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PC Sources

December 1990 $1.95

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DATAWORLD DEBUTS A 486 SYSTEM

Dataworld, a direct marketer of personal computers headquartered in Pico Rivera, California (800-736-3282), has entered the 80486 fray with its new Data 486-25, available in both desktop and tower configurations.

The Data 486-25 ($5,720) is powered by Intel's 25MHz 486 processor, and uses the Industry Standard Architecture (ISA) bus.

Dataworld's new desktop model has five half-height storage bays and a 200-watt power supply, while the tower model (which sells for $210 more) has six half-height bays and a 230-watt power supply, making it slightly more suitable for use as a network file server.

Dataworld includes free third-party on-site service from TRW and toll-free technical support.

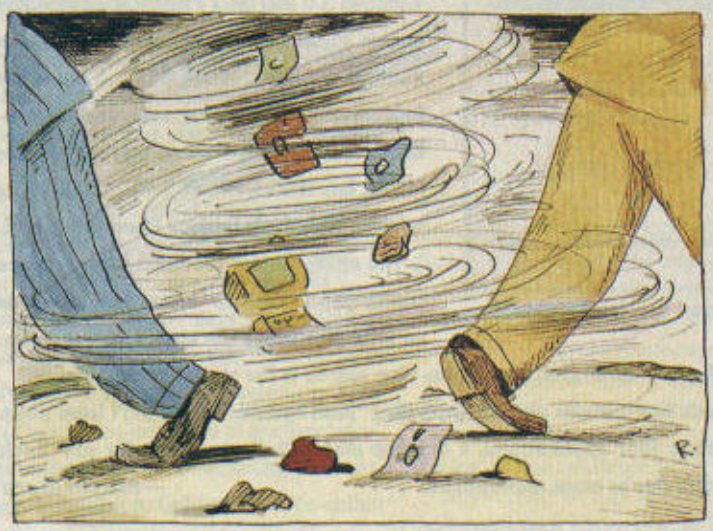
The Data 486-25 also comes with a one year warranty on parts and labor and a full 30-day money-back guarantee. *—Patrick Honan*

"A new customer is coming to this marketplace, one that is looking for service, support, and technology in addition to low prices."

—GRAHAM BEACHUM, Vice President of Marketing, Tandon Corp.

MARC ROSENTHAL

IBM AND MICROSOFT: ON THE ROCKS?



The long, often turbulent marriage of mutual interest between hardware giant IBM and software titan Microsoft has apparently taken a turn for the worse.

Frustrated with the slow acceptance of OS/2, caused in large part by the success of Microsoft Windows 3.0, IBM has decided to take control of the future of the jointly created industrial strength operating system.

Microsoft Corporation, meanwhile, is forging ahead with plans to enhance its increasingly popular Windows environment for DOS.

"It's not a divorce, but it's a postnuptial agreement," says Esther Dyson, the editor and publisher of *Release 1.0*, a widely circulated industry newsletter. "It's clearly a sign that we're going to have several different versions of DOS and OS/2 out there, and that's very unfortunate. The net effect is confusion."

At the heart of the discord are differing priorities. IBM wants OS/2 to become a success sooner rather than later so it can push ahead with plans to position corporate mainframes—its bread and butter—as the hubs of enterprise-wide networks. The acceptance of OS/2 is also likely to spur sales of high-end PCs and network servers.

Microsoft, on the other hand, is content to first allow Windows to run its profitable course, even if that course takes five years or more. When (or if) the market is ready to move, Microsoft is prepared to push OS/2 as well.

It's not the first time IBM and Microsoft have clashed over OS/2 and Windows. In the fall of 1989, the two quelled rumors of a deep rift by publicly agreeing to place a higher priority on OS/2 development than on that of Windows. But Windows 3.0 became an immediate hit, and software developers began shifting their resources to Windows applications and deferring work on OS/2 projects.

The prospect of IBM and Microsoft pursuing separate agendas has many managers and users worried, but not necessarily pessimistic.

"The market has a way of working these things out," notes Cheryl Currid, director of applied information technology at Coca-Cola Foods in Houston, which now uses Windows and plans to use OS/2 in the future. "Still, I'd much rather be spending my time looking at new applications that can help us, rather than worrying about what's underneath them." ***—Christopher O'Malley***

HOLIDAY ALERT: THE

Computer games are becoming more sophisticated, offering a blend of music and graphics with thoughtful plots and detailed simulation added for good measure.

The games are more challenging—in some you build your own city or financial empire. Even the packaging is slicker, with goodies such as cloth maps, cassette tapes, and paperback books included to add to the experience of flying jets or searching for treasure.

PC Sources selected a passel of games that are certain to keep you coming back for more. That's not to say that games not on this list are necessarily bad. In fact, winnowing the year's 150 games to a manageable and informative list was no easy task.

All of these games share certain characteristics: easy to learn but difficult to master, an ability to monopolize your interest immediately, multiple or accelerating difficulty levels, a strain on the brain more than on the reflexes, and sheer addictive fun. In alphabetical order, and with retail price and publisher in parentheses, they are:

Avenger ($60, Spectrum Holobyte): You pilot the U.S. Air Force's A-10 Thunderbolt ground-attack aircraft in this three-dimensional flight and fight simulator. Its primary mission: destroy tanks with its modern version of a Gatling gun (nicknamed the Avenger). This game can be linked to Falcon 3.0 as part of Spectrum Holobyte's electronic battlefield, in which you can fly with another player via modem. One of the year's 10 best games.

Light Speed

Centurion: Defender of Rome ($49.95, Electronic Arts): A strategy war game to buy, to see, to conquer. As a Julius Caesar wanna-be, finance your legions, march across the known world, meet new barbarians. Although the arcade chariot races and gladiator fights are uninspiring, the legion versus barbarian tactical battles offer exceptional excitement. One of the year's 10 best games.

Covert Action ($60, MicroProse): You are a CIA operative in an "espionage simulator." Tap phone lines, hack computer systems, and perform other high-tech surveillance tasks. New for the holidays.

Cycles ($39.95, Accolade): The game puts you astride a variety of motorcycles on the world professional racing circuit. One of the year's 10 best games.

Deluxe Where in the World Is Carmen San Diego? ($80, Broderbund): This is the same educational geography game as the regular version, but adds digitized location photos from *National Geographic*, digitized voices, global maps, and 50 animations. New for the holidays.

Faces ($39.95, Spectrum Holobyte): The third arcade brainteaser from Soviet designer Alexey Pajitnov (See Welltris below) is every bit as good as the first two. This time, you're matching parts of faces from historical figures such as Napoleon, Einstein, Genghis Khan, Lincoln, and Mozart. Chins, lips, noses, eyes, and foreheads drop from the top of the screen two at a time. One of the year's 10 best games.

Falcon 3.0 ($70, Spectrum Holobyte): An upgrade of the existing F-16 flight simulator. It features new three-dimensional terrain, improved flight characteristics, new missions, a campaign game, and a modem tie-in to Avenger. New for the holidays.

Flight of the Intruder ($60, Spectrum Holobyte): The computer game tie-in with the movie and book about air combat operations during the Vietnam War. You fly an F-4 Phantom fighter or A-6 Intruder attack plane. New for the holidays.

Pipe Dreams

Galleons of Glory ($45, Broderbund): The game puts you in explorer Ferdinand Magellan's boots as you circumnavigate the globe. You'll steer the ship, manage supplies, and try to quell mutiny and avoid the real Magellan's fate: death in the Pacific. New for the holidays.

Heroes of the 357th ($50, Electronic Arts): You're in the cockpit of a P-51 fighter during World War II. The emphasis is less on flight simulation and more on fast-paced aerial combat. New for the holidays.

Knights of the Sky ($60, MicroProse): You choose among British, French, and U.S. planes for three-dimensional aerial combat during World War I. New for the

Sword of the Samurai

HARD COPY... According to Computer Intelligence, the top 10 applications software packages accounted for 71 percent of all pack-

E YEAR'S BEST GAMES

Light Speed ($60, MicroProse): A role-playing space opera with three-dimensional starship combat. In your quest for a new home for the human race, you'll travel to new worlds, meet aliens, and kill them. So much for intergalactic harmony. New for the holidays.

Magic Candle II ($60, Medallist): This game puts you in a fantasy quest to save the world from black magic. New for the holidays.

Pipe Dreams ($24.95, LucasFilm): A quirky arcade game for plumbing fanatics. Arrange various sections of pipe to funnel liquid out of a drain. The longer the pipe (and the more devious the route), the more points you get. New for the holidays.

Qix ($14.95, Taito): An arcade game in which you block off sections of the screen. The more you block off, the greater your score, and there's a minimum amount you need before advancing to the next screen. One of the year's 10 best games.

Railroad Tycoon ($59.95, MicroProse): In this game of railroad building, you lay track, build stations, haul cargoes, and fend off rivals in the U.S. or Europe as you create the little railroad company that could. You'll spend hours manipulating schedules and loads, juggling finances, and rearranging track configurations as you try to outwit historical railroad barons such as Cornelius Vanderbilt and J.P. Morgan. One of the year's 10 best games.

Space 1889 ($50, Medallist): Explore Mars, Venus, and the moon in Victorian-age spaceships (complete with sails and cannon) in order to crack an earth-shattering puzzle found in an Egyptian tomb. New for the holidays.

Centurion: Defender of Rome

Their Finest Hour: The Battle of Britain

Spell Casting 101: Sorcerers Get The Girls (Legend): A bawdy tongue-in-cheek fantasy quest to rebuild the Sorcerer's University. New for the holidays.

Stormovik ($50, Electronic Arts): This game places you in the cockpit of the USSR's newest ground-attack aircraft, the Sukhoi SU-25 Stormovik. Your mission in this three-dimensional flight simulator is to make the world safe for the Peace Dividend by destroying U.S. and Soviet aircraft and vehicles manned by armed terrorists. New for the holidays.

Stunt Driver ($50, Spectrum Holobyte): You're strapped behind the steering wheel of a Corvette as you race the clock to complete the stunt course. This three-dimensional driving simulator whips you through hair-pin turns, over jumps, around loops, and down straightaways. New for the holidays.

Stunts (Price not available, Broderbund): A three-dimensional driving simulation with jumps, loops, and corkscrew turns. You pick one of 11 cars, such as a Ferrari or Lamborghini, and one of five courses. It also includes a build-your-own-course system. New for the holidays.

Sword of the Samurai ($54.95, MicroProse): Arcade sword fights mix with strategy and tactics as you battle assassins, crush peasant revolts, and command armies. If your honor is true, your sword swift, and your leadership sure, you will grasp the title of Shogun. One of the year's 10 best games.

Their Finest Hour: The Battle of Britain ($59.95, LucasFilm): You're in the cockpit of a Spitfire, Stuka, Messerschmitt 109, or other airplane that flew in the World War II Battle of Britain. It's less a flight simulation than a fight simulation. It's also challenging fun to stick on the tail of a wildly twisting fighter, watch your tracers walk up the fuselage and rip pieces from the plane, and see the smoke that signifies the end of a dogfight stream from the spinning wreck. One of the year's 10 best games.

Ultima VI ($69.95, Origin Systems): You'll have so much to explore, you may never need another fantasy-quest game again. Graphics excellence, a wide-open world, and a multitude of magical, metal, and mundane objects to manipulate make this Ultima the ultimate (so far) fantasy adventure challenge. One of the year's 10 best games.

Welltris ($34.95, Spectrum Holobyte): The sequel to the wildly addictive Tetris, from Soviet designer Alexey Pajitnov. In this arcade classic, you rotate irregularly shaped blocks down the sides of a well to create a solid wall at the bottom. When you fill a row of blocks, the row disappears, gives you points, and makes room for more blocks. You lose if blocks back up onto all four walls at once. A worthy sequel. One of the year's 10 best games.

—Russ Lockwood

Faces

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DRIVE Lessons

HARD DRIVES

40 MB 40ms MFM (A)

Half Height (B)

(C) $259 Bare Drive

$309 XT Kit (D)

$349 AT Kit (E)

(F) High Speed 28ms 65MB RLL

(G) Auto Parking Heads

(H) Requires RLL Controller

(I) $319 Bare Drive

$379 XT Kit

(J) $429 AT Kit

80 MB 25ms IDE (K)

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$535 Bare Drive

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$1079 AT Kit (P)

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HOW TO READ A HARD DRIVE AD

In a 286 or 386 system, a fast hard drive can have a greater effect on performance than a fast CPU. So if good fortune or, heaven forbid, a drive disaster has created an opening in your budget for a new hard drive, you'll want to buy as big and fast a drive as you can afford. But you'll also need to figure out which drive is right for your system, and that involves more than checking capacities and access rates.

If you're calling a company that sells lots of hard drives, you're likely to get responsible advice. You'll be better at evaluating that advice, however, if you know something about hard drives before calling.

Most 20MB drives now sell through mail order for under $200, and a 20MB kit with an XT-compatible controller might go for $250. At the other extreme, you can find a few drives made by Micropolis and Seagate Imprimis that store a gigabyte (1GB or 1,024MB) and sell direct for around $4,000. High-performance drive controller boards for these monsters start at $200. Currently, most people buy drives in the 40MB to 80MB range, which cost from $300 to $600. Depending on drive type, a matching controller card adds $30 to $100 to the total package. (See the sidebar, "Right Size, Right Price," for more information on pricing.)

HOW BIG?

How big a drive do you need? For general use with today's software, consider 40MB the minimum capacity and 65MB or 80MB a better choice.

A Slow, 40 millisecond (ms) access time makes it marginal for AT use.

B Half-height usually means a 5.25-inch drive, the size of most PC drive bays.

C Does "bare" include mounting hardware and partitioning software?

D Should include cables and 8-bit controller card.

E At this price you may do better with a faster IDE kit because the 16-bit IDE adapter costs relatively little.

F Fast enough for ATs, but just adequate for slower 386s.

G The few drives that don't have auto-parking read/write heads should provide auto-parking software.

H With all drives, the controller type must match the drive type.

I Basically a 40MB MFM drive manufactured to stricter tolerances that support the higher capacity and performance of RLL encoding. Makes a good buy.

J This AT kit includes a controller card (16-bit) or it wouldn't cost more than the XT kit. Make sure it's a 1:1 interleave controller or you won't get a high data transfer rate.

K The controller's on the drive. Needs an inexpensive adapter card if your PC doesn't provide an IDE connector.

L Make sure it comes with hardware to mount in a 5.25-inch bay.

M If you're upgrading or adding to an existing IDE drive, you won't need the kit.

N Access time is low enough for database applications, and ESDI drives provide high transfer rates appropriate for 386s.

O Half-height at this capacity means a fairly new drive. Many 160MB drives are full-height.

P A 16-bit kit for ATs and 386s. Should include cables, instructions, partitioning and formatting software, and mounting hardware. A $150 ESDI controller will provide the slowest ESDI transfer rate of 10 Mb/s.

Q A necessity, especially when buying ESDI, SCSI, and IDE drives.

R Fairly standard, but Quantum, Maxtor, and some Microscience drives have two-year manufacturer's warranties.

HARD DRIVE GLOSSARY

A guide to the acronyms drive makers and vendors use to identify their products.

MFM drives use the original ST506 interface design for personal computers. MFM (Modified Frequency Modulation) refers to the encoding method used to store data on the drive. MFM drives are now considered limited in capacity and performance.

RLL drives are also ST506 drives, but manufacturers use a more advanced encoding method than MFM called Run Length Limited that allows a drive to store 50 percent more data and deliver it 50 percent faster. Any ST506 drives used with an RLL controller should be approved by the manufacturer for RLL encoding.

ESDI (Enhanced Small Device Interface) is an improvement of the ST506 interface that allows larger recording capacities and higher rates of data transfer. ESDI drives providing 1 gigabyte (roughly a billion bytes) of storage are now available.

SCSI (Small Computer System Interface) drives are "intelligent" devices (their controller electronics are on the drive) that provide the same storage capacities and performance levels as ESDI drives. The multitasking abilities of the SCSI interface make it a better choice for systems with multiple drives and users.

IDE stands for Intelligent, Integrated, or Imbedded Drive Electronics, which refer to the fact that drives designed to this de facto standard have their controller electronics built into the drive itself, in a fashion similar to SCSI drives. Unlike SCSI, IDE specifies that the controller interface directly with the computer's electronics, either through a motherboard connector or an inexpensive adapter board. The design allows for inexpensive drives with moderate performance capabilities similar to RLL drives.

If you're upgrading a hard drive, you have a good idea how much storage capacity you need right now. Consider cutting yourself some slack for future growth, however, especially if Windows or OS/2 is in your plans. You'll have that drive for some time, and new applications just keep getting bigger. A business database may require a drive 100MB or larger, and for network and multiuser machines you may find that even 200MB of mass storage cramp your style.

Be careful of advertised capacity. Different ads sometimes claim different numbers for the same drive. Some advertisers consider a megabyte to be one million bytes; others use the technically correct value of 1,048,576 bytes (2 to the 20th power) in computing capacity. Either calculation method is close enough, as long as the ad refers to the capacity of a drive after formatting. Roughly 15 percent of a drive's total storage space is taken up by formatting information. To end up with 65MB of usable space after formatting, for example, a drive must start out with 77MB of raw storage capacity.

Most ads state formatted capacities for all drives; I've found a few that give unformatted capacity, but they were probably typos. You can often detect such mistakes by comparing stated capacity with a drive's model number. Several prominent drive companies use a drive's unformatted capacity as the last two or three digits in their model numbers. If you see a Seagate Wren ST2383N, for example, advertised as a 383MB drive, you'll know there's a problem. Though the unformatted capacity is 383MB, the formatted capacity of the drive is only 338MB. (The first digit in a Seagate model number refers to a drive's physical dimensions. In this example, the "2" specifies a 5.25-inch half-height drive.) Not all companies follow this convention; Conner Peripherals, Quantum, and Kalok end their model numbers with the drive's formatted capacity, and Fujitsu, Toshiba, and Micropolis model numbers are not related to capacity.

HOW FAST?

After capacity, performance is your next concern. The trick is to match a drive's ability to quickly deliver data with your computer's ability to process that data. (See chart,"Performance Matching.") You want to coordinate the two so that neither side of the process becomes a bottleneck. Drive performance has two aspects, only one of which gets much attention in hard drive ads. The advertised aspect is access time, the time it takes a drive's read/write heads to reach the requested data. The second performance aspect is data transfer rate, or how fast the drive can deliver data once it finds it. The relative importance of each performance measure depends on your applications.

A low access time is important to database applications, because the records in a database are often stored randomly on a drive's spinning data surfaces. During a database sort, for example, a hard drive's read/write heads may spend more time jumping between short records than they do reading and writing those records. Access time isn't as critical for other types of software, for which much more drive time is spent reading long stretches of data than moving between stretches.

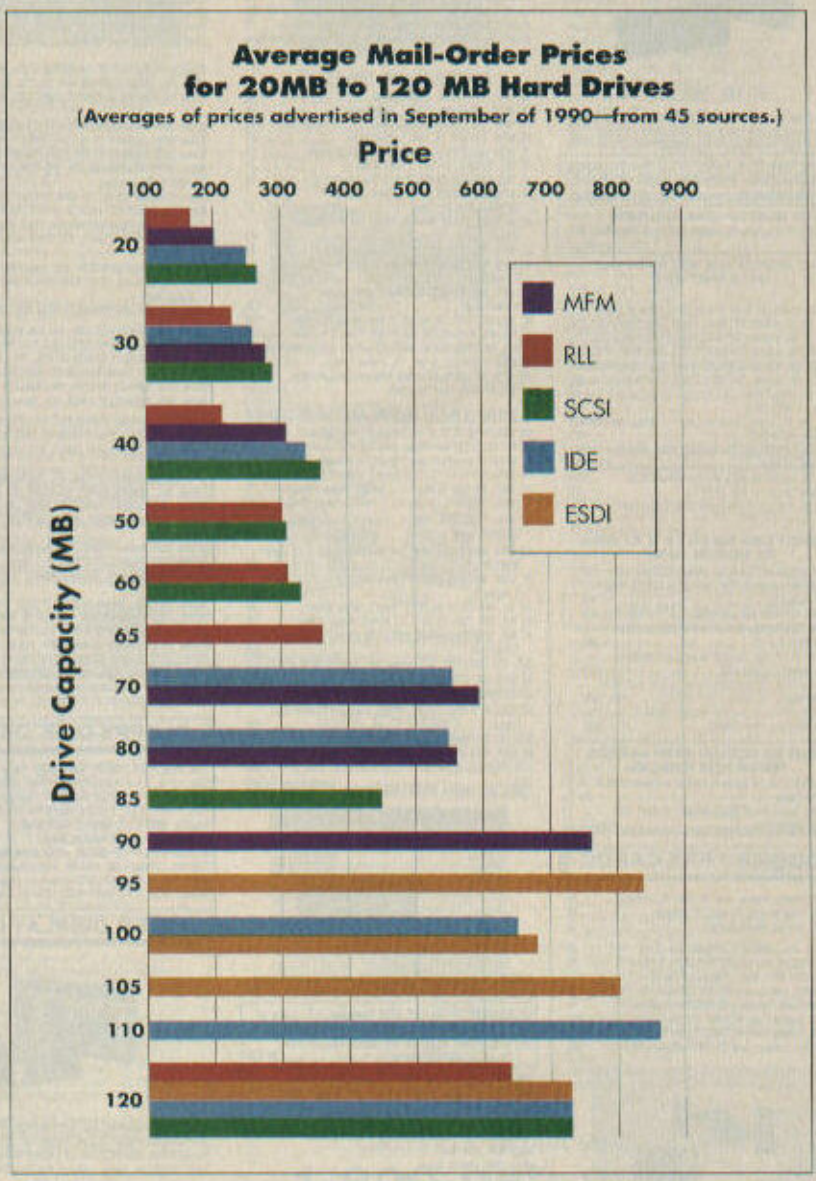
At the mechanical level, advertised access times measure the time it takes a drive, on average, to move

RIGHT SIZE, RIGHT PRICE

The following simple rule estimates current mail-order prices for bare drives. Start with a $100 base price, and add $5 for every MB of formatted storage. Following this rule, a 20MB drive should cost around $200, a 100MB drive $600. From my surveys, most prices for drives under 200MB fall within $50 of my estimated price.

What's interesting are the deviations. Prices for RLL drives stay well below the estimation, while average IDE prices hover just above for all drive sizes. Average MFM prices stay at the estimated price for 20MB, 30MB, and 40MB drives (costing $200, $250, and $300 respectively), and then soar above the estimated price. Average direct prices for small SCSI drives go both ways, costing more than the estimate for capacities of 40MB or under, and less for 60MB and 84MB drives.

The best news is for the few who need really large drives. Starting at 330MB, SCSI, and ESDI drives start dropping below this price guideline, with the best per-megabyte deal at 660MB. One gigabyte drives are also cheaper on a per-megabyte basis than smaller drives: Costing around $4,000 now, the price of these drives is soon to drop. —*D.R.*



its read/write heads to the proper track on one of the drive's rotating magnetic platters. Measured in milliseconds (ms), this value is technically random seek time. True access time also includes the period it takes the desired sector within that track to spin under the head (about another 8ms). Because all companies now advertise average random seek time as access time, the value remains a valid comparator.

Access times for PC hard drives range from a slow 80ms on small, inexpensive drives designed for XTs, to times below 12ms on some large and expensive drives. Typically, larger drives have lower access times than smaller drives. As a general guideline, an access time of 65ms or greater is adequate for XTs, while a typical AT or 386 drive needs an access time of 28ms or lower. If you're running a database, you'll find that an extra $50 to $100 for a drive with a lower access time is money well spent.

Reliability is another benefit of buying a drive with a low access time. The slowest hard drives use a stepper motor actuator to propel the read/write heads from track to track, whereas newer, faster drive

designs use a more reliable voice coil actuator for head movement. Any drive with a rated access time below 25ms uses a voice coil mechanism. If you're comparing several drives in the 25ms to 40ms range, ask which use voice coil and which use stepper motor head actuators. A salesperson who knows hard drives will key right in on this question. It's rare to find a drive slower than 40ms using voice coil.

RAPID TRANSIT

Although access time is important to system performance, data transfer rate is even more so. CAD, desktop publishing, and graphics software have always been hard drive hogs. As software becomes more graphically based, applications spend more and more of their time moving large chunks of data back and forth between memory and your hard drive. Graphics environments like Windows and Presentation Manager choke unless data flows freely from the disk drive. Even word processing can benefit from a high data transfer rate if you perform frequent spell-checks and print formatting.

Data transfer rate is harder to evaluate than access time. How fast drive data can move into your computer's memory depends not only on the drive's capabilities but also on the drive controller and the speed of your computer. Benchmark tests like Core International's Coretest combine these three components to measure transfer rate, also called throughput. Such benchmarks give results in kilobytes of data moved per second (KB/s).

With most XT systems, the computer is slower than just about any hard drive you can install, so you needn't worry too much about throughput when buying a drive. On ATs and slower 386 systems, a data transfer rate between 500 KB/s and 750 KB/s is desirable. Drive systems in faster 386s should run at 750 KB/s or higher. Some mail-order drive houses run such tests and will quote you their results. More than likely, if you run that drive/controller pair in a similar speed computer, you'll get similar results.

Other vendors can give you the manufacturer's transfer rate for a drive. This figure, given in megabits per second (Mb/s) or MHz (which give the same number), is the theoretical upper limit on that drive's transfer rate. It's based on the rotation rate of the drive (almost all spin at 3,600 RPM) and how much data can be crammed onto a track. If the computer and drive controller aren't limiting factors, data can leave the drive as fast as it spins by under the read/write heads. More expensive drives use newer recording technology to pack more data sectors per track and thus deliver more data per revolution.

It's easy enough do a rough translation from a drive's Mb/s rating to the best data transfer rating in KB/s that you'll see at the system level. Just multiply by 100. When matched with the right controller, a drive rated at 7.5 Mb/s can deliver data at a rate approaching 750 KB/s. That's an upper limit, however, and in real-world situations you're more likely to get a throughput of 600 KB/s to 700 KB/s.

MFM AND RLL

If assessing a drive concerned only capacity, access time, and data throughput, it would be simple to match the right drive system to your computer. Unfortunately, there are five drive standards to choose from, each with its own implications for capacity, performance, and compatibility. In drive ads, you'll see the terms MFM, RLL, SCSI, ESDI, and IDE, along with a few variations. (See the sidebar, "Hard Drive Glossary.") Each of these acronyms represents a drive interface standard that defines rules for electrical connections, control signals, and data encoding. Because of incompatibility between (and sometimes within) interface types, the type of drive you can buy depends on what kind of equipment you already have. You can't hook an IDE drive to an MFM controller card, for example, even if the cables were the same.

Drives advertised as MFM and RLL both follow the ST506 standard, the original standard for personal computers. The name ST506 comes from the model number of the 5MB Shugart (now Seagate) Technology drive that established the standard. (See the sidebar, "The Ubiquitous Seagate.") MFM (Modified Frequency Modulation) was the original data encoding method for ST506 and is still used for many ST506 drives. MFM drives, the slowest you can buy, are suitable mainly for XT systems. With MFM encoding, the ST506 interface has a maximum transfer rate of 5 Mb/s. Hooked to a drive controller fast enough to support a 1:1 interleave format, an MFM drive can deliv-

MATCHING SYSTEMS AND DRIVES

These guidelines for choosing the right drive type for your system take price as well as performance into consideration. For example, an AT might be able to handle a very fast, very large drive, but you wouldn't want to put a $2,000 drive into a $2,000 machine. —*D.R.*

Computer Type	Hard Drive Type
PC XT	MFM or RLL
286 or 386 (16 or 20MHz)	MFM, RLL, SCSI, IDE with 1:1 interleave controller
386 (25 or 33MHz), 486	ESDI or SCSI
386 or 486 Used as file servers	High-performance SCSI, or ESDI with caching controller

er close to 500 KB/s in an AT computer. However, an RLL drive at approximately the same cost will give you larger capacity and faster throughput.

MFM drives commonly available through mail order range in size from 20MB units like Seagate's ST125-0 or Kalok's KL 320 up to Maxtor's 160MB XT-2190. Direct prices range from $180 to $1,200 for a bare drive (without controller). An access time faster than 24ms is rare in MFM drives. Though they're not the greatest performers, people still buy them to work with the MFM controllers already in their IBM-compatible PCs.

RLL (Run Length Limited) is a denser data encoding method than MFM that lets a drive deliver data 50 percent faster, because there's 50 percent more data stored on each track. A drive controller must be designed to encode RLL, and because RLL is more demanding on magnetic media, any ST506-type drive paired with an RLL controller should be RLL certified by the manufacturer for reliability. Although RLL drive systems once had a reputation for problems, RLL is now a reliable and desirable standard for smaller hard drives. When you see the term RLL in an ad, it refers to an ST506 drive or controller, although RLL encoding is also used in ESDI, SCSI, and IDE drives.

Commonly available RLL drives range in size from 20MB to 130MB and cost from $170 to $825 for a bare drive. RLL drives with 30MB and 65MB capacities are especially common in ads. RLL drives cost less than MFM drives of comparable capacity and deliver better performance. That's because hard drive makers take the same drives and manufacture them to higher standards to handle a higher density of data. This denser data encoding puts the transfer rate of RLL drives at 7.5 Mb/s, similar to comparably priced IDE and SCSI drives. When paired with a 16-bit 1:1 controller, and plugged into an AT or 386SX, RLL drives are capable of throughput approaching 700 KB/s. Like MFM drives, however, RLL drive access times rarely drop below 24ms. Seagate's 133MB Wren ST1150R (around $800) has a rated access time of 15ms.

ESDI, SCSI, AND IDE

Hard drive manufacturers, primarily Maxtor, developed ESDI (Enhanced Small Device Interface) when faster computers and more demanding applications threatened to hit the limits of the ST506 interface. ESDI is an outgrowth of the ST506 standard that uses the same two cables between drive and controller but changes the drive and controller to increase maximum capacity and throughput. The first ESDI systems could transfer data at 10 Mb/s, twice as fast as MFM ST506 drives, but you can now find ESDI drives and controllers with transfer rates of 20 Mb/s, and 25 Mb/s drives are in the works.

Most ESDI drives commonly available in the direct channel are larger than 100MB. A 120MB drive costs around $700 mail order, and the largest 1GB drives from Micropolis currently go for around $4,000. (Prices for 1GB drives are dropping, however.) Buying a 150MB ESDI kit might cost you $1,000 for

GETTING THE RIGHT CONTROLLER

The type of controller a hard drive uses is determined not only by the drive's interface type but also by the kind of computer the drive is working with—an XT, AT, or 386.

XTs can use only 8-bit controllers, while AT and 386 PCs can take either. A 16-bit controller transfers data faster than an 8-bit. If you buy a drive kit advertised as AT-compatible, it should come with a 16-bit card. Many AT SCSI kits, however, include Seagate's 8-bit card. In such cases, advertised prices for XT and AT kits will be the same. The original SCSI standard is an 8-bit standard, and 8-bit SCSI setups have data transfer rates comparable to 16-bit RLL and IDE drives of similar price.

Most hard drive controllers support two hard disks and come in two versions: One version supports two floppy disk drives, the other doesn't. In many cases, a kit's controller lacks floppy support because the manufacturer assumes you've already got a floppy controller. If you're replacing an existing controller, however, you can order one that supports floppies for $10 to $20 more. Most hard drive vendors also sell controllers that provide higher performance than the ones they sell in their kits.

If you're junking your whole drive system for performance reasons, your choices are limited only by what's appropriate and will work with your PC. For example, you can't add an ESDI controller to an XT because the 16-bit card won't fit. Nor should you pair an MFM drive with an 8-bit controller in a fast 386.

If you're increasing storage capacity with a second drive, it must be compatible with your system's existing controller. The same is true when you're replacing a worn-out or broken drive and don't want to buy a new controller.

If you have one drive already, you also have the flexibility of adding a SCSI adapter for a second drive. Usually, a SCSI system will work with an existing controller. Most drive controllers support only two hard drives. If you want to add a third, SCSI is an option again. —*D.R.*

WHEN YOU NEED A SPECIAL DRIVE

There are compatibles, and then there are compatibles. If your IBM PC-compatible follows Industry Standard Architecture (ISA)—that is, its expansion bus is compatible with the IBM PC AT—you shouldn't have much of a problem installing a new hard drive. If the hard drive has an IDE, SCSI, or high-performance ESDI controller, you'll have to confirm the controller's compatibility with your computer. Still, your chances of running into problems are small.

If you own a PS/2, Compaq, or Tandy computer, however, you're practically guaranteed problems when buying a mail-order hard drive. IBM and Compaq use nonstandard versions of standard drives for performance reasons.

Tandy's computers aren't known for speed, so the company's motive doesn't seem to be performance. Fortunately, many direct vendors specialize in supplying drives for one or more of these brand-name computers.

IBM, for example, has its own IDE standards, two of which use different cabling than standard IDE drives. If you want to avoid paying the high prices IBM and Compaq charge to upgrade to a larger drive or add a second drive, you can buy replacement IDE drives that are PS/2- or Compaq-compatible, or add a SCSI drive as a secondary drive. (If you have an IDE drive, it must be the primary drive.)

Zenith is another manufacturer that has equipped its computers with a proprietary IDE interface. However, you're less likely to find an easy mail-order solution to this problem.

The proprietary controllers on some Compaq systems require specially modified versions of other manufacturers' drives. Compaq's IDE interface varies slightly from the predominant IDE version. Sometimes you can just plug in a Conner Peripherals drive, other times not. You can also solve the compatibility problem by adding another controller.

Two features on the Tandy 1000 limit your choice of a hard drive controller. The 1000 uses a different internal interrupt line for hard drives than do other IBM compatibles. (Interrupt lines are the means by which hard drives and other peripherals capture the CPU's attention.) Also, the Tandy 1000 has shorter expansion slots than standard compatibles, and a different slot bracket.

If you have one of these computers, check out several direct vendors who advertise solutions for your particular PC. Make some phone calls and take notes, until you get a consistent story on the compatibility problems, if any, of your particular model. If there are problems, find out the possible solutions. Then compare prices. Ask for a 30-day money-back guarantee in case you and the vendor can't work out an acceptable solution to any compatibility glitch that might pop up. —*D.R.*

the drive and $200 for the controller.

You need an ESDI controller card to run ESDI drives. Most available ESDI controllers support two hard drives, and some models can also support two floppy disk drives. A 10 Mb/s ESDI controller might cost as little as $120, but higher transfer rates, multiple drive support, and onboard caching can easily raise the price over $1,000. Not all ESDI drives work with all ESDI controllers, so it's a good idea to buy the drive and the controller from the same source unless you can get a compatibility guarantee. Most drive dealers can tell you if a drive they sell will work with commonly known ESDI controllers.

ESDI drives 660MB and larger need driver software to mask the fact that they have more tracks per disk surface than the 1,024 DOS allows. A dealer selling large drives should know exactly what software you need and supply it with the drive.

SCSI (Small Computer System Interface) drives offer the same large capacity and high throughput solutions as ESDI drives, but you can also find SCSI drives as small and slow as any MFM ST506 drive. More than a drive controller standard, SCSI is a bus standard; that is, a SCSI peripheral has an expansion system that works independently of the DOS expansion bus and communicates with the PC through a host adapter. That's a definite strength over ESDI, but only if you install multiple SCSI drives on a multiuser or heavy multitasking system where several drives can be active simultaneously. Otherwise, ESDI has a slight performance edge.

When you install a SCSI card, called a host adapter, your computer becomes just another "intelligent" device on the SCSI bus. There's no drive controller circuitry on the SCSI adapter card; the controller circuitry is on the drive itself. SCSI cards come as cheap as Seagate's 8-bit ST-01, which generally adds $30 to a SCSI drive kit price. However, 16-bit SCSI cards that support high data transfer rates can be just as expensive as ESDI cards.

You can hook up to seven devices to the SCSI bus, all connecting to the host adapter in daisy-chain fashion. In general, each SCSI device needs a software driver to translate DOS and software commands into SCSI commands. Many SCSI cards, however, supply the necessary driver support in ROM for two hard drives. If you need more than two drives or want to add other devices that SCSI supports, like optical drives or tape drives, you need software drivers that both support those devices and work with your

adapter card. If such drivers exist, you may have to pay extra for them.

Below 100MB, SCSI drives are slightly more expensive than other drive types, but at 84MB, a SCSI drive like Seagate's ST1096N with a 24ms access time is a bargain (at less than $500) when paired with Seagate's $30 host adapter. Once you get beyond 100MB, SCSI drives are comparable to ESDI drives in price and performance. SCSI, especially more recent versions of the standard, handles high data transfer rates, promising to eclipse ESDI eventually. For now ESDI and SCSI drives keep pace in both capacity and data transfer rates.

Because the controller is on the drive, SCSI drives can perform some tricks that ESDI drives can't, such as using on-drive memory buffers that work like crude caches to speed access. For this reason, SCSI prices can run marginally higher. ESDI systems do similar tricks using the controller card. SCSI has just been standardized, so not all motherboards will work with SCSI, and like ESDI, not every SCSI drive works with every SCSI host adapter. In addition, most SCSI adapters hide the presence of their hard drives from DOS. This can cause problems with some software, especially drive utilities. Again, get a compatibility guarantee from the vendor.

The most recently developed hard drive standard for PC compatibles is IDE (Intelligent, Integrated, or Imbedded Drive Electronics). It's actually a de facto standard developed between Conner Peripherals and Western Digital. Like SCSI, IDE puts the controller circuitry on the drive, but unlike SCSI, there's no separate command language. IDE drives interface directly with the PC bus and follow DOS control commands. A single cable connects one or two IDE drives to a connector on the motherboard, or to a simple adapter card called a paddle board. There are two versions of IDE: an 8-bit interface for XT compatibles and a 16-bit interface for AT and 386 PCs.

Because the controller is part of the drive, IDE drives (like SCSI drives) aren't restricted by a standard that limits how the controller works with the drive. This freedom allows drive makers to add innovations that enhance performance. Many IDE and SCSI drives have an on-drive memory area called a track buffer that allows the drive to read several tracks ahead when a program requests a sector of data. With most software, there's a pretty good chance that subsequent reads will be found in the track buffer, cutting access and transfer time substantially. How much the effective access time decreases depends on your software, but an effective drop of more than 5ms is possible.

IDE drives are popular with computer manufacturers because they offer good performance at a low cost, and they're starting to catch on with mail-order customers for the same reasons. For capacities below 100MB, IDE drives are somewhat more expensive than RLL drives. However, IDE paddle cards ($20 to $120) cost half as much as RLL controllers, bringing prices of comparable RLL and IDE drive kits closer together. IDE mail-order prices range from $230 to $1,800; capacities range from 20MB to 338MB. With data transfer ratings between 8 Mb/s and 10 Mb/s, and lower access times than most RLL drives, IDE drives have a performance edge over RLL. Because they represent a newer technology, IDE drives also promise more reliability.

Because it's a de facto standard, IDE can present compatibility problems. Older versions of the AMI BIOS, for example, don't work with IDE. (If your AMI 286 BIOS is older than December, 1989, or your 386

RECONSIDERING DRIVE RATINGS

Each hard drive manufacturer estimates the lifespan of its drives with a measurement called mean time between failure (MTBF), which is expressed in hours. Though the process for determining an MTBF rating isn't straightforward, the way to interpret one is; the higher the number, the longer your drive should run without problems. This sounds like a good measure of reliability, but unfortunately it isn't.

Drive manufacturers determine MTBF ratings using various means of estimation, and some methods are better than others. To make matters worse, some companies make conservative estimates, while others practice wishful thinking. How does this variation affect your buying decision? MTBF numbers can be useful for estimating relative longevity among one manufacturer's product line, but they're worthless when comparing brands.

Recently, marketing wars have inflated MTBF ratings beyond reason. Several years ago, reliable drives were rated between 20,000 and 50,000 hours MTBF. Now some drives have ratings of 100,000 and 150,000 hours MTBF. Yet no drive is made to last longer than five years—or 43,680 hours of continuous service. Although these numbers are not directly comparable, they should be in the same ballpark. As one mail-order hard drive vendor commented, any MTBF rating over 50,000 hours is specious. —*D.R.*

THE UBIQUITOUS SEAGATE

When you first start combing through hard drive ads, you may begin to wonder if there are any brands other than Seagate. Almost every hard drive house sells Seagate, and some sell only Seagate. Seagate, when it was Shugart Technology, engineered the first drives for personal computers and established the standard hard drive interface (ST506) for IBM compatibles. That helped, but Seagate also has the best distribution network and one of the largest production capabilities.

To further strengthen its market position, Seagate bought out Control Data Corporation's well-respected Imprimis drive division, which designs and manufactures Swift (3.5-inch) and Wren (5.25-inch) hard drives. These high-performance, high-capacity drives, mostly IDE, SCSI, and ESDI, now make up the high end of Seagate's line.

Does Seagate's market dominance mean this company makes the best drives? There's no question that the Imprimis drives are some of the most reliable available. Indeed, Seagate charges more for Imprimis drives than for comparable drives from its original line. The drives in Seagate's original line aren't as high in quality as its Imprimis drives, but they are also smaller, slower drives with some of the lowest prices. According to most people I talked with, Seagate low-end drives have a good reputation. However, other brands have as good and sometimes better reputations.

Because Seagate is so predominant in the mail-order market, you might find it worth your while to learn its model numbering system before perusing ads. It's a consistent system that lets you determine physical size, capacity, interface type, and sometimes access time. Seagate model numbers start with "ST" for Seagate Technology, including the renumbered Imprimis line. The first number after ST indicates the form factor or physical size of the drive: 4 and 2 indicate, respectively, full-height and half-height 5.25-inch drives. Every 3.5-inch drive has a model number that begins with 1. Rarely seen in mail-order ads, a 3 indicates one of the newer 1-inch high SCSI or IDE drives.

The two to four numbers following the form factor digit represent the unformatted capacity of the drive, around 15 percent larger than formatted capacity. The popular ST251 is a half-height 40MB drive, for example. If a letter follows the capacity number, it indicates an interface other than MFM: R for RLL, X for 8-bit IDE (XT), A for 16-bit IDE (AT), N for SCSI, and E for ESDI. The ST251 is thus an MFM drive, while the Imprimis Wren ST41200N is a 1 gigabyte (roughly 1,024MB) full-height SCSI drive.

Be careful when ordering Seagate's half-height drives. Many come in two speeds—some with 28ms and others with 40ms or 65ms access times. A faster drive will have a "-1" tacked onto the end of the model number; a slower 40ms or 65ms version will have a "-0," though you don't always see it in ads. You have to ask which drive is advertised when researching prices. The 28ms ST251-1 is preferable to the 40ms ST251-0. The price difference should be $25 to $30, depending on the model and vendor. —*D.R.*

BIOS is older than April 9, 1990, you need a BIOS upgrade before you can install an IDE drive and adapter card.) However, such problems are the exception rather than the rule.

NUTS AND BOLTS

The kind of drive you buy and what comes with it also depend on what you already have. If you're adding a drive to a driveless system, you'll need an interface or controller card, unless you have a computer with an IDE interface built into its motherboard. (See the sidebar, "Getting the Right Controller.") Mail-order vendors sell drives with or without matching controllers. When a drive is combined with a controller for a single price, it's called a kit. Such kits should include cables, installation software, instructions, and all the hardware you'll need for several mounting situations. At the other extreme, you can also buy just a drive with little else. The lower price you pay for such a drive is advertised as "bare" or "alone."

Some companies advertise two prices: bare and kit. With the bare drive they usually provide mounting hardware and installation software. A kit will also include cables and a drive controller appropriate to the drive's interface type and performance and to the computer you are most likely to install it in. For example, a slow 20MB drive will come with an 8-bit controller for an XT-compatible computer. A faster 65MB RLL drive will come with a 16-bit 1:1 interleave controller for an AT or 386 PC. Though you can often tell from the ad what comes with a drive, always ask.

USA Flex advertises three prices for a drive: bare, with an 8-bit XT kit, and with a 16-bit AT kit. Kits come with mounting hardware, cables, software, and appropriate controller. If you buy a bare drive, that's exactly what you get, no screws, nothing. When comparing prices from two companies that handle bare drives differently, you can value the mounting hardware at $5 to $10. Still other companies provide controllers with their XT kits only, assuming anyone buying an AT kit already has a controller. You can tell this is the case when the XT kit costs more than the AT kit.

Whether bare or in a kit, all drives should come with the results of a factory test listing bad sectors. Expect some bad sectors on a hard drive. (The advertised formatted capacity takes bad sectors into account.) A small drive may have four to ten bad sectors, while a big drive can have over 100. The bad sectors are locked out in the drive's low-level format and cause no potential problem. Although many drives come formatted, you may want or have to reformat a drive later. You'll need the list of known bad sectors to do this safely.

A drive kit should also come with installation software to take care of two big compatibility problems. Often a PC won't have in its ROM BIOS the information it needs to support newer, larger hard drives. The installation software that comes with most drives, Ontrack Computer Systems' Disk Manager, provides a driver that gets around this problem. The other problem occurs only if you're using a version of DOS earlier than 3.3 that doesn't support drives larger than 32MB. Besides guiding you through the setup process, the installation software fixes this problem, too.

The installation instructions that come with a hard drive aren't always clear. Unless you've installed drives before, you should consider buying from a house that provides good technical support, preferably toll-free at all hours. (Also, see Upgrade Clinic in this issue.)

ASSORTED SIZES

Hard drives come in different physical sizes. The largest are full-height units that take two of the standard half-height slots found in most PCs. Older drives tend to be larger than newer drives, and the only new full-height drives coming out are 660MB or larger. (We may soon see 660MB 3.5-inch hard drives, however.) If you have a small-case PC, a full-height drive probably isn't an option.

Most hard drives are 5.25-inch half-height or 3.5-inch units. If you're buying a 3.5-inch drive, you may need to specify whether you're installing it in a standard 5.25 drive bay, or a bay that accepts just 3.5-inch drives. You can get hardware for either situation. A few 3.5-inch drives, often IDE, are thinner than standard. If your computer isn't built to accommodate thin drives, the vendor should supply hardware that will make them fit. Drive kits should provide several types of plastic faceplates (called bezels). If you need to fit a half-height drive in a full-height slot, or a 3.5-inch drive in a half-height slot, ask for an appropriate bezel.

The mounting hardware that comes with a drive will also depend on whether you have an XT-compatible computer, or a 286 or higher. Drives fasten into an XT case with screws that poke through the sides of the drive bays. AT and 386 kits provide rails that you screw to the drive. The drive can then slide into its bay like a drawer into a cabinet. Check out your drive cage to see what kind of mounting hardware you need. Compaq computers need special mounting rails, which some mail-order houses can supply.

An issue related to hard drive size is the size of your computer's power supply. Fortunately, the power supplies in most computers are adequate to handle the drives appropriate for those systems. If you have an original IBM PC, though, you'll have to upgrade the power supply, and if you have an early Tandy 1000 you'll probably have to buy a Tandy drive. (See Upgrade Clinic for more on power supplies.)

WARRANTIES AND SERVICE

Advertised hard drive prices rarely include shipping and insurance-rate information. For a typical hard drive kit you can expect to pay around $10 for insured two-day delivery. For UPS ground delivery, shipping costs drop to half the two-day rate, while overnight is double the two-day rate.

A one-year warranty is prevalent among hard drive manufacturers and supported by many mail-order houses. Not all vendors are authorized dealers, but many buy from a distributor who is. Vendors in this situation usually offer their own warranties. They can replace your broken drive with the assurance that their distributor can make good on the warranty with the manufacturer. Some mail-order houses will replace a drive that fails within the warranty period with a new drive, while others will give you a refurbished drive of equivalent age.

Of the 50 mail-order vendors offering hard drives, about one in four offers a 30-day money-back guarantee.

Many mail-order hard drive vendors provide a technical support line, though it's rarely toll-free. For most people installing a hard drive, this service is a necessity. (See Upgrade Clinic in this issue.) A vendor that offers good technical support is also more likely to provide the best buying advice and understand the need for a money-back guarantee. Of the 50 or so mail-order houses advertising hard drives, close to one out of four offers a 30-day money-back guarantee.

Bigger applications and lower drive prices are compelling reasons to buy a bigger, faster hard drive. Whether you take this step out of necessity or choice, it's one of the best performance upgrades you can make. Because newer, faster, more reliable drives tend to use one of the newer interface standards, there's also a small risk to your purchase. Use the Product Buying Form in this issue to compare the information you gather from various vendors. Though experienced drive dealers are likely to guide you through the compatibility forest safely, you can insure upgrade happiness with a money-back guarantee. Insist on it: No guarantee, no sale.

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1MB Module Deskpro 386/20E,20,25&25E,286E	113131-001	$119
1MB Module Deskpro 386S/16	113646-001	$119
4MB Module Deskpro386/20E,20,25&25E,286E	113132-001	$299
4MB Module Deskpro386S/16	112534-001	$299
1MB Exp. Board Deskpro 386/20E & 25E	113644-001	$205
1MB Exp. Board Deskpro 386S/16	113633-001	$205
4MB Exp. Board Deskpro 386/20E & 25E	113645-001	$499
2MB Module Deskpro 386/33, 486/25 Compaq System Pro	115144-001	$189
1MB Upgrade Deskpro 286N, 386N	118688-001	$99
2MB Upgrade Deskpro 386N, 386SX20	118689-001	$169
4MB Upgrade Deskpro 286N, 386N, SX20	118690-001	$509
0MB Exp. Board Deskpro 286N, 386N	118700-001	$109
1MB Kit Portable 386	107651-001	$249
4MB Exp. Board Portable 386	107653-001	$899
1MB Board Portable LTE286	117081-001	$170
2MB Board Portable LTE286	117081-002	$239
1MB Board SLT/286	110235-001	$209
1MB Board SLT 386	118303-001	$209
2MB Board SLT 386	118304-001	$359
2MB Kit Portable III	107332-001	$289
1MB Exp. Board Deskpro386/16	108069-001	$369

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8MB Kit Vectra 486PC (Inst. in Pairs)	D1252A	$999
2MB Kit Vectra QS/16S & ES/12PC	D1354A	$165
1MB Kit Vectra QS/16S	D1540A	$89
4MB Kit Vectra QS/16S	D1542A	$299
1MB Kit Vectra QS/20PC, RS/25PC & 20C	D1640A	$100
4MB Kit Vectra QS/20PC, 20C, RS/25PC	D1642A	$320

IBM

PRODUCT	PART #	AMT.
128KB Kit Mode 25	78X8955	$19
512KB 30/286, Adapt Bd.1497259,50z&60	30F5348	$72
2MB Kit 30/286, Adapt Bd.1497259,50z&60	30F5360	$150
2MB Module Adapter 6450357	6450372	$329
1MB Module 70-E61,121,Adapt Bd. 6450605, 6450609 & 34F30XX	6450603	$79
2MB Module 70-E061,121,50Z,55SX,P70,65SX Adapt Bd.6450605,6450609 & 34F30XX	6450604	$159
2MB Module 70-A21,A61,B21,B61	6450608	$159
4MB Module Kit 55SX,031,061,IBM P/N 34F077 & 34F3011	34F2933	$369
1MB Board 80-041	6450375	$129
2MB Board 80-111,311,121,321	6450379	$219
4MB Bd 80-A21,A316451060		$529
2-8MB Exp. Bd. W/2MB, 70 & 80	6450605	$439
2-14 MB Exp. Bd. W/2MB, 70 & 80	34F3077	$479
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2-14MB Exp. Bd. W/2MB, 50,50Z,55SX&60,65SX	6450609	$589

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AST

2MB SIMM Premium 486	500718-004	$279
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1MB Kit Premium 386C, 386/16	500510-007	$79
4MB Kit Premium 386C, 386/16, Advanced Fastram Fast Board 386	500510-008	$279
2MB Kit Premium W.S./386SX, 286, Bravo 286	500510-002	$155
1MB Kit AST Premium/386	50010-003	$110
512K Kit Advantage/2	500709-001	$65
512KB Kit Rampage Plus/MC	500709-003	$65
4MG Kit AST Premium/386, Rampage Plus/MC	500510-004	$269

TOSHIBA

PRODUCT	PART #	AMT.
1MB Cd. T1000SE & XE	PC14-PA8311U	$269
2MB Cd. T1000SE &XE	PC14-PA8312U	$369
2MB Cd. T1200XE	PC13-PA8306U	$229
2MB Cd. T1600	PC8-PA8302U	$229
2MB Cd. T3100SX	PC15-PA8308U	$229
4MB Cd. T3100SX	PC15-PA8310U	$569
512KB Cd. T3100E	PC9-PA8340U	$169
2MB Cd. T3100E	PC9-PA8341U	$229
2MB Cd. T3200SX	PC12-PA8307U	$229
3MB Cd. T3200	PC6-PA7137U	$349
2MB Cd. T5100	PC7-PA8301U	$229
2MB Module T5200 & Desktop T8500	PC10-PA8304U	$229
4MB Cd. Port. 3200SX	PC12-PA8309U	$579

Apple

1MB Kit Mac Port.	M0248	$270
2MB Kit Mac Port.		$770
3MB Kit Mac. Port		$1190
4MB Kit Mac Port.		$1590
1MB Kit Mac II Mac IICX, IIX	M0218	$80
2MB Kit Mac II Mac IICX, IIX	M0219	$130
4MB Kit Mac IICI	M0292LLA	$250
16MB Kit Mac IICI		$1290
4MB Kit Mac IIFX	M0376LLA	$289

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1 X 8-100 NS	$52
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1 X 9-70 NS	$70
4MB X 8-80 NS	$305
4MB X 8-100 NS	$300
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1 X 1-80	$6.00
64 X 1	$2.30
64 X 4	$3.50
256 X 4-80	$6.00
256 X 1-80	$2.30

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intel Math Co-Processors

80287-10	$199
80387 SX-16	$290
80387-SX20	$290
80387-25	CALL
80387-33	CALL

Call for Other Models

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2MB Exp.Cd. Alpha Supersport SX	$449
2MB Exp.Cd. Beta Supersport SX	$449
1MB Exp. Cd. Turbosport 386E	$259
4MB Exp. Cd. Turbosport 386E	$629

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1MB Hewlett Packard	II & IID	H33443B	$119
2 MB Hewlett Packard	II & IID	H33444B	$169
4MB Hewlett Packard	II & IID	H33445B	$339
1MB IBM	4019 & 4019E	1039136	$189
2MB IBM	4019 & 4019E	1039137	$329
3.5MB IBM	4019 & 4019E	1038675	$429
1,2,4MB Toshiba Cd.	Pagelaser 6 w/1MB		$269
1MB Canon RAM Bd.	LBP-8II, 811R, 811T	S63-1300	$119
2MB Canon RAM Bd.	LBP-8II, 811R, 811T	S63-1880	$169
4MB Canon RAM Bd.	LBP-8II, 811R, 811T	N/A	$339
2-4MB Epson Bd. w/0 MB	EPL6000	IBS401	$229
2MB Epson	EPL6000	Use on IBS401	$119
1MB Apple Exp. Kit	Laser Wr. II/NTX	M6005	$75
4MB Apple Exp. Kit	Laser Wr. II/NTX	M6006	$315

800 DPI/64 Gray Levels w/PC Paintbrush Plus	STM800D	$199
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400 DPI/32 Gray Levels w/PC Paintbrush Plus	STM105D	$130
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MEMORY AT THE RIGHT PRICES!

Dell System 325D:

A Dell-icious Value

Dell Computer Corp. has made a name for itself as the manufacturer of quality systems. The Dell System 325D, a 25MHz 386 computer, does nothing to belie that reputation: It offers an impressive blend of speed, high quality components, and affordability for those in the market for single-user systems.

Before noticing the value inside the system, however, you'll certainly take note of System 325D's stylish design and small footprint. The case is a perfect 16-inch square around, and six inches high; the power switch is conveniently located in front of the machine, along with the SmartVu LED panel.

Take off the cover and you'll find one of the cleanest motherboards around. Video, I/O, and the standard IDE hard drive controller are all incorporated onto the motherboard, and are positioned close to the drives so that cables don't wander all over. ASIC chips and surface mounting of many system components also enable Dell to shrink the motherboard's size and reduce the amount of heat generated.

While the motherboard design is new, the System 325D's SmartVu feature is almost as old as the company itself. SmartVu is a four-character LED that displays error codes identifying failing or poorly performing components, such as a hard drive problem or a RAM-chip failure. In day-to-day usage, it's of little value to you. But it can be invaluable for pinpointing problems if your system ever gives you trouble.

Processing speed is comparable to that of other 25MHz 386 systems. The unit's score of 32.3 on the Norton Computing Index is within one-tenth of a point or so of most other 25MHz systems. The 80MB IDE hard drive scores an unspectacular access time of 24.4ms using Coretest, a hard drive benchmark program from hard drive maker Core International.

Despite the small footprint, you don't sacrifice much in terms of expansion slots or storage bays compared with larger 25MHz systems. There are five open 16-bit slots and one 8-bit slot, which should be more than enough for virtually any standalone user. You can add four half-height storage devices, three of which can be accessed from the front of the unit and therefore can accept removable media devices such as floppy, tape, and CD-ROM drives. The 40-, 80-, 100-, and 190MB hard drives use an IDE controller; the 330- and 650MB hard drives use an ESDI controller that plugs into one of the slots.

Of course, Dell prices are not the lowest you'll find among mail-order companies; however they are competitive. The reviewed unit, which included 4MB of RAM, a 3.5-inch 1.44MB floppy drive, 80MB hard drive, two serial ports, one parallel port, and VGA monitor, costs $3,699. Other configurations of the system are available, depending on the type of video, drive capacity, and amount of RAM memory you want.

A built-in VGA controller supports the Super VGA resolution of 1,024 by 768 pixels. Three VGA color monitors are available: a standard 640-by-480 pixel monitor, an 800-by-600 monitor, and a 16-inch monitor that supports 1,024-by-768 pixel resolution.

Documentation is superb. Three booklets are included that cover general setup, specifics about the System 325D, and troubleshooting. Each is well-illustrated, and written in a clear, friendly manner. Each has a table of contents and an index to make it easy to find topics.

Dell's service and support are also among the best in the business. Toll-free phone support is available from 7 a.m. to 7 p.m. (Central time). Dell technicians are highly professional and you generally get through immediately. One year of on-site service from Xerox is also included in the purchase price.

It's hard to find a better overall value than the System 325D. It delivers the power and sophistication of a Compaq Deskpro 386/25, but for a couple thousand dollars less than Deskpro's street price. And, though Dell's 386 machine may be slightly more costly than some other mail-order systems, remember that many don't come with the same blue-chip service, support, and documentation.

—Patrick Honan

SUMMARY

The System 325D's strong points include price, design quality, expandability, and service and support.

SPEC SHEET

Dell Computer Corporation
9505 Arboretum Blvd.
Austin, TX 78759-7299

Sales Information: 800-426-5150, 7 a.m. to 7 p.m. weekdays, 9 a.m. to 4 p.m. Saturday (Central time)
Mail-Order Price: $2,749
Base System: 25MHz 386 processor; 8MHz ISA bus; 32K RAM cache; 1MB of RAM; choice of one 5.25-inch 1.2MB or 3.5-inch 1.44MB floppy drive; 40MB hard drive; VGA monochrome monitor
System As Tested: Same as above with the exception of: 4MB of RAM; 80MB hard drive; VGA color monitor
System As Tested Price: $3,699
Expansion Slots: Five 16-bit, one 8-bit
Ports: Two serial, one parallel, one mouse
Dimensions (HWD): 6 by 16 by 16 inches
Weight: 32.25 lbs.
Warranty: One year, parts and labor
Return Policy: 30-day money-back guarantee
Restocking Fee: None
Support: 800-624-9896, 7 a.m. to 7 p.m. weekdays, 9 a.m. to 4 p.m. Saturday (Central time)
Service: Free on-site for one year
Extended Service: Available for up to four years (cost depends on system configuration)
Shipping: Airborne 2-day, $50

Hayes V-series Ultra Smartmodem 9600:

Setting a New Standard

If computer products were human, the V-series Ultra Smartmodem 9600 from Hayes Microcomputer Products might be the consummate international diplomat: it's powerful, refined, and has an innate ability to promote understanding. The Ultra 96 not only has high-speed power, but also communicates in virtually every important protocol that's part of the melange of today's communications world.

While high-speed, 9,600-bps modems are nothing new (Hayes has two other 9,600-bps models), the Ultra 96 ($1,199 list; from $769 to $899 by mail) includes all the latest high-speed protocols, plus backward compatibility with older standards. These features considered, it's a fine choice for anyone who needs to perform fast PC-to-PC transfers, mainframe hookups, or other demanding communications tasks.

Specifically, the Ultra 96 includes the new V.32 high-speed standard. V.32 is an open, internationally approved standard for 9,600-bps modems that provides compatibility and reliability for both 9,600- and 4,800-bps transfers. It also offers V.42/V.42bis, two protocols for error control and data compression. V.42bis supports compression of up to 4:1, which means the Ultra 96 provides throughput of up to 38,400 bps when working with straight ASCII files.

I evaluated two Hayes Ultra 96 modems using both local and long-distance phone lines. Their performance was phenomenal, with file transfer rates 10 to 12 times as fast as those provided by 2,400-bps modems. A 350K file, for example, transferred from one Ultra 96 modem to the other in just over two minutes. And when I hooked up to a mainframe using the Ultra 96, information filled the screen almost immediately.

Several other features make this product worth recommending. It supports the V-series "Ping-Pong" protocol that lets it communicate with any other V-series modem at up to double the rated speed, along with a long list of other protocols for lower transmission speeds (down to 300 bps) and packet-switched network connectivity. You can use the Ultra 96 for synchronous communications without an adapter card, thanks to a Hayes solution called AutoSync (a firmware feature of the modem). And the Hayes AutoStream protocol, which manages multisession operation, permits the Ultra 96 to support up to four simultaneous communications sessions.

To help shield less technical users from the ins and outs of these various parameters, the Ultra 96 has Automatic Feature Negotiation. This lets the Ultra 96 analyze another modem, determine what feature set is available (including data compression standards, error-control, and so on), and create a link using the most appropriate set of features for the fastest throughput.

Another advantage of the Ultra 96 is that it includes MNP 5, a highly popular 2:1 data compression standard. Though V.42bis is clearly the data compression standard of the near future, offering MNP 5 allows the Ultra 96 to wring the most speed from the current installed base of MNP 5 modems, and establishes a cost-effective migration path.

Setting up the Ultra 96 is extremely simple, since the sophisticated technology is mostly hidden from the user. There's a set of dip switches under the modem's front panel, but it's unlikely you will ever need to use them.

I used the Ultra 96 with the latest version of Hayes's Smartcom III, and the combination was flawless. Though the modem should work fine with most leading telecommunications packages, make sure that you are using a current version that either directly supports the Ultra 96, or at least supports the V.32 and V.42bis protocols.

The Ultra 96 comes with excellent documentation and fine overall support from Hayes. The product is backed by a two-year parts and labor guarantee, and unlimited tech support. I called in several times and reached a technical specialist without waiting.

Hayes has long been the standard-bearer for modems, and the Ultra 96 looks to be the current high-speed benchmark. It's well made, well supported, and has the ability to communicate with just about any type of modem or host anywhere over dial-up, PABX, leased lines, or packet-switched networks worldwide. Other modems may cost less, but if you're currently running a hefty phone bill for telecommunications, the Ultra 96 should be able to pay for itself.

—Jon Pepper

SUMMARY

The Ultra 96 contains every major communications protocol, including V.32, V.42/V.42bis, and MNP 5. A reliable, well-made modem for demanding communications tasks.

SPEC SHEET

Hayes Microcomputer Products, Inc.
705 Westech Dr.
Norcross, GA 30092

Sales Information: 404-441-1617, 8 a.m. to 6 p.m. weekdays (Eastern time)
Retail Price: $1,199
Mail-Order Price Range: $769 to $899
Interface: 25-pin male D-connector, line and phone jacks
Speed: 9,600 bps
Dimensions (HWD): 1.75 by 5.5 by 9.6 inches
Weight: 10 oz.
Warranty: Two years, parts and labor
Extended Warranty: An additional two years, parts and labor, for $100
Return Policy: Dealer option
Restocking Fee: Dealer option
Support: 404-441-1617, 8 a.m. to 6 p.m. (Eastern time); 404-HI-Modem or 404-US-Hayes (BBS)
Service: Return to manufacturer
Shipping: Dealer option

cc: Mail Ver. 3.15:

Neither Rain, Nor Snow...

Many office managers yearn for the paperless office, and a savvy few have looked to Local Area Networks (LANs) to help provide a solution. One cornerstone of a paperless office network is an e-mail system. Properly implemented, it can replace memos, transmit phone messages, provide workgroup discussion areas, or even offer a chronological record or audit trail of your work.

cc:Mail 3.15, the latest version of an increasingly more popular modular e-mail system, provides most of the communications services an e-mail system is capable of, provided that you buy enough of its various modules. The system's core is the LAN Package, which allows access by 25 users ($695 retail, $530 to $550 mail order).

Both the installation and operation of cc:Mail are straightforward and intuitive. You can obtain access to any function by either highlighting a menu option or typing a highlighted action key. Lack of mouse support is a minor fault, especially since the look and feel of cc:Mail seems ready-made for point-and-click operations.

When preparing a message, the program first prompts you to select addressees. They can be individuals, groups defined by the mail administrator, groups you've established for yourself, a public bulletin board which can be accessed by all users on the LAN, or a folder in which you've filed messages by such criteria as sender, content, date, or topic.

After typing in the subject or title, you're placed in the text editor. Besides offering support for basic word processing functions such as cut and paste, cc:Mail's editor allows you to select background and text colors (if you want to create some startling message screens). Text can be imported or excerpted from files.

If you need to attach a longer document or non-ASCII file to a message, cc:Mail supports multiple items, which can include another document, a DOS file, a graphics item created with the built-in drawing tool, or a screen image grabbed with an included screen-capture TSR. (If you've purchased the fax module, faxes saved in PCX format may be attached as well.)

Two TSRs contained within cc:Mail notify your addressee that a message is waiting, using either a pop-up window or optional tone. The first, Messenger, allows you to access mail from within any application, though its editing features are limited. Since Messenger takes up 88K of memory, it may be more practical to use the second TSR, Notify, which simply tells you how many unread messages you have at any given time. Bare-boned, it takes up 12K. But if you choose to include such options as special tones or headers, you can run it up to 34K.

Tech support at cc:Mail does not have a sterling reputation, though it seems to have been beefed up recently. I got fast, competent service with a single call. A friendly, knowledgeable person sent me a file I needed to upgrade my system within minutes, by shipping it from the company's own e-mail system to mine.

Many modules are available at additional cost, making cc:Mail one of the most flexible packages around, particularly in multiplatform environments. cc:Expand allows you to add 100 users to cc:Mail's 25-user base; cc:Mail for Mac uses the same network resources as the LAN package. (Note that the DOS-based package is still required for the primary system.)

cc:Remote is an off-line reader that lets your users access their mail from home or on the road using either the Dialin or Gateway utilities. cc:Fax and cc:FaxView combine to allow you to ship and receive faxes directly from your desk. Import/Export translates cc:Mail messages to ASCII format, enabling a programmer to customize an application for you that will port mail to and from your system.

Perhaps the most powerful module of the group is Gateway, which can dial remote cc:Mail-based LANs (or almost any other e-mail package using the standard Message Handling System syntax), establishing a potentially huge communications system.

While some packages like Network Courier or DaVinci offer features cc:Mail lacks, the upgrade capabilities and interoperability of cc:Mail make it an excellent choice for the corporate user. These features, and its easy-to-understand interface, make cc:Mail an excellent means of promoting office communications. —*Jim Freund*

SUMMARY

cc:Mail's e-mail system offers easy-to-learn and efficient interoffice communications, augmented by its variety of special modules.

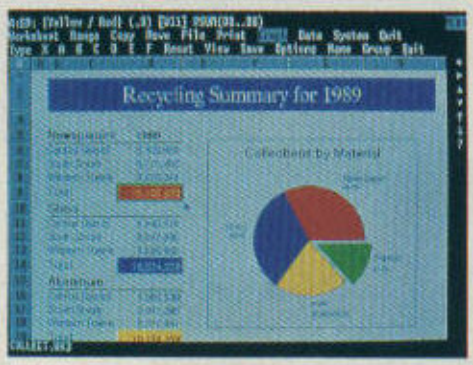
SPEC SHEET

cc:Mail, Inc.
2141 Landings Dr., Bldg. T
Mountain View, CA 94043

Sales Information: 800-448-2500, 8 a.m to 5 p.m. weekdays (Pacific time)
Retail Price: $695
Mail-Order Price Range: $530 to $550
Requirements: 350K of RAM, DOS 3.1 or later
Return Policy: Damaged disks replaced within 30 days of purchase
Support: 415-961-8800, 7 a.m. to 5 p.m. weekdays (Pacific time)
Upgrade Policy: Free from version 3.0; earlier versions vary
Shipping: Dealer option

Lotus 1-2-3, Release 3.1:

Lotus Goes Graphic



In a major revision of its DOS spreadsheet, Lotus Development Corp. skillfully integrates the "look and feel" of its standard-setting (and lawsuit-launching) text interface with a visually striking, easy to use WYSIWYG display. In advancing its spreadsheet from the Bronze to the Spage Age, Lotus has also given 1-2-3 mouse support (a practical necessity for using any graphics interface) and a memory-management process that lets users construct massive spreadsheets by using their hard drive, plus expanded or extended memory for temporary data storage. This new version of an old favorite lists for $595; $420 to $440 mail order.

Release 3.0 users will have a reasonably easy time of adapting to 3.1—the program initially loads and displays the familiar character-based menu system. Switching into the graphics mode requires invoking a WYSIWYG screen add-in. Once it is loaded, you switch between the standard "/" menu commands and the graphics command menu (summoned by the colon key). The character mode provides the commands necessary to create a worksheet (entering formulas, composing macros, and accessing file handling functions). Commands on the graphics menu control the appearance, colors, and format of your data and text.

Once in the WYSIWYG mode, the spreadsheet's appearance is absolutely elastic. Row width and column height are infinitely adjustable. Likewise, text can be resized from 3- to 72-point, inch-high letters. The default Bitstream typefaces include four sizes of Dutch, three of Swiss, and one of Symbols. Font attributes include bold italic, underline, and color. An elementary yet functional text editor enables you to easily add various sizes of multicolored text to a worksheet.

Although you can enter graphics commands from the keyboard, a mouse or trackball saves time. In addition to resizing cells, highlighting cell ranges, and making menu selections, the mouse speeds scrolling within a spreadsheet and moves between stacked 3D worksheets. Some of the time you save whipping the cell pointer around with a mouse, however, will be offset by the increased update time required by the graphics screens compared to the text screens.

In addition to dynamic on-screen updates of the spreadsheet's appearance, WYSIWYG simplifies graphing. As in release 3.0, graphs are dynamic, immediately reflecting changes made to the spreadsheet's data. In 3.1, you can now directly edit graphs; the data responds to the changes in the graph. Graphs or other images can be created from scratch, or 3.1 will import .CGM and .PIC graphics files.

After setting up the text and graphics, a page-preview feature accurately displays the printout's appearance. Release 3.1 includes drivers for Hewlett-Packard, IBM, Epson, and a selected handful of other laser and dot matrix printers.

Release 3.1 runs under Windows, but it does so as a hybrid DOS application. For instance, 3.1 will multitask only in Windows 3.0's Enhanced mode. Also, coaxing the program to exchange data with other Windows applications via the Clipboard or resizing 3.1's internal windows involves loading a lower resolution display driver.

Not surprisingly, first-time 1-2-3 users or those new to using three-dimensional graphics spreadsheets will find 3.1's learning curve steep enough to require rungs. In order to help them along, Lotus furnishes complete documentation, including on-disk and printed tutorials.

Additionally, Lotus's technical support personnel—who provide seven-day-a-week, 24-hour toll-free support—were consistently courteous and helpful when responding to routine questions.

Lotus's unique instant upgrade policy also reflects careful consideration of consumer needs. To upgrade to either release 2.2 or 3.1, users can bring the original title page of an older release of 1-2-3 to any Egghead, Computerland, or Soft Warehouse store and the store will immediately furnish the new version. Upgrade costs range from nothing (for recent 3.0 purchasers) to $150 for release 1 users.

Excluding its limited Windows 3.0 compatibility, 3.1 raises the stakes in the spreadsheet wars. Its easy-to-use WYSIWYG interface, simplified formatting commands, and presentation-quality printouts will inevitably compel Borland and Microsoft to meet Lotus's success in performance-oriented spreadsheet art.

—Howard Millman

SUMMARY

A vivid graphics interface and improved memory-management techniques put Release 3.1 way ahead of its traditional rivals.

SPEC SHEET

Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142

Sales Information: 800-343-5414, 8:30 a.m. to 8 p.m. weekdays (Eastern time)
Retail Price: $595
Mail-Order Price Range: $420 to $440
Requirements: 286 or better; 1MB of RAM; DOS 3.0 or later; EGA or better; hard drive
Return Policy: Dealer option
Restocking Fee: Dealer option
Upgrade Policy: 800-TRADE-UP or through reseller; users of 2.01 or earlier, $150; Through Dec. 31, 1990, $75 for 2.2 users; For users of 3.0 purchased prior to May 7, 1990, $35; after May 7, 1990, free
Support: 800-223-1662, 24-hour service (excluding holidays); six months free
Extended Support: $79 per year for 24-hour service; $49 per year for 12-hour service
Service: Dealer option
Shipping: Dealer option

WordStar Release 6.0:

Coming Up To Speed

Despite an installed base of over 3 million worldwide, WordStar, the grandparent of word processors, no longer enjoys the prominence it once claimed. In its heyday, the program's rapid expansion and healthy sales overloaded its technical support team; upgrades were too few and far between. As a result, competitors like WordPerfect moved in on the territory with great vigor—and success.

In the past year, however, WordStar has done an outstanding job in expanding the features of its programs, updating products with greater frequency and quality, and improving on its once lagging support. Release 6.0 is a product of this new competitiveness.

WordStar 6.0 is a full-featured, advanced word processing package that does an effective job of integrating text and graphics—and offers many features once exclusive to desktop publishing programs. The program lists for $495 and is available through mail order for $239 to $375.

The most significant new feature of this release is the program's support for scalable fonts. A number of printers now offer scalable fonts (most notably the Hewlett-Packard LaserJet III), and WordStar is the one of the first programs to support this technology. WordStar 6.0 fully supports the LaserJet III's special effects and on-the-fly font scaling from 2 to 999 points. It also supports PostScript, and its printer installation module provides choices for all the leading font cartridges and soft fonts, including Pacific Data Systems and Hewlett-Packard.

Still other features improve upon WordStar greatly. For instance, the program's new version of Star Exchange now supports automatic file conversion and retains the source file's indenting and paragraph styles. There are also improved style tags which can be used to set style formats throughout a document. These style tags are powerful yet easy to use and include inheritance and style by example.

You can customize WordStar to work the way you do. There are four different help levels, including the industry-standard pull-down menus. For touch typists there's the familiar WordStar CTRL key commands which make the majority of the program's commands and features accessible from the keyboard's home row. These commands can also be reconfigured for those less enamored of the CTRL key.

Text and graphics can be integrated with the built-in Inset program and the page preview mode will show exactly how it will look when printed. Documents with assorted fonts and type styles can be reviewed in sizes up to 72 points. Graphics can be captured from almost any program and can be edited, resized, and even cropped. You can also import Lotus 1-2-3, Quatro, Excel, and dBase files directly into documents without any additional formatting. The TeleMerge program suppports on-line information services like CompuServe and Dow Jones.

WordStar now matches leading products like WordPerfect and Microsoft Word feature-for-feature in many areas, including multiple snaking columns; footnotes; line and paragraph numbering (useful for legal documents); 14-function math; automatic hyphenation (algorithmic-based); upper-, lower-, and sentence-case conversion; typewriter mode; index and table of contents generation; and advanced mail merging, including direct access to dBase files. The program also supports two windows; the windows can be resized and you can zoom in and out of full-screen view.

One feature that stands out is speed. You can go from one end of a document to the other in seconds. The spell-checker and thesaurus are just as fast.

The warranty covers the product 60 days past the release of the next version. Getting through to technical support was no problem the three times I called. Technicians even offered to help me modify a printer driver to work better with my LaserJet II's cartridge. Support can also be purchased for program customization.

WordStar 6.0 is a full-featured package that's economical and offers a wealth of features. Although it's been passed by in recent years by such programs as WordPerfect and Microsoft Word, it is now well worth a second look. This particular old dog has indeed learned some new tricks.

—Nick Anis

SUMMARY

The well-known word processor with some new features, including support for scalable fonts, style sheets, PostScript printers, third party fonts, and more.

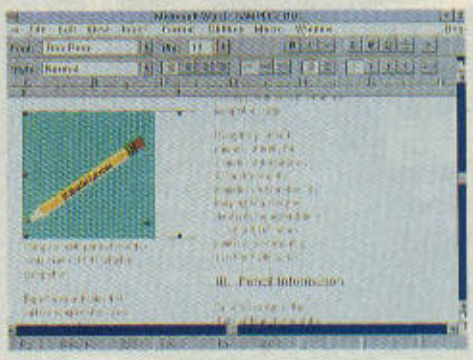
SPEC SHEET

WordStar International Inc.
33 San Pablo Ave.
San Rafael, CA 94903

Sales Information: 800-227-5609, 7 a.m. to 4 p.m. weekdays (Pacific time)
Retail Price: $495
Mail-Order Price Range: $239 to $375
Requirements: 384K of RAM (512K for graphics, outliner, or advanced page preview), DOS 2.0 or later, two floppy drives or a hard drive
Return Policy: Damaged disks replaced within 30 days of purchase
Support: 812-323-8825, 7 a.m. to 4 p.m. weekdays, except Wed., 8 a.m. to 5 p.m. (Pacific time)
Upgrade Policy: $99, plus shipping
Shipping: Dealer option

Word for Windows, Ver. 1.1:

Word For the Wise



Although a loyal user of WordPerfect for eight years, about six months ago I switched to Word for Windows—primarily because the graphics-based environment was so attractive. But there were other, more compelling reasons too. The revision and annotation modes make disk-based group editing effortless; the flexible field codes allow simple insertion of text, document data, and special items such as index references and equations; and the powerful, comprehensible macro language is a welcome relief from the cryptic notation used by WordPerfect.

Word for Windows 1.1 is visually more appealing and adds new enhancements to an already feature-rich package. The mail-order cost of Word for Windows ranges from $295 to $340, and there is only a modest $7.50 charge for upgrading from version 1.0. If you're using the DOS-based version of Word, Microsoft will sell you Word for Windows 1.1 for $150.

If you've been using version 1.0, the first thing you'll notice is that the three-dimensional graphics flavor of Windows 3.0 has been incorporated into the program's buttons, dialog boxes, icon bars, and ribbons. For instance, when you click on the sculpted buttons, they depress realistically. Unfortunately, the color of these items cannot be changed from the dull gray the designers probably decided was unobtrusive. With the ribbon, ruler, and status bar visible, the page looks sandwiched between two slabs of concrete.

More useful—if less artistic than the moveable buttons—is the extensive selection of new file-import filters. Microsoft has made a concerted effort to make Word for Windows function effectively with other Microsoft products—filters for Works, Windows Write, and Word for the Macintosh are now provided, along with an enhanced version of a Word for DOS filter. If you are saving a file in the latter format, you now have the option to save the style sheet in Microsoft Word 5.0 format as well. Conversion from Word for DOS files is smoother and faster with the new filter too.

Text filters are also provided for Wordstar 3.3, 3.45, and 4.0; WordPerfect 4.1, 4.2, and 5.0; and MultiMate 3.3, Advanced, and Advanced II. The plain-vanilla crowd can save text in assorted ASCII formats (with and without breaks, 8-bit, and so on) as well. The program does a good job of translating text attributes such as italic and boldface.

Graphics import has been significantly improved in this version of Word for Windows. You can import color images using either the Pagemaker .CGM or the Micrografx Designer .PIC formats. Hewlett-Packard Graphics Language (.HPGL) files, which were restricted to 64K in version 1.0, are now limited to the amount of memory in your computer. Other filters that are supplied but were not tested are AutoCAD (.ADI), Lotus graphics (.PIC), Video Show (.PIC), and Zenographics Mirage (.IMA).

However, while Microsoft asserts that you can import color .PCX files, attempts to do so resulted in the same monochrome picture that version 1.0 displays. The Widows Metafile (.WFM) filter didn't work either. I called Microsoft's technical support service, which has one of the most long-winded menu-driven phone routing systems ever designed. After a 20-minute wait, the technical service representative, while polite and friendly, had no explanation as to why these filters did not work as advertised. Although we tried several methods of correcting the problem, the program refused to import WFM files, and the color .PCX files still converted to gray scales.

Several new, self-installing macros have been added to the EXAMPLES.DOC file. The new mail-merge macros have friendlier dialog boxes and meaningful prompts that ease the chore of producing form letters and mailing labels. PostScript support has been enhanced, with the addition of a macro that can shade paragraphs in any gray percentage, and add a custom border too.

If you enjoy working with Word for Windows, you'll find the new look and thoughtful additions well worth the price of the upgrade. If you are not currently using the program, you might want to check it out—especially if you're currently stuck in the text-only world. This program is powerful, infinitely customizable, and, with the new graphics interface, visually satisfying.

—Susan Glinert Stevens

SUMMARY

A visually more attractive version of Word for Windows with many additional file importing filters. Well worth the update price.

SPEC SHEET

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

Sales Information: 800-426-9400, 6:30 a.m. to 5:30 p.m. weekdays (Pacific time)
Retail Price: $495
Mail-Order Price Range: $295 to $340
Requirements: 286 or better; Microsoft Windows version 2.11 (version 3.0 strongly recommended); EGA, VGA, or Hercules graphics card; hard drive; 1MB of memory (2MB strongly recommended); mouse or other pointing device recommended
Return Policy: 30-day money-back guarantee
Support: 206-454-2030, 6 a.m. to 6 p.m. weekdays (Pacific time)
Upgrade Policy: $7.50 for users of version 1.0; $150 for users of Microsoft Word for DOS
Shipping: $5.50 for upgrade only; $6.50 for complete package

HP LaserJet III: High Class

The LaserJet III Prints Sharply and Quickly, and Just Keeps on Going

BY EDWARD MENDELSON

When I was in the market for a new printer a few months ago, everyone I knew in the computer industry agreed that Hewlett-Packard's LaserJet III produced the best-quality output, with features and flexibility that exceeded any other laser printer in its price range. In an industry where no one ever seems able to agree on most subjects, this was a convincing recommendation. And it turned out to be accurate in every detail.

What I hadn't heard was how easy it was to use this latest member of the LaserJet family. Setup and installation took 10 effortless minutes, thanks to a well-illustrated manual. All I had to do was lift out some packing material, drop in the toner cartridge, pull out a plastic sealer from the toner cartridge, plug in the cables, and start printing. Like the Series II, the III prints text at 8 pages per minute—no slower and no faster than other Canon SX-engine printers, but twice as fast as small-footprint printers like the LaserJet IIP.

The LaserJet III's reputation for great output rests on its new Resolution Enhancement Technology, which adjusts the pixel size on the printed page to reduce jagged curves and diagonals. The output is, in fact, sharper and clearer than anything I have ever seen from a 300 dpi laser printer. And, after months of use, the printer has continued to produce output that is sharp and clean.

Because I had already been using a LaserJet Series II, I didn't have to reconfigure my software to use it with the LaserJet III. Every application that had supported the earlier LaserJet model worked perfectly with the LaserJet III, so it didn't matter that LaserJet III-specific printer drivers weren't available for some applications when my printer arrived. I've never had to do so little to adjust my software after making a major change in my hardware.

When I reconfigured my software to work specifically for the LaserJet III, I was able to use the printer's eight built-in scalable typefaces. This was a mixed blessing. The CG Times font, in normal, bold, italic, and bold italic weights, looks crude and coarse compared to the bitmapped fonts available in HP's classic series of font cartridges. But the printer also includes four weights of the elegant Univers typeface, a face similar to the otherwise ubiquitous Helvetica, but subtler. With the most advanced printer drivers, like WordPerfect's, I was able to rotate text and add different levels of shading.

With most text applications, the LaserJet III simply worked without fuss or bother. I found that I could plug any HP or HP-compatible font cartridges into its two cartridge slots.

A few third-party megafont cartridges designed for the LaserJet II didn't work when I first plugged them into the III. HP's tech support explained that the printer's memory handling had been altered, but that all HP cartridges continue to work perfectly. When I called the cartridge manufacturers, I found that they had already rushed to modify their designs. The moral: If you order a non-HP font cartridge, make sure to specify that you want to use it in a LaserJet III.

Although the LaserJet III includes built-in scalable fonts, I found that few manufacturers have released add-on cartridges with scalable

fonts instead of bitmaps. HP has two scalable font cartridges with rather baffling names: The first, called "Distinctive Documents I, Compelling Publications I," includes 24 text faces and the symbols in the Zapf Dingbats font; the other, "Brilliant Presentations I, Compelling Publications II," has 24 text faces and two fancy display faces. Each HP scalable cartridge lists for $399, and is available by mail order for about $300. I tried Pacific Data Products' clone versions, and found that they use the identical AGFA Compugraphics scalable typefaces found in the HP models, but sell for about $50 less on the street.

In the middle of my testing period, HP issued the best cartridge of all: the LaserJet Adobe PostScript Cartridge, which gives true PostScript for a list price of $699, and a street price of around $450. I tried three other cartridges, all of them using clone PostScript instead of Adobe's, and HP's proved by far the fastest—about twice as fast as Pacific Data Products' PacificPage Personal Edition, which you can get by mail for $319, and three to five times faster than Computer Peripheral's JetScript and ImageSoft's ImageScript. All these cartridges need at least an extra 1MB of RAM in the printer.

After months of use, the Hewlett-Packard LaserJet III has continued to produce output that is crisp and clean.

The only drawback that I found with the HP PostScript cartridge was its stranglehold on the printer. When the LaserJet III is switched on with the HP cartridge plugged in, it can be used only as a PostScript printer. When I wanted to use it as an ordinary LaserJet, I had to turn off the printer and pull out the cartridge. The non-HP cartridges all make the printer boot up as a PostScript printer, but let me switch back and forth into LaserJet mode via software commands or the front panel.

To test HP's support, I pretended not to understand some front panel choices and phoned for help. (This was slightly embarrassing, because the front panel menus are absurdly easy to use.) I waited on hold for a few seconds, and then was answered by a technician who was expert, friendly, and polite.

The only serious trouble I ever encountered using the LaserJet III occurred when I used WordPerfect to print a page that included rotated text and some very elaborate graphics. The printer simply stopped, and the message "ERROR 21" appeared on the front panel until I pressed the reset button to clear the problem.

The manual suggested that I avoid this error message by turning on the "Page Protection" option on the front panel menu, which cleans up the printer's memory management. I checked WordPerfect's "Printer Helps and Hints" and found that the error could be avoided by adding more memory in addition to turning on Page Protection. I ordered HP's 1MB memory board (list $335) for a street price of $265, and never had a problem again. Installing the memory board was a matter of turning a couple of screws on the side of the printer and pushing the board into its slot.

Like the LaserJet Series II, the III still crumples envelopes while printing, although the seriousness of the problem depends on the paper used in the envelope. The only solution I found was to experiment until I found envelopes that went through the printer with little or no crumpling. Even with the best envelopes, I almost invariably noticed a slight smudging in the return address when I didn't use preprinted envelopes. This seems a small price to pay for the convenience of all the other varieties of printing.

The only other trouble the LaserJet III ever gave me was the inevitable and minor one that arrives when the toner cartridge runs out. The front panel gave plenty of warning with a "Toner low" message. I shook the toner cartridge a few times, put it back in the printer, and got about two more weeks' heavy use from it before the printing began to fade. I was able to get a true HP toner cartridge by mail for less than $80 (list price $125). It took no more than two or three minutes to unpack the new cartridge and drop it in the printer.

My experience with the LaserJet III matches the experience of everyone else I know who owns one. In brief: it's the most reliable and best-supported printer that I've ever used. You'll have to work hard to find a plausible reason to buy anything else.

SUMMARY

HP's latest is the most flexible and best-supported printer in the industry and the finest 300 dot-per-inch printer on the market. It's hard to think of a good reason to buy anything else.

SPEC SHEET

Hewlett-Packard Company
19310 Pruneridge Ave.
Cupertino, CA 95014

Sales Information: 800-752-0900, 6 a.m. to 5 p.m., weekdays (Pacific time)
Retail Price: $2,395
Mail-Order Price Range: $1,550 to $1,700
Base System: 1MB of RAM; 300 by 300 dpi graphics with enhanced resolution; two font cartridge slots; 200-sheet paper tray
System As Tested: Same as above with the addition of: 1MB RAM expansion card; HP Adobe PostScript Cartridge; HP Scalable Typeface Cartridge
System As Tested Price: $3,824
Emulations: HP LaserJet Plus, HP LaserJet II, and HP LaserJet IIP
Interfaces: Parallel, serial, Appletalk optional
Fonts: CG Times, Univers (scalable); Courier, Line Printer (bit-mapped)
Rated Speed: 8 ppm
Dimensions (HWD): 10 by 18 by 25 inches (with paper tray)
Weight: 50 lbs.
Warranty: One year, parts and labor
Extended Warranty: Priority Support (four-hour response time), $40/month; Next Day Support, $22/month; Scheduled Support (weekly visits), $15/month; Customer Return Service (product returned to HP), $15/month; Priority Plus (24 hours), $50/month
Return Policy: Dealer option
Restocking Fee: Dealer option
Support: 208-323-2551, 7 a.m. to 5 p.m. weekdays; 7 a.m. to 4 p.m., Wed. (Mountain time)
Service: During the first 90 days on-site service is available, but if used, the one-year warranty no longer applies after 90 days