pack installed, it weighs 5.9 pounds. The AC adapter adds almost 1 pound more, to produce a total carrying weight of just under 6.9 pounds (see the photo above). Included with the system is a full-travel 83-key keyboard with 12 function keys and a complete assortment of connectors to the outside world, including ones for an external

keyboard and a mouse.

Unfolding the top reveals a 9½-inch LCD monitor. Currently, you can choose either monochrome or, for \$500 more, passive-matrix color. An upgrade to an active-matrix color screen is planned to be available by the end of the year. The displays provide 640- by 480-pixel VGA resolution with 64 shades of gray or 256 simultaneous colors. Inside, the PowerExec has a 25-MHz 386SL with a 64-KB cache, 4 MB of RAM (user-expandable to 20 MB), a coprocessor socket (you can add the chip yourself), a floppy drive, and up to a 160-MB hard drive.

One of the first things that many of us think about is how quickly our new purchase will become obsolete. AST claims that the PowerExec's 386SL processor can be replaced with a 3-volt 32-bit processor when one becomes available. This is not a user upgrade, because it requires a processor board change. The PowerExec uses an upgradable flash-EPROM BIOS.

AST is among the first companies to offer two PCMCIA slots. It also provides six optional cards to fill them: a 2400-bps modem; a 2400-bps modem/9600-bps fax

modem; a 14,400-bps data/fax modem; and a 10Base-T Ethernet, Token Ring, or SCSI adapter. Several third-party vendors have recently announced PCMCIA peripherals, as well. PCMCIA-based storage sells for about \$50 per megabyte at the retail level. The PowerExec also has a connector to drive an external monitor simultaneously with its LCD.

AST claims that the notebook's power management approach lets the system operate for nearly 6 hours on a charge (BYTE did not perform its battery-life tests on this beta version of the PowerExec). In a pinch, you can use 12 AA cells for about 1½ hours. NiMH batteries, a more efficient backlighting and power-supply design, and the use of components that consume less power contribute to the PowerExec's long battery life. The notebook has heuristic power management software that "learns" how you use the system and adjusts sleep mode, hard drive halting, and backlighting shut-off according to your work habits. For convenience, you can hot-swap batteries by putting the system into a "suspend" mode, and you can charge a battery in about 90 minutes with the system off

or between 2 and 3 hours with the system on, depending on use.

If you've ever tried to use external or clip-on pointing devices and their attendant connecting cables with a notebook, you probably wished for something simpler. On the front of the PowerExec is a special connector/mounting clip similar to a camera's hot shoe. AST has a trackball-like SmartPoint pointing device (\$69) that slips into this hot shoe, eliminating the cabling requirements. With the SmartPoint

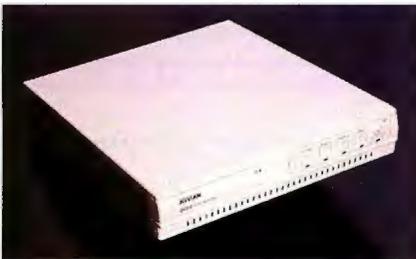
installed, you can close the PowerExec case and fit the system into an optional leather briefcase (\$99).

A couple of other features are worth noting: First, there is a connector for a security cable lock. If someone steals your PowerExec and you have the password option activated, the thief will have difficulty using the purloined portable. A special plug-in ROM hardware key is required to defeat the password requirement. Second, if you need to do massive data ex-

changes between a desktop system and your PowerExec, an AST-designed receptacle fits into a spare 5 1/4-inch floppy drive slot on your desktop system and enables you to connect the removable hard drive from the PowerExec directly to the desktop machine.

AST's PowerExec represents an intelligent refinement of the notebook PC. Its attention to expansion, upgradability, and usability exemplify what the next generation of portable systems should be. □

WHAT'S NEW



Portable Presentations

Giving the best presentation possible—to make a sale, to get your ideas noticed, or simply to deliver a message—has become more and more dependent on the computer as multimedia has become increasingly important for presentations. People who give presentations on the road can never be sure that the proper equipment for their needs will be available at their destination.

Jovian Logic says that its Genie portable scan converter allows for mobile multimedia presentations with a minimum of equipment. The 10-pound unit lets you play presentations off your notebook's hard drive on any standard video device, such as a TV, VCR, or portable LCD projector. The Genie is plug-and-play; there is no need to install an internal card in your computer.

The Genie costs \$1695. Contact Jovian Logic Corp., 47929 Fremont Blvd., Fremont, CA 94538, (510) 651-4823; fax (510) 651-1343.

Circle 1002 on Inquiry Card.

Totable Pointers

The NewPoint trackball from Mouse Systems mounts on the side of your portable PC and comes with software for both DOS and Windows. It features what

Mouse Systems refers to as the Advanced Positioning System, an optomechanical tracking system designed for accuracy. The NewPoint's base resolution is 200 cpi, adjustable via a ballistic driver from 20 to 6400 cpi. The trackball is Microsoft protocol-compatible.

The NewPoint trackball is priced at \$129.95 and comes with a lifetime customer-service guarantee. Contact Mouse Systems Corp., 47505 Seabridge Dr., Fremont, CA 94538, (510) 656-1117; fax (510) 770-1924.

Circle 1003 on Inquiry Card.

IMSI's PC Stylus appears to be a cross between a trackball and a pen. You can roll it across a surface to move the cursor, as you would with a pen or a mouse, or you can flip it and rotate the ball with your thumb, as you would with a trackball. It is adjustable from 400 to 1600 dpi. Standard software includes MenuDirect, a hard drive management and menuing utility, and Cursorific, a Windows utility that lets you modify the cursor for legibility.

The PC Stylus sells for \$89.95. Contact International Microcomputer Software, Inc., 1938 Fourth St., San Rafael, CA 94901, (800) 833-4674 or (415) 454-7101; fax (415) 454-8901.

Circle 1004 on Inquiry Card.



Three New Ways to Connect to a LAN

Xircom led the way in LAN adapters that plug into the parallel port of your portable computer. Now it leads the way again with the CreditCard Ethernet Adapter, a PCMCIA 2.0-compatible card. The card's dimensions are about the same as its namesake's, except that it is just under 1/4 inch thick. It fits into the PCMCIA slots found in notebooks from Toshiba, AST Research, Dell, and others.

The CreditCard supports major Ethernet 10Base-T network operating systems, including Novell NetWare, Artisoft LANtastic, Microsoft LAN Manager, and DEC Pathworks. Xircom claims that its 16-bit interface provides performance similar to that of 16-bit internal Ethernet cards.

The CreditCard is expected to sell for under \$500. Contact Xircom, Inc., 26025 Mureau Rd., Calabasas, CA 91302, (800) 874-7875 or (818) 878-7600; fax (818) 878-7630.

Circle 1138 on Inquiry Card.

Reflexion Technologies has introduced a highly integrated parallel-port LAN adapter called the EtherPort Executive. This device, the company claims, sports

FIRST IMPRESSION

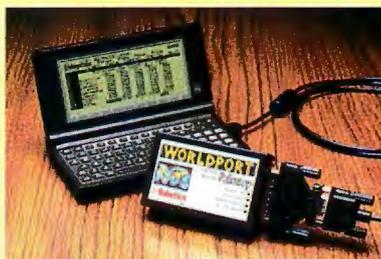
THIS MODEM DOESN'T NEED ANY FAX SOFTWARE

TREVOR MARSHALL

USRobotics has just released the first fax modem designed specifically for palmtops and personal organizers, which just don't have the CPU speed (or the RAM) to successfully run fax software on their own. The WorldPort Palmtop Fax/Data Modem uses the Hayes AT command set for data transmission, with extensions to support fax operation. These fax commands must be issued manually from the DOS command line or by using a communications program.

For example, to dial the number 555-1212 for data transmission, you send the string ATDT5551212 to the modem (in ASCII). If you send ATB7DT5551212, the modem goes into fax mode and prompts you to send the file you want to transmit. There are also commands to set up the caller ID and the font sizes to be used.

I tested the modem with a Hewlett-Packard HP 95LX and found that it worked well until the file size exceeded a page (about 4000 bytes). A buffer



USRobotics's WorldPort Palmtop Fax/Data Modem provides fax operation to hand-held PCs without the need for a separate software package.

in the modem holds the page being transmitted, and when the buffer is full, the modem sends a Control-S (X-OFF) character to the computer. The HP 95LX's built-in software did not recognize the X-OFF, and a buffer overflow ensued. I tried using the DOS command line, as suggested in the manual, but that produced similar results.

USRobotics says that it is addressing the problem and that it should be fixed by the time you read this report.

Nevertheless, this modem is a significant technological achievement, enabling palmtop and organizer users to send faxes with a minimum of hassle. There will no doubt be many more all-in-one fax modems becoming available over the next few months.

THE FACTS

WorldPort Palmtop Fax/Data Modem
\$249

USRobotics, Inc.
8100 North McCormick Blvd.
Skokie, IL 60076
(800) 342-5877
(708) 982-5010
fax: (708) 982-5235

Circle 1001 on Inquiry Card.

a thin-net connector that relieves strain on your notebook's connector. In addition to thin-net, the EtherPort Executive supports twisted-pair Ethernet and provides a local-printer pass-through parallel port. Drivers currently support Novell NetWare, and Reflexion Technologies says it will release drivers for NDIS and NetBIOS shortly.

The EtherPort Executive sells for \$399 with a two-year warranty. Contact Reflexion Technologies, Inc., 109 Fourier Ave., Fremont, CA 94539, (800) 767-4901 or (510) 656-4900; fax (510) 656-0527.

Circle 1139 on Inquiry Card.

Intellicom boasts that its TPair-PNA/QL portable network adapter is the first available with universal network drivers that support multiple protocols simultaneously. It is compatible with any 10Base-T Ethernet network and provides a pass-through parallel port.

The TPair-PNA/QL sells for \$468. Contact Intellicom, Inc., 20415 Nordhoff St., Chatsworth, CA 91311, (818) 407-3900; fax (818) 882-2404.

Circle 1140 on Inquiry Card.

Where's an RJ-11 When You Need One?

As anyone who travels frequently knows, not every hotel is accommodating when it comes to telecommunications via modem. The phones are hardwired into the system, and no jacks are available for your modem. At this point, you can give up, or you can splice into the line using a jackknife and alligator clips, or you can get an acoustic coupler.

An acoustic coupler attaches to the phone's headset and works, well, acoustically. The Telecoupler II from Computer Products Plus works at speeds of up to 9600 bps and allows you to transfer both data and fax. It runs on a 9-volt battery and weighs 9.2 ounces. A Velcro strap helps ensure a snug connection.

The Telecoupler II sells for \$159.95. Contact Computer Products Plus, Inc., 16351 Gothard St., Huntington Beach, CA 92647, (714) 847-1799; fax (714) 848-6850.

Circle 1141 on Inquiry Card.

SCSI Comes to the Portable

Many significant storage devices, such as CD-ROM drives, optical drives, and tape drives, rely on SCSI connections to the host system. Unfortunately, portables rarely have SCSI ports built in. The AL-1000 SCSI adapter from Always Technology attaches to the parallel port and provides that missing SCSI connection.

Always Technology claims that its parallel-port inquiry scheme provides superior performance and works with a wide range of parallel-port chips, including both unidirectional and bidirectional designs. The AL-1000 also comes with a set each of both DOS and Windows software for installation with many types of SCSI devices.

The AL-1000 sells for \$199. Contact Always Technology Corp., 31336 Via Colinas, Suite 101, Westlake Village, CA 91362, (818) 597-1400; fax (818) 597-1496.

Circle 1142 on Inquiry Card.

The World At Your Fingertips.

INTRODUCING A 1.3 LB. PC. SEND & RECEIVE E-MAIL AND MORE.

Imagine a portable PC that lets you send and receive e-mail, modem a memo to the home office, write reports, create spreadsheets, manage your calendar, calculate your expenses...*work non-stop for ten hours*...and is so portable that it weighs about the same as a notepad.

A futuristic fantasy? Not unless the future is now. It's the ZEOS Pocket PC, and only ZEOS has it. You're going to love how portable and affordable it is. In fact, we think you'll find it's the one PC you'll want to take with you everywhere!

COMPACT YET COMPLETE.

At only 9 3/4" x 4 1/2" and only 1.3 lbs., what's great about the ZEOS Pocket PC is that it has a keyboard you can really use. If you're accustomed to typing with both hands, switching to a palmtop can be awkward because the keyboard only lets you type with one hand or even one finger. Yet the ZEOS Pocket PC's keyboard lets you use both hands easily, so you won't sacrifice comfort and speed for portability.

And even though it's small, the ZEOS Pocket PC carries a *full suite of industry standard* software already loaded and ready to go! You get Microsoft DOS 5.0 system files with built-in file transfer and Microsoft Works 2.0 with word processing, spreadsheet, database and communications programs. Plus, you get a personal organizer which includes a calendar/planner, "to do" list, business card file, information retrieval (for country codes, converting measurements and currency) and more. It's everything you need to manage your life!

Word processing, spreadsheet, database and communications programs ... plus a personal organizer. Already loaded and ready to go!

Circle 84 on Inquiry Card.

YOUR LINK TO THE WORLD.

Modem a memo to a client; send and retrieve your e-mail. With the Pocket PC's optional fax/modem, you can communicate worldwide. Plus, expanding the memory is another easy option—with an additional memory card that slips right into a slot on the system's underside. And that's not all.

IT JUST KEEPS GOING . . .

Ten hours of continuous use? Absolutely! All it takes is the two AA alkaline batteries included with your system. And your ZEOS Pocket PC has great power management, too—it automatically switches to the suspend mode when you take a break. Plus, when you turn off your system, then turn it on again, it goes right back to where you left off. What a time-saver!

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Questions about your purchase? ZEOS technical support is 24 hours a day, 365 days a year, and always toll-free. And we back every ZEOS purchase with our 30-Day Absolute Satisfaction Money-Back Guarantee, One Year Limited Warranty and more.

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-PC Week

September 14, 1992

ONLY \$595!

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- **Carrying case, cables and adapters included.**
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- **Keyboard:** 81-key with 12 function keys, embedded numeric keypad and special-function hot keys.
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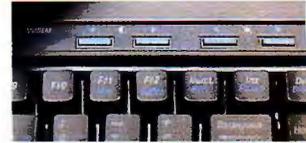
All prices and specifications are subject to change without notice. Please call for current pricing and warranty details. ZEOS is a publicly traded company: NASDAQ symbol: ZEOS. © ZEOS International, Ltd., 530 5th Ave. NW, St. Paul, MN 55112 USA. All products and company names are trademarks or registered trademarks of their respective holders. PT2-BYT-9211



The only notebook with a tilt & swivel display. Great for sharing data or keeping it private. Easily adjusts for perfect viewing.



This fine Italian leather carrying case is an additional option. Loaded with pockets and features everyone will appreciate.



Digital brightness and contrast buttons make screen adjustment so easy.

ZEOS® Freestyle/SL. More features at a lower cost than any other notebook.

To try and compare the new ZEOS Freestyle/SL to any other notebook is next to impossible. Because nothing else has all its features. And even with all these great features, nobody can match the price. Features and price. It would seem the new ZEOS Freestyle/SL is the best of all worlds. It is.

DESIGNED BY USERS. JUST LIKE YOU!

We asked our customers what it is they want in the perfect notebook. The first thing they told us is that most notebooks look like a cigar box with a lid. They told us they wanted not only good looks, but things like great power *and* great battery life. Lightweight too, like five pounds and change. And the keyboard should be effortless to use. The entire product had to be extremely durable. And that was just for starters.

SL POWER. SL BATTERY LIFE. 64K CACHE!

We listened well.

Then we got down to work. For the chipset and CPU we selected the Intel 25MHz SL. We then built in a high-speed 64K SRAM cache as standard. We know this system might well replace a desktop for many users.

And power to your ZEOS Freestyle/SL system is provided by our advanced battery system. The fully enclosed lightweight battery packs easily snap in and out and can be "quick-charged" when the system is not being used or trickle-charged when in use. So what happens when the power is on?

GREAT VIDEO TOO.

You get great video! Because for video control, we chose the amazing new Cirrus Logic VGA controller. It not only consumes less power, it also produces the fast crisp images you're looking for. And with a business machine like this you'll also appreciate our dual display capabilities. You can connect an external VGA color monitor for simultaneous co-display. And that's not all.

Period.

A NOTEBOOK KEYBOARD YOU'RE GOING TO LOVE.

We re-designed and re-sculpted every key from scratch. Even the key-switch mechanism was invented anew. And we added the mouse key for easy cursor control. It is the

absolute perfect notebook keyboard. What else?

Lots else! Like the best display system of any notebook available anywhere. We listened here too. The screen is big and easy to read. Plus, it's high contrast and it's fast. It's also very easy to adjust. People said contrast and brightness knobs were hard to use. So we replaced them with soft touch buttons that *electronically* adjust screen settings at your command. Then we really got creative.

THE ONLY NOTEBOOK WITH A TILT & SWIVEL DISPLAY.

Can you imagine your desktop PC without a tilt and swivel display? Neither

could we. So why not incorporate that feature into a notebook. With the ZEOS Freestyle/SL notebook you can adjust the screen left and right as well as tilt it up and down. Now you can truly adjust your notebook screen to the perfect viewing angle.

IT FLOATS TOO.

And then there is the "floating" screen. When you're facing your new ZEOS Freestyle/SL, the screen actually appears to "float" in the air in front of you. It's the only notebook that can really be used sitting on your lap!

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Built-in mouse key provides easy cursor control. Leave those bulky mice behind!



This sliding port door won't break off or come loose. Saves your fingers too.



ZEOS. #1 RATED NOTEBOOKS, SERVICE & SUPPORT!

PC Magazine recently surveyed notebook users for their Service and Reliability issue. Their findings? "Only ZEOS portable PCs achieved significantly higher-than-average ratings in all four categories." The categories were reliability, future purchase plans, repair service satisfaction and technical support. And remember, ZEOS technical support is 24 hours a day, 365 days a year, toll free. And we back your new ZEOS Freestyle with our 30-Day Absolute Satisfaction Money-Back Guarantee, One Year Limited Warranty and more.

ORDER YOUR AMAZING ZEOS FREESTYLE/SL NOW.

Ordering your new ZEOS notebook is easy. Simply pick up the phone and give us a call. A friendly ZEOS Systems Consultant is ready to answer any questions you may have. You're going to love your new ZEOS notebook. Give us a call!

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NEW ZEOS FREESTYLE/SL ONLY \$1895

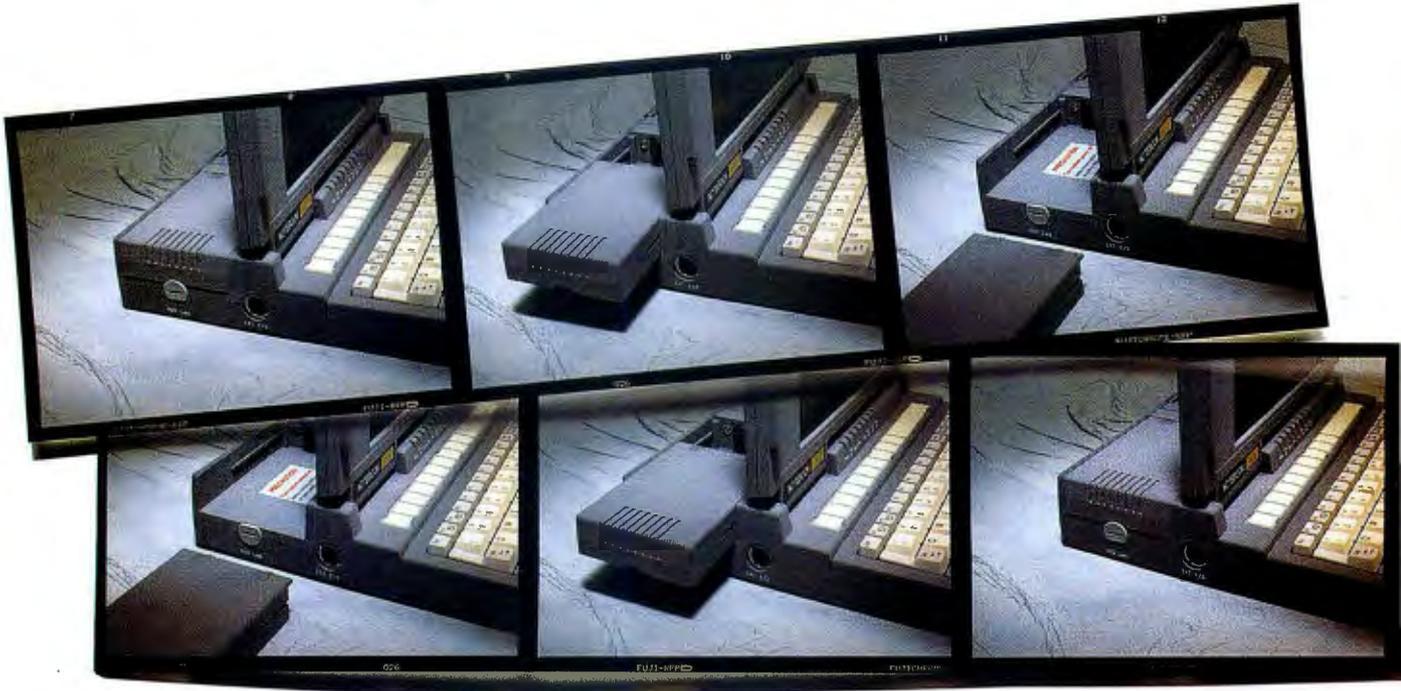
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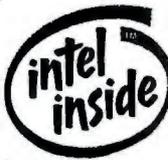
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Memories.

Remember the time you borrowed the company laptop and couldn't find the files you left in the hard drive? Or the time you needed to get at some data in the hard drive when someone had the computer on the road?

Aurum's new 486 notebook computer — *with interchangeable 2.5" hard drives* — will make such unpleasant memories a thing of the past. Because now each of the notebook's users can have a 60, 80, or 130 MB hard drive of their very own. Not only is data security enhanced, but the hard drives can be connected to any of our powerful desktop systems so data is available even if the notebook isn't.



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BYTE'S ESSENTIAL GUIDE TO NOTEBOOK PCS

The BYTE Lab tests 65 notebooks for performance, portability, value, and suitability as desktop replacements

MICHAEL NADEAU AND JOHN WOLFSKILL

Of all the genres of portable PCs, the notebook represents the largest and fastest-growing segment. Approaching the desktop in computing power, the notebook provides a means of carrying large volumes of important data, transmitting and receiving data remotely, and working at locations where no other computer is available. It has also become a strategic weapon for businesses looking to get a competitive edge. For these reasons, focusing on notebooks for this buyer's guide was a simple decision.

The BYTE Lab tested 65 notebooks for value, portability, suitability as a desktop replacement, and performance. On the surface, the systems are remarkably similar, with few exceptions. Most are within a fraction of an inch of the same dimensions—11 by 8.5 by 2 inches—and range from 6 to 8 pounds in weight. The real differences occur where the vendors made compromises. For example, using a lighter battery saves weight but gives you less battery-operation time. Using a color LCD improves the video, but it adds weight and bulk, boosts the price, and reduces battery life.

A word to the wise: All notebooks are the result of some sort of compromise. It is physically impossible to include all the functionality of a desktop system, or even to have every desirable notebook trait, in a package the size of a hardcover book. Not one of the systems here received the highest rating in all categories.

We designed our tests and the presentation of the results to allow you to make easy comparisons among the systems according to your primary needs. The table starting on page 34 allows you to quickly see the strengths and weaknesses of each system. Again, no notebook does it all. A few come close, but those are also among the highest-priced systems.

Selection and Testing

Our selection process was simple: We reviewed every commercially available notebook PC we could get our hands on, providing it used at least a 386SX processor. We considered the so-called subnotebooks, which weigh 2 to 3 pounds, as a different class of computer (see the text box "Zeos Pocket PC One-Ups Poqet PC" on page 33). Some vendors chose not to participate in the review. AST Research and CompuAdd (but not its mail-order cousin CompuAdd Express) were in the midst of model changes and could not get their new units to us in time. For a look at a repro-

duction version of AST's new PowerExec, see "AST's PowerExec Heralds the Next Generation" on page 8.

For each rating category, we weighed variables from each system's specifications, results of the benchmark tests, and our experiences while using each notebook. The five ratings we used are poor, fair, satisfactory, good, and excellent. A color-coded icon appearing next to the description of a system indicates that we rated the notebook good or excellent in that category. An explanation of how we came to our conclusions in each rating category follows.



Value: The price of a system is not as important as what you get for it. For 386SX/SL-class systems, we expect the following as standard equipment: a floppy drive, DOS, a 60-MB hard drive, a VGA screen, and 2 MB of RAM. More powerful systems should have at least an 80-MB hard drive, a pointing device if Windows comes standard, and 4 MB of RAM. With all other factors being equal, performance expectations should be roughly proportional to the price.

Standard extras, such as a modem, applications software, or a spare battery, were also taken into account. All the notebooks came standard with either DOS 5.0 or DR DOS 6.0. In addition, we considered how a system is sold. Direct marketers generally do not discount listed prices. Systems sold through dealer channels are often discounted, perhaps by as much as 25 percent. Value is also a function of how well each notebook fares in the other categories: Someone might be willing to pay a premium for a portable system that also works well as a desktop unit, for example.

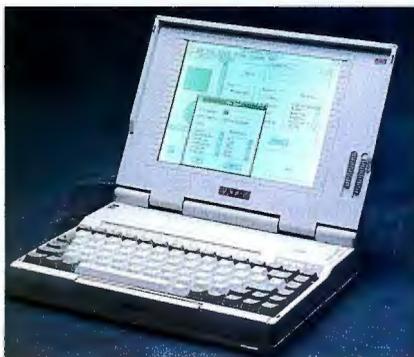
Systems that we think offer exceptional value include the Acma 386DX/33 Executive Notebook, the ALR Ranger MC4SX/25 Model 120, the Gateway Nomad 420SXL, and the MicroExpress NBDX33. Notebooks rated less highly may represent good buys to people willing to pay a premium for their strengths.



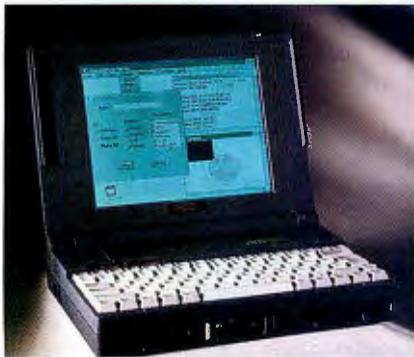
Portability: We considered both obvious and not-so-obvious factors for what is arguably the most important of our four categories. Size and weight are obvious factors; however, people rarely carry



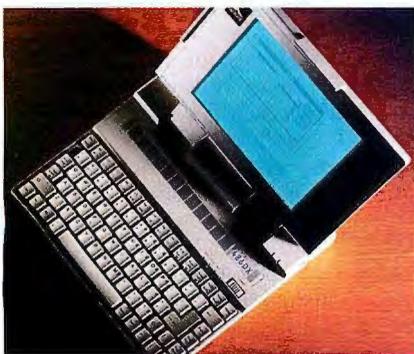
ACMA 386DX/33



ALR RANGER



AMREL MLT486DXU



AQUILINE 3500

just the basic notebook when traveling. We weighed not only the system, but also the power supply, an extra battery, and the necessary cables to determine traveling weight. That weight could be more or less, for example, if you include manuals or leave the extra battery behind.

Battery life is an important portability consideration for some, especially those who use a notebook frequently while they are away from a source of AC power. Our battery tests were run with the systems' power management enabled. For units that allow a range of power-saving settings, we set them to a median level. BYTE's Thumper II battery-life test-bed uses eight pairs of robot arms, powered by servo motors, to simulate an actual working session, including both typing and disk I/O. A host 286-based system monitors everything and keeps track of time.

Most notebooks include an internal floppy drive; some, however, have external units. This could be a plus or a minus in terms of portability depending on how you use your notebook. If you use a floppy disk only to install software, then you can save weight and bulk by leaving your floppy drive behind. Otherwise, lugging one more separate component around is a hassle. We did not consider how the floppy drive was implemented in determining our ratings.

For durability, we looked for a strong, rigid case that protected the LCD, port doors that offered good protection and stayed with the machine, good fit and finish, and a keyboard with a solid feel.

We rated 11 systems as excellent in the portability category: the Compaq LTE Lite/25, the Dell NL20, the three machines in the Gateway Nomad series, the Grid 1660, the NCR 3170, the three machines in the Texas Instruments TravelMate 4000 series, and the Toshiba T2200SX. These notebooks provide small size, low weight, ruggedness, and long battery life all in one package. The only system we rated as poor in the portability category is the Ergo Note-Brick 486, one of the heaviest and biggest we reviewed.



Suitability as a desktop replacement: As notebooks become more capable, many people are using them as their only computer, perhaps connected to a docking unit, a CRT monitor, and a full keyboard at the office. The advantages of such a setup include cost savings and the knowledge that you always have the files you need with you when you travel.

Users generally expect greater performance from a desktop than from a notebook, and many of the 386SX/SL-class

systems we reviewed simply cannot deliver such performance. Similarly, the lower-end notebooks often have limited expansion capability; they often have no docking unit available, and their maximum RAM levels are sometimes as low as 5 or 6 MB.

We expect a good desktop replacement to be capable of running popular business software as well as a desktop does; to have Super VGA external video capability; to be expandable to at least 10 MB of RAM; and to have a full complement of external ports and the option of a docking unit. The docking unit generally provides additional storage (important for backing up the notebook's hard drive), slots for full-size add-in cards, and a base to attach a full-size monitor and keyboard.

If a docking unit is not available, then a good keyboard and superior LCD quality are musts. The best keyboards approximate the feel and layout of a desktop keyboard, providing full-size key caps, full travel, and separate PageUp, PageDown, Home, and End keys. Building a good notebook keyboard often means making a wider system, however.

A color LCD, especially an active-matrix type, greatly improves a notebook's standing as a desktop replacement. The Toshiba T4400SXC80, for example, offers crisp, bright colors and superior resolution; the only feature of a color CRT monitor that you give up is screen size.

In fact, the three active-matrix color systems—the Compaq LTE Lite/25, the NEC UltraLite SL/25C, and the Toshiba T4400SXC80—are the only ones that received an excellent rating as a desktop replacement. They did so on the strength of their video, usability, performance, and expandability. Systems we cannot recommend as your only system are the ARC 3025, the Bondwell 386SL/F, the Everex AGI Travelpro SX/25, the Keydata Keynote 386SX-25, and the Tandy 3800 HD. Limited expansion capability and performance were deciding factors for all these notebooks.



Performance: This may or may not be an issue for you. If you simply want to run basic DOS applications, such as a word processor, a communications package, a scheduler, or perhaps a flat-file database manager, any of the systems reviewed here will more than meet your performance needs. On the other hand, if you want to run Windows or if your applications are more demanding—financial analysis or CAD, for instance—you will want all the power you can afford to buy.

The BYTE portable benchmarks test at

both the low level, measuring the speed of all a system's individual components (CPU, FPU, hard drive, and video), and the applications level, which gives you an idea of what to expect for real-world performance. The applications benchmarks provide performance indexes for both DOS and Windows operation (see the figure). All scores are compared against our baseline system, the Toshiba T2200SX.

The T2200SX was one of the better-performing notebooks when we first tested it over two years ago. Now most notebooks, with their faster CPUs, outperform it with ease. The five top-performing Windows systems we reviewed were the Amrel MLT486DXU, the Aquiline 3500, the Ergo NoteBrick 486, the Gateway Nomad 425DXL, and the TI TravelMate 4000 WinDX/25. The five fastest DOS notebooks were the Amrel MLT486DXU, the Aquiline 3500, the CompuDyne 4DX/33, the Ergo NoteBrick 486, and the Gateway Nomad 425DXL.

The Contenders

The notebooks we reviewed are listed below in alphabetical order by company. The table lists them alphabetically within CPU groups. We've used symbols to indicate which systems were rated good or excellent in a particular category.

Acma 386DX/33 Executive Notebook 

At \$2299, the Acma 386DX/33 offers a list of impressive features, good performance—especially for Windows—and top-notch documentation. Fitted with all full-size keys, the 386DX/33 provides excellent typing action despite its abbreviated key travel. A built-in fan keeps the electronics cool, but it could be the main cause of the system's mediocre 1 hour, 41 minutes of battery operation. The company offers a healthy list of options that includes a docking station. Although the 386DX/33 comes with a pair of serial ports, there's no provision for an internal modem. One of the heaviest systems tested (at 8.56 pounds), the 386DX/33 is not very luggable by notebook standards.

ALR Ranger MC4SX/25 Model 120   

Advanced Logic Research has a reputation for producing high-performance desktop PCs, and the Ranger does nothing to tarnish that image. Outfitted with a 25-MHz Intel 486DX, the Ranger screamed through our benchmarks with a DOS index of 5.79 and a Windows index of 3.60. If that's not fast enough, the unit is upgradable to a faster 486 CPU. The system comes in a sturdy case with a built-in

carrying handle. The rubber-coated, full-travel keys provide excellent tactile response—a commodity that you'll find missing in the keyboards of many notebook PCs.

The bright, paper-white LCD displays easy-to-read text. The \$2495 (for the 60-MB version) Ranger offers options such as a hand-scanner port and a SCSI connector for CD-ROM drives. It also features an odd but interesting Quick-Snap mouse connector. Although the Ranger is one of the larger systems we tested, its high performance and low price more than make up for it. A version of the Ranger equipped with a 20-MHz 486SX and a passive-matrix color LCD (which was not available in time for testing) costs \$2949.

Altima 325XL and 420   

The 325XL comes with a 25-MHz AMD 386SL CPU, an 80-MB hard drive, and a 100-pin system-expansion bus. Although the 325XL is only a middle-of-the-pack performer, its power management system worked as advertised in our battery endurance tests, delivering nearly 3 hours of operation.

Virtually identical in appearance to the 325XL, the slim and handsome Altima 420 strikes a good balance between the essentials of performance and weight. At \$2499 and 6.63 pounds, the 20-MHz 486SX-based 420 offers better-than-average performance and a crisp LCD with excellent display-response time. Business presenters will appreciate the 420's ability to display video on the built-in LCD and on an external monitor simultaneously. Other features include an upgradable CPU, external 800- by 600-pixel Super VGA graphics, and an optional built-in trackball.

Amrel MLT386DXL-33 and MLT486DXU      

Although bulkier than the average notebook PC at 2.3 inches high, the Amrel MLT386DXL-33 is aimed squarely at legions of Microsoft Windows users who require above-average performance. The 33-MHz AMD 386DXL system comes standard with dual memory caches (32 KB internal, 64 KB external), an 80-MB hard drive, and a built-in trackball. The keyboard lacks dedicated page-control keys, and the resting-L cursor/arrow key arrangement may require some adjustments for users who are used to desktop keyboards. On the back of the system you'll find a pair of serial ports and a built-in hand-scanner port.

Break out the fire hoses, gang! The Amrel MLT486DXU really smokes. The \$2795 machine screamed through the performance benchmark suite to surface as the fastest 33-MHz machine in the group. Its 11.02 index for DOS performance bested every other system reviewed here. With the exception of its 128-KB internal memory cache, the Amrel MLT486DXU provides the same features as the Amrel MLT386DXL-33.

Aquiline 3500  

A heavy hitter in more ways than one, this solid 8.56-pound notebook delivers excellent performance. Among its features are a 33-MHz Intel 486DX CPU, a 120-MB hard drive, a built-in cooling fan, dual serial ports, and a saddleback battery that kept the lights burning for 2 hours, 24 minutes, long enough to exceed its manufacturer's claims. At \$2695, the Aquiline 3500 cuts the cost of a high-performance notebook system down to size.

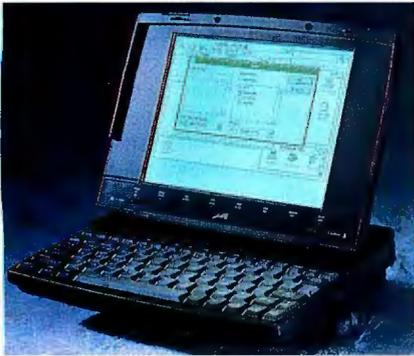
ARC 3025 

A veteran of the PC compatibles business, American Research Corp. offers this 25-MHz 386SX notebook complete with a 120-MB hard drive for a modest \$1595. Unfortunately, the ARC 3025 that we tested came with its share of problems. The keyboard has the annoying tendency to flex under your fingertips as you type. Neither the computer or its AC power adapter provides any indication of when the battery is charging. We also noted problems in the documentation: The sparsely written text occasionally lapses from English into German.

Despite the efforts of helpful ARC technical-support specialists, the ARC 3025 was unable to complete the full battery of benchmark tests. The problem was attributed to a possible fault in the machine's ROM BIOS firmware. The ARC 3025 performed well in the battery endurance test, surviving a respectable 3 hours, 38 minutes on the test grid. Although most of its problems are minor ones, you may want to take a closer look at the ARC 3025 before you make a decision to buy.

BCC Avanti 025 

"Dare to be different, but do so with a purpose" may be an appropriate phrase to describe Beaver Computer Corp.'s Avanti 025. With slick European styling, this notebook is both handsome and easy to carry. The center-hinged LCD was obviously designed by a veteran of coach-class airline travel. In the operating position, the Avanti uses only half the horizontal space required by most portables. The case also slopes gently from back to front to pro-



BBC AVANTI 025

vide comfortable typing and viewing angles.

At \$1995, the Avanti 025 comes with a 25-MHz AMD 386SXL CPU, an 85-MB hard drive, a built-in modem, and a bright backlit LCD. The documentation, which includes a section for advanced technical users, is well written and easy to digest. Although the Avanti 025 held its own in the performance benchmarks, it fell short of the manufacturer's 3- to 6-hour battery-life rating, delivering only 2 hours, 15 minutes of operation.

Bi-Link Hyperbook 2200SX



The Bi-Link Hyperbook 2200SX features a 25-MHz AMD 386SXL CPU, 4 MB of memory, an 80-MB hard drive, dual batteries, and a sidelit LCD. The 6.94-pound notebook includes several unique features that distinguish it from the rest of the pack. A built-in LED power meter provides a visual indication of remaining battery power; in a pinch, the system will accept alkaline batteries rather than its standard nickel-cadmium batteries. Another handy feature is the AutoBright switch, which automatically senses and adjusts LCD brightness and contrast. Finally, you may find the built-in SCSI connector a convenient way to add a CD-ROM drive to the system for special applications. At \$1495, these features make the Hyperbook an attractive system.

Bondwell 386SL/F



At \$1699, Bondwell's 386SL/F may appeal to the buyer who's purchasing a notebook for personal use. With a 25-MHz Intel 386SL CPU, a 60-MB hard drive, and a removable 3 1/2-inch 1.44-MB floppy drive as standard equipment, the 386SL/F looks and feels solid. However, the keyboard suffers from a nonstandard cursor-key arrangement and lacks independent page-control keys.

Whether you consider it a gimmick or a necessity, the 386SL/F comes with a programmable security-alarm system. After you punch in your secret access code, you can then "arm" the system with the touch of a key. Should an unauthorized (or unsuspecting) pair of hands then attempt to move the computer, its speaker complains with a shriek that can be heard in the next county. Although not a standout performer, the 386SL/F is a power miser extraordinaire, running for an impressive 4 hours, 52 minutes on the battery-test bench.

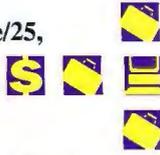
CAF AquaLite-II



CAF Computer offers the trim, 5.59-pound AquaLite-II standard with a 25-MHz Intel 386SX CPU, 2 MB of memory, an 80-MB

hard drive, and a bright, 10-inch backlit LCD. The AquaLite-II can display 800-by 600-pixel Super VGA graphics on an external CRT. Other features include a 160-pin system-expansion bus and simultaneous CRT and LCD operation. Options include a docking station that accepts two 16-bit ISA expansion cards.

Compaq LTE 386 Lite/25,



LTE Lite/25,

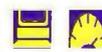
and Contura 3/25

The LTE 386 Lite/25, the latest version of the notebook that many companies try to emulate, is a solid performer for its class. The system uses a 25-MHz Intel 386SL CPU and features an excellent LCD display. The four predetermined power management levels are accessible via a hot key. A pop-up power gauge keeps you informed of the battery's status.

The LTE Lite/25 is the active-matrix color LCD version of the LTE 386 Lite/25. One obvious way in which it differs from the 386 Lite/25, besides the color video, is a trackball built into the lower right corner of the LCD bezel. Although it works well, the trackball requires you to take a hand off the keyboard, and left-handers will find it frustrating. Battery life is tremendous for a color notebook: 3 hours, 4 minutes. As you would expect, the color display is crisp and bright, although the Toshiba T4400SXC80's display is a little better. The LTE Lite/25 costs \$500 less than the Toshiba, however.

The Contura 3/25 doesn't look like a Compaq. Its contoured shape is unique and subject to taste, but underneath is a solid system based on a 25-MHz Intel 386SL CPU. At \$2099, the Contura is Compaq's best monochrome notebook value. Windows 3.1, PFS:Windows Works, a trackball, and a 60-MB hard drive are standard. The keyboard is above average for feel and layout.

CompuAdd Express 425CXL



CompuAdd Express, the mail-order subsidiary of CompuAdd, offers the 425CXL for \$2245. Based on a 25-MHz Cyrix 486SLC CPU, the 425CXL includes 4 MB of memory, an 80-MB hard drive, a 9.5-inch backlit LCD, and a built-in trackball. With full-size keys, the keyboard provides excellent typing action. Our test unit had a warped case that should have been flagged by CompuAdd's quality-assurance department. The LCD provides excellent contrast and sharp text. All I/O ports are located in a single compartment at the rear and are protected by a sliding door.



BI-LINK HYPERBOOK



COMPAQ LTE 386 LITE/25



COMPAQ LTE LITE/25 & CONTURA 3/25

CPU CHOICES

ROGER C. ALFORD

The primary challenge in designing notebook computers is to provide advanced functionality within modest power constraints. Users want a fast processor, a bright high-resolution display, a big hard drive, lots of memory, and a variety of I/O devices. But size and weight constraints limit the amount of battery power available to support these functions, so the product-design engineer is forced to find imaginative ways to stretch the number of hours that can be coaxed from the system battery.

The microprocessor is a key component when it comes to minimizing system power consumption. There are ways to reduce the power consumption of the processor itself, but the presence or lack of special processor features determines what other system-level power-saving functions can be easily and reliably implemented. Several processors have been introduced over the past two years that have features optimized for use in portable, battery-operated systems.

There are three basic ways in which microprocessors can achieve lower power consumption: reduced clock frequency, lower operating voltage, and static CMOS implementation. All these areas involve cost, performance, and engineering trade-offs.

Reducing the clock frequency to the processor, and therefore also to the chip set and other system components, is a popular way to reduce power consumption in notebooks. For the processors used in desktop computers, IC power consumption is directly proportional to the operating frequency of the chip. Most of today's systems include dual-speed support, allowing you to switch to a slower speed to increase battery life. But given the performance demands of both users and applications, especially Windows-based applications, this is rapidly becoming an unacceptable alternative.

A better approach is a technique called *performance on demand*. With this technique, the processor operates at full speed during normal program execution but is slowed to a much lower clock rate during noncritical operations, such as waiting for keyboard input. This dynamic-clock approach provides the full performance of the processor when needed, while saving battery power during periods of noncritical processor activity. Performance on demand can be most effectively implemented with static CMOS processors that incorporate special power management features.

For the past several years, 5 volts has been the standard supply voltage for ICs, and the components used in all conventional notebooks conform to this standard. However, a new 3.3-V standard has emerged that is gradually gaining acceptance in battery-operated systems. An increasing number of ICs, including chip sets, memories, and processors, are now being introduced that can operate at this lower voltage. Soon even disk drives and other subsystems will be available that operate from a 3.3-V supply. This technology will lead the next generation of portables into 8-plus hours of operation on a single battery charge.

Most microprocessors found in today's personal computers, including such favorites as the 386DX/SX and 486DX/SX, are implemented as partially CMOS dynamic devices. These pro-

cessors require that a minimum clock frequency be maintained to ensure proper operation and to maintain internal register contents. A fully static all-CMOS design, in contrast, offers lower power consumption during normal, full-speed operation and allows you to reduce the operating frequency of the CPU to any desired level—even a dead stop—to reduce power consumption.

Virtually all notebook computers now include power-switching technology, where key system components (e.g., disk drives, I/O ports, and the LCD) can be electronically switched off and on, either automatically or on user demand. The hard drive, for example, can be programmed to turn off after not being accessed for a certain number of minutes. Taking this a step further, users of battery-operated systems often find it desirable to suspend their system's operation for a certain period of time when they are interrupted and later resume operation where they left off, without substantially depleting the battery. Thus, when suspended, the system must power-down all unused components and subsystems while maintaining system memory and other configuration parameters, such as the video display mode and mouse initialization.

Initial—even some existing—attempts at intelligent power-switching and suspend/resume operation have met with varying degrees of success, but they've generally compromised the goal of achieving total software compatibility. Problems arose because the operating system, applications software, and power management software were all trying to share common system resources (e.g., memory, interrupts, and I/O ports), resulting in occasional clashes. This was particularly a problem when running protected-mode operating systems, such as OS/2 and Windows 3.x, which want to maintain control over essentially all system resources. There was no practical way for the processor to handle the power management functions while not affecting anything else in the system.

Intel was the first of four suppliers to provide a solution to this problem with the introduction of its 386SL processor. The 386SL includes a new operating mode, SMM (System Management Mode), that is distinct from, and invisible to, the standard protected modes of the 386 processor. SMM has its own interrupt, I/O space, and memory space isolated from the rest of the system so that it can operate without affecting any aspect of normal system operation. The special interrupt input—SMI (System Management Interrupt)—is nonmaskable and has a higher priority than the 386's standard NMI (nonmaskable interrupt). SMM allows the processor to handle all power management-related functions, including intelligent power switching and suspend/resume operations, without conflicting with normal system operation—even when the processor is running a protected-mode operating system with several tasks active.

The 386SL is a fully static CMOS component, offering low-power operation and the ability to operate at speeds as low as 0 MHz to further reduce power consumption. Intel now offers a 3.3-V version of the 386SL (which runs at slower speeds than 5-V components) for even lower power consumption. In November, Intel is expected to announce its

CPU CHOICES (continued)

486SL family, which is rumored to also operate at 3.3 V.

AMD has also been aggressively pursuing the 386 market. The company initially offered its static CMOS 386SXL and 386DXL components, which have the ability to operate at speeds as low as 0 MHz, for further power reduction for applications requiring lower power consumption than standard dynamic components require. More recently, AMD introduced its low-voltage 386SXLV and 386DXLV processors, which operate at 3.3 V and incorporate an SMM; these are similar to Intel's 386SL offering. AMD has not kept its 486 processor development efforts a secret and has revealed its intent to eventually introduce a 3.3-V 486-compatible processor.

The company to most recently throw its hat into the personal computer processor ring is Cyrix, with its 486SLC processor. Another fully static CMOS design, the 486SLC is offered in a 3.3-V version to minimize system power consumption. While the 486SLC does not currently have a sophisticated SMM to support power management operations

like the other processors described above, it does have special pins on the chip to suspend and resume processor operation without affecting normal software execution. Cyrix has announced its intention to introduce a new version of its 486SLC with "advanced power-management features," which may be similar to the 386SL's SMM.

Processors provide the key to keeping hot-selling notebook and subnotebook computers running coolly. With support for intelligent power management operations, the ability to operate with a 3.3-V supply voltage, and static CMOS implementation that supports clock rates down to 0 MHz, the latest power-sensitive processors are poised to support lightweight portable systems that will operate for many hours on a single charge, or even from disposable batteries.

Roger C. Alford is a BYTE consulting editor and president of Programmable Designs, a Michigan-based electronics design firm. You can reach him on BIX as "rogera."

Compudyne 4DX/33

The Twinhead-designed Compudyne 4DX/33 is a high-performing, feature-rich package. The 33-MHz Intel 486DX sys-



tem comes standard with a 127-MB hard drive, a built-in trackball, Windows 3.1, and Polaris Software's PackRat personal information manager.

The machine's display is exceptionally bright and readable. At \$2999, the Compudyne 4DX/33 offers good value for the performance. *continued*

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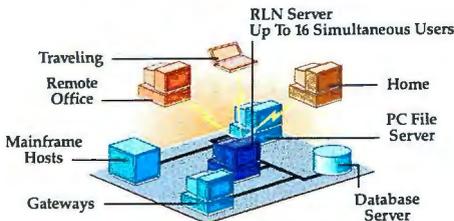
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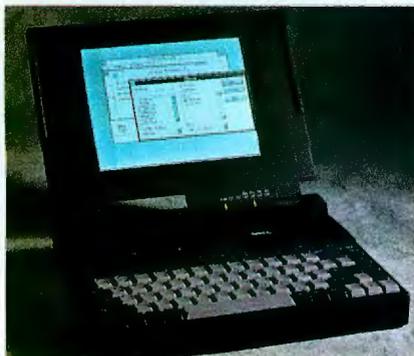
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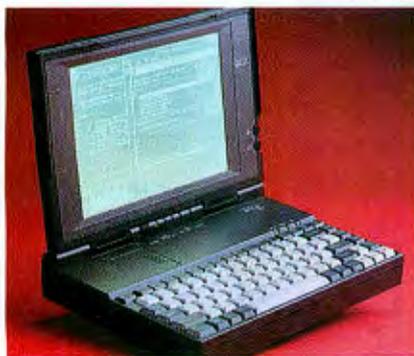
COMPUDYNE 4DX/33



DAUPHIN 500-GT



DELL NL20



DELL 325N

Cube Horizon 325SXL



Cube Computer's Horizon 325SXL is another of the so-called Windows-ready notebooks. Moderately priced at \$2150, the Horizon 325SXL comes standard with a 25-MHz AMD 386SXL CPU, an 80-MB hard drive, preinstalled Microsoft Windows 3.1, a built-in fax modem, and a trackball. The keyboard provides good typing action but suffers from an inefficient control- and cursor-key arrangement that makes it cumbersome to use with some applications. An expansion chassis is optional. Its built-in features and overall quality make the Horizon 325SXL stand out.

Dauphin 500-GT



Dauphin Technology first entered the laptop market as a contractor for the U.S. government, providing products that had to meet rigid government specifications. Dauphin claims the 500-GT is designed to withstand a shock force of 5 gs while operating and can be stored in temperatures of over 100°F. At \$1795, the 25-MHz 500-GT comes with an AMD 386SXL CPU and a 10-inch monochrome LCD. The 100-pin system-expansion bus provides a way to connect an optional 16-bit expansion chassis with space for one full-size and one half-size expansion card.

DECpc 320P

Early this year, computer giant DEC established Desktop Direct, a division that sells PC systems directly to business users. The DECpc 320P is one of the company's first portable offerings. The small and ultraslim 6.41-pound notebook is one of the remaining few based on a 20-MHz Intel 386SX CPU; most other vendors are moving to faster processors. The 320P comes standard with a 40-MB hard drive and a built-in 2400-bps modem. The keyboard offers reversible Control and Caps Lock keys, and it produces good typing action. Unfortunately, the monochrome LCD can be difficult to read under harsh indoor lighting. This dark cloud has a silver lining, though. Thanks to Desktop Direct's throttling back on the 320P's LCD power, the system has a long battery life. The notebook bested its manufacturer's rating of 2.5 hours by staying alive for more than 3 hours, 37 minutes in the battery endurance test.

Dell NL20,  **NL25,** 

325N,  **and 325NC** 

Topping the list of offerings from Dell Computer is the NL20. The crisp and bright backlit LCD is easy to adjust for the right amount of contrast and brightness. A full-travel keyboard provides re-

sponsive typing action and an audible muted click with each keystroke. The Intel 386SL-based system also shines in power management. The NL20's nickel-cadmium battery survived for over 5 hours in the battery endurance test. At \$1499, the NL20, with its high-quality components and excellent documentation, is a good value.

A rung up the performance ladder from the NL20 is the Dell NL25. Although outfitted with a slightly different case design, the 25-MHz Intel 386SL-based notebook offers virtually the same features as the NL20. At times, an intermittent mechanical connection prevented the battery from charging on our review unit, but this might be attributable to damage during shipping.

Except for the weight and size of their respective LCD screens, the Dell 325N and 325NC are identical twins. The 25-MHz Intel 386SL-based notebooks offer rugged construction and full-travel keyboards. The sliding port doors are a nice touch that provides a full measure of protection for the vulnerable port connectors. The 325N's monochrome screen delivers sharp text. By contrast, the 325NC's edge-lit passive-matrix color LCD appears dull and slightly washed out.

Both notebooks offer excellent power management; they seem to extract every available electron from their NiMH (nickel-metal-hydride) battery packs. The 325N lasted 5 hours, 48 minutes in the battery endurance test, while the 325NC stayed afloat for an amazing (for a color system) 4 hours, 51 minutes.

Epson NB-SL/25



The Intel 386SL-based NB-SL/25 is a dual-battery system with a well-designed keyboard. Its performance is on a par with that of other 25-MHz notebooks. The Epson's screen, however, was not as bright as others in this review. On the positive side, Epson provides a "road-service" guarantee that promises speedy replacement of defective parts, or the entire system, while you are traveling.

Ergo NoteBrick 486

The 33-MHz Intel 486DX-based NoteBrick might be the Hulk Hogan of notebook PCs. Measuring 11.2 by 10.2 by 2.2 inches and weighing 8.7 pounds, it is one of the biggest and heaviest we tested. It makes up for the heft in performance, however, blasting through the BYTE benchmarks with indexes of 7.64 for DOS and 4.32 for Windows.

It doesn't skimp on standard equipment, either; it has a 170-MB hard drive and 4 MB of RAM. A Logitech mouse, Windows 3.1, and Addstor compression soft-

ware are also included for the base price of \$2995.

Everex AGI Travelpro SX/25



Everex offers the Travelpro SX/25 to PC resellers. It comes standard with a 25-MHz AMD 386SXL CPU, a removable 40-MB hard drive (we tested the optional 80-MB version), a host of utility programs, and Microsoft Windows 3.1 preinstalled. Although the Travelpro is a solid performer, its nickel-cadmium battery and power management system lack staying power. That's unfortunate, because the Travelpro is otherwise one of the lightest, most portable systems we tested, weighing 8.51 pounds, including the AC adapter and an extra battery.

First International Leo PhD



You might expect a system with a moniker like Leo PhD to roar like a lion and recite the encyclopedia backward. But First International Computer's Intel 486SX-based notebook turned in only average benchmark scores.

However, the \$1700 notebook comes with standard features that make it an exceptional value: a handy removable 2 1/2-inch 80-MB hard drive, a bright monochrome backlit LCD, a 100-pin system-expansion bus, and dual serial ports. The optional AT-bus expansion chassis allows you to expand the Leo with three full-size 16-bit ISA expansion cards.

Gateway Nomad 325SXL,



Nomad 420SXL, and



Nomad 425DXL



Gateway 2000's Nomad series includes three Windows-ready notebooks based on the popular TI core-logic chip-set design. The 25-MHz Nomad 325SXL is powered by an AMD 386SXL CPU, the 420SXL uses a 20-MHz Intel 486SX CPU, and the 425DXL comes with an Intel 486DX CPU. Each portable features a large and bright backlit LCD; each also provides support for 16-color 1024-by-768-pixel graphics on an external VGA monitor.

The systems' keyboards are logically arranged, with a variety of system functions assigned to 10 dual-purpose function keys mounted atop the case. The keyboard has a hard but responsive feel. All three notebooks lack independent page-control keys.

The Nomads' power management system is aided by a utility called BatteryPro. For comparison, we tested the machines with and without this utility installed. All three portables earned high marks in the battery endurance test (e.g., 4 hours, 34

minutes for the Nomad 325SXL). The 425DXL, along with its near-twin TI TravelMate 4000 WinDX/25, was the most powerful notebook we reviewed to also receive an excellent rating for portability.

Grid 1660



Grid Systems, a subsidiary of Tandy, concentrates on portables designed for the well-heeled power user. At \$2995, the Grid 1660 features a 25-MHz Intel 386SL CPU and a 125-MB hard drive. To enhance per-

formance, the 1660 also has a 64-KB external (four-way set-associative) memory cache. The built-in micro-trackball makes the 1660 ideal for CAD users or for navigating within Microsoft Windows (which comes standard with the system).

The Grid 1660 offers what may be the ultimate in LCD screen protection: a cover lid constructed of magnesium. Designed for work in harsh environments, the case is rated to withstand a shock of 80 gs and temperatures of up to 100°F, according to

Big screen. Will travel.

Introducing new ScreenStar™ from BitWise, the world's first portable with dual-page display. It's a 486 50MHz PC workstation constructed within a suitcase for unrivaled performance in a portable package.

DUAL-PAGE ScreenStar's massive 21.3" gas plasma screen folds flat within the suitcase, and easily displays two 8-1/2" x 11" documents at full size, to powerfully present data in meetings, in the field, or on the road.

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Actually, we'd say impossible to beat. And so will you.

Just compare Express notebooks to the competition — the way leading computer publications have been doing. And you'll see that we have the most features at the lowest prices.

You'll see why *Computer Shopper* (8/92) said the Express 325NXL was "...destined to be the power accessory of the future." Why *Computer Buying World* (8/92) praised its "small, light, attractive and reasonably priced package." Why *PC Magazine* (8/92) said the 325NXL is the notebook made for "those looking for a good value at the \$2,000 price point."

And why there should be no question which notebook computer to buy.

"... will help you get your work done comfortably at the right price."

PC Magazine, August 1992

These are the notebooks you've been waiting for — whether you need a 25MHz 386SX like our 325NXL or a 25MHz 486 like our 425CXL. As *Computer Buying World* said, "CompuAdd Express' 325NXL has most of the extras every notebook should have." So does the 425CXL. And they've got performance, too. *PC Magazine* gave the 325NXL high marks on video and graphics benchmarks and on battery life tests — "the third-highest score of the 70 systems tested."

Our super-twist backlit liquid crystal display has 64 levels of gray scale and a .30mm dot pitch. It measures 9.4" diagonally.

We install a 9600 baud fax/2400 baud modem, both with send/receive capabilities. And we include Quick Link II fax/modem software FREE.

Brightness and other display controls are on the keyboard surface.

Most notebook microprocessors run at only 16MHz or 20MHz. Ours run at 25MHz. 425CXL contains Cyrix CX486SLC; 325NXL contains AMD 386SX.

Sleep button and built-in power management logic for up to 3 hours battery life on the 425CXL; 3 to 4 hours on the 325NXL.

High density 1.44MB 3.5" internal floppy drive.

Two click buttons work with the trackball to select icons and commands.

True notebook size (8.5"x11"x2")

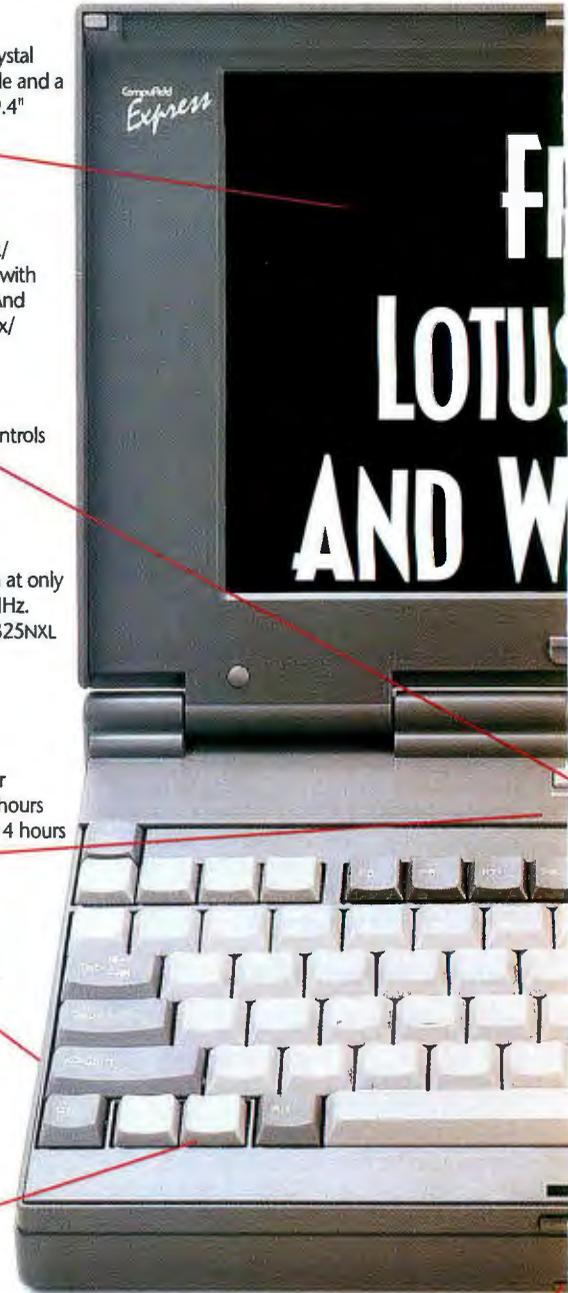
See for Yourself. Express Has The Most Features

	Express 325NXL	Dell 325N	Compudyne 386SX/25	Gateway 325SXL	Austin 386SX/25	PC Brand 386SX/25
MSDOS/WIN	Yes	Yes	Yes	Yes	No	Yes
HD SIZE	80	60	60	80	60	60
WT w/ADAPTER	6.6 LBS	7.6LBS	7.6LBS	7.1LBS	8.7LBS	8.8LBS
RAM	4MB	4MB	2MB	2MB	1MB	2MB
FAX/MODEM	Yes	Option	Option	Option	Option	Option
GRAY SCALE	64	32	64	64	32	32
ZDIGIT RUNDN	5hr 28min	5hr 12min	3hr 26min	5hr 41min	4hr 48min	2hr 45min
BLT N TKBALL	Yes	No	Yes	No	No	No
PRICE	\$2,095	\$2,698	\$1,806	\$2,095	\$2,293	\$1,944

Based on PC Magazine Survey. August 1992

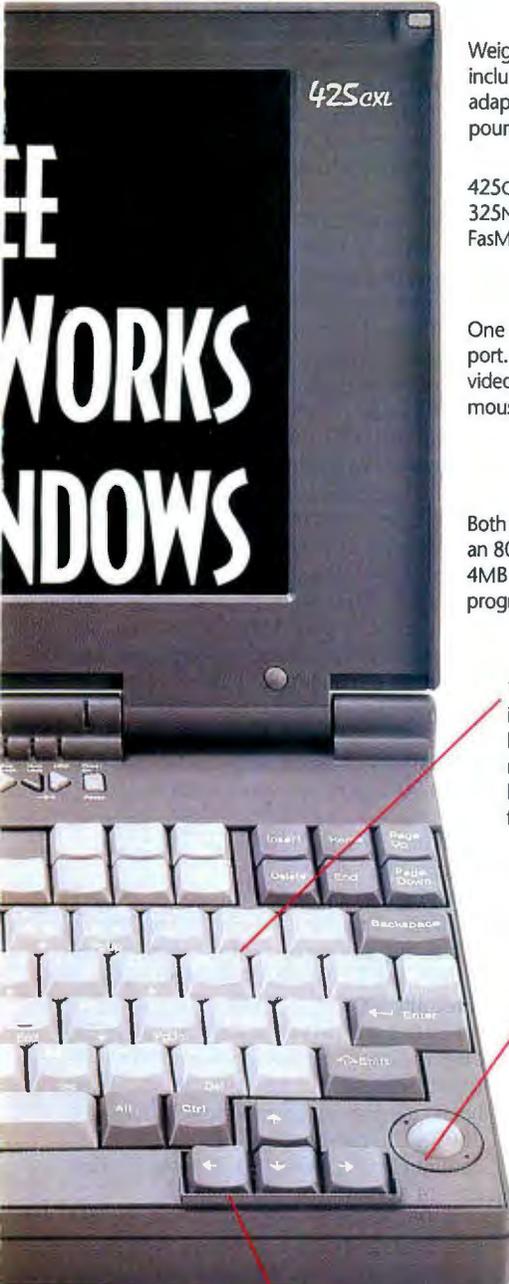
"The clear winner... with its terrific balance of performance and extras."

Computer Buying World, August 1992



PRICE — REALLY TOUGH TO BEAT.”

Computer Shopper, August 1992



Weights only 5.3 pounds, even including the battery. Add the AC adapter, and it still weighs only 6.6 pounds.

425CXL includes a math coprocessor; 325NXL contains socket for Cyrix FastMath™ 83S87 math coprocessor

One serial port, one parallel port. External 800x600 VGA video, PS/2 keyboard and PS/2 mouse connectors.

Both the 425CXL and the 325NXL have an 80MB hard drive, and both have 4MB of RAM — so big Windows programs run great!

101-key function keyboard implemented with 84-key layout has an IBM “feel” because it’s made by Lexmark, formerly IBM’s keyboard division. Fullsize function keys, too!

Built-in trackball with 200dpi for accurate pointing.

Our FREE carrying case has a shoulder strap and pockets. Pack adapters, diskettes and other supplies.

Inverted “T” arrow keys are in the lower right hand corner, where they belong.

Express 325NXL

Everybody loves our notebooks’ features. *Computer Shopper* wrote that “The built-in 2,400bps fax/modem is snazzy” and called the keyboard, sliding door covering ports and general design “an admirable piece of work.”

PC Magazine wrote: “The Lexmark keyboard is comfortable to use. Large and prominent function keys are ranged along the top, and the cursor keys are in an inverted-T layout just left of the trackball.”

Computer Buying World also praised the keyboard, which it said “is remarkably well laid out.”

~~WAS \$2,095~~
\$1,895

Express 425CXL

The 425CXL has all the terrific features that made its 386 partner so popular. But it has extra speed, thanks to its Cyrix CX486SLC microprocessor.

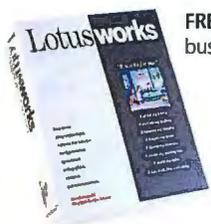
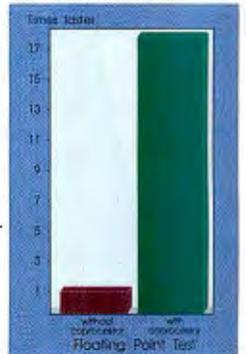
This processor is smaller than other 486 chips, so it fits easily into a portable computer. It uses less power than other 486 chips, so you’re less likely to run out of juice in the middle of a big job. Yet it has a built-in cache. And the 425CXL contains a math coprocessor, so applications that use floating point instructions are swift indeed.

~~WAS \$2,595~~
\$2,245

Lease for only \$83/mo

The 425CXL has a built-in math coprocessor. You can add one to your 325NXL. So programs that use floating point instructions run 17 times faster than an equivalent system without a coprocessor. Test: PC Tech FFT.

17 Times Faster!



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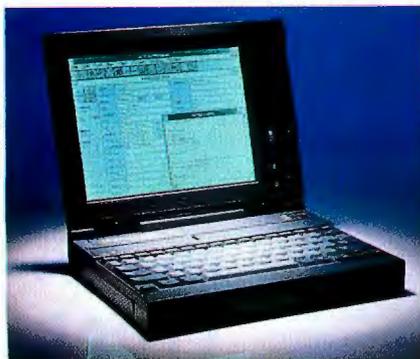
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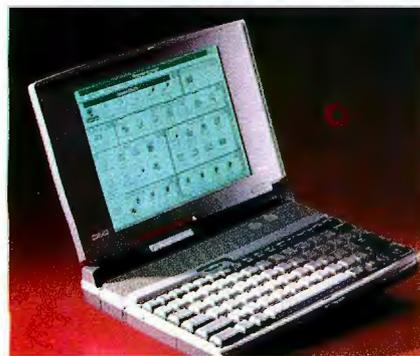
GATEWAY NOMAD 425DXL



GRID 1660



IBM PS/2 NOTE N51 SLC



NCR 3170

Grid. In discussions of notebooks, *tough* often translates into *heavy*, but not with the 1660. It is one of the lightest systems we tested, weighing under 8 pounds with both the AC adapter and extra battery.

The 10-inch sidelit monochrome LCD is bright and easy to read, while the 1660's keyboard provides excellent typing response. Other features include an internal modem slot and a 200-pin ISA system-expansion bus for attaching the optional expansion chassis.

IBM PS/2 Note N51 SLC and PS/note N45 SL

Slim, elegant, and weighing less than 7 pounds, IBM's \$2265 PS/2 Note N51 SLC notebook comes with a 40-MB hard drive, a Micro Channel expansion bus, and a few surprises as well. The first is the outstanding performance of its IBM 386SLC CPU. In the benchmark tests, the 16-MHz N51 SLC outclassed several 25-MHz systems, thanks to the CPU's built-in cache. The N51 SLC's keyboard delivers a smooth typing action, and every key is located where your fingers expect to find it. A few disappointments include the mediocre backlit LCD, a short battery life (1 hour, 19 minutes), and system documentation that is at times incomplete and confusing.

Following the trend of other top-tier manufacturers, IBM has recently added a lower-cost/performance alternative to its growing line of notebook PCs. The PS/note N45 SL comes with a 25-MHz 386SL CPU, 2 MB of memory, and an 80-MB hard drive. The notebook offers excellent battery staying power, good performance, and a keyboard that delivers smooth typing response. The backlit LCD is bright but not exceptionally crisp. At \$2295, the N45 SL is a better value than the N51 SLC, but it falls short of the high quality we've grown to expect from a company like IBM.

Insight 386SXL-25

Insight's 5.8-pound notebook makes use of a 25-MHz AMD 386SXL CPU. For \$1499, an 86-MB hard drive and a mouse come standard with the system. The screen quality is good; some might find the keyboard feel too soft.

Keydata Keynote 386SX-25

Direct marketer Keydata International is offering a deal that may be too good to refuse. For \$1395, the KeyNote 386SX-25 comes with a 25-MHz Intel 386SX CPU, 2 MB of memory, two serial ports, an 80-MB hard drive, and a backlit LCD. The company also includes a mouse and Microsoft Windows 3.1 to sweeten the deal. We had a difficult time installing the

battery, however, and battery life was subpar at 1 hour, 41 minutes.

MicroExpress NB925 and NBDX33

Mail-order firm MicroExpress offers the thrifty NB925 for \$1899. Based on Intel's 386SXL CPU, the 25-MHz notebook comes with 2 MB of memory, a 120-MB hard drive, a 10-inch paper-white backlit display, two serial ports, and dual batteries. Either of the battery compartments can be transformed into expansion slots for add-on devices (called function packs), including a fax modem, a scanner, an Ethernet (LAN) pack, or a SCSI connector.

The NBDX33 is a portable aimed at Microsoft Windows users. Sporting a brushed-satin-finish case and a speedy 33-MHz Intel 386DX CPU, the NBDX33 comes with dual memory caches (32 KB internal, 64 KB external), 4 MB of memory, a 120-MB hard drive, and a high-contrast backlit display. Other features include two serial ports, a hand-scanner port, and a system-expansion bus that accepts the optional two-slot expansion chassis. MicroExpress offers a 15-month warranty, the longest of any vendor in this review, and a 30-day money-back guarantee.

Mitsuba Ninja Notebook 386SX and Ninja 486

Mitsuba may be better-known for its floppy drives than for its systems. The 386SX is one of the company's first notebook offerings. At \$1595, the 386SX provides an Intel 386SX CPU, 2 MB of memory, an 80-MB hard drive, and a backlit LCD. During operational testing, we noted a malfunctioning Enter key that should have been flagged on the production line. The 386SX did reasonably well on the battery endurance test, providing 3 hours, 15 minutes of operation.

A few notches up the performance and price scale from the Ninja Notebook 386SX, you'll find Mitsuba's Ninja 486. This \$2125 notebook features an Intel 486SX CPU, 4 MB of memory, and an 80-MB hard drive. Although the Ninja 486 scored effectively in the performance benchmarks, its battery lasted only 1 hour, 56 minutes. The 80-key keyboard provides good typing action but lacks dedicated page-control keys.

NCR 3170

Once better-named the Safari, the 3170 has some of the most advanced features of any system reviewed here. Powered by a 25-MHz Intel 386SL, it comes with a cellular-ready fax modem and a PCMCIA slot standard. Its FingerPoint Mouse, a kind of mouse button with movement keys

The Kodak Diconix 701 printer. It's the mobile printer that delivers affordable laser-quality 300 dpi text and graphics, in less desk space than a sheet of paper.

The Kodak Diconix 701 printer delivers desktop quality that makes your communications, and you, look good. Yet it needs only 7.4 x 11.7" of desk space, even with the ingenious 30-page built-in paper feeder. It's a compact ink-jet printer, in the award-winning Diconix tradition, quiet, easy-to-use, sleekly handsome. And it prints up to three pages per minute.

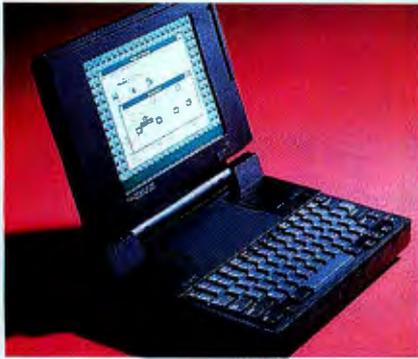
At less than 6 lbs., including the optional battery, this is the definitive mobile printer. Use it at the office, at home, or anywhere in between. Wherever you work, don't wait: call for the name of a dealer near you in the U.S. and Canada. 1.800.344.0006, Ext. 413.

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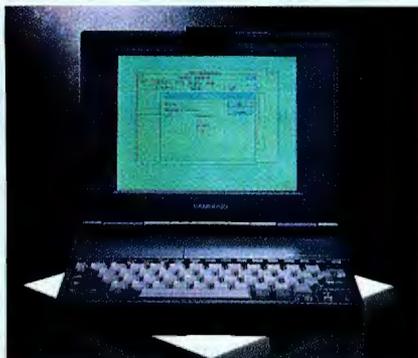
KODAK

Kodak Diconix 701 printer

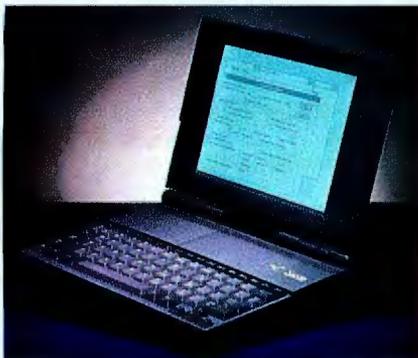




NEC ULTRALITE SL/25C



SAMSUNG NOTEMASTER 386S/25



SWAN 386SX/25



TANDY 4800 HD

on either side, is viable as a portable pointing mechanism, although it takes some getting used to and is not meant as a mouse or trackball replacement. Standard software includes Windows, AT&T Mail Access Plus, and BitFax 2.0. The 3170's screen is one of the most readable of the systems we reviewed. The very stylish 3170 suffers in one area—price. It will set you back nearly \$4500.

NEC UltraLite SL/20 and UltraLite SL/25C



One of the few 20-MHz Intel 386SL systems still available, the UltraLite SL/20 features configurable power management, a better-than-average LCD, and good battery life. The cursor-movement keys are placed below and to the right of the space bar, and they are easy to press by accident.

The UltraLite SL/25C is the 25-MHz active-matrix color LCD version of the SL/20. The SL/25C's screen is not as bright as those of the active-matrix notebooks we reviewed from Toshiba and Compaq. NEC could have cut down on the backlighting to conserve battery power. The SL/25C managed 2 hours, 51 minutes of operation in our tests—not bad for a color system. NEC's keen attention to power management played a role as well.

Noteable 386SXL-25



For \$1399, Noteable Computers offers the 386SXL-25. The 7.16-pound notebook includes a 25-MHz AMD 386SXL CPU, 1 MB of RAM, a 60-MB hard drive, a backlit LCD, and DR DOS 6.0. Other features include a 100-pin system-expansion bus, a hand-scanner port, and a slot for installing an internal modem.

Notestar NP-925

Notestar Computers is a U.S. subsidiary of Modern Computer, a Pacific-Rim OEM. The company offers the ruggedly designed 25-MHz NP-925 for \$1895. Features include an Intel 386SXL CPU, 2 MB of memory, an 80-MB hard drive, a 10-inch paper-white backlit display, two serial ports, and dual batteries. The NP-925 is similar in design to the MicroExpress NB925; either of its battery compartments can be turned into an expansion slot for add-on devices.

PC Brand NB 486/SLC



PC Brand, the mail-order subsidiary of Tandon, sells the NB 486/SLC system for \$1995. Standard equipment includes a 25-MHz Cyrix 486SLC CPU, 2 MB of memory, a 120-MB hard drive, dual serial ports, a paper-white backlit LCD, and Microsoft Windows 3.1. Special features include a custom-designed BIOS ROM chip set with

built-in password security, five language options, and a custom setup program.

As with the other Cyrix-based notebooks reviewed here, we found the NB 486/SLC's performance to be not quite up to that of the Intel 486SX-based systems. It was more on a par with that of 33-MHz Intel 386DX-based systems.

QSI Klonimus Lite

QSI takes the trophy for most original notebook name. For \$1950, the Klonimus Lite features an Intel 386SL CPU, 2 MB of memory, a 60-MB hard drive, dual batteries, and a backlit LCD. A good performer for a 386, the Klonimus Lite was also a standout on the battery endurance test, staying aloft for 4 hours, 48 minutes.

Samsung NoteMaster 386S/25



For \$2199, the 5.91-pound NoteMaster comes with an AMD 386SXL CPU, 2 MB of memory, and a removable 60-MB hard drive. Other features include modem and memory-expansion slots. The notebook ships with a hand-held caddy that allows your PC dealer to install a variety of industry-standard 2½-inch hard drives in the removable-storage-device compartment. This feature also allows several people to share one system; rather than buying several systems for occasional use by various staff members, a company can buy just one system and separate hard drives for everyone.

Sharp PC-6781

Sharp has implemented some good ideas on the PC-6781, although it didn't implement all of them well. The PCMCIA slot means the system can take advantage of this portable expansion slot of the future. Its rubberized case is easy to grasp. The built-in trackball, however, requires you to use both hands, and it can move the cursor so fast that you lose it on the screen. The keyboard is subpar, with limited travel and a hard feel. At 4.9 pounds, the 20-MHz Intel 386SL system is one of the lightest we tested. It ran only 1 hour, 6 minutes on battery power, however.

Swan 386SX/25



Mail-order vendor Swan Technologies has priced its 386SX/25 moderately at \$1895. The system includes a 25-MHz Intel 386SX CPU, 2 MB of memory, a removable 60-MB hard drive, a large backlit LCD, and a spare battery pack. Special features include an auxiliary alkaline battery pack that plugs into the modem slot to provide 45 to 60 minutes of emergency power. The company offers a 30-day money-back guarantee and optional 24-hour repair service.

continued



The 486 notebook that lets you shift to another gear.

The power you need from your computer today may not be enough for tomorrow. But now, thanks to the new Altima 400 Series, you can rev the processor from a speedy 20 or 25 to a screaming 33 MHz 486DX with math coprocessor. So instead of buying a new computer later, you simply buy more speed and power when you want it.

Upgradeable and affordable, the Altima 5.7 pound, 486 notebook runs about the same price as most 386's.

The 400 Series is up to 4-times faster than a typical 386SX, plus it features 64 level gray scaling (not 32); a large 10" diagonal screen; simultaneous display on LCD and external monitor; hard disks with up to 120 megabytes; and a keyboard arrangement that makes sense, not sacrifices.

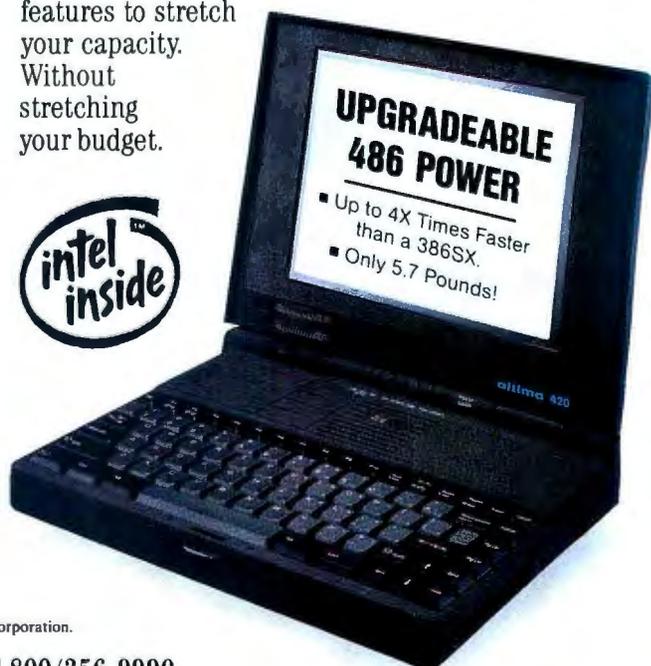
For even greater flexibility, Altima offers options to put you in the express lane. Like an integrated

trackball that snaps right into the unit. Or an internal modem with 2400 BPS, MNP-5 Data and 9600 BPS send/receive fax. There's even a DC adapter for your car.

Shift to the New Altima 400 Series. It has the features to stretch your capacity. Without stretching your budget.



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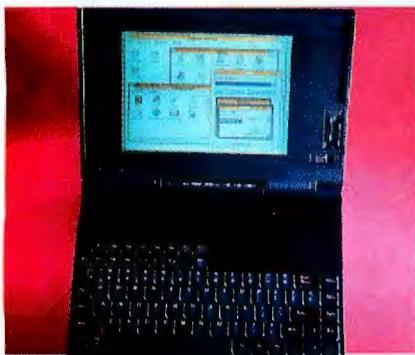
TOSHIBA SATELLITE T1800



TOSHIBA T4400SXC80



ZENITH Z-NOTE 325L



ZEOS COLOR NOTEBOOK

With a short (2-millimeter) key travel, the keyboard provides a hard but responsive typing action that may require some acclimatization for hunt-and-peck typists. All the TravelMate systems lack independent page-control keys.

TI's engineers increased the critical LCD refresh rate to enhance video performance within Windows applications. In addition, the on-board ROM BIOS is designed to place you inside Windows within 30 seconds after you turn on the power switch. To complete this Windows makeover, TI increased these notebooks' overall CPU performance by implementing full burst-mode operation of the Intel 486 chip's on-board memory cache.

The TI machines provide the best balance between portability and suitability as a desktop replacement. Recent price reductions make them a reasonable value as well.

Toshiba T2200SX,

Satellite T1800,

T4400SXC80,

and T4400 SX/LCD

The notebook to beat when it was first introduced, the Toshiba T2200SX features a 20-MHz Intel 386SX CPU, 2 MB of memory, a 9½-inch sidelit LCD, and an 80-MB hard drive. At 5.66 pounds, the T2200SX defines the standard for quality and craftsmanship in a notebook computer. Although the T2200SX is no longer considered a stellar performer, it scored high in the battery endurance test (4 hours, 8 minutes). One of the T2200SX's unique features is its user-definable "hard RAM," a hardware scheme that allows you to select portions of memory as battery-backed non-volatile RAM. A system-expansion bus also allows Toshiba's Desktop Station IV to serve as a stationary desktop host for the T2200SX. Despite recent price cuts, the T2200SX is not competitively priced at \$2599.

The \$1799 Satellite T1800, aimed primarily at college students and home users, features a 20-MHz Intel 386SX CPU, 2 MB of memory, a sidelit LCD, and a 60-MB hard drive. At just under 7 pounds, the attractive but hefty T1800 follows Toshiba's traditional high standards of quality and craftsmanship. Like the T2200SX, the Satellite scored high in the battery endurance test (4 hours, 25 minutes), sports user-definable hard RAM, and offers an auto-resume mode that allows you to freeze an application and then resume exactly where you left off in your next computing session.

The Toshiba T4400SXC80 features a 25-MHz Intel 486SX CPU, 4 MB of memory, a TFT (thin film transistor) active-matrix color LCD, and an 80-MB hard drive. At 7.75 pounds, the T4400SXC80 rates high marks for quality construction and comes with some of the best documentation in the business. The keyboard features active key travel that produces excellent typing action. For users who have been waiting for a notebook with a high-quality color LCD, this is it. The T4400SXC80's TFT active-matrix color LCD is superb, and it makes use of a tweaked graphics controller for smoother color gradations. It displays 256 crisp and true colors with a wide field of view. Other features include a system-expansion bus, a rear-mounted CPU reset button, and a nickel-cadmium battery pack that lasts for nearly 4 hours. The entry level is a steep one, though. The T4400SXC80 will set you back a cool \$5499. The T4400 SX/LCD is the monochrome version of the T4400SXC80.



Veridata Execulite 386SXL/25e

The Execulite 386SXL/25e's standard equipment includes a 25-MHz AMD 386SXL CPU, 2 MB of memory, a 60-MB hard drive, a 3½-inch external floppy drive, and a backlit monochrome CRT. The Execulite can also display 16-color 800- by 600-pixel graphics on an external CRT. Similar to the Wyse DecisionMate 486SLC in design, the Execulite accepts optional plug-in personality modules, including a serial port, a digital mouse pad, and a 9600-bps fax modem.

Wyse DecisionMate 486SLC

Wyse Technology, better known as a manufacturer of computer terminals and monitors than as a manufacturer of systems, offers the DecisionMate 486SLC. The DecisionMate is one of the first notebooks to incorporate Cyrix's 486SLC CPU. The chip includes a 486-compatible instruction set and a 1-KB on-board cache to enhance performance.

At 4.81 pounds (with battery), the DecisionMate is one of the most portable systems we reviewed; unfortunately, its battery lasted only 1 hour, 35 minutes on the test-bed. For \$2299, the 486SLC comes with 4 MB of memory, an 80-MB hard drive, an external floppy drive, and a paper-white sidelit LCD. Aimed at Windows users, the DecisionMate includes a compartment that allows you to insert optional plug-in personality modules.

XiC425NB

At \$1649, the Xi Computer XiC425NB is the lowest-priced notebook in its perfor-



THE MAC ON THE ROAD

TOM THOMPSON

Apple was late to the notebook market, but its Mac PowerBook line has made everyone take notice. Apple claims to have sold 300,000 units in the first nine months since its introduction.

The PowerBook lineup consists of the low-end 16-MHz 68000-based PowerBook 100 and the high-end 68030-based PowerBook 145 and 170 (see photo A).

All have backlit screens, a slot for extra memory, and a slot for a fax modem board. A centrally placed trackball at the front favors either hand and lets you move the pointer without taking your hands from the keyboard.

An Apple survey of PowerBook owners revealed that two out of three had previously owned DOS notebooks. There are several reasons to switch to a Mac notebook. When it comes to a GUI operating system, the Mac still does it best. The Mac OS has had eight years to evolve. Also, the PowerBook's built-in trackball avoids the problems of those bolted-on pointing devices that plague most DOS notebooks. The DOS notebooks that do sport built-in trackballs have designs that favor one hand or require moving your hands from the keyboard.

The built-in 1.44-MB SuperDrive on the PowerBook 145 and 170 (it's an option on the PowerBook 100) reads and formats DOS and OS/2 floppy disks. An Apple File Exchange application comes bundled with the basic system software and provides a minimalist interface to copy a DOS disk's files. Optional software extensions, such as Apple's Apple PC Access, Dayna Communications' DOS Mounter, and Insignia Solutions' AccessPC, offer click-and-drag access to a DOS floppy disk's files, just as they do for Mac floppy disks.

Recent trends in mainstream DOS applications have enhanced the SuperDrive's desirability: These applications now have Mac counterparts. Spreadsheets (e.g., Microsoft Excel and Lotus 1-2-3), word processors (e.g., WordPerfect and Microsoft Word), graphics programs (e.g., Adobe Illustrator), and page-layout applications (e.g., Aldus PageMaker) are now available.

Keep in Touch

The PowerBook's other strong suit is its ability to keep on-the-go workers in touch with their office or clients. Its fax modem board slot lets you use either Apple's 2400-bps fax modem board or faster (9600- or 14,400-bps) third-party boards.

The fax capabilities are closely integrated to the PowerBook's design. The Mac printing mechanism uses QuickDraw—the same imaging engine used to paint pixels on the screen—to create high-resolution output for a printer. Adding fax capabilities is just a matter of supplying what looks like a

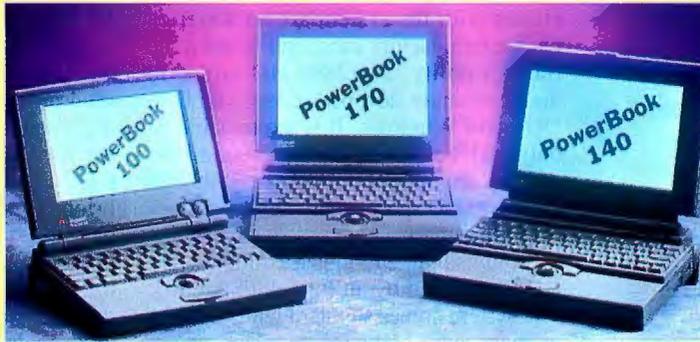


Photo A: The Mac PowerBook series is popular with DOS users.

printer driver to the operating system. Thus, you select a document to fax from the Chooser desk accessory and simply print the document. QuickDraw draws the document at fax resolution (200 or 400 dots per inch) and sends the image to the fax driver, which ships the data out the modem.

All vendors provide fax software with their fax modem boards. Two

vendors, Global Village and PSI Integration, offer fax modem boards that can also receive faxes. The PowerBooks are designed to switch on when a modem board detects a phone ring, so an incoming fax to a slumbering PowerBook can actually wake up the computer. The PowerBook then receives the transmission and falls back into a power-conserving sleep mode, all in a few minutes.

The PowerBook's most versatile communications capability is its ARA (AppleTalk Remote Access) software. It lets you dial into another networked Mac running ARA and become a remote node on its AppleTalk network. From the Chooser, you can access the remote office's file servers (AppleShare or NetWare for Macintosh), mail servers, and printers. You can copy files to and from the PowerBook or send a finished document back to the office to be printed for the boss, even from across the country.

Since ARA uses AppleTalk as its transport mechanism, most third-party network software operates with it. For example, you can dial into the office and use On Technology's Meeting Maker to update your agenda, drop notes to coworkers with CE Software's QuickMail, or use Broadcast to ask someone to put paper in the office printer. ARA even supports MacTCP; thus, in combination with NCSA Telnet, you can establish TCP/IP terminal sessions with Unix workstations on the network to read your Internet mail.

The drawback to ARA is that the modem becomes a severe bottleneck. The typical 2400-bps serial connection hardly comes close to matching LocalTalk's 230,400-bps data transfer rate. ARA is proving to be so versatile, though, that users are already clamoring for faster modems. Global Village and PSI Integration have complied with the demand, offering fax modem boards that operate at 14,400 bps.

The fact that the PowerBook is simply the best GUI notebook on the market isn't enough. The PowerBook's ability to keep you in touch via E-mail, fax, or ARA, no matter where you are, gives it a big advantage over other notebooks.

Tom Thompson is a BYTE senior technical editor at large. You can contact him on GENIE as "TTHOMPSON" or on BIX as "tom_thompson."



TI TRAVELMATE 4000 WINSX/25



TOSHIBA T2200SX

Tandy 3800 HD and 4800 HD



Priced at \$1799, the Tandy 3800 HD is based on Cyrix's 486SLC CPU. The 20-MHz notebook comes with 2 MB of memory, a 60-MB hard drive, a 9-inch edgelit LCD, and Microsoft Windows 3.1. Included with the system are an America Online introductory subscription and a file transfer utility. The 3800 HD turned in disappointingly slow performance for both DOS and Windows. It is expandable to only 4 MB of RAM, the lowest of all the systems we reviewed. Both the 3800 HD and 4800 HD sport superb keyboards—a Tandy hallmark.

Tandy's light but rugged 20-MHz 4800 HD is powered by an Intel 486SX CPU. The system comes standard with 4 MB of memory, a 60-MB hard drive, a 9.5-inch edgelit LCD, and Microsoft Windows 3.1. Although the keys are somewhat noisy, the 4800 HD's keyboard delivers excellent typing action.

The 4800 HD fared very well in both the performance and battery endurance tests. If you're in the market for a speedy 486 system, the 4800 HD is a good value at \$2499.

TI TravelMate 4000 WinSX,



WinSX/25,



and WinDX/25

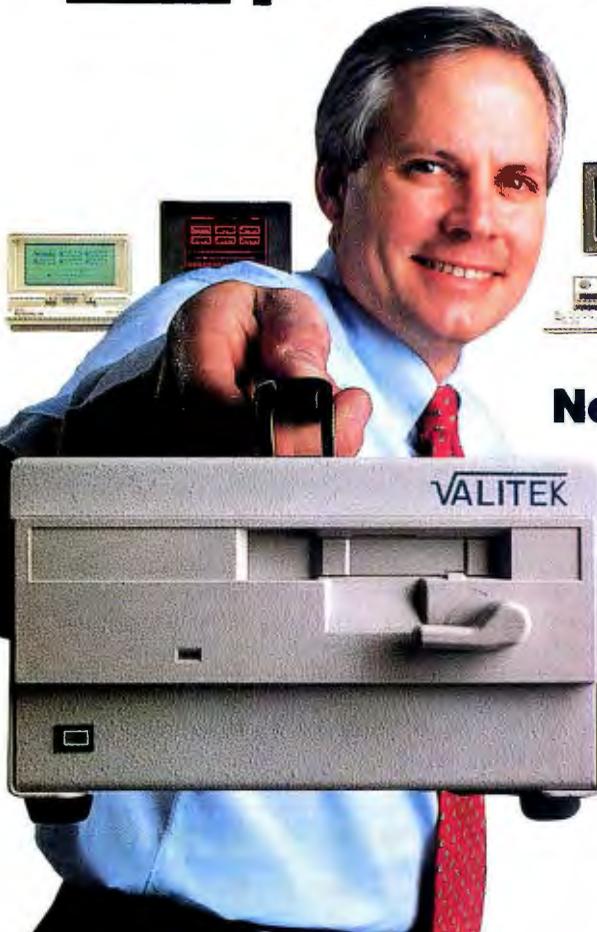


TI offers a trio of notebooks optimized for Microsoft Windows users. All the machines in the TravelMate 4000 series are based on TI's proprietary core-logic chipset design. The WinSX and WinSX/25 are equipped with an Intel 486SX CPU, while the WinDX/25 comes with an Intel 486DX CPU. The machines feature large and bright 10-inch backlit LCDs. The WinSX provides support for 16-color 800- by 600-pixel graphics on an external VGA monitor. The WinSX/25 and WinDX/25 boost the external CRT resolution to 1024 by 768 pixels. All TravelMates are shipped with an optimized version of Microsoft Windows 3.1 preinstalled.

The keyboards are logically arranged, with a variety of system tasks (e.g., system setup and LCD control) assigned to function keys to ensure that you won't need to exit Windows to perform housekeeping chores. Other features include a modem slot and a system-expansion bus.

continued

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Circle 83 on Inquiry Card.



Oct. 15, 1990
PST-160



Feb., 1991
PST-160

Reported cases of Dataphobia:



Bob has a fear of leaving one of his files behind, so he always brings at least 236 floppies in his briefcase.

This time, he arrived with 235.

Joe's worst nightmare came true when he discovered that his customer didn't have a removable cartridge drive.



Too bad, Joe.

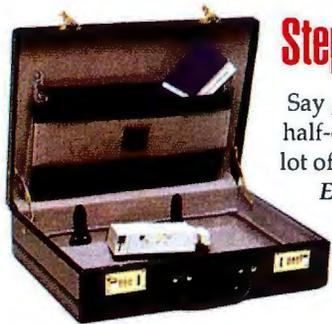
Dan was afraid to leave his data at the office so he tried to make his disk drive more portable.

Unfortunately, he couldn't quite get a handle on it.



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the *EasyStor*TM plan.



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Say goodbye to 200 floppies, a half-dozen cartridges, and a lot of stress. Just attach the

EasyStor Portable Data Module to your parallel port and add an additional 60, 80, 120, or 180

megabytes of on-line storage to

your notebook or desktop computer instantly.

Unique *EasyStep*TM software configures virtually any PC in minutes...with personalized password protection included!

Step 2: Lighten up.

Why carry the weight of the world on your shoulders?

Now you can leave your bulky, cumbersome hard drive or "luggable"

computer at home. *EasyStor*'s small size and light weight make it ideal for travel between computer locations. With the latest in media and shock mounting technology, *EasyStor* is also highly resistant to the bumps, bangs and occasional drops encountered on the road.



Step 3: Recharge & go.



A patent-pending power management system and rechargeable

NICAD batteries make *EasyStor* the ideal traveling companion.

With a battery life of up to three hours, you can work when and where you want to...in your hotel room, by the pool, or in-flight. And when you're ready to take a break, an exclusive *AutoNap*TM software feature transfers your *EasyStor* to the sleep mode to further extend battery life!



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Circle 89 on Inquiry Card (RESELLERS: 90).

Step 4: Make new connections.



Unique IDE to parallel port circuitry gives you the freedom

to connect with almost any standard PC in the world. Attach *EasyStor* directly to the parallel port of your notebook, desktop or tower PC, or use the eight-inch extension cable included. An optional printer port multiplexer lets you use your printer in conjunction with your *EasyStor*!

Step 5: Demand the best.



EasyStor lets you avoid the frustration of waiting for slower parallel port devices. A state-of-the-art 8-bit IDE to parallel design translates to the fastest parallel port data transfer rates available. Of

course, *EasyStor* is also backed by a one-year warranty and UniStor's dedicated team of technical and customer service "doctors".

Step 6: Start today.

The next step is up to you! Throw away those floppies and leave the heavy hardware at home. Call your local reseller or UniStor today to place your order!



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ZEOS POCKET PC ONE-UPS POQET PC

MICHAEL NADEAU

I was prepared to dislike the 1.3-pound Zeos Pocket PC. Like its near-namesake, the Fujitsu Poqet PC, it seemed too compromised to be useful for many of the tasks required of a portable PC. With its small 640- by 200-pixel screen, condensed keyboard, limited storage, and 7.15-MHz V30 CPU, the Pocket PC could hardly match the functionality of the current crop of 5- to 6-pound notebooks.

Well, it doesn't, but its subtle improvements over the Poqet's design have resulted in a highly portable hand-held system that can easily handle the most common tasks performed on the road. The Pocket PC measures 7 by 1 by 2.75 inches—big enough for a keyboard that allows touch typing (see photo A). At \$595, it is less expensive than the Poqet, but software and memory for its two PCMCIA 2.0 slots are still expensive, despite recent price drops.

What makes the system click, though, is the software embedded in ROM. RacePen, for example, is a suite of applications and utilities accessed via a graphical menu and designed for use on the road. It includes a scheduler, a calculator, a card file, a to-do list manager, and a file management utility. An information module contains international area codes, weight and measurement conversion tables, international time zones, and currency exchange rates. All information in the modules is editable. If RacePen is not your fancy, however, Microsoft Works is also built in for good measure.

Maneuvering through the built-in software is easy, although I found some of the applications clumsy to use. For instance, you must enter each new item in the Planner scheduling module through a menu command rather than through a data-entry mode that would permit simultaneous multiple entries. When you're away from the office, the Pocket PC is quite

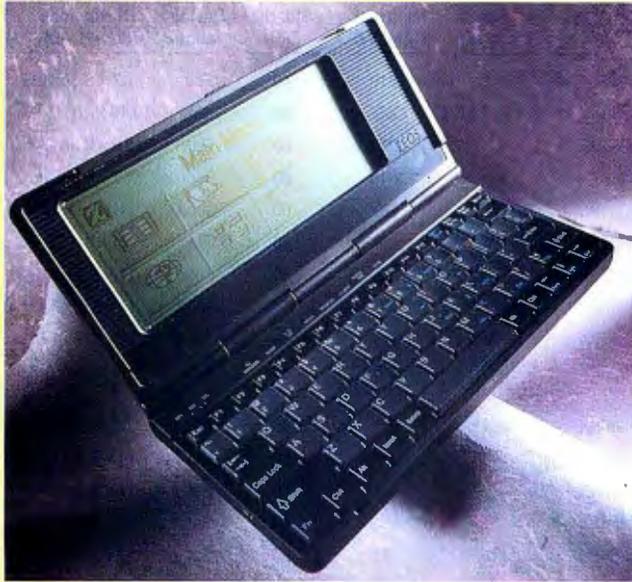


Photo A: The Zeos Pocket PC weighs just 1.3 pounds and features the RacePen software suite.

handy as a workable computer and as an electronic Day-Timer.

In addition to the software's limitations, the Pocket PC has other drawbacks that will require patience if you intend to use it daily. One such drawback is the keyboard. Although its layout is less cramped and better designed than that of other similarly sized systems, the key action leaves something to be desired. Striking a key on the edge rather than at the center causes it to bind; as a result, it might feel as if the keystroke registered when in fact it didn't. This sticky key action impedes reliable touch typing. Fujitsu had a similar problem, which it eventually solved, with early versions of its Poqet PC.

Zeos claims 10 hours of continuous use on two AA batteries, or 30 days in suspend mode. Either way, you should expect to replace the Pocket PC's batteries at least once a month. And although the nonbacklit screen has adjustable contrast, low lighting conditions may present a readability problem.

The Pocket PC has both a serial and a parallel port. PCMCIA-format memory upgrades cost \$149 for 512 KB, \$249 for 1 MB, and \$449 for 2 MB—several times more expensive than conventional memory. Zeos sells an external fax modem for \$249.

On the plus side, the rubberized case provides a good grip and a sleek look. It is very scratch resistant, too. And as PCMCIA slots become more prevalent (and they are—quickly), prices will continue to slide downward.

Despite its warts, the Zeos Pocket PC is a welcome alternative to lugging larger portables. It performs the most basic functions required on the road reasonably well, and you can use it without having to immediately buy extra memory. For casual or temporary use, or when you just like to travel light, the Zeos Pocket PC can be a cost-effective solution.

mance range that we looked at. The sturdy system comes with a 25-MHz Cyrix 486SLC CPU, 1 MB of memory, an 80-MB hard drive, a hand-scanner port, and a backlit LCD.

The XiC425NB can display 16-color 800- by 600-pixel graphics on an external CRT. Xi Computer offers customers a 30-day money-back guarantee and on-site re-

placement within the one-year warranty period.

Zenith Z-Note 325L

and Z-Sport 325S

If looks are important to you, the Z-Note won't disappoint you. The rest of the system isn't bad, either. The video is among



the best we've seen, especially when running Windows. Battery life is over 4 hours. Most interesting is the fact that a network adapter is built in. Zenith offers an optional Port Replicator, into which you plug all the cables you use for the desktop. When you bring in the Z-Note, you simply attach the Port Replicator, and you are ready to work. The Z-Note uses a 25-MHz

NOTEBOOK FEATURE COMPARISON

The notebook PCs compared in this table are arranged by CPU type, beginning with 16-MHz 386-class systems and ending with 33-MHz 486 systems. The feature categories are grouped by value, portability, and suitability as a desktop replacement. (N/A = data not available at press time.)

System	VALUE						PORTABILITY					
	Price	CPU	Std. extras	Min./max. RAM (MB)	Std. HD (MB)	Overall rating	Dimensions (W x H x D)	System weight	Travel weight	Durability rating	Battery life (h:m)	
IBM PS/2 Note N51 SLC	\$2265	16/386SLC	M,O	2/10	40	Fair	11.7 x 8.3 x 2.1	6.56	8.62	Good	1:19, NC	
DECpc 320P	\$1795	20/386SX	MO,W,TB,DS	2/8	40	Sat.	12.19 x 10 x 1.81	6.41	8.53	Good	3:37, NC	
Toshiba Satellite T1800	\$1799	20/386SX		2/10	60	Sat.	11.8 x 8.5 x 2.2	6.94	9.38	Sat.	4:25, NC	
Toshiba T2200SX	\$2599	20/386SX		2/10	80	Poor	11.7 x 8.3 x 1.6	5.66	8.41	Good	4:08, NMH	
Dell NL20	\$1499	20/386SL	W,M	2/8	60	Good	11 x 8.3 x 1.8	6.19	8.72	Good	5:47, NC	
NEC UltraLite SL/20	\$2199	20/386SL	W	2/8	80	Fair	11 x 9 x 2.2	6.4	8.20	Sat.	3:42, NC	
Sharp PC-6781	\$2599	20/386SL	TB	2/8	80	Poor	11 x 8.5 x 1.6	4.9	6.65	Sat.	1:06, NC	
ARC 3025	\$1595	25/386SX	W,M	1/5	120	Good	11 x 8.6 x 2.1	6.78	9.18	Fair	3:38, NC	
CAF AquaLite-II	\$1495	25/386SX	W	2/8	80	Good	11 x 8.6 x 1.6	5.59	8.03	Sat.	2:41, NC	
Keydata Keynote 386SX-25	\$1395	25/386SX	M,W	2/5	80	Exc.	11.7 x 8.2 x 1.8	7.19	9.50	Sat.	1:41, NC	
Mitsuba Ninja 386SX	\$1595	25/386SX		2/8	80	Sat.	11 x 8.5 x 2	7.28	10.35	Sat.	3:15, NC	
Swan 386SX/25	\$1895	25/386SX		2/8	60	Sat.	11 x 8.5 x 1.8	5.81	8.00	Sat.	1:54, NC	
Zenith Z-Sport 325S	\$2199	25/386SX		2/8	80	Sat.	11 x 8.5 x 1.9	6.22	9.00	Good	2:47, NMH	
Compaq Contura 3/25	\$2099	25/386SL		4/12	60	Sat.	N/A	6.20	8.19	Good	3:18, NC	
Bondwell 386SL/F	\$1699	25/386SL	U	2/8	60	Sat.	11.7 x 9 x 1.6	6.15	8.75	Sat.	4:52, NC	
Compaq LTE 386 Lite/25	\$2799	25/386SL		4/10	84	Fair	11 x 8.5 x 1.75	6.0	8.0	Sat.	3:54, NMH	
Compaq LTE Lite/25	\$4999	25/386SL	TB,W	4/20	84	Good	11 x 8.5 x 2.1	6.45	8.45	Sat.	3:04, NMH	
Dell NL25	\$1799	25/386SL	W,M	2/8	60	Good	11 x 8.5 x 1.8	6.13	9.01	Sat.	3:19, NC	
Dell 325N	\$2249	25/386SL	W,M	4/12	60	Sat.	11 x 8.5 x 2.3	6.50	9.63	Good	5:48, NMH	
Dell 325NC	\$2899	25/386SL	W,M	4/12	60	Good	11 x 8.5 x 2.3	7.38	10.26	Good	4:51, NMH	
Epson NB-SL/25	\$2599	25/386SL	B	4/20	60	Fair	11.7 x 9.25 x 2	7.2	9.10	Sat.	2:54, NC	
Grid 1660	\$2995	25/386SL	W,TB	2/20	125	Fair	11.7 x 8.7 x 1.7	5.94	7.69	Exc.	2:32, NMH	
IBM PS/note N45 SL	\$2295	25/386SL	B,O	2/8	80	Sat.	12.4 x 8.2 x 1.8	6.81	9.61	Sat.	3:47, NC	
NCR 3170	\$4449	25/386SL	TB,W,FM,FS	2/20	80	Poor	11 x 8.5 x 1.8	4.9	6.99	Good	3:00, NC	
NEC UltraLite SL/25C	\$4599	25/386SL	W	2/10	80	Sat.	11.5 x 9 x 2.4	7.5	9.30	Sat.	2:52, NC	
QSI Klonimus Lite	\$1950	25/386SL	W,M	2/8	60	Fair	11 x 8.5 x 2	7.81	10.50	Sat.	4:48, NC	
Zenith Z-Note 325L	\$2949	25/386SL	TB,NIC	4/12	85	Sat.	11.9 x 8.5 x 1.9	5.9	8.68	Good	4:06, NMH	
Zeos Color Notebook	\$2695	25/386SL	SS, WP, W	2/20	60	Good	11 x 8.5 x 2.1	6.84	9.21	Sat.	1:47, NCS	
MicroExpress NB925	\$1899	25/386SL		2/8	120	Sat.	12.2 x 9.5 x 2.1	7.94	10.44	Good	3:50, NC	
Notestar NP-925	\$1895	25/386SL	CMS	2/8	80	Sat.	12.2 x 9.5 x 2.1	8.00	10.56	Good	4:07, NC	
Altima 325XL	\$1999	25/Am386SXL		2/6	80	Fair	11 x 8.7 x 1.6	5.97	8.56	Sat.	2:57, NC	
BCC Avanti 025	\$1995	25/Am386SXL	W,FM,FS,TB,MO	4/8	85	Sat.	11 x 8.5 x 2.3	6.5	8.87	Sat.	2:15, NC	
Bi-Link Hyperbook 2200SX	\$1495	25/Am386SXL		4/8	80	Good	11 x 8.5 x 1.6	6.94	9.13	Sat.	2:52, NC/A	
Cube Horizon 325SXL	\$2150	25/Am386SXL	FM,FS,W,TB	4/16	80	Sat.	11 x 8.5 x 2.1	5.22	7.66	Sat.	2:14, NC	
Dauphin 500-GT	\$1795	25/Am386SXL		2/16	80	Sat.	11 x 8.5 x 2.2	6.47	9.10	Good	2:39, NC	
Everex AGI Travelpro SX/25	\$2025	25/Am386SXL	W,M	2/9	40	Poor	11 x 8.5 x 1.8	5.97	8.51	Sat.	1:36, NC	
Gateway Nomad 325SXL	\$1995	25/Am386SXL	W,M,IS,PMS	4/6	80	Good	11 x 8.5 x 1.8	5.81	8.25	Sat.	4:34, NC	
Insight 386SXL-25	\$1499	25/Am386SXL	M	4/8	86	Good	11 x 8.5 x 1.8	5.8	N/A	Sat.	3:36, NC	
Noteable 386SXL-25	\$1399	25/Am386SXL	TB	1/12	60	Good	11.6 x 8.7 x 2.4	7.16	10.16	Sat.	3:27, NC	
Samsung NoteMaster 386S/25	\$2199	25/Am386SXL		2/8	60	Sat.	11 x 8.5 x 1.8	5.91	8.10	Sat.	2:01, NC	
Veridata Execulite 386SXL/25e	\$1750	25/Am386SXL		2/8	60	Sat.	11 x 8.6 x 1.4	4.81	7.56	Sat.	2:16, NC	

NOTEBOOK FEATURE COMPARISON

DESKTOP REPLACEMENT

Overall rating	B&W/color, shades/col.	Video res. ext.	Screen size (in.)	Readability	Number of keys	Key travel	Ind. page-control keys?	External ports	Internal expansion	Docking unit?	Overall rating
Sat.	B&W, 64	640 x 480	9.5	Sat.	84	Full	Yes	S,P,V,M,E	FPU, M	No	Fair
Sat.	B&W, 16	640 x 480	8.5	Fair	84	Full	Yes	S,P,V,K	FPU, M	No	Fair
Sat.	B&W, 64	640 x 480	9.5	Good	82	Full	Yes	S,P,V,M,K,KP	FPU, M	No	Good
Exc.	B&W, 16	640 x 480	9.5	Good	82	Full	Yes	S,P,V,M,K,E	FPU, M	Yes	Sat.
Exc.	B&W, 32	800 x 600	8.5	Exc.	85	Full	Yes	S,P,V,M,E	FPU, M	No	Fair
Sat.	B&W, 32	800 x 600	9.5	Good	78	Abbrev.	No	S,P,V,K,KP,F,E,M	FPU, M	Yes	Sat.
Sat.	B&W, 32	800 x 600	10	Good	79	Abbrev.	No	S,P,V,KP,E,B	FPU, PCMCIA	Yes	Sat.
Sat.	B&W, 32	640 x 480	8.5	Sat.	84	Full	Yes	S(2),P,V,K,F	FPU	No	Poor
Good	B&W, 64	800 x 600	10	Sat.	84	Full	Yes	S,P,V,M,E	FPU, M	No	Sat.
Sat.	B&W, 16	640 x 480	9.5	Sat.	83	Abbrev.	Yes	S(2),P,V	FPU	No	Poor
Sat.	B&W, 32	800 x 600	8.5	Sat.	80	Full	No	S,P,V,M,E	FPU, M	Yes	Fair
Good	B&W, 64	640 x 480	10	Sat.	80	Full	No	S,P,M,K	FPU, M	No	Fair
Good	B&W, 64	800 x 600	9.5	Good	86	Abbrev.	Yes	S,P,V,M,K,E	FPU, M	Yes	Good
Good	B&W, 64	640 x 480	9.5	Sat.	79	Full	Yes	S,P,M,KP	FPU, M	No	Sat.
Good	B&W, 64	640 x 480	8.5	Sat.	80	Full	No	S,P,V	FPU, M	No	Poor
Exc.	B&W, 64	640 x 480	9.5	Good	79	Full	Yes	S,P,V,K,KP,E,F	FPU, M	Yes	Sat.
Good	C, 256	640 x 480	8.5	Exc.	78	Full	Yes	S,P,V,K,M,KP,E	FPU, M	Yes	Good
Good	B&W, 32	800 x 600	9.5	Good	85	Full	Yes	S,P,V,M,K	FPU, M	No	Fair
Good	B&W, 32	1024 x 768	9.5	Exc.	85	Full	Yes	S,P,V,M,K	FPU, M	No	Sat.
Sat.	C, 256	1024 x 768	9	Fair	85	Full	Yes	S,P,V,M,K	FPU, M	No	Good
Sat.	B&W, 64	640 x 480	9.5	Fair	82	Full	Yes	S,P,V,K,KP,M,E	FPU, M	Yes	Good
Exc.	B&W, 64	640 x 480	10	Good	84	Full	Yes	S,P,V,M,K	FPU, M	Yes	Good
Sat.	B&W, 32	640 x 480	10	Sat.	85	Full	Yes	S,P,V,M,K	FPU, M	No	Sat.
Exc.	B&W, 32	640 x 480	9.5	Good	78	Abbrev.	No	S,P,V,M,E,F	PCMCIA	Yes	Sat.
Fair	C, 256	800 x 600	9.5	Exc.	78	Abbrev.	No	S,P,V,M,K,KP,F,E	FPU, M	Yes	Good
Sat.	B&W, 64	640 x 480	9.5	Sat.	83	Full	Yes	S,P,V,K,F,E	FPU	No	Fair
Good	B&W, 64	800 x 600	9.5	Good	82	Abbrev.	Yes	S,P,V,K,E,N	FPU, M	Yes	Good
Sat.	C, 256	800 x 600	9	Good	85	Abbrev.	Yes	S,P,V,M	FPU, M	No	Good
Fair	B&W, 64	800 x 600	10	Good	83	Full	Yes	S(2),P,V,K,E	FPU, PM	No	Fair
Fair	B&W, 64	640 x 480	10	Good	83	Full	Yes	S(2),P,V,K	FPU, PM	No	Fair
Good	B&W, 64	800 x 600	9.5	Sat.	84	Full	Yes	S,P,V,M,K,E	FPU, M	Yes	Fair
Good	B&W, 32	640 x 480	10	Fair	80	Full	Yes	S,P,V,M	FPU	No	Fair
Good	B&W, 32	800 x 600	9	Sat.	80	Full	No	S,P,V,M,K,SCSI	FPU	No	Sat.
Good	B&W, 64	800 x 600	9.5	Sat.	86	Full	Yes	S,P,V,M,K	FPU	No	Good
Good	B&W, 32	800 x 600	10	Sat.	80	Full	No	S(2),P,V,M,F,E	FPU, M	Yes	Good
Good	B&W, 64	800 x 600	8.5	Sat.	81	Abbrev.	Yes	S,P,V,M,K	FPU, M	No	Poor
Exc.	B&W, 64	800 x 600	10	Sat.	79	Abbrev.	No	S,P,V,M,E,KP	FPU, M	No	Fair
Good	B&W, 64	N/A	10	Good	80	Abbrev.	No	S,P,V,M,K,KP	FPU, M	No	Sat.
Fair	B&W, 64	800 x 600	10	Sat.	80	Full	Yes	S,P,V,M,K,E,SC	FPU, M	Yes	Fair
Good	B&W, 64	640 x 480	10	Sat.	80	Full	No	S,P,V,M,K	FPU, M	No	Fair
Good	B&W, 32	800 x 600	8.5	Good	79	Abbrev.	No	S,P,V	M, PM	No	Fair

NOTEBOOK FEATURE COMPARISON

System	VALUE						PORTABILITY				
	Price	CPU	Std. extras	Min./max. RAM (MB)	Std. HD (MB)	Overall rating	Dimensions (W x H x D)	System weight	Travel weight	Durability rating	Battery life
Acma 386DX/33 Executive Notebook	\$2299	33/i386DX		4/16	120	Exc.	11 x 8.6 x 2	8.56	12.5	Sat.	1:41, NC
MicroExpress NBDX33	\$2495	33/i386DX	W,FM,CS	4/8	120	Exc.	11.6 x 8.7 x 2.3	7.56	10.63	Good	3:53, NC
Amrel MLT386DXL-33	\$1995	33/Am386DXL	CS,CMS,TB	4/8	80	Exc.	11.6 x 8.7 x 2.3	7.56	10.63	Good	3:09, NC
TI TravelMate 4000 WinSX	\$2499	16/i486SX	W,PMS,U	4/8	80	Good	11 x 8.5 x 1.8	5.59	8.03	Sat.	4:16, NC
Altima 420	\$2499	20/i486SX		4/20	80	Sat.	11 x 8.7 x 1.6	6.63	9.28	Sat.	2:32, NC
First International Leo PhD	\$1700	20/i486SX		4/16	80	Good	11.4 x 11 x 1.9	6.84	9.71	Sat.	1:39, NC
Gateway Nomad 420SXL	\$2495	20/i486SX	W,TB,M,IS,PMS	4/20	80	Exc.	11 x 8.5 x 1.8	5.8	7.89	Sat.	4:24, NC
Tandy 4800 HD	\$2499	20/i486SX	W,CS	4/20	60	Good	11 x 8.5 x 1.6	5.97	9.16	Good	2:53, NC
Tandy 3800 HD	\$1799	20/Cx486SLC	W,CS	2/4	60	Fair	12.2 x 10 x 1.7	6.19	7.59	Sat.	2:26, NC
Mitsuba Ninja 486	\$2125	25/i486SX		4/20	80	Sat.	11 x 8.6 x 1.8	6.91	9.00	Sat.	1:56, NC
TI TravelMate 4000 WinSX/25	\$2799	25/i486SX	W,M,PMS,U	4/20	120	Good	11 x 8.5 x 1.8	5.63	8.07	Sat.	4:23, NC
Toshiba T4400 SX/LCD	\$3399	25/i486SX		2/10	80	Fair	11.2 x 8.3 x 2.2	7.25	10.97	Good	4:42, NC
Toshiba T4400SXC80	\$5499	25/i486SX		4/20	80	Sat.	11.7 x 8.3 x 2.2	7.75	11.81	Good	3:53, NC
CompuAdd Express 425CXL	\$2245	25/Cx486SLC	TB,B,FS	4/16	80	Sat.	11 x 8.5 x 2	5.22	7.69	Fair	2:50, NC
PC Brand NB 486/SLC	\$1995	25/Cx486SLC	W	2/16	120	Good	11 x 8.7 x 2.1	6.91	10.54	Sat.	1:55, NC
Wyse DecisionMate 486SLC	\$2299	25/Cx486SLC	W,FTS,S	4/16	80	Sat.	11 x 8.6 x 1.45	4.81	7.94	Sat.	1:35, NC
XIC425NB	\$1649	25/Cx486SLC		1/5	80	Good	11.6 x 8.7 x 2.4	7.34	10.25	Sat.	2:38, NC
ALR Ranger MC4SX/25 120	\$2495	25/i486DX	PMS	4/16	60	Exc.	11.75 x 8.5 x 2.3	7.5	10.97	Good	2:41, NMH
Gateway Nomad 425DXL	\$2995	25/i486DX	W,M,IS,PMS	4/20	120	Good	11 x 8.5 x 1.8	5.81	8.25	Sat.	3:52, NC
TI TravelMate 4000 WinDX/25	\$3299	25/i486DX	W,M,PMS,U	4/20	120	Sat.	11 x 8.5 x 1.8	5.63	8.07	Sat.	4:27, NC
Amrel MLT486DXU	\$2795	33/i486DX	CS,CMS,TB	4/32	130	Good	11.6 x 8.7 x 2.4	7.19	10.23	Sat.	2:48, NC
Aquiline 3500	\$2695	33/i486DX		4/16	120	Good	11 x 8.6 x 2	8.56	12.50	Sat.	2:24, NC
Compudyne 4DX/33	\$2999	33/i486DX	TB,W,PIM	4/20	127	Sat.	11 x 8.7 x 1.6	6.25	N/A	Sat.	2:00, NC
Ergo NoteBrick 486	\$2995	33/i486DX	W,M,FCS	4/16	170	Sat.	11.2 x 10.2 x 2.2	8.7	12.30	Exc.	1:42, NC

Standard Extra Key

B = extra battery
 CMS = contact management software
 CS = communications software slot
 DS = diagnostic software

FCS = file compression software
 FM = fax modem
 FS = fax software
 IS = integrated software

M = mouse
 MO = modem
 NIC = network interface card
 O = OS/2

PIM = personal information manager
 PMS = power management software
 S = security kit
 SS = spreadsheet

TB = trackball
 U = utilities
 W = Windows
 WP = word processor

Intel 386SL CPU.

The 6.22-pound Zenith Z-Sport 325S, which is based on a 25-MHz Intel 386SX CPU, is sleek, decidedly handsome, and built like a tank. Standard equipment includes 2 MB of memory, an 86-key tactile keyboard, and a 9.5-inch backlit LCD. Other features include a system-expansion bus and a suspend/resume mode that maintains main memory for up to an hour after the main battery has discharged. At \$2199, this high-quality notebook is a best buy among the systems that we reviewed for this article.

Zeos Color Notebook



Mail-order vendor Zeos International has chosen the road less traveled with its newest model, which is called simply the Color Notebook. At \$2695, the Color Notebook features a 25-MHz Intel 386SL CPU, 2 MB of RAM, and a 60-MB hard drive.

Preloaded with Windows 3.1 and a host of bundled software, the Color Notebook comes with shrink-wrapped copies of Lotus 1-2-3 for Windows and Lotus Ami Pro 3.0, a full-featured Windows word processor. The Color Notebook sports an at-

tractive case and a logically designed keyboard that provides excellent typing action.

However, like many passive-matrix color LCDs, the Zeos Color Notebook's screen serves up only minimal brightness and contrast sensitivity when you are viewing monochrome text, and it delivers slightly muted screen colors. The Color Notebook deserves high marks for overall quality and workmanship, though. The bundled software makes this system a bargain for those who yearn for a color notebook with an affordable price tag. We

NOTEBOOK FEATURE COMPARISON

DESKTOP REPLACEMENT

Overall rating	B&W/color, shades/col.	Video res. ext.	Screen size	Readability	Number of keys	Key travel	Ind. page cont. keys?	External ports	Internal expansion	Docking unit?	Overall rating
Fair	B&W, 32	800 x 600	9	Sat.	82	Abbrev.	No	S(2),P,V,K,KP	FPU, M	Yes	Sat.
Sat.	B&W, 64	800 x 600	9	Good	83	Full	No	S(2),P,V,K,SC,E	FPU, M	Yes	Sat.
Sat.	B&W, 64	800 x 600	10	Good	83	Full	No	S(2),P,V,K,SC	FPU, M	Yes	Sat.
Exc.	B&W, 64	800 x 600	10	Good	79	Abbrev.	No	S,P,V,M,E	FPU, M	Yes	Sat.
Good	B&W, 64	800 x 600	9.5	Sat.	85	Full	Yes	S,P,V,M,K,E	M	Yes	Good
Sat.	B&W, 16	800 x 600	9.5	Sat.	80	Full	No	S(2),P,V,E	FPU	No	Fair
Exc.	B&W, 64	1024 x 768	10	Good	79	Abbrev.	No	S,P,V,E,M,KP,K	M	No	Good
Good	B&W, 64	800 x 600	9.5	Good	84	Full	Yes	S,P,V,K	FPU, M	No	Good
Sat.	B&W, 32	640 x 480	9	Sat.	84	Full	Yes	S,P	FPU, M	No	Poor
Sat.	B&W, 32	800 x 600	10	Sat.	80	Full	No	S,P,M,E	FPU, M	No	Sat.
Exc.	B&W, 64	1024 x 768	10	Good	79	Abbrev.	No	S,P,V,M,E	FPU, M	Yes	Good
Sat.	B&W, 64	640 x 480	9.5	Good	82	Full	Yes	S,P,V,E,K,M	M	Yes	Good
Fair	C, 256	640 x 480	8.5	Exc.	82	Full	Yes	S,P,V,M,K,E	M	Yes	Exc.
Sat.	B&W, 64	640 x 480	9.5	Good	84	Full	Yes	P,S,V,M,K	M	No	Good
Sat.	B&W, 32	640 x 480	9	Good	81	Full	No	S(2),P,V,K	FPU, M	Yes	Sat.
Good	B&W, 32	800 x 600	8.5	Sat.	79	Abbrev.	Yes	S,P,V,M	FPU, M, PM	No	Fair
Fair	B&W, 64	800 x 600	10	Sat.	80	Full	No	S,P,V,M,SC,E	FPU, M	Yes	Good
Sat.	B&W, 32	800 x 600	9	Good	82	Full	Yes	S,P,V,K,M,E,SC	CPU, M, SCSI	Yes	Good
Exc.	B&W, 64	1024 x 768	10	Good	79	Abbrev.	No	S,P,V,M,E,K,KP	M	No	Good
Exc.	B&W, 64	1024 x 768	10	Good	79	Abbrev.	No	S,P,V,M,E	M	Yes	Good
Fair	B&W, 64	1024 x 768	10	Sat.	85	Full	Yes	S,P,V,M,K,E	FPU, M	Yes	Good
Fair	B&W, 32	640 x 480	9	Sat.	82	Abbrev.	Yes	S(2),P,V,K,E	M	Yes	Sat.
Sat.	B&W, 64	800 x 600	10	Good	84	Abbrev.	Yes	S,P,V,E	M	Yes	Good
Poor	B&W, 32	800 x 600	9	Sat.	82	Full	Yes	S(2),P,V,E	M	Yes	Good

Battery Key

A = alkaline
 NC = nickel cadmium
 NMH = nickel metal hydride

External Port Key

B = extra battery
 E = expansion slot
 F = floppy drive
 K = keyboard

KP = keypad
 M = mouse
 N = network adapter
 P = parallel

S = serial
 SC = scanner
 SCSI = SCSI
 V = extended video

Internal Expansion Key

CPU = upgradable CPU
 FPU = math coprocessor
 M = modem

PCMCIA = PCMCIA slot
 PM = personality module
 SCSI = SCSI

could not measure the Color Notebook's battery life with its power management enabled.

Best Bets

From among the systems we tested, several clear favorites emerged, each for different reasons. For color systems, the Toshiba T4400SXC80 has a slight edge over the new Compaq LTE Lite/25. The Toshiba's screen is brighter, and the system itself is well designed. The Compaq is \$500 less, but it uses a 386SX CPU rather than a 486SX.

The similarly designed Gateway and TI systems are remarkably well balanced, offering good performance in very portable packages. The TI line is available with an optional docking unit, which turns the more powerful versions into good desktop replacements.

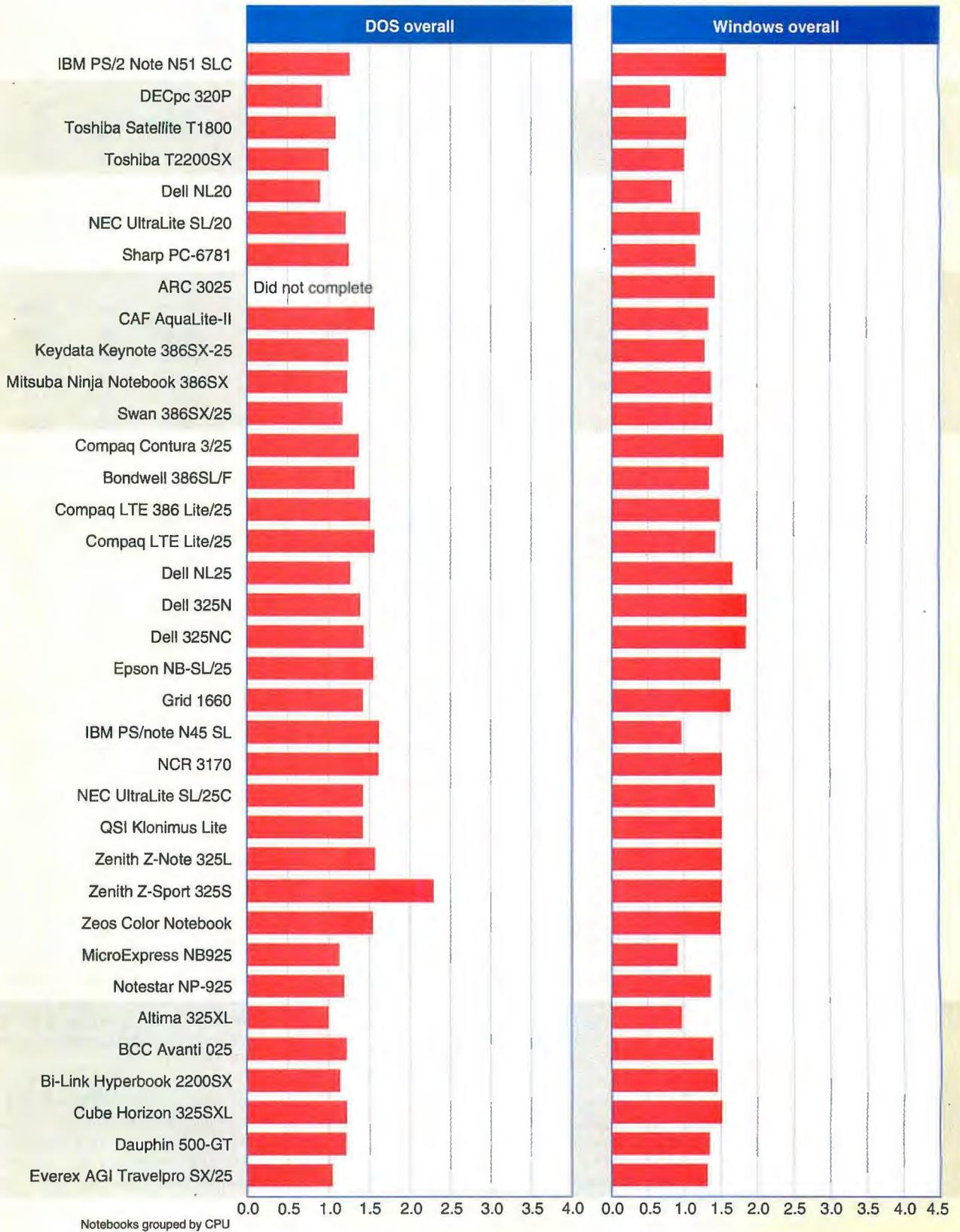
Zenith offers some valuable innovations, such as built-in LAN connectivity, with its new, redesigned notebooks. The Z-Sport in particular is a system that's both portable and powerful, and it's reasonably priced.

Along with the 486-based Gateway and

TI systems, the ALR Ranger offers exceptional performance for both DOS and Windows users, and it is one of the few notebooks we reviewed that has an upgradable CPU. ■

Michael Nadeau is a BYTE senior editor. You can reach him on BIX as "miken." John Wolfskill is a freelance writer and president of Powertrain Development, a New Hampshire-based company specializing in multimedia and retail point-of-sale advertising software. You can reach him on BIX c/o "editors."

BYTE NOTEBOOK BENCHMARKS



Benchmarks continued on next page

BYTE NOTEBOOK BENCHMARKS



All results are indexed, and higher numbers indicate better performance. For each index in the DOS and Windows tests, a Toshiba T2200SX running DOS 5.0 and Windows 3.0 = 1.

BYTE's application performance suite measures the performance you can expect to see running a given application category under a given operating environment. We test under two environments: DOS 5.0 and Windows 3.0. We test

three application categories for each environment, running test scripts using the following programs: Word Processing: WordPerfect 5.1 and Lotus Ami Pro 2.0; Spreadsheet: Lotus 1-2-3 release 2.3 and Microsoft Excel 3.0a; and Database: Software Publishing Superbase 4 version 1.3 and Borland dBase IV. The data files and test scripts are available from BYTE.

The benchmark indexes shown here represent each system's overall performance running DOS and Windows. The baseline machine, a Toshiba T2200SX, has an index of 1. A DOS score of 2.5, therefore, means the notebook in question runs DOS applications an average of 2.5 times faster than the T2200SX.

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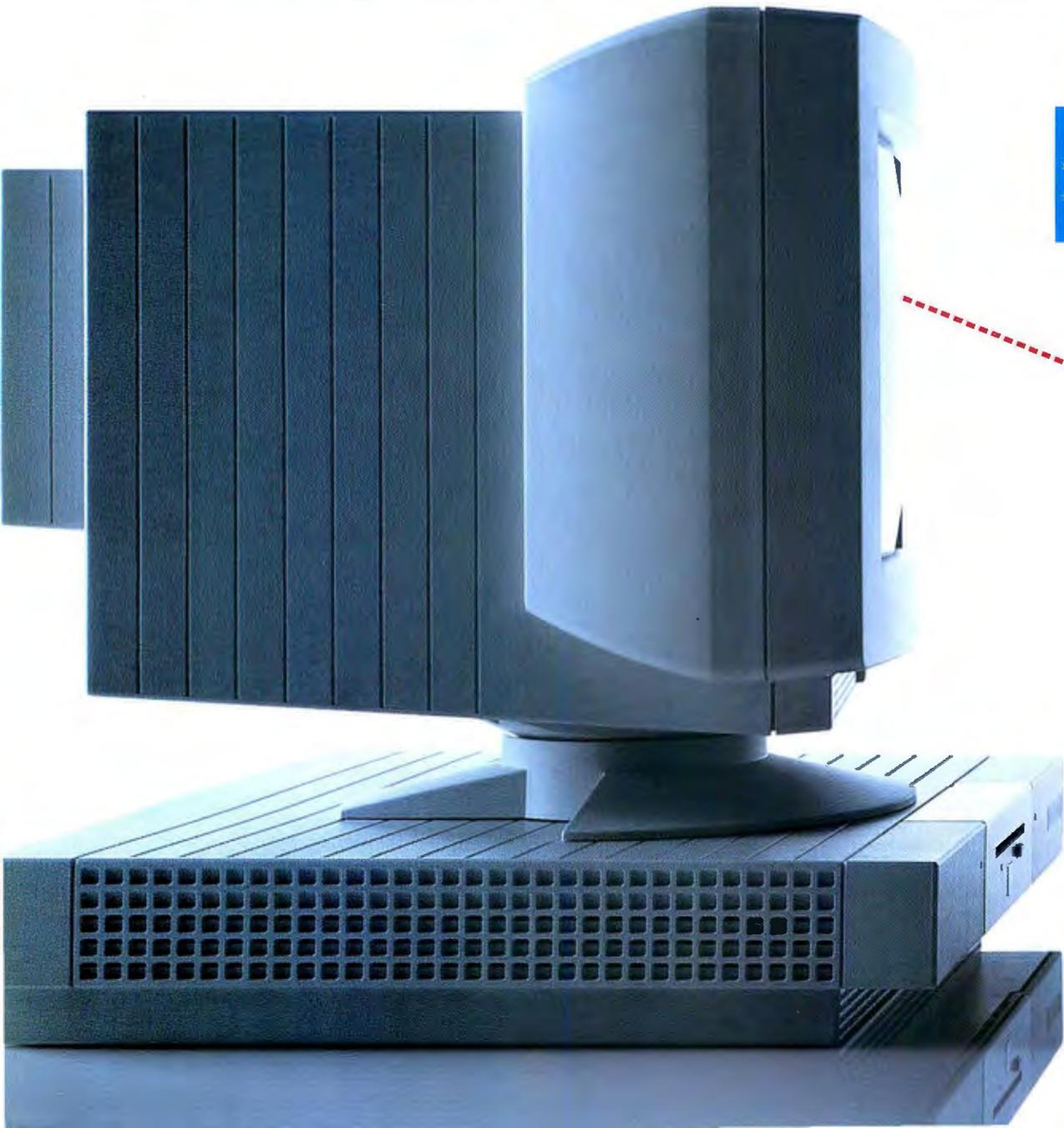


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Helen Lim,
ZDS Systems
Software Engineer



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TAG-ALONG HARD COPY

Today's portable printers deliver near-laser-quality output in eminently totable packages

STAN MIASTKOWSKI

On the road, with a notebook and portable fax/data modem, it's pretty easy to keep in touch with E-mail or the corporate computer. But what happens when you need high-quality hard copy? You can take along one of the seven portable printers reviewed here. Using technologies ranging from dot-matrix impact to 64-nozzle ink-jet, this cross section of available printers offers near-laser-quality output without the need for special paper.

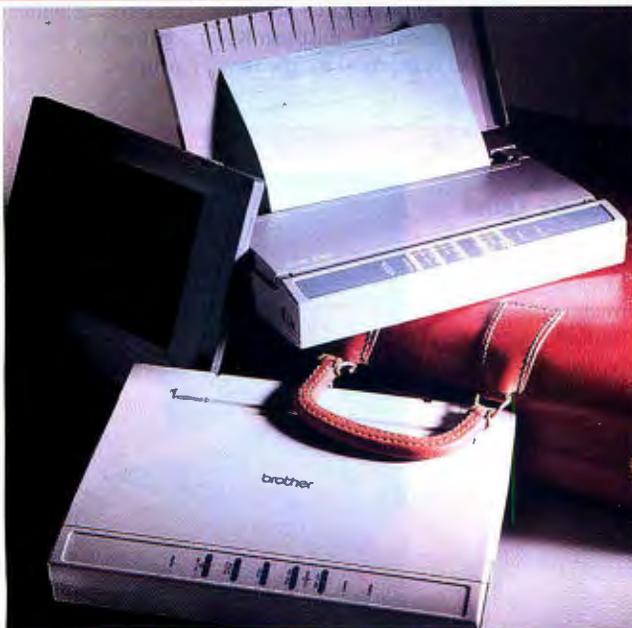
The seven printers range in weight from 2½ to 6 pounds and are small enough to take along without requiring that you carry extra luggage. Some can even fit in your briefcase along with your notebook computer. For work away from an AC outlet, most come with a battery pack or offer batteries as an option.

SUMMARY

Brother's HJ-100i and Star Micronics' StarJet SJ-48

PROS
Excellent graphics print quality; bubble-jet technology

CONS
High per-copy cost



Living in the Real World

I tested each printer in real-world traveling situations, taking several on business trips and some while traveling between many work locations. All were tested with a Dell NL20, a 20-MHz 386SL-based 6.3-pound notebook, which is typical of the kind of system most businesses are apt to use with these printers. To judge print quality, I ran the print test supplied with Lotus's Ami Pro word processor. To compare features, see the table.

The printers come with a full array of built-in type styles and font sizes and emulate industry-standard printers such as those of IBM or Epson. I tested the printers from within Windows using either standard Windows printer drivers or the custom drivers shipped with the Eastman Kodak Diconix printers.

Brother's HJ-100i and Star Micronics' StarJet SJ-48

Except for the color and design of the external cases and switches and for using different emulation modes, Brother International's HJ-100i and Star Micronics America's StarJet SJ-48 are identical printers based on Canon's BJ-10 Bubble-Jet printer (Canon declined to participate in the review). In the bubble-jet approach, the actual print head (with up to 64 nozzles) is part of the ink cartridge, and heat produces bubbles of ink that spray onto the paper. Every time you change the ink cartridge, you change the print head. It costs about \$25 for a cartridge that produces a respectable 700,000 characters.

The HJ-100i and the SJ-48 are about the size of a typical notebook computer and weigh 4 pounds each. Rechargeable battery packs are available, although the units that I tested weren't equipped with them.

The printers take single sheets only; however, optional sheet feeders are available. If you want to use the printers in a standard flat-on-the-desk configuration, loading paper is straightforward: You simply insert the sheet into a slot in the back and then press the LF/Top button. The paper automatically puts itself into position for printing.

For limited-space applications, a rotating foot makes the printer stand vertically. You load paper through a slot in the bottom. Print quality is good to excellent, with both printers doing a particularly good job at reproducing colors, shades of gray, and (especially) graphics. *continued*

Citizen's PN48 Notebook Printer and Lexmark's IBM Portable Printer

The Citizen America PN48 Notebook Printer and the Lexmark International IBM Portable Printer are identical except for the design of the outer case (i.e., the innards of the Lexmark are the same as those of the Citizen). These two thermal-fusion printers are incredibly small and lightweight but still produce high-quality print. Of the seven printers, they work best for delivering near-laser quality for text and most graphics. They had some problems with some of the graphics on my test page, but they were the only ones able to print white text on a black background.

Both printers come with built-in rechargeable battery packs. They are the most portable of the printers I tested, so they're also the most likely to be used on battery power. Using a fully charged battery, you can print about 25 pages of text—about half that amount if your documents include a lot of graphics.

BYTE ACTION SUMMARY

- **WHAT PORTABLE PRINTERS DO**
These small and lightweight portable printers let you print from your notebook computer when you travel. Most offer battery power (or have it available as an option). With some exceptions, the output is nearly the quality of a laser printer's.
- **LIKES**
All seven printers are easy to transport and use. They emulate industry-standard printers for easy setup.
- **DISLIKES**
Portable printers (like portable computers) are expensive for their abilities. The graphics abilities of some of the higher-priced units were disappointing.
- **RECOMMENDATIONS**
The Citizen PN48 Notebook Printer and the Lexmark IBM Portable Printer (which are identical) are recommended for their eye-popping output, light weight, and incredibly small size.

SUMMARY

Citizen's PN48 Notebook Printer and Lexmark's IBM Portable Printer

PROS
Lightest and smallest; nearest to laser quality

CONS
Difficult to load paper and to reproduce some graphics



It takes a bit of practice to load the paper into these printers so that it goes through straight—it's all too easy to put the paper in at an angle. You set the printers on their sides to print, and motorized rollers grab the paper.

The per-copy cost with the Citizen and Lexmark printers is surprisingly low. Single-strike or multistrike ribbons are available in packs of five for \$24.95. These are also the only printers of the lot that have a darkness-control feature for controlling the image density.

Kodak's Diconix 180si

Along with being lightweight (3 pounds) and comparatively small, the Eastman Kodak Diconix 180si is the most inexpensive

printer I tested. The 180si uses 12-nozzle ink-jet technology. Its overall print quality is only fair to good, not quite up to near-laser. For those people on a budget, that's not a huge problem; however, you get what you pay for, and you might hesitate to use it to prepare a critical document.

On the plus side, the 180si has a built-in tractor feed for fanfold paper (as does the Kodak Diconix 701). I'd recommend this printer for someone who needs a lot of hard copy on the road but doesn't need near-laser quality.

Loading single sheets is a bit tricky, because you have to manually load the paper into the rear of the printer. A rechargeable battery pack is available as an option but wasn't included with my test printer.

SUMMARY

Kodak's Diconix 180si

PROS
Most inexpensive; tractor feed for fanfold paper

CONS
Lowest print quality



TAG-ALONG HARD COPY

SUMMARY

Kodak's Diconix 701

PROS
Fastest printer tested; takes multiple sheets without external sheet feeder

CONS
Disappointing print quality for the price



SUMMARY

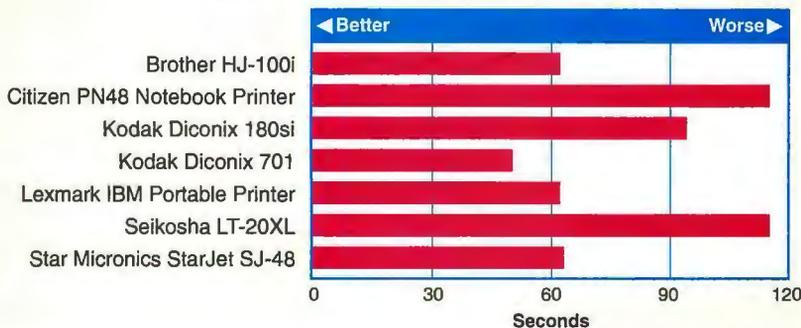
Seikosha's LT-20XL

PROS
Lowest per-page cost; built like a tank

CONS
Large, heavy, and noisy



PRINT SPEED COMPARISONS



The times to print a sample graphics page vary greatly. The fastest printer, the Kodak Diconix 701, was three times faster than the slowest units.

Kodak's Diconix 701

The Eastman Kodak Diconix 701 is the flip side of the 180si. It is Kodak's top-of-the-line portable printer. It's on the heavy

side (5.6 pounds), but its 50-nozzle ink-jet technology makes it easily the fastest printer tested. The 701's basic text speed for near-letter quality is 120 cps (characters per second) (compared to around 80

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PORTABLE PRINTERS COMPARED

The print technology used by the portable printers reviewed varies from a standard dot-matrix device to a laser-like thermal-fusion process.

Model	Price (as tested)	Options	Dimensions	Weight (lbs.)	Technology	Print speed (cps) (letter-quality text)	Emulation
Brother HJ-100i	\$499	Rechargeable battery, \$50; sheet feeder, \$90	12.2 × 8.5 × 1.9	4	64-nozzle ink-jet (bubble-jet)	83	Epson LQ-850 (default), Epson LQ-510, IBM Proprinter X24E, Brother HJ-100i
Citizen PN48 Notebook Printer	\$549	Deluxe carrying case, \$95	11.7 × 3.5 × 2.0	2.5	48-cell thermal fusion	80	Epson LQ-2550 (default), Citizen GSX, IBM Proprinter X24
Kodak Diconix 180si	\$399	Serial version, \$419; rechargeable battery, \$49.95; carrying case, \$29.95; printer/computer case, \$59.95	1.97 × 6.5 × 10.8	3	12-nozzle, drop-on-demand thermal ink-jet	85	Diconix 180si (default), Epson FX-85, IBM Proprinter
Kodak Diconix 701	\$549	Rechargeable battery, \$49.95; carrying case, \$59.95	2.4 × 7.68 × 11.7	5.6	50-nozzle, drop-on-demand thermal ink-jet	120	Diconix 701 (default), HP DeskJet Plus, IBM Proprinter X24E
Lexmark IBM Portable Printer	\$549	None	11.7 × 3.5 × 2.0	2.5	48-cell thermal fusion	80	Epson LQ-2550 (default), IBM Proprinter X24
Seikosha LT-20XL	\$549	Extra cut-sheet tray, \$46.99; carrying case, \$74.99	14.6 × 2.0 × 11.3	6.5	Impact, 24-pin dot-matrix	60	IBM Proprinter X24
Star Micronics StarJet SJ-48	\$499	Rechargeable battery, \$50; sheet feeder, \$90	12.2 × 8.5 × 1.9	4	64-nozzle ink-jet (bubble-jet)	83	Epson LQ-850 (default), IBM Proprinter X24E, NEC 24-pin

cps for the other portable printers tested). In addition, it sailed through the graphics print test in just 50 seconds, well over twice as fast as several of the other printers.

One of its nicest features is the ability to take up to 30 sheets of paper without the need for an external sheet feeder. It also has a built-in tractor feed for fanfold paper. The optional battery pack was not avail-

able for the review.

After all those pluses, I was disappointed by the print quality, which can only be characterized as fair. I even requested a second printer to do the test again, but I came up with the same results. Besides rough graphics, the 701 printed very lightly, and you can't adjust the darkness of the print.

COMPANY INFORMATION

Brother International Corp.
(HJ-100i)
200 Cottontail Lane
Somerset, NJ 08875
(908) 356-8880
fax: (908) 469-5167

Circle 976 on Inquiry Card.

Citizen America Corp.
(PN48 Notebook Printer)
2450 Broadway, Suite 600
P.O. Box 4003
Santa Monica, CA 90411
(310) 453-0614
fax: (310) 453-2814

Circle 977 on Inquiry Card.

Eastman Kodak Co.
(Diconix 180si, Diconix 701)
Printer Products Division
343 State St.
Rochester, NY 14653
(800) 344-0006
fax: (716) 726-6158

Circle 978 on Inquiry Card.

Lexmark International, Inc.
(IBM Portable Printer)
740 New Circle Rd. NW
Lexington, KY 40511
(606) 232-3000
fax: (606) 232-2380

Circle 979 on Inquiry Card.

Seikosha America, Inc.
(LT-20XL)
10 Industrial Ave.
Mahwah, NJ 07430
(800) 338-2609
(201) 327-7227
fax: (201) 818-9075

Circle 980 on Inquiry Card.

Star Micronics America, Inc.
(StarJet SJ-48)
420 Lexington Ave., Suite 2702
New York, NY 10170
(212) 986-6770
fax: (212) 286-9063

Circle 981 on Inquiry Card.

Seikosha's LT-20XL

The Seikosha LT-20XL is the biggest, heaviest (6.5 pounds), and loudest of the seven printers, especially when printing graphics. It uses 24-pin dot-matrix technology, and if you're used to the ultracrisp images from laser printers, you'll immediately recognize that the Seikosha is a dot-matrix printer.

Seikosha has one of the best paper-handling methods of the lot. In addition to feeding single sheets, you can place up to 50 sheets in a cassette that slides into the printer, much like with a laser printer; however, the cassette was prone to jamming, especially if the paper had been exposed to humidity.

The Seikosha LT-20XL comes standard with a battery pack that uses either rechargeable batteries (supplied) or, in a pinch, 13 standard AA alkaline batteries. I discovered that a charged battery would produce about 20 pages of letter-quality output.

TAG-ALONG HARD COPY

Maximum graphics resolution (dpi)	Bundled software	Warranty
360 x 360	None	1 year (parts)
360 x 360	Hypertext manual	1 year standard; 2-year extended available
192 x 192	Windows driver	1 year
300 x 300	Windows driver	1 year (replacement printer in 2 business days)
360 x 360	Hypertext manual	1 year express service
360 x 360	None	2 years
360 x 360	None	2 years

Because of its size and weight, the Seikosha isn't the type of printer I would take along for a heavy travel schedule. It's well-suited for a location where you'll be setting up a temporary office for a few days or weeks, or as a second printer for the home or office.

Picking the Portables

The portable printers tested here represent a wide variety of sizes, weights, and technologies. Picking the best depends on how you will use your portable printer. If you travel heavily and want the ultimate in portability, the Citizen PN48 and the Lexmark IBM Portable Printer are the obvious choices. Their small size, light weight, and excellent print quality put them at the top of the list.

If you want printers that both travel and work well for occasional desktop use, the Brother HJ-100i and the Star Micronics StarJet SJ-48 are good choices based on their proven bubble-jet technology.

Finally, for those on a budget, the Kodak Diconix 180si, despite having the lowest-quality output, is great if you need to produce lots of output on fanfold paper. ■

Stan Miastkowski, a former BYTE senior editor for new products, is a BYTE consulting editor and freelance writer specializing in computer technology and news. He can be reached on BIX as "stanm."

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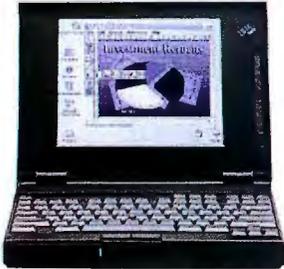
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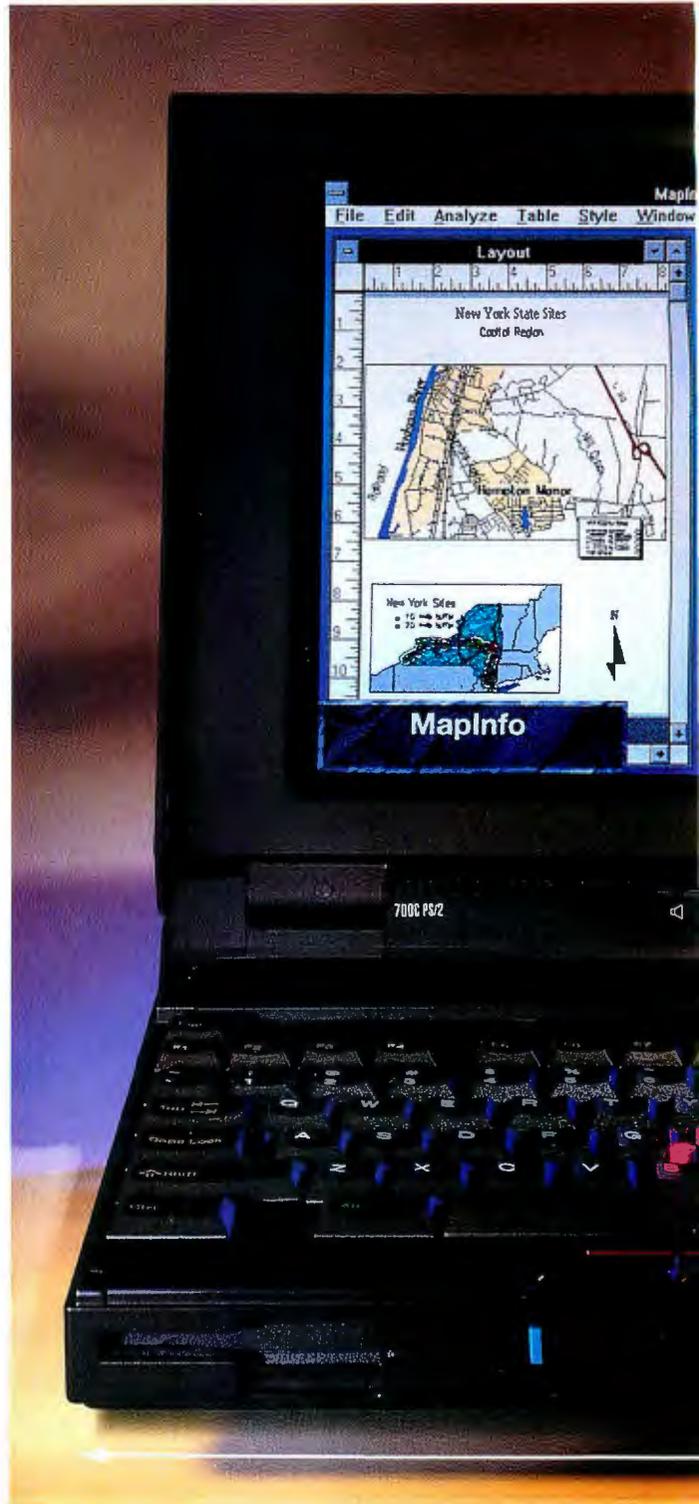


the ThinkPad 300 series has the same slim design and an even slimmer price tag. And all ThinkPads are expandable,

with a range of add-on products available.

IBM ThinkPads are easy on the eyes in more ways than one. Immediately apparent is their attractive silhouette. But their beauty extends far beyond the superficial. The 700 series screens rival desktop display clarity. All screens are eminently

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Display	10.4" Active Matrix 256-Color Screen	9.5" Monochrome Display 64 Grayscale Screen	9.5" Monochrome Display 64 Grayscale Screen
Battery Life[†]	2-4 Hours	3.8-7.5 Hours	4-10 Hours
Weight	7.6 Lbs. with Battery	6.5 Lbs. with Battery	5.9 Lbs. with Battery
Warranty	3 Years (International)	3 Years (International)	1 Year (International)
Price^{††}	\$4,350	\$2,750	\$2,375

[†]Depending on usage and configuration. ^{††}MSRP. Dealer prices may vary.

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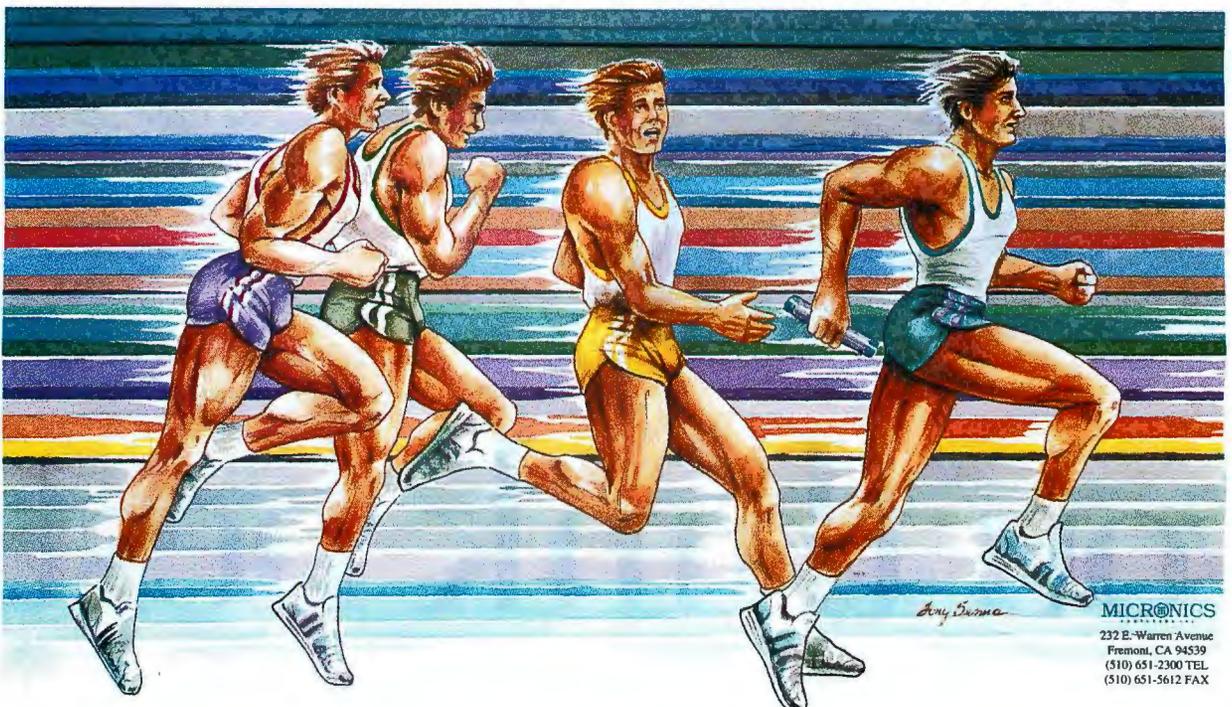
Micronics VL-Bus 80486-33MHz

In addition to supporting VL-Bus video adapters from major peripheral manufacturers, the new local bus 486 offers bus mastering, Flash EPROM BIOS support, local bus IDE on-board, and support of Intel OverDrive processor technology. It is also based on Micronics' own Gemini chip set design. This design is field proven with over 150,000 installed units. This multi-functional system board provides the ultimate in product reliability, while providing industry standard compatibility.

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FAX MODEMS TO GO

Ten small, portable packages deliver varying degrees of performance while you're on the road

WAYNE RASH JR.

The debut of the AT&T Fax/Modem chip set, along with similar chip sets from other manufacturers, has brought a flood of capable, but tiny, portable fax modems to the market. About a year ago, these devices required a full-length PC expansion card. Now they are in boxes smaller than a pack of cigarettes.

Despite their diminutive size, portable fax modems have features that are normally associated with larger desktop modems and communicate using the V.42bis standard that supports 4-to-1 compression. This means that a 2400-bps modem appears to the computer to be running at 9600 bps. Likewise, most of these modems support a variety of other standards, including MNP reliability and data-compression modes.

The portable fax modems reviewed here all run on batteries. A few include travel cases, nearly all include batteries, and all include necessary items, such as serial and phone cables and a power supply. All weigh no more than about ½ pound.

Review Procedure

The fundamental requirement of a fax modem is that it can communicate with modems and fax machines. Thus, it must be able to connect with modems that do and do not support the V.42bis compression and MNP reliability standards. In addition, these devices must be able to communicate accurately with fax machines, transmitting both text and graphics files.

All the fax modems I tested advertised the ability to handle ASCII text and PCX files, so I created a sample file of each type. In addition, I created sample files of a WordPerfect document for those products that claimed to support WordPerfect. The PCX graphics test was important, because while all the packages did support PCX, they did so with varying degrees of success. The greatest problem was that some of the conversion software created a fax image of the PCX file that was far smaller than the original.

I used a Zenith Z-Note notebook for my test platform. The Z-Note has a 25-MHz

386SL processor, 4 MB of RAM, and an 80-MB hard drive. I tested the fax modems by transmitting to fax machines near Washington, D.C., and also with a BYTE fax machine, the plain-paper Canon Model Fax-L920, in Peterborough, New Hampshire. This let me determine if there was any degradation in performance between local and long-distance calls. A performance problem would show up as a drop in communications speed below the maximum 9600 bps these devices support in fax mode. I tested the receive capabilities by sending test pages from a local fax machine to each of the fax modems and printing the results on a networked Hewlett-Packard LaserJet IIIP.

These fax modems ship with some communications software. In some cases, this was a program such as Procomm or BitCom that was completely separate from the fax software. In other cases, the fax software and the communications software were combined into a single package.

Testing modem communications was more complex. I needed to be sure that I was communicating with a known source of reliable and/or compressed data communications. I attempted communications with a computer near Washington that uses a Telebit T2500 that supports MNP level 5, V.42, V.42bis, and V.32 communications (among others); with MCI Mail's MNP and 9600-bps services as well as its standard 2400-bps service; with BIXnet's MNP service in Washington; and with Tymnet. I first tested each modem at the maximum communications speed it would support, so that a 2400-bps modem supporting V.42bis would be accessed by the computer at 9600 bps, for example.

After testing each modem at its maximum speed with each service supporting it, I then attempted lower-speed operations on standard services. This demonstrated a modem's ability to switch to slower operations. I performed a series of file transfers using Procomm Plus and a dedicated computer, but I found that there were no significant differences among them. I thus dropped attempts to benchmark these fax modems.

Considering that the fax modems use a nearly identical chip set, most of the differences are in the manner in which the chip set is implemented. In this area, there are some differences. In addition, there are important differences in the Multi-Tech fax modem, which is based on a proprietary chip set. Otherwise, the primary differences involve such things as the number and type of status lights on the modem, whether there is a connector for one or



Portable fax modem prices are largely a function of speed. The Multi-Tech MultiModem, for instance, is both the fastest and most expensive unit reviewed.

two phone lines, and whether the serial cable uses nine, 25, or some other number of pins on the modem.

The Fax Modems

Unless otherwise noted, each of the fax modems in this review is a pocket-size unit with both battery and AC-power capabilities. Each is shipped with fax and communications software that enables both sending and receiving. Most of the devices include a speaker and status lights that let

you monitor the progress of your communications session. Finally, most of the devices are sufficiently easy to set up and use that only minimal reference to the documentation is required. See table 1 for a comparison of the features of the fax modems I looked at.

Carrier 24/96E

Everex's Carrier 24/96E is notable for what it includes. The communications software is the shareware version of Procomm,

but Everex provides its own fax software.

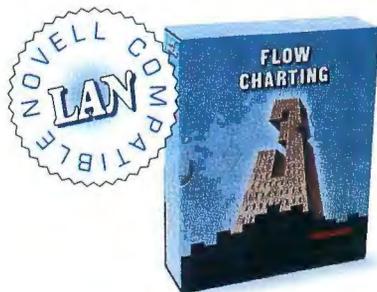
The Carrier 24/96E does not include a power switch. Instead, it gets its commands to turn on and off from the state of the serial port or from signals on the phone line. You can tell what it's doing by listening to a series of multitone beeps that Everex calls *sound cues*. This probably saves battery power over status lights, but many users may find themselves trying to remember what "beep-BOOP" means. The Carrier 24/96E's fax software shrinks PCX files down to images much smaller than the original.

MaxLite/PC

This is one of the nicest packaging jobs among the fax modems in this review. The MaxLite/PC fax modem from Macronix is a slick-looking, streamlined unit done in flat black. It comes with a black velvet bag designed to hold the unit itself and its cables. Unfortunately, it does not have enough space to hold the AC adapter.

The MaxLite/PC also has a well-designed selection of software, combining Tradewind Software's Comit, Delrina Technology's highly regarded WinFax Pro

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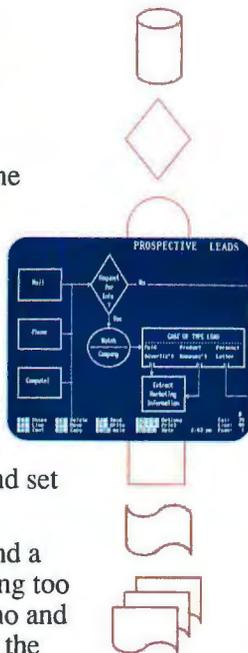
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BYTE ACTION SUMMARY

- **WHAT PORTABLE EXTERNAL FAX MODEMS DO**
They give you a light, battery-powered solution that will let you communicate with fax machines and on-line services while you're on the road.
- **LIKES**
The good ones give you nearly every feature you expect in a full-size, desktop fax modem in 20 percent of the space.
- **DISLIKES**
A few of the compromises to size, such as tiny speakers, permanently attached serial cables, and single RJ-11 connectors.
- **RECOMMENDATIONS**
The Multi-Tech MultiModem portable is one of the best modems I've ever used, portable or desktop. While it's expensive, you get blistering speed, reliable operation, sound construction, and excellent software. Nothing else comes close.

PORTABLE FAX MODEM ADAPTERS COMPARED

Table 1: Price for portable modems is directly connected to performance.

Model	Price	Dimensions (H x W x D in inches)	Modem speed (bps)	Accessories	Standards supported	File types	Comments
Carrier 24/96E	\$399	5.25 x 3.25 x 1	2400	a, c, d, e, g	MNP 5, V.22, Bell 103 & 212A	A, B, E	1, 2, 6, 7
Complete Fax/Portable Plus	\$199	6 x 3 x 1	2400	a, b, c, d, e	V.42, V.42bis MNP 5 Bell 103 & 212A	A, B, C, E, J, K	1, 2
MaxLite/PC	\$349	4.5 x 2.7 x 1	9600	a, b, c, d, f	V.42, V.42 bis, V.32, V.32 bis, MNP 5, Bell 103 & 212A	A, B, C, E, G, I	1, 2, 3
MultiModem MT1432MU	\$899	2.75 x 5.25 x 1.1	14,400	a, b, c, d, e, f	V.42, V.42 bis, V.32, V.32 bis, V.22, V.22 bis, MNP 5, Bell 103 & 212A	A, B, C, E	1, 2
Pocket Laptop Fax Modem P224FMV	\$379	2.25 x 3.25 x 1	2400	a, c, d, f, h	V.42, V.42 bis, MNP 5, Bell 103 & 212A	A, B, C, E	4, 7
Pocket Laptop Fax Modem P296FMV	\$669	2.25 x 3.25 x 1	9600	a, c, d, f, h	V.42, V.42 bis, V.22, V.22 bis, MNP 5, V.32, Bell 103 & 212A	A, B, C, E	4, 7
Practical Pocket Modem	\$299	Modem: 3 x 2.25 x 1 Battery pack: 3 x 2.5 x .75	2400	a, c, d, e	V.42, V.42bis, V.22, MNP 5, Bell 103 & 212A	A, B, C, D, E	4, 5, 7
Smart One Traveler Pocket Fax/Data Modem 9624FP	\$199	5.25 x 2.75 x 1.25	2400	a, c, d	V.42, V.42bis, V.22, v.21, MNP 5, Bell 103 & 212A	A, B, C, D, E, G, H	4, 6
Viva 2442P	\$269	4.9 x 2.7 x 1	2400	a, b, c, d	V.42, V.42 bis, V.22, V.22 bis, Bell 103 and 212A MNP 5,	A, B, C, D, F, G	4
WorldPort 2496	\$379	4.5 x 2.5 x 1	2400	a, b, c, d, e, g	V.42, V.22, V.22 bis, Bell 103 & 212A	A, B, E	4

Accessory key

- a: 120-volt power supply.
- b: 9-V battery supplied.
- c: Modular phone cable supplied.
- d: Serial cable supplied.
- e: Serial cable adapter supplied.
- f: Traveling case supplied.
- g: Acoustic coupler cable supplied.
- h: 2 AA cells supplied.

File types

- A: ASCII
- B: PCX
- C: TIFF
- D: MacDraw
- E: Epsprn
- F: PCL
- G: WordPerfect
- H: Microsoft Word
- I: WordStar
- J: Dr. Halo CUT
- K: MSP

Comment key

- 1: Includes fax software.
- 2: Includes communications software.
- 3: Includes Windows software.
- 4: Includes combined fax modem software.
- 5: Fax is send-only.
- 6: Batteries not included.
- 7: No status LEDs.

2.0, and MaxTalk from Macronix. This is the only fax modem in this review with true Windows capability. The MaxLite/PC also lets you create faxes with files from WordPerfect, WordStar, and HiJaak Fax, along with the usual text, PCX, and Epson files.

The MaxLite/PC's modem operates at 9600 bps, which means that you can communicate with the modem at 38,400 bps when it's using V.42 or MNP level 5. Getting it to do that proved to be a bit of a problem, though, because the supplied communications software had the wrong initialization sequence, which kept the modem portion from communicating. A check of the manual allowed me to correct that, and from that point, the modem worked just fine.

MultiModem MT1432MU

There's no question that this is the best modem in this test. It's simply no contest when it comes to operations and quality. Of course, considering its cost, it *should* be a lot better.

The first indication of its difference is in its speed. Modem communications can be as fast as 14,400 bps, provided that you can find someone else who has a modem that fast. The unit I tested supported fax speeds of only up to 9600 bps, but the company says that by the time you read this, the MultiModem will support V.17 fax connectivity at 14,400 bps. Since the MultiModem uses flash-memory PROMs for its firmware, current users of this fax modem should be able to upgrade their systems with a phone call.

You'll never have any doubts about the activities of the MultiModem. Like other Multi-Tech products, this one has 12 status lights. You'll always know at what speed the modem is running, the status of data transmissions, and whether information is actually passing through the modem or the fax at any time.

Multi-Tech includes its own communications and fax software. This is the only software except for WinFax Pro in this review that gave full mouse support. The Multi-Tech software handles Epson, PCX, TIFF, and text files, and PCX files are faxed in their full size. Both the hardware and software manuals are complete, accurate, and well written. The MultiModem comes with a soft travel case that has space for the modem, the cables, the AC power

PORTABLE FAX SOFTWARE RATED FOR DOS AND WINDOWS

TREVOR MARSHALL

How do you send and receive faxes when you are away from your office or home? What do you do in hotel rooms where you can't plug into the phone lines? What if you need to travel overseas? I had these questions in mind while experimenting with software and hardware products that are designed for faxing on the road.

Fax programs for DOS are primarily designed to transmit files, with or without a cover page, although they often offer a print-capture capability. Of this group, I looked at Macronix's MaxTalk, Bit Software's BitFax SR, Sofnet's FaxitLAN, and Delrina's DOS-Fax Pro. The latter two are intended to be DOS look-alikes of the corresponding Windows programs.

Windows fax software acts as a printer driver. To send a fax, you merely select the modem as the output device and print the pages you want to transmit. Delrina's WinFax Pro, Bit Software's BitFax for Windows and BitFax/OCR, Sofnet's FaxitWindows, and Eclipse Software's Eclipse Fax represent the Windows fax packages. (See the Company Information box in the main article for vendor phone numbers.)

The products selected for review all work as stand-alone packages and are suitable for use with portable computers. All the packages I tested could control a fax modem connected to a telephone line.

For my testing, I used Macronix portable fax modems. They are well designed and use the Rockwell fax chip sets. One was a MaxLite-144 external modem, which squeezes both a V.32bis (14,400-bps) data rate and full V.17 (14,400-bps) fax capability into a 7-ounce, battery-operated package. The other was a standard MaxLite, with a 9600-bps Group 3 fax and 2400-bps data modem.

I used a Konexx Koupler acoustic coupler from Unlimited Systems when no direct exchange connection was

available. The Koupler was connected to an ancient telephone, which limited the maximum data transmission rate to 4800 bps. Consequently, the Koupler was also invaluable in assessing the way each package handled poor line conditions and the value of the software's status and error indications.

Sending a Fax?

Faxes are transmitted throughout the world using a standard transmission format called Group 3, which provides for four data transfer rates: 9600, 7200, 4800, and 2400 bps. When a fax transmission is started, the sending machine first "negotiates" with the receiver to ensure that they are compatible (this is a warbling sound). Included in the negotiation are other machine-dependent parameters, such as the time delay between each line to allow for paper advance and whether the transmission is in the fine (200-line-per-inch) or standard (100-lpi) mode.

A series of training pulses at 9600 bps is then transmitted (this sounds like roaring surf). If the receiver gets a low error rate, it tells the transmitter to go ahead at 9600 bps. Otherwise, both ends switch to 7200 bps and try again. If the training pulses are not properly received at 2400 bps, the transmission is aborted. The new V.17 (14,400-bps) fax standard is compatible with Group 3, but the machines indicate the high-speed capability in the initial handshake.

It is important to know what speed your fax modem is using because transmission at 2400 bps will take four times longer than you were expecting, and it may be more economical to hang up and try to get a better line. Only MaxTalk displayed the actual connection speed for the fax being transmitted or received.

Using Pay or Hotel Phones

I tested the fax software for its ability to operate from places where a direct exchange connection is not available, such

as a hotel or pay phone. Even if you manage to get connected, you still have to overcome the problem of dealing with the hotel's switchboard operator and sometimes the telephone company operator as well. It often takes several minutes to set up the call and have your charge-card number verified.

During this time, the fax software must wait in a condition ready to send your fax, and it should *not* be waiting for a dial tone or ring signal, as it would be if it were controlling a modem directly connected to the line. Neither of these signals will be forthcoming. All the packages flagged as possible in table A under "Manual transmit?" could be set up to work in this mode, although in most cases you have to manually turn off the wait-for-dial-tone parameter during setup. MaxTalk, DOSFax Pro, and WinFax Pro have special menu items for manual transmission.

Receiving a remote fax is even more tricky than sending one. Most fax programs are set up to go into a receive mode waiting for the 90-volt ring signal to come in on the phone line. In a hotel room, this will not work, as you invariably have to receive all incoming calls through the operator.

WinFax Pro, DOSFax Pro, and MaxTalk have manual receive modes. When you enter this mode, the modem is immediately put in the answer mode, off-hook, searching for the fax handshake from the sending party. These packages do not need a direct connection to the exchange to receive faxes.

All the other packages need a ring signal on the line before they will receive a fax. Even though Eclipse Fax has a menu item for manual receive, it still needs to detect the 90-V signal and thus cannot perform true manual reception.

Which Software Is Best?

Although installing the fax transmission software as a printer driver makes sense in Windows, I have never used the printer-capture feature of the DOS

FAX SOFTWARE COMPARED

Table A: Delrina Technology has good programs on both sides : DOSFax Pro and WinFax Pro. (●= yes; ○= no.)

	Disk megabytes used	Shows connect speed?	Manual transmit?	Manual receive?	Send quick message?	Support V.17 modems?	Price
For DOS:							
BitFax SR	1.3	○	Possible	○	●	○	\$69
DOSFax Pro	1.8	○	●	●	Cover	●	\$79
FaxitLAN	2.1	○	Possible	○	Cover	○	\$149
MaxTalk	0.9-2.5	●	●	●	●	●	Comes with hardware
For Windows:							
BitFax for Windows	1.3	○	Possible	○	Cover	○	\$79
BitFax/OCR	3.8	○	Possible	○	Cover	○	\$199
Eclipse Fax	0.9	○	Possible	○	Cover	○	\$119
FaxitWindows	2.2	○	Possible	○	Cover	○	\$99
WinFax Pro	1.3	○	●	●	Cover	●	\$119

fax software packages. It is quicker to throw together the PCX image of your letterhead with a quick message and send them both off. Both BitFax and MaxTalk do this well. BitFax transmits a page with good, clean letters, selectable from fonts similar to Helvetica, Times Roman, and Courier. MaxTalk uses a dot-matrix internal font, and you have to use a more complex procedure to make it transmit letter-quality text. Both packages are easy to use to manually send faxes, but only MaxTalk has a manual receive mode.

If you do most of your faxing from inside an application and you need a printer driver package, DOSFax Pro will work well. It has both manual transmit and receive modes. Although both MaxTalk and BitFax SR have the ability to capture laser or dot-matrix printer output from other DOS applications, DOSFax Pro has been designed specifically for this task and is much easier to use.

On the Windows side, WinFax Pro,

FaxitWindows, and BitFax for Windows have interfaces that are easy to use and give good control over all parameters of the transmission and the modem. Of the three, only WinFax Pro provides manual transmission and reception facilities and support for the new V.17 hardware. WinFax Pro does not have built-in OCR (optical character recognition), but Calera's FaxGrabber can be configured to scan (in the background) the directory for incoming faxes and convert each and every incoming WinFax Pro file it sees.

The Faxit products from Sofnet provide the best environment for reception of your faxes in the background (whether you are in DOS or Windows), but you will lose some of your system RAM to the TSR program it installs. The display of incoming faxes can be difficult.

All the packages reviewed here require you to select a file from a rather cryptic list of computer-generated filenames. For a fixed installation, the

small images can be very helpful indeed, as it is easy to select exactly which fax you want to work on.

BitFax/OCR is easy to use and has every necessary feature except manual receive. Its OCR capability is excellent, with support for output formats. Indeed, I can't think of any word processor format that BitFax does not generate.

Eclipse Fax directly supports a scanner and can be used in a photocopy mode. Those features are attractive for a fixed installation but will probably be of little use on the road.

Overall, the manual receive capability of WinFax Pro makes this product from Delrina Technology stand out as the Windows fax package of choice for portable operation.

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supply, and maybe a manual or two. If you can afford it, this is the fax modem to buy.

P224FMV and P296FMV

With the exception of speed, these two fax modems from Megahertz appear to be identical. Both are slightly smaller than most of the others in this group and use a pair of AA cells rather than the 9-volt battery used by the rest. This is an advantage for travelers, because AA batteries are readily available throughout the world.

The Megahertz fax modems use MTEZ communications software with Express-Fax from Magicsoft (Lombard, IL). This software supports partial mouse use—arrow keys but no clicks. PCX images are converted to fax with little shrinkage. The manual noted that there are a few incompatibilities with these modems and Datastorm's popular Procomm Plus. Apparently, one such incompatibility made it difficult to use the Megahertz modems when calling the MNP service on MCI Mail.

As is the case with a few other fax modems in this review, the incompatibility problems might have been easier to solve had the hardware documentation been adequate, but it was not. Contributing

to the difficulty of use was a lack of status lights and a speaker so small that it was difficult to hear.

Practical Pocket Modem

It's hard to understand why Practical Peripherals calls its product "Practical" when it will not receive a fax, especially when similar units in its price range will do the whole job, not just part of it. Practical Peripherals has taken an unusual tack in its modem design. The Practical Pocket Modem is contained in two cases: the modem itself and a rechargeable battery. The result is a pair of small boxes that when taken together require more desktop real estate than the other modems in this class.

The Practical Pocket Modem has no speaker and no status lights. It uses a limited version of Quick Link II Fax from Smith Micro Software (Huntington Beach, CA) that's minus the receive capability and the capability to use WordPerfect files. While the communications capability and the fax transmission capabilities are consistent with the others in this class, the whole package is not. In short, the Practical Peripherals product is overpriced, undercapable, and not very practical.

Smart One Traveler

At first, I had difficulty getting this product from Best Data Products to successfully transmit or receive a fax. However, with a different notebook, the Smart One worked with no trouble. I was unable to determine whether I had a defective unit or there was some compatibility problem with the Z-Note.

One problem: The hardware documentation is so skimpy that it was impossible to tell exactly what the unit required. Calls to the company's technical-support number were not particularly helpful.

The Smart One fax modem includes Quick Link II Fax in the same implementation as the Viva 2442P (see below), so it should handle the same broad mix of files for input. With a retail price of less than \$200, this modem is a good deal.

Complete Fax/Portable Plus

Once you get the Complete Fax/Portable Plus running, it's a nice product. The problem is *getting* it running. When you install the software, the installation software asks you if you want to have it modify your AUTOEXEC.BAT file. If you say you do not want it to, you are not left with any

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instructions on how to run the software manually. I eventually figured out that you must run a program called Frieze and then run the background-processing TSR program, but none of that was in the manual.

The fax modem is shipped with BitCom communications software and a proprietary fax package that supports a good range of file formats, including Dr. Halo CUT files and MSP files from Microsoft Paint. The fax software directly supports a number of popular scanners; this is the only unit in this review with this capability. In addition to the normal PCX and Epson files, you can also use Class B TIFF files.

In its communications mode, the Complete Fax/Portable Plus was a real plug-and-play unit. The default settings were chosen intelligently, and I was able to connect with every service I called on the first try. At under \$200, this one is a steal.

Viva 2442P

The reasonably priced Viva fax modem from Computer Peripherals is typical of this class of device. It includes an excellent combined fax and communications package, Quick Link II Fax. This package supports a wide variety of file types for con-

version to fax, including MacDraw and WordPerfect, which the other fax modems don't support and which most users might need.

The Viva has a tiny speaker that is barely capable of producing enough sound for call monitoring, but it is adequate. The Viva also has status LEDs, so you don't have to depend on the speaker alone. The manual is missing an index, so while the explanations are clear, you'll have a tough time finding specific topics if they're not in the table of contents.

WorldPort 2496

USRobotics is one of the most experienced players in the modem business, but, unfortunately, the WorldPort is only an average product and is somewhat more expensive than is the rule in its class. The greatest problem with the WorldPort was that the installation instructions had a few minor errors that were correctable only by deeper reading into the manual. Fortunately, the manual is a good one.

USRobotics includes its own fax and communications software, which works well but seems somewhat less intuitive than most other products. On the other hand, USRobotics includes an acoustic

coupler adapter for Radio Shack couplers, so you never need to worry about dismantling a hotel's phone system again. USRobotics supports only PCX and Epson graphics files, along with standard text files.

Best Bets

If you can afford it, get the Multi-Tech MultiModem. If you can't afford it, save until you can. If you have to get a cheaper fax modem, look at The Complete PC's Complete Fax/Portable Plus or Macronix's MaxLite/PC. If those won't do or you can't find them locally, take a look at the Viva 2442P.

All these fax modems will give you good service and fast communications. Remember, though, that some are faster than others. The MaxLite/PC is a 9600-bps unit, and the MultiModem runs at 14,400 bps. If you need speed, these are the fax modems to shop for. ■

Wayne Rash Jr. is a consulting editor for BYTE. He is the coauthor of two books for business network users: The Executive Guide to Local Area Networks and The Novell Connection. You can contact him on BIX as "waynerash."

COMPANY INFORMATION

Best Data Products, Inc.
(Smart One Traveler)
(800) 632-2378
(818) 773-9600
fax: (818) 773-9619
Circle 1146 on Inquiry Card.

Bit Software, Inc.
(BitFax SR, BitFax for Windows, BitFax/OCR)
(510) 490-2928
fax: (510) 490-9490
Circle 1147 on Inquiry Card.

Calera Recognition Systems, Inc.
(FaxGrabber)
(800) 544-7051
(408) 720-8300
fax: (408) 720-1330
Circle 1148 on Inquiry Card.

The Complete PC
(Complete Fax/Portable Plus)
(800) 229-1753
(408) 434-0145
fax: (408) 434-1048
Circle 1149 on Inquiry Card.

Computer Peripherals, Inc.
(Viva 2442P)
(800) 854-7600
(805) 449-5751
fax: (805) 449-5742
Circle 1150 on Inquiry Card.

Delrina Technology, Inc.
(DOSFax Pro, WinFax Pro)
(800) 268-6082
(416) 441-3676
fax: (416) 441-0333
Circle 1151 on Inquiry Card.

Eclipse Systems
(Eclipse Fax)
(312) 541-0260
Circle 1152 on Inquiry Card.

Everex Systems, Inc.
(Carrier 24/96E)
(510) 498-4499
fax: (510) 683-3398
Circle 1153 on Inquiry Card.

Macronix, Inc.
(MaxLite/PC, MaxTalk)
(800) 468-4629
(408) 453-8088
fax: (408) 453-8488
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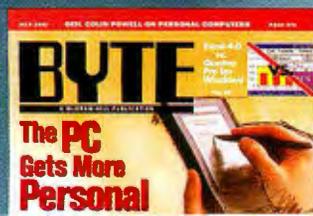
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MAKING CONNECTIONS



Seven external Ethernet adapters offer a wide range of capabilities to suit networkers on the move

WAYNE RASH JR.

Several years ago, Xircom introduced the first Ethernet adapter that attached to a computer's parallel port. Other companies followed, and now many adapters are available from which to choose. With these external, parallel-port units, you can easily connect nearly any PC to a network without opening up its case. This makes these adapters especially convenient for traveling, for testing, or when you have no slots available. All of the adapters use a standard 25-pin parallel-port connector and an external power supply—usually a small box that plugs

directly into a wall socket.

External Ethernet adapters have continued to grow in acceptance as well as in capabilities, and with the introduction of the Intel 386SL processor, parallel-port technology has also improved. Currently, only Xircom is able to take advantage of the enhanced, high-speed—3 to 4 times faster—parallel ports supported in 386SL-based machines from Zenith, Compaq, Dell, and other companies. Eventually, though, it is a safe bet that more companies will move to this higher-speed capability.

Testing Setup and Approach

I used a Zenith Z-Note notebook for my test platform. The Z-Note is the leading example of the new wave of fast, capable notebooks that are making their way into offices worldwide. It has a 25-MHz 386SL processor, 4 MB of RAM, and an 80-MB hard drive, and it supports the enhanced parallel-port standard. In addition, Zenith has included in the Z-Note a built-in Ethernet port, which gave me an interesting comparison to the performance of the external adapters. I used Novell NetWare 3.11 running on a 16-MHz Novell 386/AE file server with 10 nodes, but my node was the only one active during testing.

I tested 10Base-2-compliant adapters using a BNC coaxial cable connector. Most of these adapters are also available for 10Base-T (twisted pair) and 10Base-5 (which uses an AUI connector). In addition, most of the manufacturers also offer adapters for the Token Ring and/or ARCnet networks. While these other adapters may resemble the Ethernet adapters tested here, there's no guarantee that my experiences are applicable to them.

Once I had satisfied myself that the adapters worked as intended by logging on to a network and confirming that I had access, I began performance testing. My principal approach was to measure the time required for a 10-MB file transfer. I set this up by dividing a 10-MB file into eight segments and transferring them sequentially. These file sizes were not unusual for the graphics images found in desktop publishing or CAD files. In addition, they were substantially larger than the available buffer space in the network operating system, thus taking the disk buffering out of the equation.

I also tried using Novell's Perform3 test, which purportedly tests data transfer speed by measuring times for different-size data packets. I am not reporting the Perform3 results because I am not convinced that these results accurately predict actual performance in a production LAN. The results are notable in their inconsistency, and it may be that Perform3 simply does not work accurately with parallel-port Ethernet adapters. While you may see references to these tests elsewhere, I think the results should be viewed with caution.

Pocket Ethernet Adapter II

Xircom's Pocket Ethernet Adapter II is improved in a number of ways over the original and is the only unit I tested that supported this higher-speed capability. The unit is smaller than the original, and

EXTERNAL ETHERNET ADAPTERS COMPARED

The LAN adapters reviewed here differ most in the software each offers and the available versions. (N/A=not applicable.)

Product name	Price	10-MB file copy time (min:sec)	Pregenerated NetWare shells	Other software	Other versions	Notes
Accton Technology's EtherPocket-CX46	\$399	2:59.8	No	ODI, LAN Manager, NetBIOS, PC NFS, Packet, NDIS-DOS, NDIS-OS/2	10Base-T	D
D-Link Systems' Ethernet Pocket LAN Adapter	\$395	2:17.8	Yes	ODI, 3Com, NDIS-DOS, NetBIOS, LANSmart, Nexos, PC TCP, PC NFS	AUI, 10Base-T	D
Hong Technologies' HT-PP108ECX	\$299	3:33.6	Yes	None	None	B, C, E
IQ Technologies' pLAN Ethernet	\$495	2:40.6	Yes	NDIS, LAN Manager	AUI, 10Base-T	C, D, E
Solectek's LAN-CX Pocket Adapter	\$349.95	N/A	No	ODI, NetBIOS, 3Com, LAN Manager, FTP TCP/IP, PC NFS, NDIS-DOS	ARCnet, 10Base-T, Token Ring	F
Xircom's External Ethernet Adapter	\$499	2:41.5	Yes	ODI, NDIS-OS/2, NDIS-DOS, Packet, PC NFS, WIN TCP, DECnet	Token Ring	B, C
Xircom's Pocket Ethernet Adapter II	\$399	2:12.4	Yes	ODI, NDIS-OS/2, NDIS-DOS, Packet, 3Com, AT&T StarLAN, LAN Manager	ARCnet, 10Base-T, Token Ring	A, C, E

A: Supports enhanced parallel port.
 B: Includes AUI and/or 10Base-T support.
 C: Includes activity indicator.

D: Includes multivoltage power supply.
 E: Includes parallel-port pass-through.
 F: This product test not performed due to product failure.

attaching it to the parallel-port connector is easier. You connect it by turning a device that looks like a tiny tractor tread encircling the adapter. This turns the mounting screws, eliminating the frustrating thumbscrews used by other devices.

In operation, the Pocket Ethernet Adapter II was fast and trouble-free. It performed the file transfer test faster than any other Ethernet device in this review. It also beat the time of a 3Com Etherlink II card mounted in a 33-MHz 386 desktop system.

Xircom includes an activity monitor light and supports the 386SL sleep mode by providing automatic log-on when you reactivate the machine. The unit does not have a printer-port pass-through connector, so you must print to the network, but the

company makes a port multiplexer if you want to print locally with this machine.

External Ethernet Adapter

This sibling of Xircom's Pocket Ethernet Adapter II is designed to be used in an office environment. It consists of a box that attaches to the computer via a cable, allowing the unit itself to mount behind the computer. It is too large to be really portable, but it includes support for 10Base-2, 10Base-5, and 10Base-T. This unit currently ships in a hardware and software version that doesn't support the enhanced parallel port. In addition, all the network software included with the unit seems to be of an earlier version than that accompanying the pocket unit. This may not matter

to you, but it will in some installations.

This adapter powers down when you shut off the computer. There is a power light as well as a network activity light and a link indicator for 10Base-T connections. This unit was much slower than the Pocket Ethernet Adapter II, even when the newer unit was not using the enhanced parallel port.

The unit and the driver software are auto-sensing, detecting which of the unit's three ports the Ethernet is connected to and which computer parallel port the cable is attached to. This means that the External Ethernet Adapter, like the pocket version, is essentially a plug-and-play device. You hook it up and load the software, and you're ready for networking.

Ethernet Pocket LAN Adapter

D-Link Systems' Ethernet Pocket LAN Adapter is clearly meant for use on the road. It includes a handy carrying case and an attached T connector, and the manual fits in the case. Unfortunately, the power supply, which is required for operation, does not. Regardless, the power supply is designed to operate on nearly any AC voltage supply, and it has a wide selection of available network drivers. This is a serious network adapter.

The Ethernet Pocket LAN Adapter is fairly small, and its multivoltage power supply is the smallest in its class. The adapter comes packed in a plastic case that resembles those used for videotape rentals; the case is reusable for shipping. If you have a heavy travel requirement, this adapter is an obvious choice.

The Ethernet Pocket LAN Adapter has the virtue of being completely nondramatic in use. For example, most of the external Ethernet adapters need to be rebooted when the computer using them is rebooted. D-Link's adapter does not. It apparently senses the computer's reset and adjusts. Although the Ethernet Pocket LAN Adapter does not support the enhanced

BYTE ACTION SUMMARY

■ **WHAT EXTERNAL ETHERNET ADAPTERS DO**

They let you connect to an Ethernet LAN by attaching to the parallel port on your computer, without having to install an Ethernet network interface card.

■ **LIKES**

They are easy to use and usually provide effective network communications for computers, such as laptops and notebooks, that otherwise couldn't be used on a network.

■ **DISLIKES**

All the adapters reviewed are more expensive than most widely used Ethernet network interface cards, are frequently slower, and may not work with your computer.

■ **RECOMMENDATIONS**

Unless price is a critical item for you, buy Xircom's Pocket Ethernet Adapter II. It's faster than the others, it has broader software and driver support, and you can buy a version that will work with your network. It's also easier to attach to your computer than the others. If you have a computer with a 386SL processor, this is the only one that currently utilizes the enhanced parallel-port standard supported by the 386SL. If price is a problem or you can't use the enhanced parallel port anyway, you might want to consider D-Link Systems' Ethernet Pocket LAN Adapter.

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parallel-port technology of the Z-Note, it was nearly as fast as Xircom's Pocket Ethernet Adapter, which does.

EtherPocket-CX46

Like the D-Link adapter, Accton Technology's EtherPocket-CX46 is set for international travel. It's the smallest of this already diminutive set, but it's got the largest power supply. That supply is designed with a voltage range compatibility nearly as wide as the D-Link adapter, and

it has a replaceable power cord—which means that you need to take along only the appropriate cord instead of a box of adapters for the power plugs.

Unfortunately, the EtherPocket is rather slow. It also sometimes caused boot problems with the Z-Note, and it does not have pregenerated shells. If you are going to travel, and if you will have the ability to either use Novell ODI shells or be able to generate your own, you can survive with the EtherPocket. But with the avail-

ability of the D-Link adapter, what's the point?

HT-PP108ECX

Hong Technologies, Inc., makes an adapter that is similar in concept to Xircom's External Ethernet Adapter. It's a separate box that sits apart from the computer and is connected by a cable to the parallel port. HTI's HT-PP108ECX adapter includes a parallel-port pass-through, as well as a BNC connector and an AUI port.

Unlike the External Ethernet Adapter, though, the HT-PP108ECX is not auto-sensing. Instead, a slide switch on the front of the unit selects the port you are using. In addition, you can select a regular or long Ethernet segment length—a capability unique in this group.

Also unique to the HTI adapter is a light that announces packet collisions. Although this is of limited usefulness to most users, it is handy to be able to see if there are potential performance problems on your network. Unfortunately, the HTI adapter is unique in providing only Novell support. LAN Manager users and others are out of luck with HTI.

pLAN Ethernet

IQ Technologies' pLAN Ethernet adapter resembles the other external Ethernet adapters in that it is attached by a cable, it includes a parallel-port pass-through, and it has activity lights. Unlike the others, though, the pLAN Ethernet supports only one version of Ethernet; when you order, you have to specify whether you want a BNC, AUI, or 10Base-T connection.

On the other hand, the pLAN Ethernet includes a pregenerated NetWare shell, NDIS, and LAN Manager drivers. More important, it also includes a multivoltage power supply, so if your portability requirements include international travel, pLAN makes the choice easier.

LAN-CX Pocket Adapter

I never got Solectek's LAN-CX Pocket Adapter to work. There appears to be a hardware conflict between the adapter and the Z-Note's PS/2-compatible mouse port. I also attempted to try the Solectek adapter with a 25-MHz 486 Unisys PW/2, also equipped with a PS/2-compatible mouse port, but it wouldn't work there, either.

On two occasions, I was able to log on to the network and actually access the file server, but the connections never lasted long enough to perform any tests. During the time that the connections existed, performance was extremely slow. Conversations with Solectek failed to reveal either the reason for the problem or the solution

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to it. For this reason, no formal tests of the Solectek adapter were possible.

Which to Choose

As similar as some of these units are, you might think that it would make sense to buy whichever is cheapest. That's not the case, however. The price differences aren't all that great, and there are significant differences in the features and software included with each unit that could very well tip the scales for you.

For example, Xircom's Pocket Ethernet Adapter II was clearly the fastest device in this test. It was faster even than the internal network interface cards in the desktop computers that I compared it to. In fact, the only faster method (by about 1 second) of Ethernet communications I found in this test was using the Z-Note's built-in Ethernet port.

If you need speed and you have a machine with an enhanced parallel port, then the Pocket Ethernet Adapter II is the only intelligent choice. Of course, if you travel internationally, then you may prefer a product that supports the electrical power requirements in any country you might visit.

In this case, D-Link Systems' Ethernet

Pocket LAN Adapter is the clear choice. It's nearly as fast as the Pocket Ethernet Adapter II, has wide software support, and is more forgiving than the Xircom adapter when you reset your computer.

If you can't give up your local parallel port because you need to print locally and have only one, you have three choices. Of the three external Ethernet adapters, Xircom's External Ethernet Adapter offered the best support for an environment that has a variety of topologies, and it comes with a wide selection of software. Unfortunately, it does not support the enhanced parallel-port technology that gives its pocket-size sibling its speed. Of course, if you plan to travel with your external adapter, then IQ Technologies' pLAN Ethernet is the best choice, despite its more limited software support.

Unfortunately, there's no ideal solution, so no one choice in parallel-port Ethernet adapters will suit everyone. Perhaps if Xircom were to start shipping multivoltage power supplies as standard equipment, that solution might be closer. In the meantime, the best solution is to compare your needs with the support offered by each product and pick the best fit. ■

Wayne Rash Jr. is a consulting editor for BYTE and director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He is co-author of two books for business network users: The Executive Guide to Local Area Networks and The Novell Connection. He can be reached on BIX as "waynerash."

COMPANY INFORMATION

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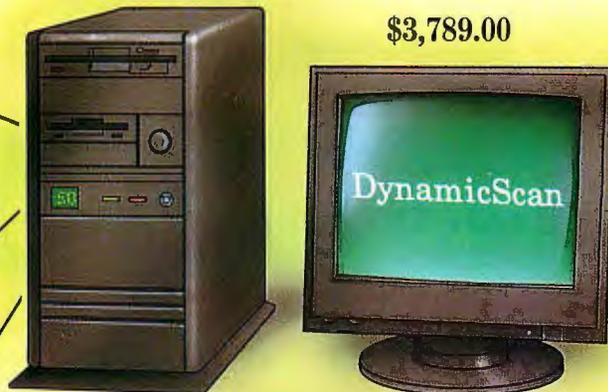
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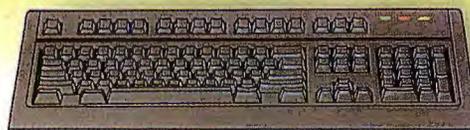
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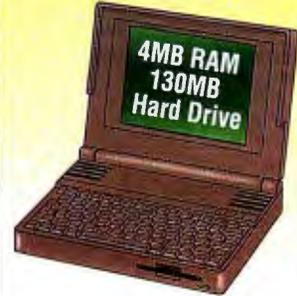
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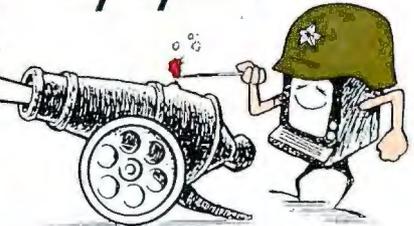
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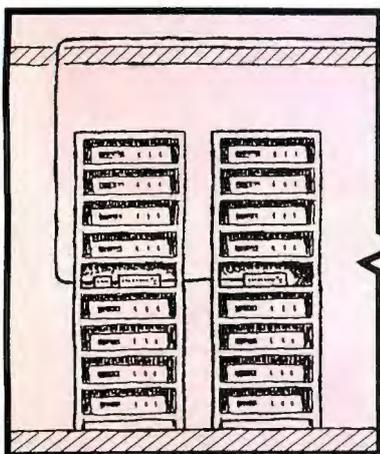
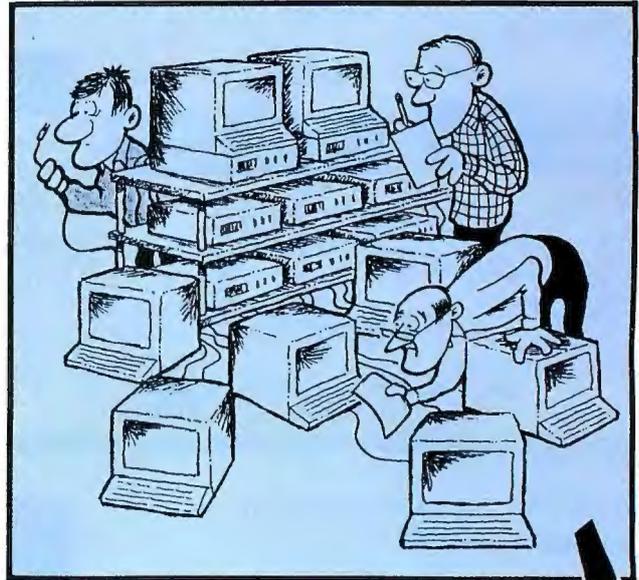
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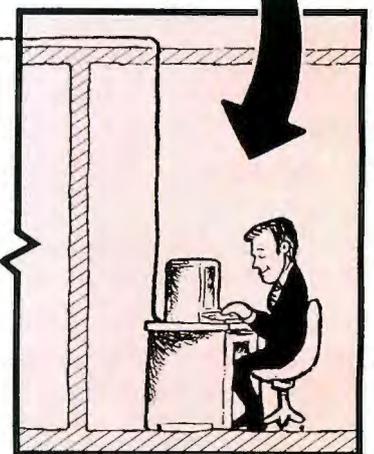
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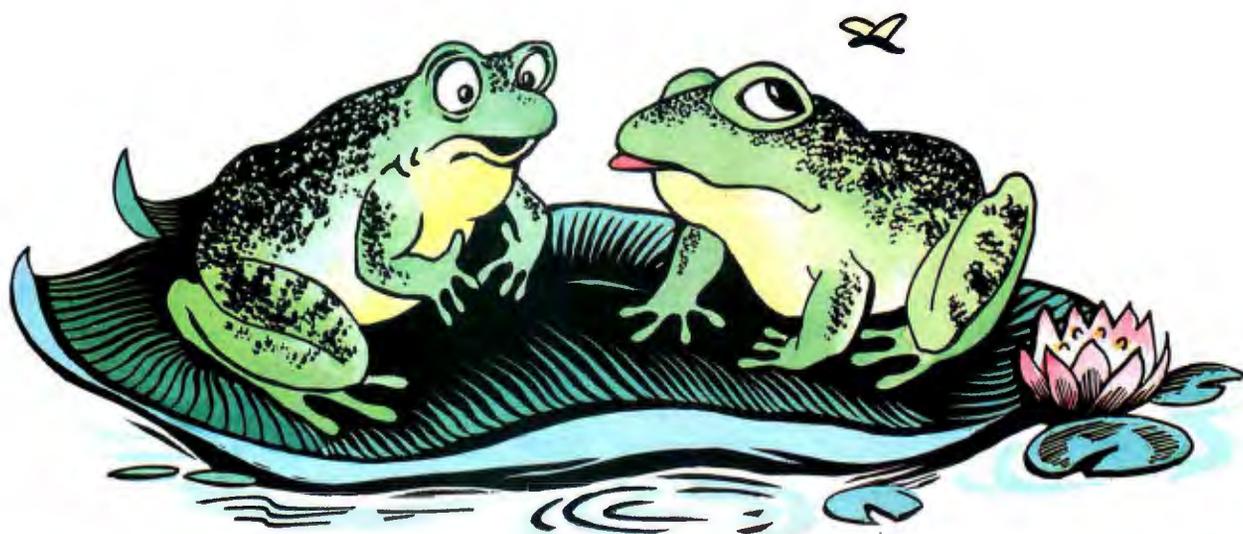
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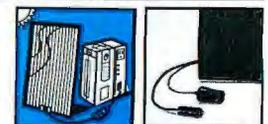
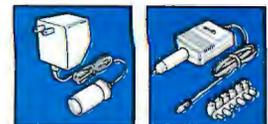
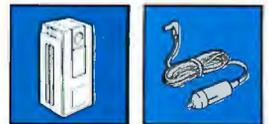
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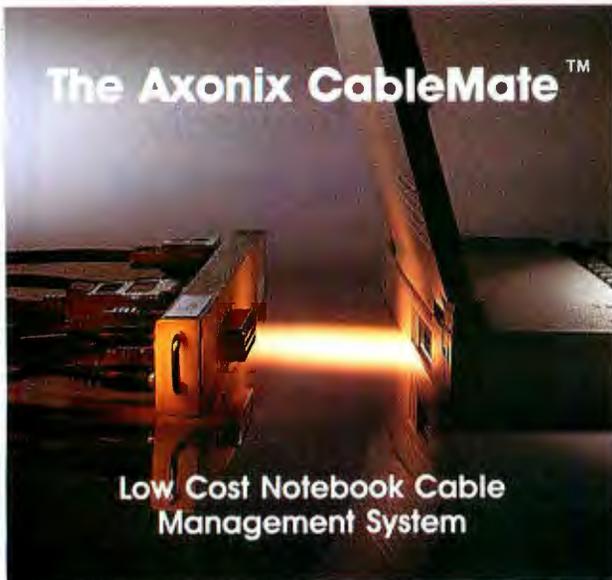
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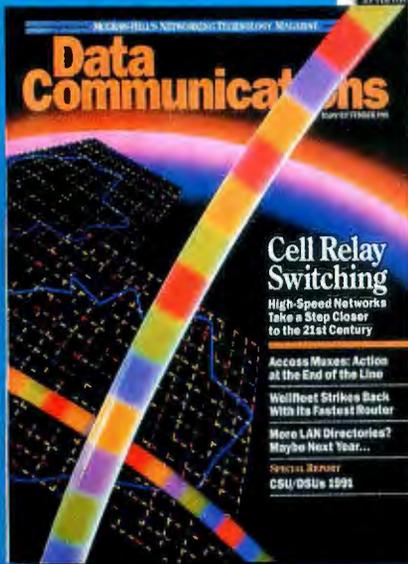
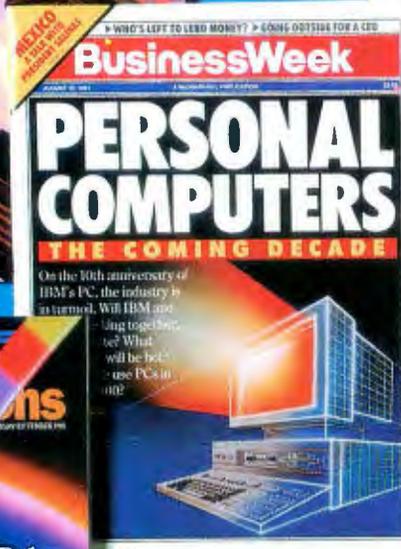
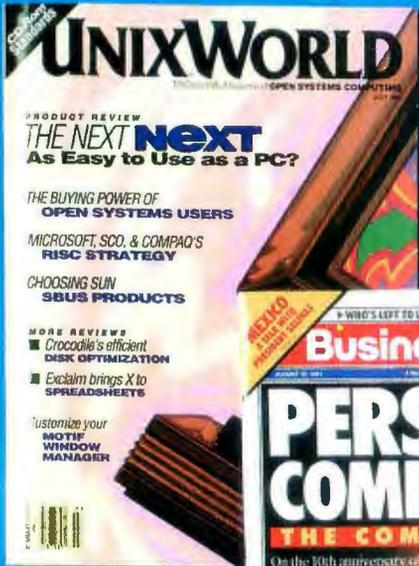


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PRODUCT CATEGORY INDEX

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For more information on any of the companies covered in articles, columns, or news stories in this issue, circle the appropriate inquiry number on Your Direct Link Card. Each page number refers to the first page of the article or section in which the company name appears.

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 Title _____
 Company _____
 Address _____
 City _____ State _____ Zip _____
 Phone _____ Fax _____

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- 1 MIS/DIP
- 2 Programmer/Systems Analyst
- 3 Administration/Management
- 4 Sales/Marketing
- 5 Engineer/Scientist
- 6 Other

B. What is your level of management responsibility?

- 7 Senior-level
- 8 Middle-level
- 9 Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

- 10 Yes
- 11 No

D. What operating systems are you currently using? (Check all that apply)

- 12 PC/MS-DOS
- 13 DOS + Windows
- 14 OS/2
- 15 Unix
- 16 MacOS
- 17 VAX/VMS

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- 19 26-50
- 20 51-99
- 21 100 or more

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775	801	827	853	879	905	931
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778	804	830	856	882	908	934
779	805	831	857	883	909	935
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785	811	837	863	889	915	941
786	812	838	864	890	916	942
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1130	1156	1182	1208	1234	1260	1286
1131	1157	1183	1209	1235	1261	1287
1132	1158	1184	1210	1236	1262	1288
1133	1159	1185	1211	1237	1263	1289
1134	1160	1186	1212	1238	1264	1290
1135	1161	1187	1213	1239	1265	1291
1136	1162	1188	1214	1240	1266	1292
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1138	1164	1190	1216	1242	1268	1294
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250	275	300	325	350	375	400
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253	278	303	328	353	378	403
254	279	304	329	354	379	404
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604	629	654	679	704	729	754
605	630	655	680	705	730	755
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608	633	658	683	708	733	758
609	634	659	684	709	734	759
610	635	660	685	710	735	760
611	636</					

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Product Category	Information	Hardware	Accessories/Supplies	Add-in Boards	Bar Coding	Communications/Networking	Computer Systems	Data Acquisition	Disks & Optical Drives	Diskettes/Duplicators	Fax Boards/Machines	Graphics Tablets/Mice/ Pen Input	Keyboards	LAN Hardware	Laptops & Notebooks	Mail Order	Memory/Chips/Upgrades	Miscellaneous Hardware	Modems/Multiplexors	Monitors & Terminals	Multimedia	Printers/Plotters	Programmable Hardware	Scanners/OCR/Digitizers	Tape Drives	UPS	Software	Business	CAD/CAM	Communications/Networking	Data Acquisition	Database	Educational	Engineering/Scientific	Entertainment	Graphics	Macintosh	Mail Order	Mathematical/Statistical	Miscellaneous Software	On-Line Services	Operating Systems	Programming Languages/Tools	Security	Shareware	Software Duplication	Spreadsheets	Unix	Utilities	Windows	Word Processing	General	Books/Publications	Recruitment	Miscellaneous
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60	86	112	138	164	190	216
61	87	113	139	165	191	217
62	88	114	140	166	192	218
63	89	115	141	167	193	219
64	90	116	142	168	194	220
65	91	117	143	169	195	221
66	92	118	144	170	196	222
67	93	119	145	171	197	223
68	94	120	146	172	198	224
69	95	121	147	173	199	225
70	96	122	148	174	200	226
71	97	123	149	175	201	227
72	98	124	150	176	202	228
73	99	125	151	177	203	229
74	100	126	152	178	204	230
75	101	127	153	179	205	231
76	102	128	154	180	206	232
77	103	129	155	181	207	233

Inquiry Numbers 409-590

409	435	461	487	513	539	565
410	436	462	488	514	540	566
411	437	463	489	515	541	567
412	438	464	490	516	542	568
413	439	465	491	517	543	569
414	440	466	492	518	544	570
415	441	467	493	519	545	571
416	442	468	494	520	546	572
417	443	469	495	521	547	573
418	444	470	496	522	548	574
419	445	471	497	523	549	575
420	446	472	498	524	550	576
421	447	473	499	525	551	577
422	448	474	500	526	552	578
423	449	475	501	527	553	579
424	450	476	502	528	554	580
425	451	477	503	529	555	581
426	452	478	504	530	556	582
427	453	479	505	531	557	583
428	454	480	506	532	558	584
429	455	481	507	533	559	585
430	456	482	508	534	560	586
431	457	483	509	535	561	587
432	458	484	510	536	562	588
433	459	485	511	537	563	589
434	460	486	512	538	564	590

Inquiry Numbers 766-947

766	792	818	844	870	896	922
767	793	819	845	871	897	923
768	794	820	846	872	898	924
769	795	821	847	873	899	925
770	796	822	848	874	900	926
771	797	823	849	875	901	927
772	798	824	850	876	902	928
773	799	825	851	877	903	929
774	800	826	852	878	904	930
775	801	827	853	879	905	931
776	802	828	854	880	906	932
777	803	829	855	881	907	933
778	804	830	856	882	908	934
779	805	831	857	883	909	935
780	806	832	858	884	910	936
781	807	833	859	885	911	937
782	808	834	860	886	912	938
783	809	835	861	887	913	939
784	810	836	862	888	914	940
785	811	837	863	889	915	941
786	812	838	864	890	916	942
787	813	839	865	891	917	943
788	814	840	866	892	918	944
789	815	841	867	893	919	945
790	816	842	868	894	920	946
791	817	843	869	895	921	947

Inquiry Numbers 1123-1304

1123	1149	1175	1201	1227	1253	1279
1124	1150	1176	1202	1228	1254	1280
1125	1151	1177	1203	1229	1255	1281
1126	1152	1178	1204	1230	1256	1282
1127	1153	1179	1205	1231	1257	1283
1128	1154	1180	1206	1232	1258	1284
1129	1155	1181	1207	1233	1259	1285
1130	1156	1182	1208	1234	1260	1286
1131	1157	1183	1209	1235	1261	1287
1132	1158	1184	1210	1236	1262	1288
1133	1159	1185	1211	1237	1263	1289
1134	1160	1186	1212	1238	1264	1290
1135	1161	1187	1213	1239	1265	1291
1136	1162	1188	1214	1240	1266	1292
1137	1163	1189	1215	1241	1267	1293
1138	1164	1190	1216	1242	1268	1294
1139	1165	1191	1217	1243	1269	1295
1140	1166	1192	1218	1244	1270	1296
1141	1167	1193	1219	1245	1271	1297
1142	1168	1194	1220	1246	1272	1298
1143	1169	1195	1221	1247	1273	1299
1144	1170	1196	1222	1248	1274	1300
1145	1171	1197	1223	1249	1275	1301
1146	1172	1198	1224	1250	1276	1302
1147	1173	1199	1225	1251	1277	1303
1148	1174	1200	1226	1252	1278	1304

Inquiry Numbers 234-408

234	259	284	309	334	359	384
235	260	285	310	335	360	385
236	261	286	311	336	361	386
237	262	287	312	337	362	387
238	263	288	313	338	363	388
239	264	289	314	339	364	389
240	265	290	315	340	365	390
241	266	291	316	341	366	391
242	267	292	317	342	367	392
243	268	293	318	343	368	393
244	269	294	319	344	369	394
245	270	295	320	345	370	395
246	271	296	321	346	371	396
247	272	297	322	347	372	397
248	273	298	323	348	373	398
249	274	299	324	349	374	399
250	275	300	325	350	375	400
251	276	301	326	351	376	401
252	277	302	327	352	377	402
253	278	303	328	353	378	403
254	279	304	329	354	379	404
255	280	305	330	355	380	405
256	281	306	331	356	381	406
257	282	307	332	357	382	407
258	283	308	333	358	383	408

Inquiry Numbers 591-765

591	616	641	666	691	716	741
592	617	642	667	692	717	742
593	618	643	668	693	718	743
594	619	644	669	694	719	744
595	620	645	670	695	720	745
596	621	646	671	696	721	746
597	622	647	672	697	722	747
598	623	648	673	698	723	748
599	624	649	674	699	724	749
600	625	650	675	700	725	750
601	626	651	676	701	726	751
602	627	652	677	702	727	752
603	628	653	678	703	728	753
604	629	654	679	704	729	754
605	630	655	680	705	730	755
606	631	656	681	706	731	756
607	632	657	682	707	732	757
608	633	658	683	708	733	758
609	634	659	684	709	734	759
610	635	660	685	710	735	760
611	636	661	686	711	736	761
612	637	662	687	712	737	762
613	638	663	688</			

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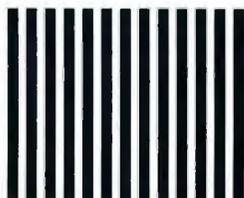
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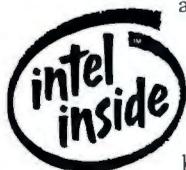
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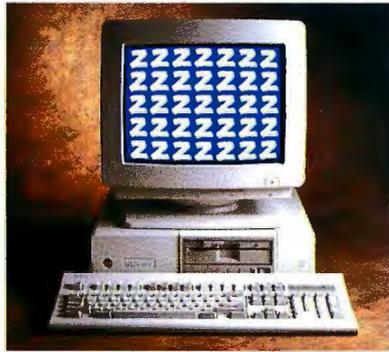
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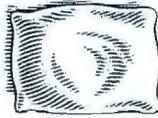
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- ONE FLOPPY DRIVE (3.5" OR 5.25")
- MS-DOS 5.0

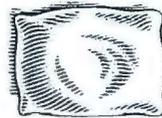
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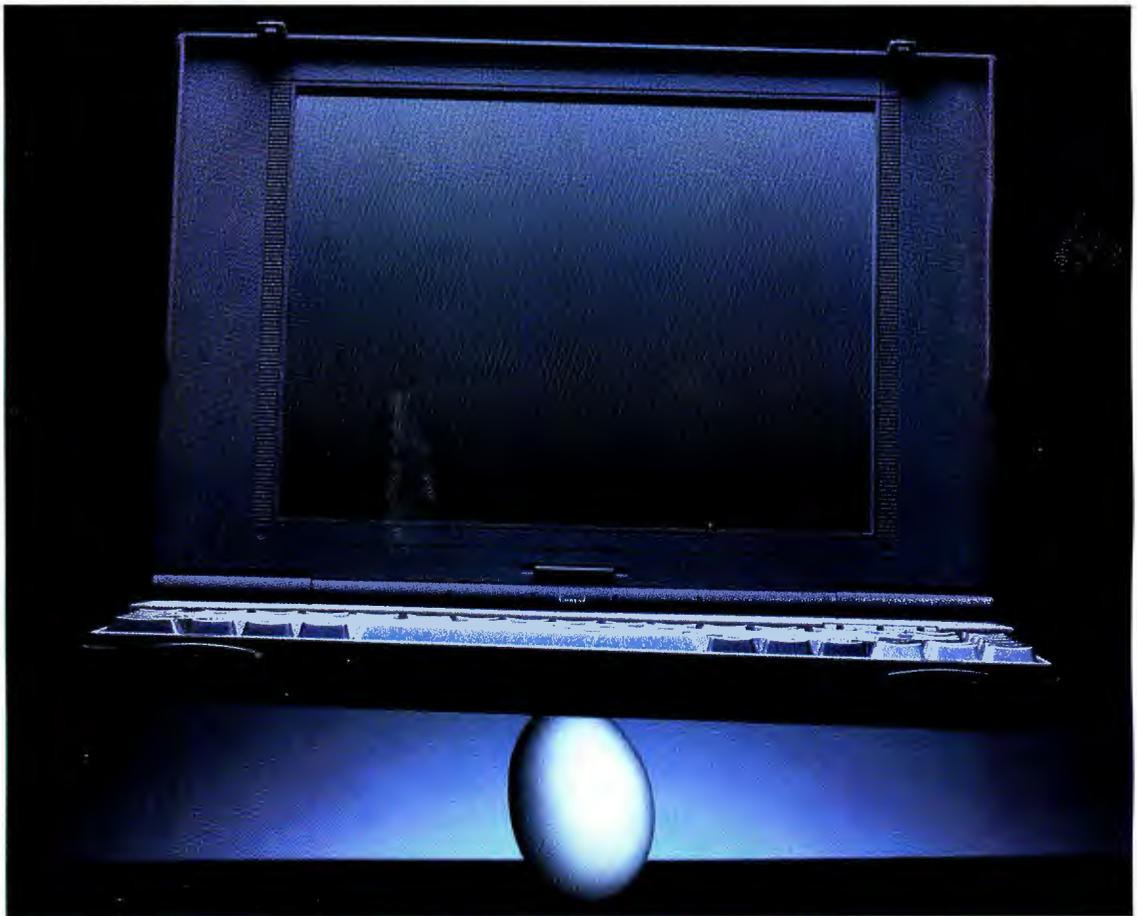
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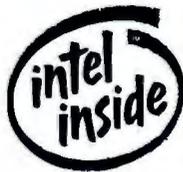
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