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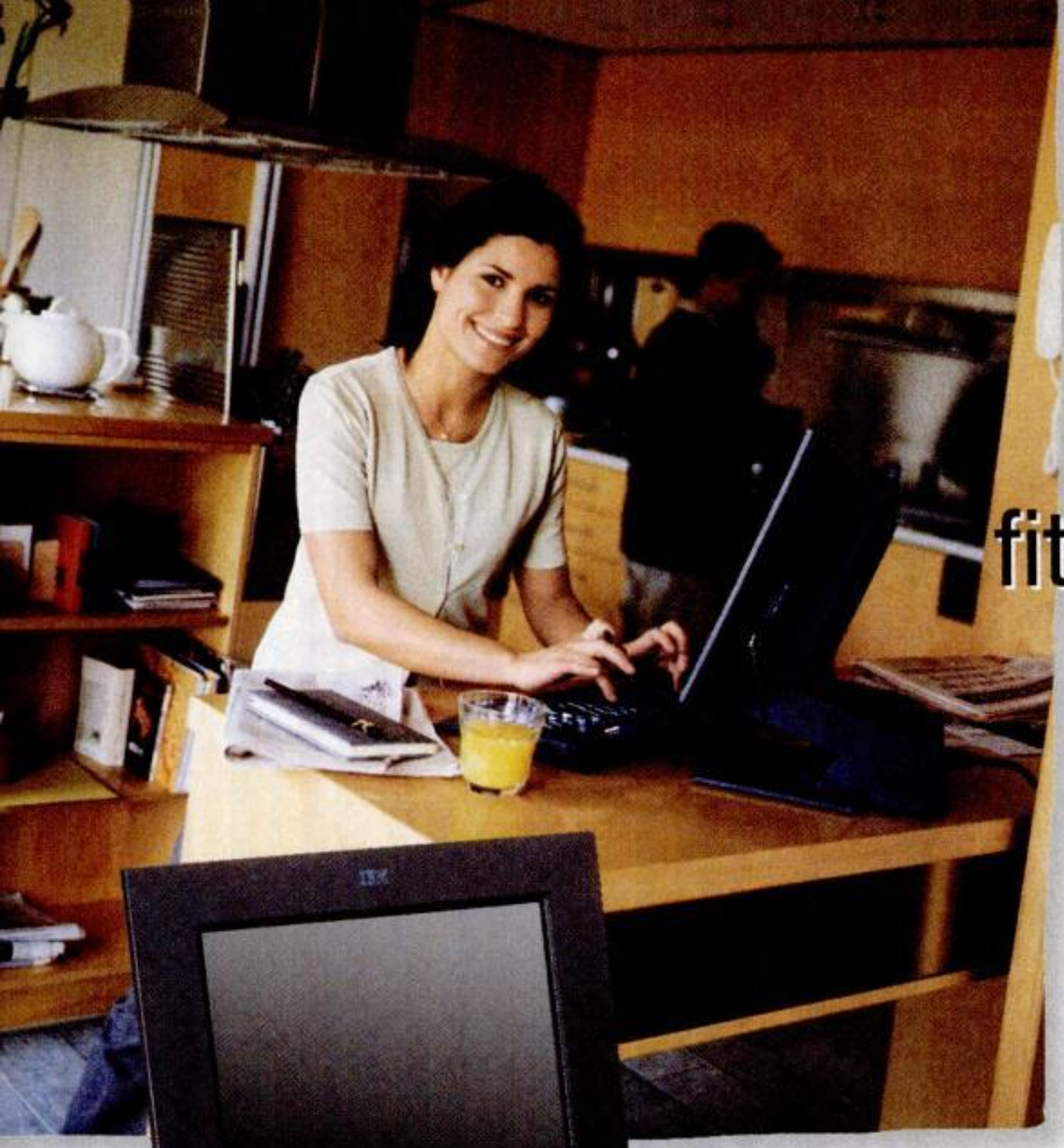

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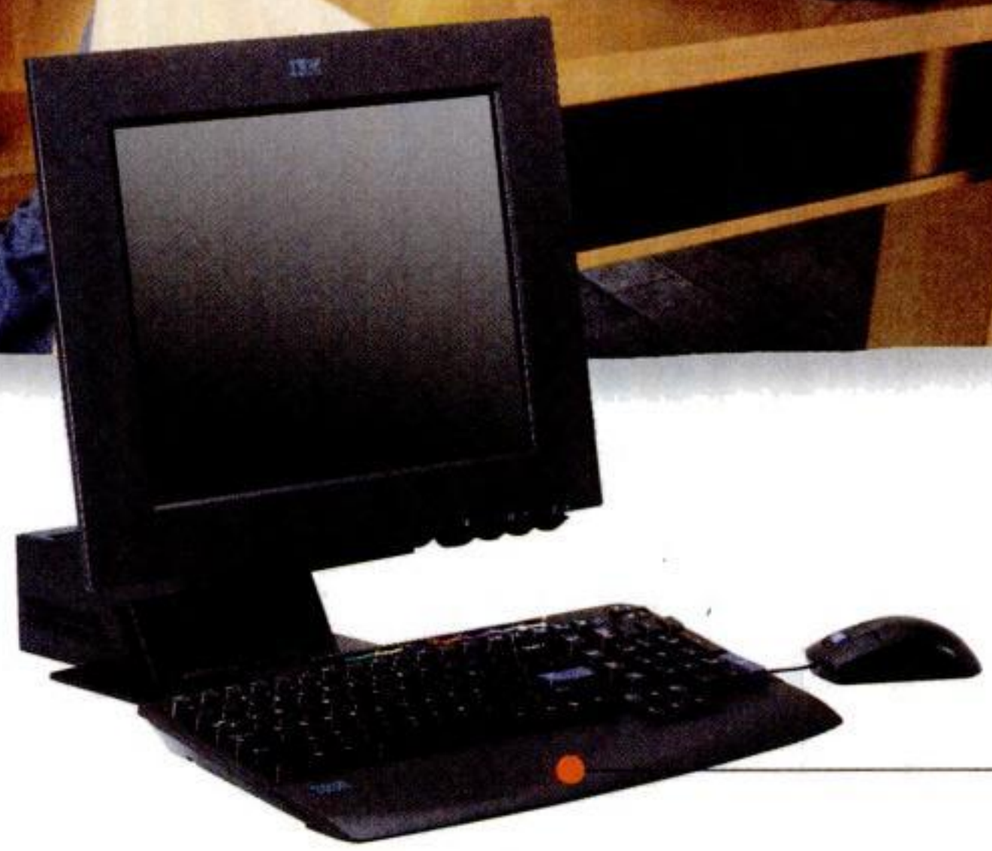

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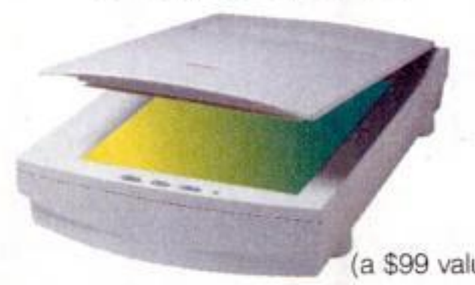

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THIS ISSUE

34 Smackdown!

50 PC Makers Talk

62 Spy Gadgets

▶ FEATURES

▶ TECH FILES

▶ PRODUCTS

▶ NEWS

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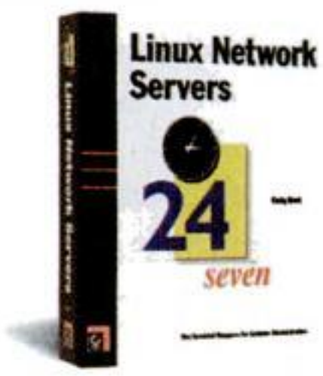

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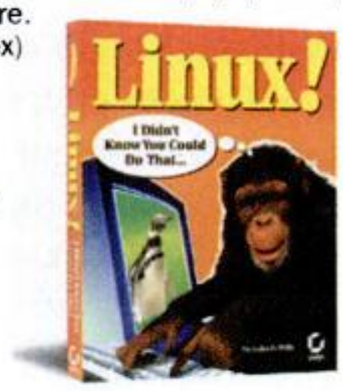

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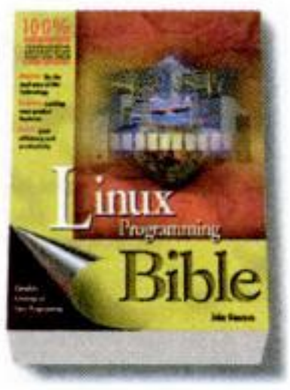

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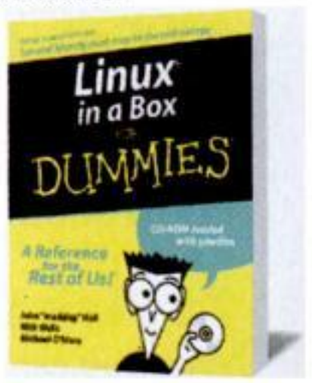

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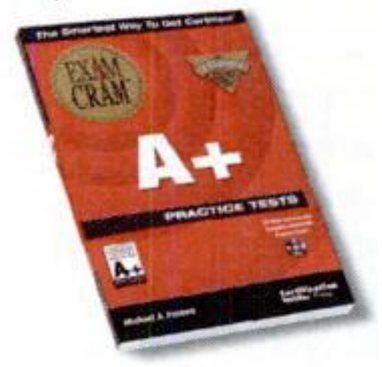

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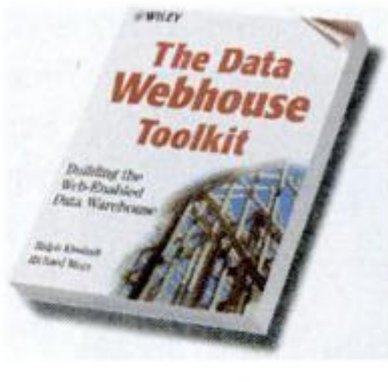

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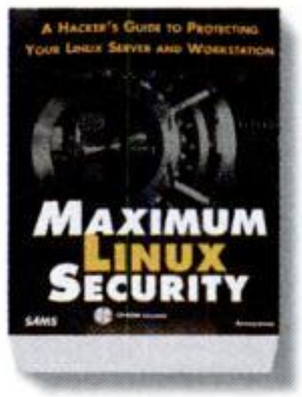

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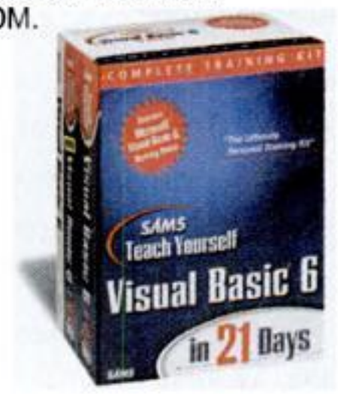

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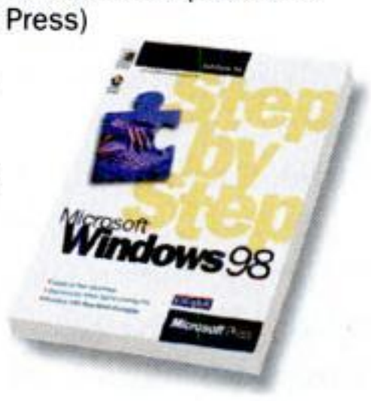

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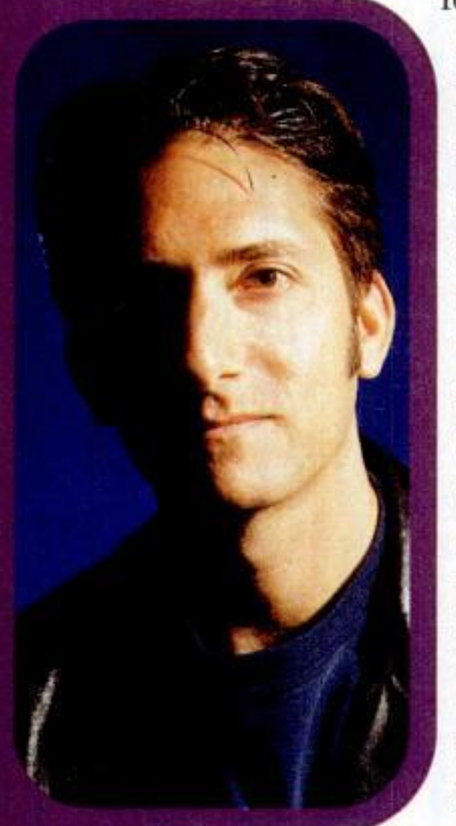

We've reached August 2000, and the best 3D games *still* haven't justified a need for the best 3D cards. Sure, *Quake III* at its highest detail settings is a wicked pissa of a challenge for last year's 3D chipsets, but as we discovered while reporting this month's cover story, even Carmack's most complex models and visual effects are quite playable on the latest 3D silicon. And *Quake III* is just one game—today's less intense titles still perform quite nicely on the nVidia TNT2s of the world, which are now three generations removed.

So why buy a new videocard if your old card is more than fast enough?

Two words: frame rates. *More* frame rates. *More frame rates than the other guy.*

It's time to admit that many of us buy the latest videocards for the sheer pleasure of benchmarking, not for getting fluid graphics during actual gameplay. Does anyone really need the full 64MB of memory that comes on the GeForce card that Dell custom-configured in March? Conventional wisdom around the *Maximum PC* offices says, no, the 64MB is overkill—glorious, decadent overkill, and we'll take it any way we can get it! The extra 32MB adds about 6fps in *Quake III*, and while six extra frames won't reinvent anyone's gaming experience, they can give a person benchmarking bragging rights for a good four-month stint.

To wit: There are gamers, and there are hardware geeks. Both groups long for the fastest possible frame rates in their favorite games, but only hardware geeks are afflicted with an irrational drive to continually improve performance by any means necessary. In fact, today's PC gearhead has more in common with the muscle car fanatic whose 1968 GTO sits disassembled on the front lawn than with the stereotypical "computer nerd" celebrated by popular media. The difference? The nerd actually *uses* his computer, while the gearhead spends half his time with his hands inside the case, swapping parts. And after a two-hour tweaking marathon, the gearhead finally fires up his machine for what will ultimately be a two-minute benchmarking run—the PC equivalent of the quarter mile. Then it's back to the workshop to bore out the system bus, or install a high-performance heatsink, or whatever else it takes to eke out a few extra frames.

Today's videocards are essentially nitrous kits for already-screaming-fast PCs. No one who drives an automobile in North America really needs to go a quarter mile in 13 seconds, and no gamer really needs to run 98 percent of his games in excess of 75fps. But we can't deny the sheer pleasure derived from taking a stock rig and recrafting it into our own vision. In fact, the end *doesn't* justify the means. Rather, the means are an end in and of themselves. Running *Quake III* to discover that all your BIOS tweaking garnered an extra 3fps is thrilling indeed, but the kick is fleeting, and can't equal the satisfaction derived from the tweaking process itself.

Today's videocards are essentially nitrous kits for already-screaming-fast PCs.

Not everyone has the heart of hardware junkie, and no one should upgrade his videocard unless he truly needs faster frame rates or has to satisfy an unquenchable benchmarking jones. But, let's call a spade a spade: Until the software industry begins delivering more complex games, the only way we'll really be able to enjoy our new 3D hardware is on the proverbial quarter mile. In today's current environment, the best videocards are way too fast for public pavement.

—Jon Phillips, editor-in-chief

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AUG00 vol5issue8

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What A Difference a Slash Makes

Two things became abundantly clear to us last month: Many of you were very, very interested in our June cover story, "How to Completely Revamp Your Windows PC for a Clean Start," and many of you should begin actively seeking employment as proofreaders. You sent us e-mail after e-mail to note a slight blunder we made when recounting a particular DOS command. We'll let one man's words represent the lot:

"Just thought I would let you know, even though you have probably heard it already, that in the 'Clean Start' article, there is a misprint. The command to make C: bootable is not FORMAT C: \S, it is FORMAT C: /S."

Indeed it is. Luckily, the reversed parameter slash causes no damage, but it does return an Invalid Parameter message. We're sorry for the typo—if nothing else, you have at least convinced us that you really are reading every single word of the magazine.

Thanks. We couldn't ask for anything for more.

Clean Start Stoppage

Following the advice given in the "Clean Start" article, I set my swap file size to zero so that I could totally defrag my hard drive. That's when the trouble started. Now my computer won't shut off or reboot automatically. I have to manually power off the machine, and suffer through Scan Disk at every startup. It has also slowed to a snail's pace. Just opening My Computer now takes between 90 and 110 seconds, and I can't get any apps to run. Finally, I can longer open System Properties, so I have no way to restore my swap file. Any advice you can give me to counteract the last bit of advice you gave me would be greatly appreciated.

—Eddie Watkins

Contributing Editor Will Smith replies: Sounds like a memory issue. Several readers with 32MB PCs wrote in with your same problem. Unfortunately, we didn't test the Clean Start procedure on machines with less than 64MB of RAM. With the way Windows 95/98 manages memory, there isn't enough headroom on 32MB systems to open the System Properties control panel after the swap file is disabled.

Fortunately, you can re-enable your swap file in Safe mode. Just press F8 repeatedly when you see the 'Starting Windows 98' message as your PC is booting up. This will bring up Windows' boot menu. Selecting option 3 will launch you into Safe mode, where you should be able to access System Properties and recreate your swap file.

I set my swap file size to zero so that I could totally defrag my hard drive. That's when the trouble started.

Virtually Excessive

Why not exceed 256MB when setting the virtual memory? I looked all over Microsoft's web site and couldn't find a reason for this. Is Windows limited by some insidious DOS anomaly or Registry setting? If I follow the "two and a half times physical memory" rule of thumb that you used in the "Clean Start" feature, my virtual memory setting should be 320MB.

—John William Hearn

Contributing Editor Will Smith replies: There isn't a hard-coded rule on how big your swap file should be, but a swap file greater than 256MB is really just a waste of hard drive space for most people. This is why we recommend putting a cap on how much hard drive space you use for your swap file.

Remember, virtual memory, a.k.a. the swap file, is simply an "overflow" to be used when you fill your RAM. Most applications that really demand a lot of memory, such as *Photoshop*, include their own virtual memory schemes.

In your case, you have 128MB of RAM and probably don't need a 320MB swap file. You can always test this, though, to see if you run enough applications (at a reasonable speed) to fill up your physical memory *and* 256MB of virtual memory.

Task Scheduler Takedown

I'm not sure which editor wrote about this, but twice in *Maximum PC*, it has been stated that if you click on the Task Scheduler on the task bar, go to advanced properties, then click on 'stop using task scheduler', it will no longer appear on the task bar. However, I end up doing this every time I boot up, because even though I have clicked on 'stop using', Task Scheduler still shows up every time I start my computer. Any help? It's not a major problem, just an irritating one.

—Shirley Breznai

Features Editor Sean Downey replies: I've used this trick on several machines and haven't experienced the problem you're having. Most likely, Task Scheduler has been successfully disabled on your

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machine and the task bar icon is just occupying space.

If you really can't stand to see the Task Scheduler icon in your task bar, there's another, more reliable way to kill it. Task Scheduler should remove itself from the Registry when you select 'stop using task scheduler' from the Advanced Properties. If it doesn't, you'll need to go into your Registry and remove the command that makes it automatically load every time Windows starts. To do this, launch the Registry Editor by typing REGEDIT in the Start Menu's Run command box. Then browse to Hkey_Local_Machine\Software\Microsoft\\Windows\CurrentVersion\RunServices, and delete the Scheduling Agent entry found there.

Of course, you may want Task Scheduler back at some point, and along the lines of "better safe than sorry," you should back it up by using Regedit's Export Registry File option, which is located in the Registry pull-down menu. Select the RunServices key and save it as OLD RUNSERVICES.REG in a place where you'll be able to find it later. Also be sure to tell Regedit to export just the selected branch, or else you'll end up exporting the entire Registry.

False Advertising?

On page 47 of your May issue, an ad for the Compaq Presario 5900Z-1 states that the computer's PC100 memory is expandable to 384MB. But on page 74 you say in a review of the same Presario that the machine is expandable to 512MB.

Who is telling the truth here? I own a Presario 5838, which has a 500MHz Athlon and 384MB of RAM, and fear that I've reached my memory limit. I've talked until I'm blue in the face with the salespeople at the store where I purchased the computer, and they have no idea either way. Some say the maximum amount of RAM allowed in the machine is 384MB, and others say it's 768MB. One person even said that my limit is 1536MB.

In the same review, you say, "The most stunning feature of the Presario is that after bootup, nothing is running in the background—nothing!" It says that when you tapped Ctrl+Alt+Del, only one program was shown running in the background. You also say that if retail systems differ one iota from the configuration you reviewed, you'll make a big stink about it. Well, my friends, get out the fan because you have some stink to blow away. Even after I took every program out of my Startup folder, I was still running stuff in the background, so how the heck did it work for you?

—Kim Wofford

Reviews Editor Josh Norem responds: Kim, don't you trust us? The motherboard that comes standard with the 5900-Z Compaq is a FIC SD11 with two DIMMs. In the PC we evaluated, one DIMM was holding a 256MB DIMM, leaving 256MB of expansion room in the other slot. Together, that equals 512MB. In the Compaq ad you mentioned, it says the PC comes with 128MB of PC100 SDRAM, which leaves one DIMM empty. If you put 256MB in that slot after purchase, you'll have 384MB! See, it all makes sense.

We can't vouch for what is running in the background on your older Compaq system, but the one we reviewed was clean as a whistle. The reason we mentioned this in the review is because Compaq is notorious for loading a bunch of crap on their systems. We'll wait to raise a stink when someone who owns this system writes in with a different configuration. To get your PC to boot up clean, check out our step-by-step guide to "evicting system hobos" at **www.maximumpc.com/reprint/christen/index.html.**

I own a Presario 5838, which has a 500MHz Athlon and 384MB of RAM, and fear that I've reached my memory limit.

Price Matters

Your DV camcorder feature in the June issue ("Sharper Images") was flawed because you compared camcorders ranging in price from $1,700 to $900. In the camcorder world, that's like comparing fishheads to lunar landers. Anyone remotely familiar with video could have easily predicted the winner by simply asking which was the highest priced. And, sure enough, your buzz-saw ratings predictably decline in proportion to lower prices.

How about a legitimate 'shoot-out' between DV camcorders in the *same* price range? The current article is useless for comparison shopping. Better yet, you should do a performance and compatibility test of each card's DV interface. I would suggest testing at least two capture card types—one that uses the 4-pin FireWire connectors, such as Canopus, and one that uses the 6-pin connectors, such as Digital Origin or Pinnacle. To be fully DV compatible, each camcorder and capture card should successfully perform video captures, export to tape, and support tape jogging purely via the computer interface—all without incident or manual intervention.

My own experience indicates that a great deal of incompatibilities may exist under the umbrella names of "iLINK" and "FireWire." For example, my own JVC GRDVL-9500 does not recognize the DV-in initialization signal from the Canopus capture card—I have to engage it manually—but it *does* recognize the DV-in signal from Digital Origin's card.

—J. B. Briggs

Associate Editor Geoffrey Visgilio responds: When you look at any consumer product, you have to look at the different options and price ranges, just as you would when shopping for a new car. Not everyone can afford a Lexus, but they still like to hear about how a Lexus performs. And people who don't have money to burn want to be sure that they can get at least some of the Lexus' goodies in a Toyota. It's a poor analogy, I grant you, but it holds weight.

Our feature focused on the newest cameras available at four different price points. We tested all the cameras in the same way and under the same guidelines—and, yes, the more expensive cameras did better. But I don't think our findings were unfair. Sometimes, this kind of testing reveals a lower-priced product to be a real bargain, or a higher-priced one to be a real dog. This time, that wasn't the case. But not everyone wants, or is able, to shell out $1,700 for a Kick-Ass Canon DV camera. Even so, before they buy *any* camera—cheap or expensive—they should know what the best available features are, and what they'll be getting or giving up, depending on what they purchase.

As for tests with the DV computer interface, we didn't do those for many reasons. The main reason was the compatibility issues you described. We wanted a feature that focused on the cameras them-

selves—their CCD capabilities, still-shot capabilities, digital zoom qualities, etc. We also wanted to avoid a situation in which the cameras were limited by their compatibility with certain cards.

In future issues, we plan to conduct stand-alone reviews of capture boards from companies such as Pinnacle, Canopus, and Orange Micro. These reviews will cover more of the interface end and tackle more of the compatibility issues you addressed. Also, look for reviews of DV systems in this issue (pages 76 and 80).

Videocard Variety

This is in reference to the AGP vs. PCI showdown. In the article, you seem to come to the conclusion that there really isn't much of a difference between the two as far as performance goes. The article also states that you found out that nVidia had done something to their chipset to make both the AGP and PCI versions similar. I was just wondering why you didn't try out a different manufacturer's card, such as the ATI All-in-Wonder 128 that also has AGP and PCI versions. Since [ATI] may not have done any special tinkering on their PCI version, you may get the results you were looking for (i.e., which is faster, AGP or PCI).

—Doug Heimann

Features Editor Sean Downey replies: The idea for the AGP vs. PCI showdown came when Elsa sent us a PCI TNT2 videocard. Since we still had some AGP TNT2 boards lying around, I thought it would make a good article to benchmark and compare two cards with the same graphics processor, clock speed, and memory configurations, operating on two different buses. At the time of the article, I wasn't able to get a PCI All-in-Wonder 128; in fact, the only chipsets I could test in both PCI and AGP were the TNT2 and the Voodoo3. Since the Voodoo3 isn't much of an AGP card, I went with the TNT2. *Maximum PC* will definitely revisit the AGP vs. PCI issue in the future, and we'll include a better variety of videocards in our testing.

Sound Off

I'm writing to point out a contradiction in opinion toward the Creative Desktop Theatre 2500 speaker system. In the December issue review of the Alienware Area 51, you said, "Of course, a great soundcard is nothing without good speakers, and the bundled Cambridge Soundworks DTT2500 Desktop Theatre System—a digital surround system that harbors Dolby Digital decoder amplifier—is awesome." Sounds like you guys think these speakers are pretty hardcore, right? However, in the April issue, you said, "the mediocre Cambridge Soundworks DTT2500 speakers and the XingSoft DVD offer average image and sound quality, at best." What's with the mixed opinions? I am aware of the four month gap in between these issues, but "awesome" speakers don't go to "mediocre" in four months.

—Mark Dunlop

Reviews Editor Josh Norem replies: While your recitation of quotes from the December and April issues is correct, you should also consider a few words from the review of the Desktop Theatre 2500 (DTT2500) system that we ran in January.

We took apart the drive and shook all the pieces of *Age of Empires II* out of it, then put it all back together and found that it still worked fine.

To quote Contributing Editor Brad Dosland, "These are speakers with no glaring blemishes, but you can do better for the money—much better." Big Daddy Dosland then goes on to compare them to the Klipsch ProMedia V2.400 speakers, which completely destroy the DTT2500s in side-by-side listening tests.

Hey, we used to love the Cambridge speakers as well, but that was before the Klipsch ProMedia, and even the Sirocco Crossfire (reviewed on page 83 of the July issue), showed us how good a home speaker set can sound.

Heads Up Eyewitnesses

I was very interested to read the letter from Jon Ruyle in the July issue regarding a CD that had exploded in his drive. I had something very similar happen to me when a CD that had spent too much time in my drive shattered. My blowout was far less physically damaging, though. It only made a couple of nicks in the plastic tray of the drive. According to a techhead friend of mine, the reason that CDs sometimes do this is because they rapidly heat up and cool down as the drive spins up and down (particularly on high-speed drives). This can cause the plastic of cheaply pressed CDs to become "crystallized" and brittle. Once that happens, it's only a matter of time before a slight imperfection in the CD can cause an explosion as the CD spins up. Now, if I have a CD that I know needs to spend lots of time in the drive, I just copy it onto my hard drive and use it from there. So far, this has worked for me, I just can't fit too many CDs on my little 12GB hard drive.

—Dave Helmer

I am a computer technician at a small computer store in Newport News, VA (CTI Computers), and I've seen two CD-ROM drives explode just like the one in your July issue. The first time it happened, a customer came in complaining that the Samsung 48x IDE drive he bought from us was dead. He said he was playing *Age of Empires II* when he heard a loud noise like a light bulb popping—the game just stopped and he couldn't eject the CD. We took apart the drive and shook all the pieces of *Age of Empires II* out of it, then put it all back together and found that it still worked fine. The customer came back later to tell us he had called Microsoft, and they sent him a replacement CD and a gift certificate. I never would have believed it possible if I hadn't seen it myself. The other technician and I theorized that a combination of heat, the unbalanced disk (because of the CD art work), and the spin-speed caused it to shatter.

The second time was when a customer brought his boss's IBM system in with a bad CD-ROM Drive. And sure enough, there was a shattered children's game in the drive. We shook out the pieces, and the drive still worked.

All of this says to me that there are some serious problems with the fragility of CD-ROM drives that need to be addressed. Especially before someone gets hurt.

—Michael V. Miller

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Stupid CPU Tricks

Pentium III And FC-PGA Celeron Have Common Roots

If you think your new flip chip Celeron looks suspiciously similar to a flip chip Pentium III, you're on to something. It's widely believed that FC-PGA Celerons are nothing more than Pentium III Coppermine CPUs with half of the onboard L2 cache memory switched off.

"The Celeron either doesn't QA [all of its cache] or Intel purposely turns half the cache off," says Keith Difendorff, editor in chief of *Microprocessor Report*.

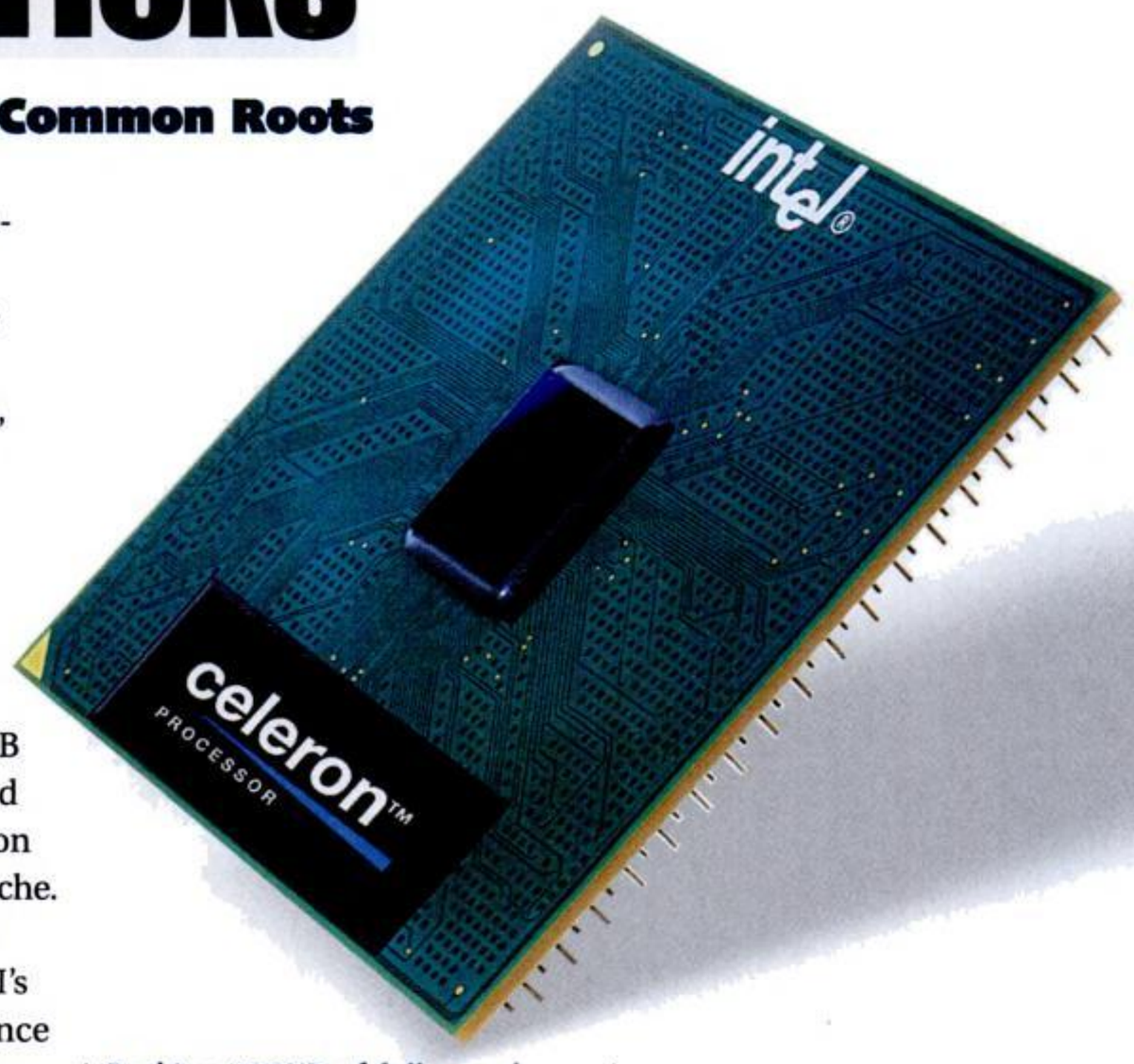
Surprised? Don't be. Technology analysts say it's no surprise that computer companies sometimes sell what are essentially two versions of the same product, but at different prices. It's called marketing, and it's the way the industry works.

"There are perfectly legitimate reasons for doing those kinds of things, and the net of it is largely good for consumers, not bad for them," Difendorff says.

Intel's mantra has long been, "One core, multiple uses." By leveraging economies of scale across its entire lineup, Intel can offer cutting-edge technology at relatively reasonable costs. For example, the same essential P6 core anchored the Pentium II, the Xeon, and the Celeron, but each package had its own traits. The P-II and Katmai P-IIIs used 512KB of external cache at half speed. The Xeon included extra management features and up to 2MB of L2 cache at full speed. And the "A" versions of the Celeron featured 128KB of on-die cache.

Of course, the Celeron's 128KB of L2 versus the P-III's 256KB isn't the only difference between the two chips. The flip chip Celeron is locked down to a 66MHz system bus, and lacks the P-III's controversial processor serial number feature that attributes unique IDs to every CPU. But the advent of on-die cache renders the difference between a P-III and a Celeron less obvious, so the money Intel once spent adding external cache to the P-II and P-III is now spent disabling the on-die cache on the Celeron.

That Intel would put resources toward making a Celeron perform slower than a P-III sounds odd, but analysts say that it's only because Intel can sell P-IIIs for $800 and Xeons for $1,500 that the company can afford to sell Celerons at all.



Packing 128KB of full speed cache, the 0.18-micron Celeron may be more similar to the P-III than you think.

The whole scenario is reminiscent of Intel's 486SX, which began as a 486DX with a disabled math co-processor. Disabled or not, the co-processors all cost the the same amount—yet Intel sold the SX for less than half the price of the DX. To save money on the die, Intel did eventually eliminate the co-processor from the SX, but most remember the chip for its controversial first iteration.

As for the current flip chip flap, keep in mind that, though the Celeron's core is based on the P-III core, the two chips don't necessarily match in overall functionality. And enabling the Cellie's disabled portions isn't a matter of simply throwing a switch, because modifications are made with lasers at the die level.

SPIN CYCLE

This month's top stories broken down ►

HEADLINE	NEWS	DETAILS	THEIR SPIN	OUR TAKE
New Technology Promises 50x Speed Increase for Broadband	Texas-based Advent Network says it's preparing to test a high-speed cable technology that will offer more than 50 times the bandwidth of DSL.	Dubbed UltraBand, the patented technology can scale up to 40Mbps and beyond over a hybrid fiber coax cable.	"UltraBand enables streaming media companies to become interactive television broadcasters."	We feel the need for speed, but doubt we're going to get it from this promising technology anytime soon.
Return to Doom	John Carmack and the crew at id Software will turn their efforts toward creating an updated version of *Doom*.	*Doom*, released in 1993, is arguably the father of modern first-person shooter games. It set a new standard for videogame violence.	"id Software forever changed computer games with the *Doom* franchise, and only id can carry on the cultural and technical tradition of the original masterpiece."	Our scatter guns are locked and loaded, and we can't wait.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

Intel isn't the only company acting as a change-up artist; analysts say that AMD pulled the same stunt with its 486 CPUs. And other fabrication companies, including IBM, Motorola, and Sun, also engage in the practice.

What do consumers think about it? Some who are buying the less expensive Celerons are annoyed. After all, if the company can sell the chip at the lower price point, why can't the entire die remain enabled? It's not as though any features are being added to the costlier chip.

But some see it the other way around. "You have to realize that in the whole industry, there is not a very strong correlation between die size or manufacturing cost and the price of the unit," Difendorff says. "It's a very, very weak correlation. There are lots of DSPs that have enormous die sizes."

Analysts say that to meet market demands, Intel disables half of the 256KB L2 on P-III CPUs.

"We're bringing a lot more to the table than just megahertz and price," says Intel spokesman Seth Walker. "We're bringing performance and we're bringing features." He argues that the shared core means that the FC-PGA Celeron can offer the SSE instruction set and advanced transfer cache. A 600MHz FC-PGA is up to 56 percent faster than the older Celeron, "all at the exact same price that we were asking for the older technology," says Walker.

"It's not a lot different than American Airlines selling first class seats for $1,000, and economy for $300, and maybe booking some tours where people are paying $100," says Insight64 chip analyst Nathan Brookwood. "You can argue that they're all getting to the same destination at the same time."

If you feel as though you're getting the shaft-end of the deal, blame the high-end performance market—research-and-development dough is spent where people are willing to pay more. Cyrix and WinChip are examples of what happens when a company just sells low-cost CPUs—both have failed.

"A vendor has a responsibility to shareholders to try to get the maximum amount it can. Customers have a responsibility to buy the right product," Difendorff says. "It's just the way the system works."

Thunderbirds Are a Go!

AMD's Latest CPU Packs Punch

Emergency message from International Rescue to AMD: Your external memory cache is expensive. It's killing your performance at high frequencies. Suggest you trade the closely coupled L2 for on-die cache, before the competition mops the floor with you.

AMD to IR: Send help now and scramble all Thunderbirds!

Life isn't a Gerry Anderson super-marionette TV series, but if it was, AMD's team of marionette engineers would be working overtime. The company's just-released sequel to its Athlon CPU boasts the on-die cache and copper interconnects that put it on par—and maybe then some—with Intel's best and brightest.

Codenamed Thunderbird, in honor of the classic American car of the same name (not in honor Anderson's famous puppet sci-fi series), AMD's new CPU integrates 256KB of Level 2 cache directly into the core. Even better, says AMD, is that the cache is mutually exclusive, which means that data in the L1 will not be duplicated in L2 cache, equipping T-bird Athlon's with an effective cache amount of 384KB—128KB of L1 and 256KB of L2—at full clock speed.

AMD's Thunderbird will carry the Athlon name, followed by the tagline, "Performance Enhancing Cache Memory." Initial versions of the chip will come from AMD's new Dresden, Germany plant, and from the company's plant in Austin, Texas. However, only the Dresden plant will produce chips with copper interconnects; for now, the Texas plant will continue to churn out chips with aluminum interconnects. AMD says the differences will be nil at current clock speeds. The 1GHz Athlon with on-die cache is priced at $990 in lots of 1,000. The 950MHz Athlon runs $750, the 900MHz costs $589, the 850MHz rings in at $507, and the 800MHz will set you back $359.

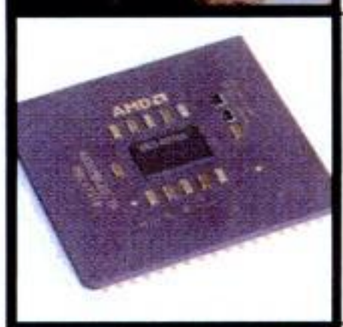
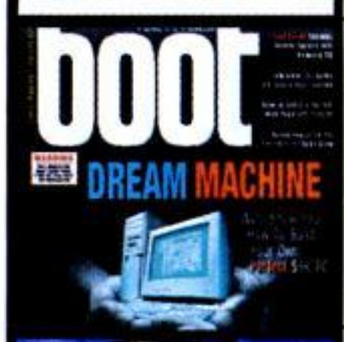
to the pertinent details.

◀ 18

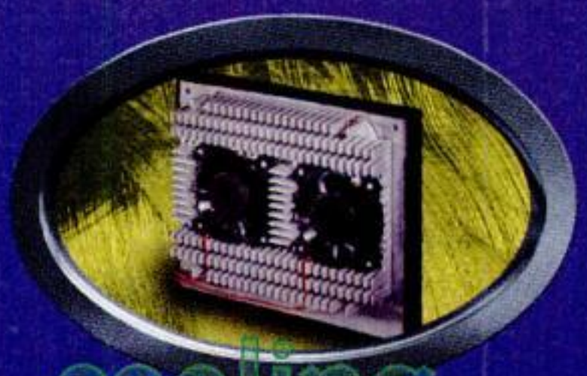
HEADLINE	NEWS	DETAILS	THEIR SPIN	OUR TAKE
DDR Preps for Launch	As if the current memory options weren't confusing enough, Double Data Rate SDRAM may hit the retail shelves as soon as this year.	DDR SDRAM, which sends two bits of data per cycle instead of one, is expected to give Direct RDRAM a serious run for its money.	"DDR266 is a sensible evolutionary solution for the PC industry..."	DDR will become a reality. The question is, what will happen to RDRAM?
Quantum Finalizes ATA/100	Quantum has officially announced the arrival of ATA/100, the follow-up to ATA/66 that ups maximum EIDE transfer rates to 100MB/sec.	By fine-tuning the spec, Quantum believes that the interface will be ready to take advantage of the faster drives that are due out next year.	"ATA/100 has the bandwidth capacity to ensure that the hard disk-to-host data transfer pipeline does not become the albatross limiting next-generation system performance."	You don't need to dump your ATA/66 controller for ATA/100 until you get a next-generation hard drive.

Worth Its Weight?

For about $58, you can get an ounce of Beluga Caviar. An ounce of gold will set you back $271. Precious gems, fine foods, illicit drugs—all high-ticket items, and all valued according to their weight. Which made us wonder how much, say, Bill Gates was worth. By our estimates, he'd fetch about $182 million per ounce—assuming he's laying off the fried foods. Herewith, the cost-per-ounce of some of the most sought-after items to be had in this world, and our verdict on whether each is actually Worth Its Weight.

	Item	Price Per Ounce	Our Take
	**2568MB PC800 Rambus RIMM**	**$1,000/ounce**	Per ounce, a stick of Direct RDRAM costs more than black tar heroin or gold. Hell, it's even more expensive than that crazy-ass Voodoo5 6000 board. **Verdict:** Not worth it. Unless we start seeing truly blazing performance and lower prices, RDRAM may become the most costly paperweight in recent memory.
	**Marlon Brando[1]**	**$769/ounce**	Don Vito Corleone, Stanley Kowalski, and Colonel Walter E. Kurtz, all rolled up into one big jelly roll that's been deep fried in butter. **Verdict:** Worth it. We don't know why the game industry hasn't yet exploited this great resource.
	**1GHz Thunderbird Athlon (PGA version)**	**1,650/ounce**	AMD's most powerful chip to date, this über-K7 packs 384KB of on-die cache. Plus, you can actually buy it—unlike some other vendors' Gigahertz CPUs. **Verdict:** For alternative silicon fans, kicking sand in the face of Intel users is priceless. Worth it.
	**Voodoo5 6000**	**$9.37/ounce**	Packing four VSA-100 chips and a funky external power brick, 3dfx's Voodoo5 exemplifies the philosophy that more is better. In this case, that means more silicon, more PCB, and more memory. **Verdict:** Worth it. As silly as the board looks, it packs major firepower.
	**Cocaine**	**$650/ounce**	Drug of choice during the Boy George years. **Verdict:** Not worth it. Terribly passe, and hey, who needs a brain hemorrhage?
	**15,000rpm Seagate Cheetah Hard Drive**	**$36/ounce**	"Fuh-fuh-fift-t-t-t-eeeen hundred RPM!" Nothing comes close to PC nirvana like cutting-edge technology. **Verdict:** Worth it. We can name 15,000 reasons why.
	***boot* #1 in polybag with CD**	**$0.81/ounce**	The all-time muscle PC mag, *boot* was a classic in its time. **Verdict:** Worth it because we say it is.
	**Saline Breast Implant**	**$437/ounce**	The government says they're safe as pie, and who are we to argue? **Verdict:** Worth it. They made Pamela Anderson Lee a star—imagine what they could do for you!

[1] Price based on $4 million fee for appearing in *Superman The Movie* and weight based on that during the filming of *Apocalypse Now*.



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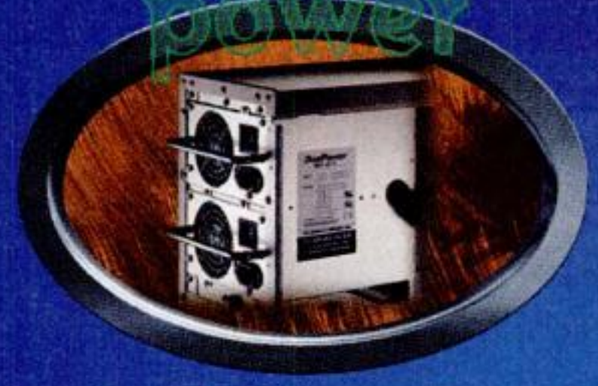

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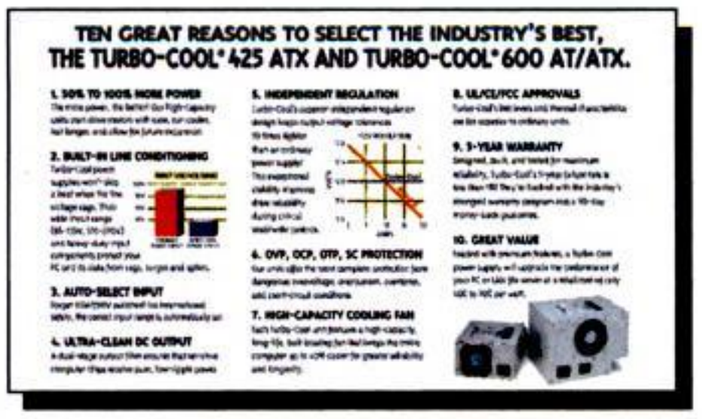

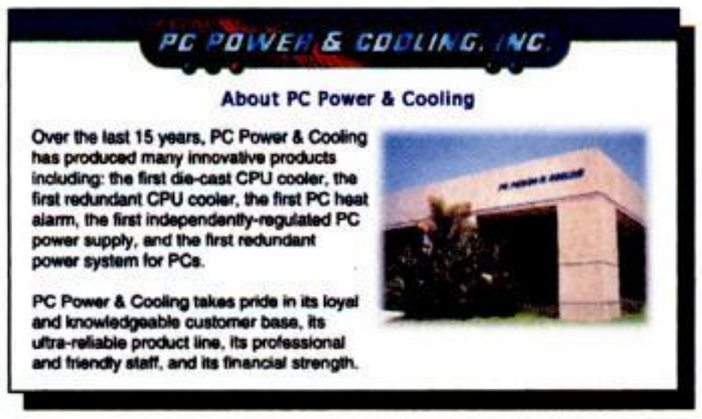

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▶ **Maximum PC takes a bite out of bad service and gear**

WATCHDOG

Got a bone to pick with a vendor? Been spiked by a fly-by-night operation? Sic The Dog on them by writing Watchdog @maximumpc.com. The Dog promises to get to as many letters as possible, but only has four paws to work with.

NOT SO SMART AND FRIENDLY?

DEAR DOG: My friend and I are having major problems with Smart and Friendly. I bought a 2/2/24 CD-RW drive from the company about a year ago. A few months later, the drive went haywire—it would fail to recognize any CD. Smart and Friendly replaced the drive, but the second drive went bad as well. I spoke with a technician who said the company would overnight a new 4x CD-R SCSI as a replacement. It never arrived. I have frequently tried to call and e-mail the rep, but to no avail. Neither Smart nor Friendly, if you ask me. I think The Dog needs to step out of the house and take a bite out of this ridiculously unprofessional business.

—Lucien Freeman Jr.

THE DOG RESPONDS: Lucien was one of a handful of customers who barked to The Dog about Smart and Friendly's tepid response. The problem was undoubtedly related to financial problems between the company and its creditors: In April, Smart and Friendly's main lenders abruptly shut down the operation after the discovery of an accounting error that affected the company's profits.

Though Smart and Friendly says it was current on all of its payments, "The banking syndicate responded by declaring the loan in default, freezing Smart and Friendly's credit line, and requesting the turnover of possession of the company and its assets," Smart and Friendly officials said in a written statement to The Dog. At one point, Smart and Friendly's creditors had the company's employees locked out of the building, which probably caused the lack of customer support that Lucien wrote about.

At that point, Smart and Friendly had no choice but to file Chapter 11 in order to regain control of the company. The company reopened, and officials promised to address *Maximum PC* readers' problems. Within weeks, however, Smart and Friendly fell apart once more.

"The Chapter 11 was set aside," Sam Perry, president of Smart and Friendly, told The Dog. Perry declined to comment on why creditors were so hot to liquidate the company, but did say that he hoped customers were not hurt by the closure.

Those seeking repairs on Smart and Friendly drives may get relief from the drives' actual manufacturers. Perry said that Smart and Friendly's 12x and 8x drives were manufactured by Sanyo, its 6x drives were made by Ricoh, and its 4x drives were made by JVC or Teac. Most of Smart and Friendly's drives carried FCC ID tags; to find out who manufactured your drive, grab its FCC ID number and visit www.fcc.gov/oet/fccid/.

Creditors have rendered Smart and Friendly inoperable.

IBM RECALLS NOTEBOOK ADAPTERS

IBM is recalling more than a quarter-million AC adapters that were included with some IBM notebooks, because the adapters may overheat and cause a fire.

The voluntary recall affects AC adapters sold with ThinkPad 310 (type 2600), ThinkPad I-series (type 2611), and WorkPad z50 (type 2608) notebooks. IBM sold about 330,000 of the adapters worldwide; about 220,000 of the defective units were sold in the United States. Nine cases were reported of the adapters getting excessively hot, and in one instance, the AC unit sparked a minor fire. The units were sold between May 1997 and November 1999.

To find out if your AC adapter is affected, look on the bottom of the adapter next to the bar code label. Check the four-digit type number against those listed above (the type number is followed by a three-digit model number and a seven-digit serial number), and check the adapter's FRU numbers. Affected adapters bear one of the following FRUs: 12J0537, 12J0539, or 02K6562.

If your adapter is one of those affected, IBM advises you not to leave it plugged into a power socket if unattended. The company also says it will replace the adapter free of charge. Contact IBM at www.ibm.com/adapterrecall, or by phone at 800.426.3387.

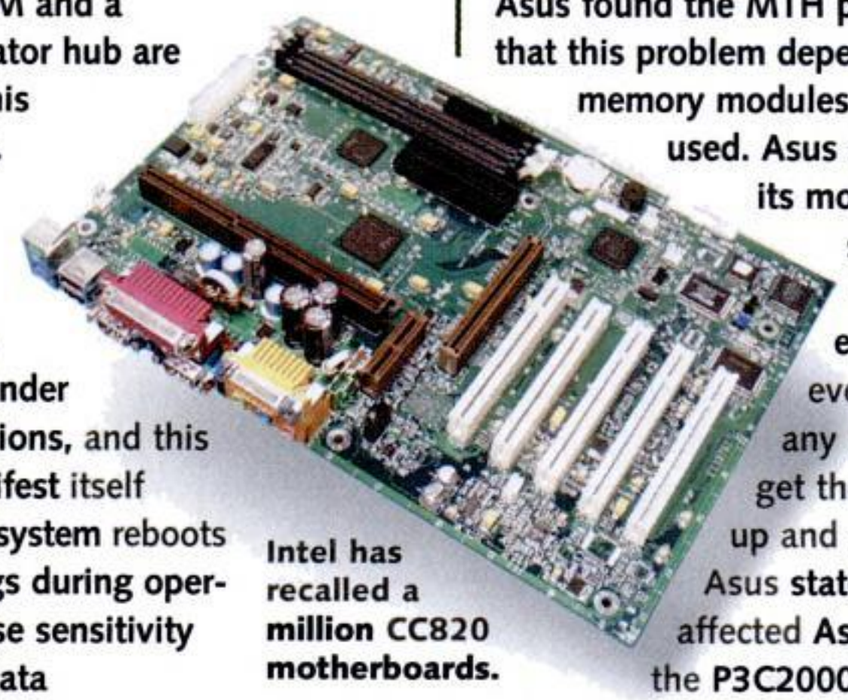
INTEL MEMORY PROBLEMS

Are you experiencing spontaneous reboots, stalls, or lockups with your OS? If your motherboard uses an Intel CPU and memory translator hub (MTH), your OS may not be the problem.

In a wide-ranging, multimillion-dollar gaffe, Intel has recalled some one million 820-series motherboards that

use SDRAM memory. The recall does not affect Intel mobos that use expensive Direct RDRAM memory—only those that use SDRAM and a memory translator hub are in the eye of this growing storm.

"...Some boards using the MTH may be sensitive to system noise under extreme conditions, and this issue may manifest itself in intermittent system reboots or system hangs during operation. This noise sensitivity may result in data loss and/or corruption," said an Intel statement.



Intel has recalled a million CC820 motherboards.

Intel officials have said that the flaw may not affect all SDRAM 820 motherboards, but because the company is unable to say which boards are affected, it's recalling all of its CC820s, a.k.a. Cape Cod 820 boards. The company is offering customers a refund or a replacement VC820 Vancouver board with a single 128MB PC700 Direct RDRAM memory module—a pretty sweet deal, considering that a single 128MB RDRAM module fetches about $600.

"Some boards using the MTH may be sensitive to system noise under extreme conditions, and this issue may manifest itself in intermittent system reboots or system hangs during operation."

Intel consumers who believe their board is one of those in question are advised to first contact the store that sold them the system or motherboard, and to visit www.intel.com/support/mth/ for more details.

Intel's replacement offer extends only to those customers who purchased Intel-packaged motherboards. Those with an Intel CPU and MTH on a non-Intel motherboard are asked to contact their motherboard vendors for advice.

Not every motherboard company that has employed MTHs is being as cautious or generous as Intel. Though Asus pledged to rectify the MTH problem on its own boards, the popular motherboard maker is telling customers that the majority of its motherboards simply won't experience problems.

"Of the few [motherboards] on which Asus found the MTH problem, Asus found that this problem depends on the type of memory modules and power supply used. Asus strongly feels that its motherboards are stable enough to prevent the end-user from ever experiencing any problems once they get their motherboards up and running," read an Asus statement. Potentially affected Asus boards include the P3C2000, CUC2000, CUC200-M, and P3C models using the DR1 or DR2 DIMM risers. All of these boards feature the MTH. So far, there's been no mention of refunds, but Asus is reportedly getting financial assistance from Intel in order to compensate customers. And the company has decided to retire products that use the MTH.

Board maker Giga-Byte is taking the same approach with its GA-6CXC, GA-6CXC7, GA-6CMC7(R), GA-6CXC7-H motherboards. Giga-Byte says it sold thousands of units without any complaints and believes the boards are stable, but is retiring them nonetheless. Like Asus, Giga-Byte has yet to make a public statement regarding refunds.

Is Intel being overly cautious, or are Asus, Giga-Byte, and other motherboard vendors being too optimistic? For its part, Hewlett-Packard isn't taking any chances with its XM600 or XU800 Kayak-series of PCs that use the 820 and MTH. The machines use Asus motherboards, with riser cards for the memory subsystems that can be configured with either SDRAM or Direct RDRAM. For those with SDRAM, HP is recommending a quick fix.

"HP will upgrade the memory in Kayak XM600 and Kayak XU800 to the higher-performance RDRAM, free of charge. The upgrade will be performed through onsite scheduled visits," HP says.

Of course, The Dog has to ask: If Intel is willing to recall one million boards and HP feels the issue is serious enough to warrant replacing the memory on its Asus boards, why don't all motherboard makers feel similarly compelled? Are other motherboard vendors taking an intentionally myopic view? Let The Dog know if you're irked that you're not getting a replacement board or memory out of your vendor. Woof.

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PERIPHERAL VISION

Arcadia T-Series AR3.2T 32-inch Monitor

Twenty-one inch monitors are great…if you live in a van down by the river and can't afford a real monitor, that is. For true power users, a 32-incher is the only way to go. Of course, you'll have to rearrange your house to fit the thing somewhere, but the extra screen real estate is well worth it. Although it looks like a television, the Princeton Ar3.2T (**www.princetongraphics.com**) is actually an invar shadow mask monitor, complete with a 32-inch viewable surface and 0.74-0.77mm variable dot pitch. It's HDTV-ready, supporting both 1080i and 720p formats, and includes a built-in TV tuner that connects to VHF/UHF antennas, cable boxes, and satellite dishes. Within minutes of connecting it to a test system, we had *Unreal Tournament* running—to gauge image quality, of course. Yeah, that's it, image quality. Naturally, the monitor is ideal for games, running resolutions all the way up to 1024x768 and kicking out decent sound from the twin 18W speakers flanking the massive screen. Two words describe this monitor: big and beautiful. **$2000 | Princeton Graphics**
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How many times have you been on the phone while surfing the web, and found yourself thinking, "I wish I could integrate my phone with my mouse." Well, today is your lucky day. The Mouse Phone (**www.transnet-inc.com**) is "a new communication concept in computer times," according to the product's press material. It performs like a standard two-button PS/2 mouse, and includes a Y-plug that connects to your PS/2 port and to the analog line of your modem. Once connected, no special drivers are required—just insert the earphone, hit the "hand free" button, punch in the digits, and you're in business. We checked out the translucent, aqua-colored, two-button mouse, but the company also offers a scroll-wheel version and a variety of case colors, including black, purple, and pink. It takes some time to get used to people saying, "Hey, your mouse is ringing," but it's easy to adapt. **$30 | Trans-net Buy www.SeeMeBuyMe.com 877.751.7467 ID#0801**

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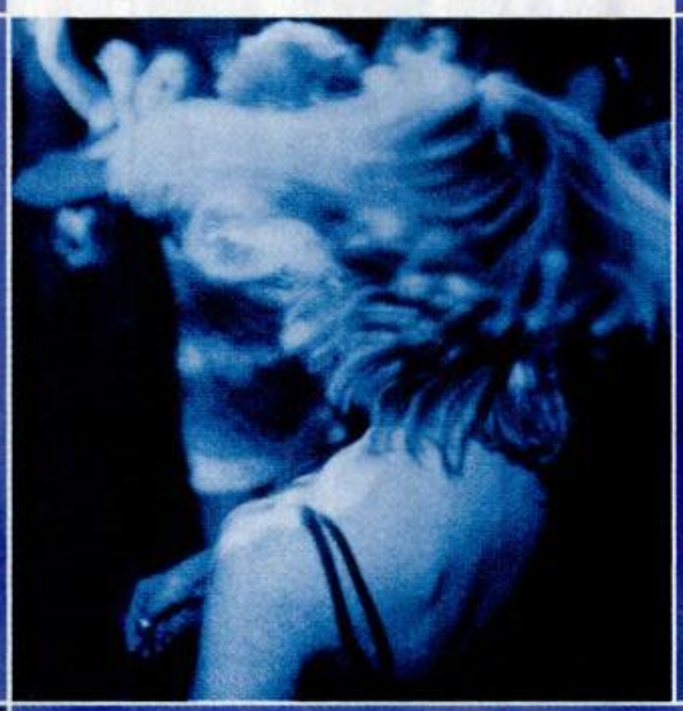
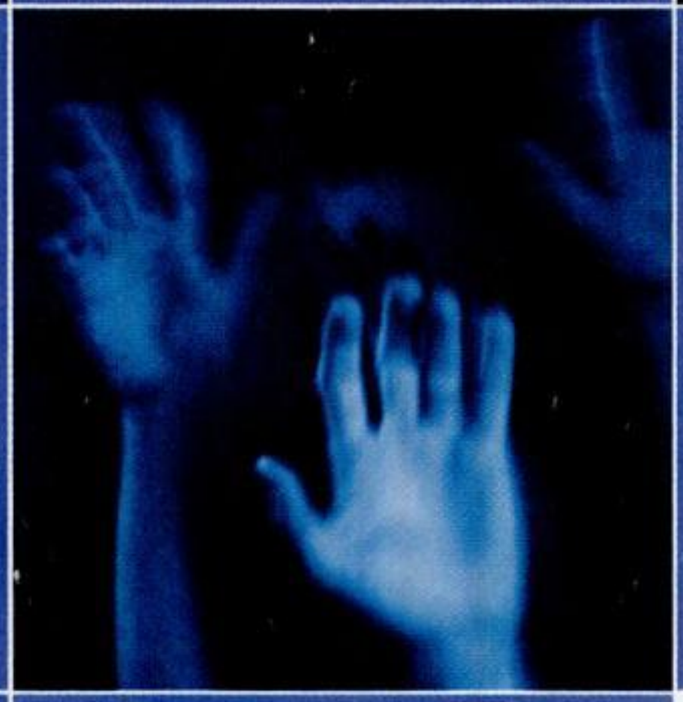


DIGITAL AUDIO



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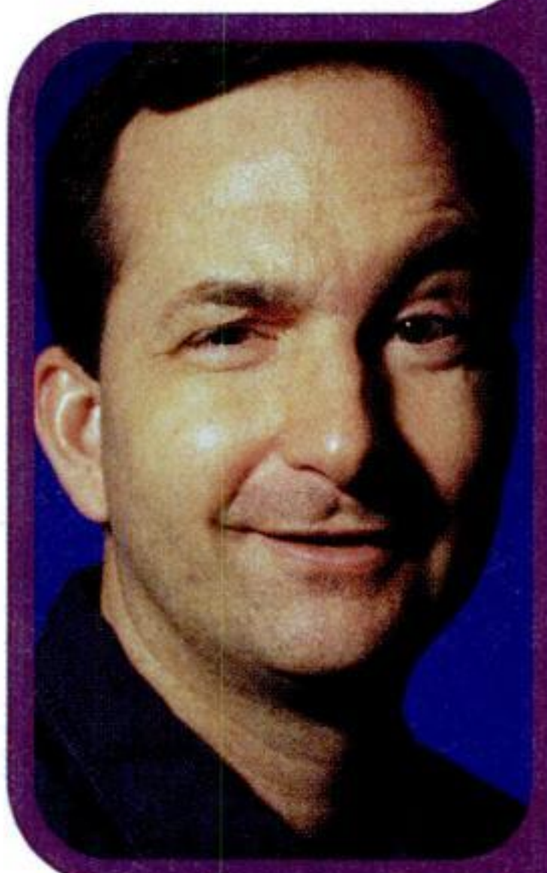

TOM HALFHILL
was senior editor at *Byte* magazine and is regarded as one of the most knowledgeable experts on processor technology in the industry. Contact him at **thalfhill@maximumpc.com.**

Why FireWire Won't Catch On

ONCE AGAIN, INDUSTRY POLITICS DOUSE TECHNICAL WIZARDRY

Gigahertz processors hog all the attention, but there's nothing like a warp-speed disk drive to make a computer seem wicked fast. When you double-click on a program icon and see the splash screen burst into view like an express train roaring out of a dark tunnel, even a PC with a pokey CPU seems like a hyperactive wonder.

The best PC builders try to make balanced systems. Attaching a gigahertz processor to a turtle of a disk drive is a waste of expensive silicon. That's why it's important to have high-speed peripheral interfaces that can keep up with the primo CPUs.

A few years ago, it seemed as though the industry hit upon an interface for the future: FireWire, officially known as IEEE 1394. FireWire was an innovative attempt to replace such aging standards as the Centronics printer interface (now known as IEEE 1284), IDE (ATA), and SCSI. Those older standards are called parallel interfaces because their cables have numerous wires running side by side; each wire carries the signals for one bit-stream of data. In contrast, a serial interface such as RS-232—the standard for your PC's COM ports—carries all the data on a single wire (although additional wires are needed for error correction and other purposes). All other things being equal, a parallel interface is faster than a serial interface for the same reason that an eight-lane superhighway is faster than a one-lane road.

Of course, all other things aren't always equal. Among other changes, ever-shrinking chips have meant less real estate for the numerous connections needed by wide parallel interfaces. FireWire, a serial interface adopted in 1995 by an industry-standards organization (IEEE), was the proposed solution. FireWire supports hot plugging of up to 63 devices per chain, and data-transfer rates of 100, 200, and 400 megabits per second (Mbps). To put that into perspective: IDE ATA/16, a rival standard at the time FireWire was released, delivered 128Mbps to two devices without hot plugging. ATA/33 delivers 264Mbps. Fast-Wide Ultra SCSI reaches 320Mbps.

Unfortunately, good technology and PCs sometimes go together like Napster and Metallica.

Unfortunately, good technology and PCs sometimes go together like Napster and Metallica. One problem with FireWire is that it isn't PC—politically correct, that is. FireWire was invented by Apple. Some Wintel PC companies don't like the idea of Apple earning royalties from their products, even though Apple's share is paltry (about 25 cents per machine). And some PC companies just didn't predict the need for such a fast interface.

FireWire also lost the crucial support of Intel, the leading manufacturer of core-logic chipsets. Without FireWire interfaces built into chipsets, PC makers must put separate FireWire chips on their motherboards or add a FireWire PCI card. That costs much more than Apple's royalties. Intel decided to throw its weight behind its own solution, USB, even though FireWire is up to 33 times faster.

One advantage of USB, from Intel's point of view, is that it requires a PC somewhere in the chain, whereas FireWire is a peer-to-peer standard that doesn't require a PC as a hub. With FireWire, you can plug a digital video camera directly into editing equipment or into another camera—not an appealing trait if you make money from PCs. Intel designed a chipset with FireWire but never released it, claiming a lack of demand.

Today, everybody recognizes the need for a high-speed serial interface such as FireWire. But Intel is promoting USB 2.0, an upgrade of today's USB 1.1 standard, and Serial ATA, an upgrade of the parallel ATA/66 standard. USB 2.0 hits 480Mbps, which is faster than the original FireWire and 40 times faster than USB 1.1. Serial ATA starts at 1,200Mbps and scales up. But USB 2.0 and Serial ATA won't be ready until 2001, and FireWire is evolving, too, with 800Mbps and higher speeds on the horizon.

Although FireWire is catching on for digital video, it will never be a popular PC standard. Sony (which uses the term i.LINK to describe FireWire) and other companies build FireWire ports into DV cameras and similar equipment. Some of Apple's iMac and G4 computers also have FireWire ports. But even Apple isn't replacing internal SCSI and IDE interfaces for disk drives with FireWire. The relative scarcity of FireWire drives makes them more expensive.

That's a shame, because FireWire once had a bright future. It's another good idea that was too far ahead of its time. ✹

Random Thoughts

▶ The CPU2000 benchmarks from SPEC (Standard Performance Evaluation Corp.) are the first updates to the CPU95 benchmarks released in 1995. To find CPU2000 scores for your favorite processors, go to **www.spec.org/**.

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▶THE SCOOP FROM A MAJOR PLAYER

GAME THEORY

Beyond the Looking Glass

ONE OF GAMING'S MOST TALENTED DEVELOPERS IS NOW DEFUNCT. WHY?

Looking Glass Studios, consistently among the most innovative and interesting game developers in the world, is now dead. When a company this old, established, and respected goes down, it pays to pause for a moment to consider just what went wrong.

Looking Glass' list of bad games is short; in fact, only *British Open Golf* comes to mind. Its string of hits reads like a Hall of Fame roster: *Ultima Underworld 1 & 2*, *Thief 1 & 2*, *System Shock 1 & 2*, the *Flight Unlimited* series, *Terra Nova*. But, however respected these games are by the gaming cognoscenti, critics, and hardcore fans, they never achieved blockbuster status—most were simply successful, and simple success was only enough to keep Looking Glass in business if it didn't make any mistakes. Which, of course, it did.

Creativity seems to go hand-in-hand with bad business decisions, and Looking Glass made its fair share. In fact, it's a bad business decision made several years ago that sealed Looking Glass' fate. At the height of its critical success, Looking Glass decided to self-publish its titles. *Flight Unlimited* did respectable business and made money. *Terra Nova*, despite sales in excess of 100,000 units, never earned out. *British Open* was a costly bomb that bled the company.

Looking Glass was left strapped for cash and at the mercy of investors. To save money, LGS jettisoned Warren Spector's off-site development wing—a shortsighted, and ultimately disastrous decision. The finest products to ever come out of Looking Glass had Spector's name on them, and his departure was ruinous to LGS. By cutting loose this irreplaceable talent pool, Looking Glass lost much of what had made it a success. Fine developers such as Doug Church stayed on, but the company simply didn't have enough people to helm complex projects. Looking Glass Studios—the developer's developer, the company comprised of the most respected game designers in the game community—was forced to send what was ultimately its finest title to an outside developer. *System Shock 2*, a brilliant, nearly-flawless game that bore all the LGS hallmarks, was created by Irrational Games. Certainly, LGS was involved in the game's development, but Irrational gets the lion's share of the credit.

Eidos attempted to save LGS, but was itself suffering the effects of a tightening game market and the loss of $40-plus million down a Texas toilet called Ion Storm.

Working with a better marketing department, Looking Glass bounced back a bit with the financial success of *Thief* and *System Shock 2*. But *Flight Unlimited III* and the long-delayed *Jane's Attack Squadron* ate into this money, leaving the company strapped once again, and fishing for a new deal. *Deep Cover*—a co-production with Irrational—was started and shopped, but for complex reasons, the deal eventually fell apart. Eidos attempted to save LGS, but was itself suffering the effects of a tightening game market and the loss of $40-plus million down a Texas toilet called Ion Storm.

It's tempting to say that Looking Glass tanked because it was different, or because it was innovative. I've covered this company as a writer since the days when it was called Blue Sky. In my deep respect for LGS, I began this story expecting to rail against an industry that punishes innovation. Research proved me wrong. As sales figures show, Looking Glass was, in fact, most successful when it innovated, as with *Ultima Underworld*, *Thief*, and *System Shock*. Though none were blockbusters, profits from these games was enough to keep Looking Glass afloat. Only *Terra Nova* could possibly bear out the "punishment of innovation" theory, but even that seems like a cheap way out. Poor marketing and distribution were as much, if not more, of a factor in *Terra Nova's* failure than was the game's uniqueness. In fact, Looking Glass' biggest failures were its non-innovative titles, such as *British Open* and the *Flight Unlimited* titles.

I planned for this column to prove that PC gaming is struggling because it has no room for new ideas. Looking Glass was to be my Exhibit A. The truth is, gamers *are* always looking for something different. Sometimes, it's just hard for marketing to convey a game's unique properties. It's this issue, and not a blinkered consumer mentality, that shuns originality and may account for the failure of some watershed games. Looking Glass is gone, and that's a shame for the workers out of jobs and for the fans deprived of the company's future work. But the reasons behind Looking Glass' demise are not so obvious. Those reasons say more about the tricky nature of running a game development house than they do about the people who buy the games. ✹

T. LIAM MCDONALD is a veteran gamer and game writer. His reviews appear regularly in *PC Gamer* and other publications. Write him at **tmcdonald@maximumpc.com.**

Random Thoughts

▶ *Old Man Murray* (**www.oldmanmurray.com**) wrote about a Croatian Game called *Serious Sam*. Despite never being sure when OMM is serious (particularly after reading the developer interview), I downloaded the test. Sure enough, this looks like an offbeat 3D shooter. Check it out at **www.croteam.com**.


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VIDEOCARD SMACKDOWN

By Sean Downey

Live… live… live…

From the *Maximum PC* Arena… Arena… Arena…

We bring you…the Ultimate Videocard Battle over frame rates and features!

Eight cards will face off to settle, once and for all, the fight over who is King of the 3D Ring. You'll see the biggest and baddest boards from the likes of nVidia, 3dfx, and ATI—all vying to prove their worth in the games and applications you actually use.

First up, the Steel Cage Match, in which the best cards of the past year—the Viper II, the Rage Fury Maxx, the Erazor X^2, the Neon 250, the Millennium G400 Max, and the Permedia3 Create!—butt heads in a Battle Royale. We'll analyze the strengths and weakness of each card, then pit them against one another, to help you determine which one belongs in your next PC. Each card is at the top of its class, offering more fill rates and features than last year's contenders did. These six cards will enter the Cage for a brutal showdown—they'll pummel, pound, and beat each other down, until just one is left standing.

Next, we have the Main Event—a no-holds-barred grudge match between the Voodoo5 and the GeForce 2. Both cards will get down and dirty when it comes to frame rates, features, and visual quality, but only one will emerge from this title bout as your champion of next-generation performance.

The time has come to separate the kick-ass from the candy-ass. Let's get ready to rrrrruuuuummmmble!

ILLUSTRATIONS BY RON MCPHERSON

VIDEO CARD SMACKDOWN

VIPER II

Powered by S3's Savage 2000 graphics processor and stocked with 32MB of memory, the Viper II can slam through two multitextured pixels with each tick of its 125MHz clock. The Savage 2000 equips the Viper II's two pixel pipelines with two texture units apiece, giving the chip a theoretical fill rate of 500 million texels per second.

A fill rate with that kind of heft should make multitextured gore fests, such as *Unreal Tournament*, look incredible. Unfortunately, poorly written Direct3D drivers don't take full advantage of the Viper II's hardware. And the Savage 2000's transform and lighting engine is busted beyond repair, causing unacceptable performance drops whenever T&L support is enabled. The Viper II initially shipped with drivers that didn't expose the card's geometry acceleration, but the drivers have since been updated with an on-and-off toggle for hardware T&L.

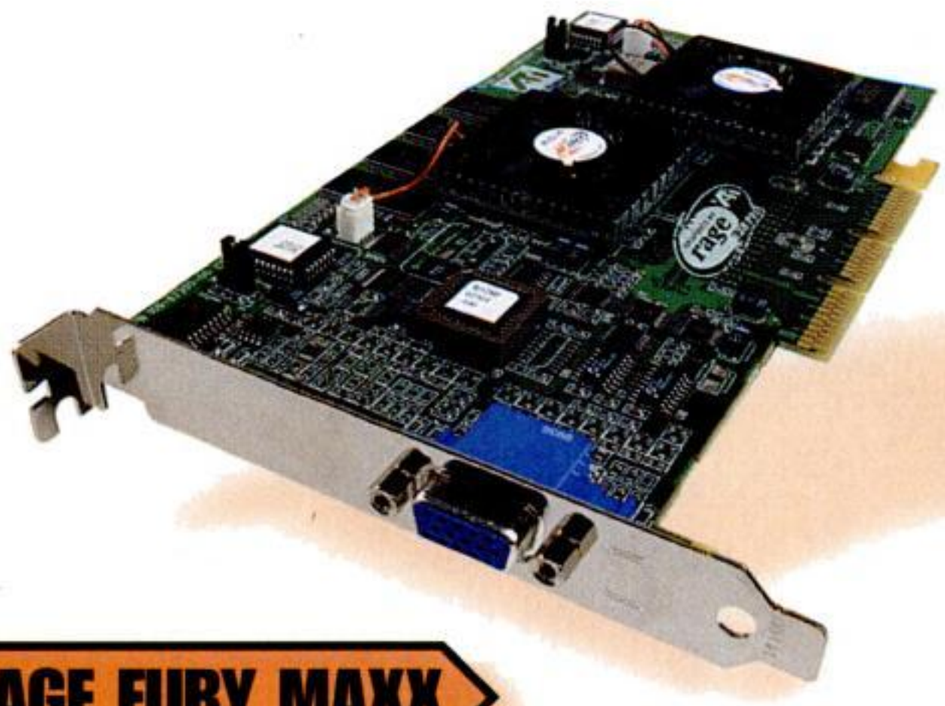
STEEL CAGE MATCH

Strengths: S3 deserves kudos for putting together a card that's free of the memory bandwidth problems that plague GeForce-based boards. On S3's hardware, frame rates at 32-bit color don't drop off at high resolutions—unlike nVidia's hardware. The Viper II also kicks out impressive DVD playback, and supports TV-out.
Weaknesses: With its Virge chip, S3 held the distinction of offering the first 3D-rendering *de*celerator. S3's Savage 2000 actually tops that achievement with the world's first geometry decelerator. Turning up the Viper II's geometry "acceleration" resulted in a significant frame rate slowdown in every T&L benchmark we ran. We were also treated to some ugly visual anomalies in *Quake III* and *MDK2* when T&L was enabled.
Match Results: The Viper II walloped the Erazor X^2 board in our *Quake III* quaver and *MDK2* benchmarks, but Elsa's GeForce DDR board and ATI's Rage Fury Maxx took the Viper II to the mat in every other test. In Direct3D games, the Viper II essentially kept pace with the Millennium G400 Max. Blame it on immature drivers, because the hardware should be capable of much more than that. *Received a 7 verdict in the February 2000 issue.*

$179; S3/Diamond; Buy SeeMeBuyMe.com | 877.751.7467 | ID#0804

VIPER II BENCHMARKS	
Quake III demo001	32.9fps (29.4fps)[1]
Quake III quaver	49.6fps (41.3fps)
MDK2 demo	75.4fps (59.3fps)
Expendable demo	48.9fps
3DMark2000 game 1, 16-bit	31.6fps (23fps)
3DMark2000 game 1, 32-bit	20.1fps (16.4fps)
SYSmark2000 Graphics Apps	576

[1] Scores in parentheses are with the Savage 2000's hardware T&L turned on.
See page 48 for benchmark settings.



RAGE FURY MAXX

The Rage Fury Maxx is a rendering tag team living in the body of a single videocard. It divides its workload between two Rage 128 Pro graphics processors, which render alternate frames. The card's driver ensures that one processor is always busy crunching new data while the other is spitting the current frame onto the screen. The card is stocked with 64MB, which the graphics processors divvy up so that each has its own 32MB frame buffer.

Multi-chip architectures are difficult to pull off in an AGP videocard, since the AGP protocol doesn't support multiple devices. The Voodoo5 is forced to run in PCI mode because of this restriction, but ATI gets around it by tricking the OS into seeing each chip as a separate device—one AGP and the other PCI. This is presumably why ATI can't get the Maxx to work in Windows 2000.

The disadvantage of the Maxx's AFR technology comes into play when one processor renders ahead of another, resulting in herky-jerky frame rates as the processors struggle to get back into sync. ATI has done a good job of smoothing out the frame rate bumps, but this problem is still noticeable in some games.
Strengths: The Rage 128 Pro chips were built to run games in 32-bit color, so there isn't a huge difference between 16-bit and 32-bit performance. The Maxx also has excellent hardware support for MPEG-2 decoding, making your old hardware decoder unnecessary.
Weaknesses: The Maxx's AFR technology is less elegant than the Voodoo5's programmable SLI. AFR isn't good at balancing the load between processors, resulting in occasional frame rate stuttering. In addition, the Rage Fury Maxx works only with Windows 98.
Match Results: Both the Erazor X^2 and the Viper II gave the Maxx a working over in our Quake III benchmarks, especially in the quaver timedemo. Since the Maxx isn't very efficient at texture management, it was reduced to nothing by the massive load of textures which abound in quaver. The Maxx fought back in *MDK2*, and absolutely dominated in our *Expendable* benchmark, where it put out the best score of any card we tested. *Received an 8 verdict in the March 2000 issue.*

$200; ATI; Buy SeeMeBuyMe.com | 877.751.7467 | ID#0805

RAGE FURY MAXX BENCHMARKS	
Quake III demo001	38.6fps
Quake III quaver	31fps
MDK2 demo	65.5fps
Expendable demo	78.2fps
3DMark2000 game 1, 16-bit	41.6fps
3DMark2000 game 1, 32-bit	35.5fps
SYSmark2000 Graphics Apps	576

See page 48 for benchmark settings.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

STEEL CAGE MATCH

NEON 250

Unlike the standard vertex-based rendering produced by other cards In this roundup, the Neon 250 does things a bit differently. Armed with a PowerVR Series 2 graphics processor, the Neon works its magic through tile-based rendering. This is the same technology that puts the dazzle in Sega's Dreamcast; in fact, the graphics processor in the Neon 250 is based on the Dreamcast's 3D chip.

While other 3D chips process all the triangles in a scene and then use a z-buffer to remove anything obscured from view, the Videologic PowerVR chip first considers what will or won't be visible onscreen, then breaks the scene into tiles that are independently processed and sent through the rendering pipeline. PowerVR's architecture is designed to pre-process each tile so that it renders only the foreground pixels—it doesn't render anything that would be obscured by a later pass.

Theoretically, this should give the Neon 250 an advantage, because it has no need for a z-buffer and requires only textures needed for the visible surfaces. The PowerVR Series 2 chip requires less memory bandwidth than other graphics processors and makes more efficient use of its clock cycles. Unfortunately, Videologic has failed to capitalize on these advantages—the Neon 250 ships with pathetic drivers and a mediocre clock speed of 125MHz for both the core and memory.

Strengths: The Neon 250's unique rendering architecture doesn't suffer the same memory bandwidth limitations that plague other cards. But it does suffer from a 64-bit memory interface.

Weaknesses: Overall, the Neon 250 is a waste of good RAM. Flaky drivers and temperamental hardware meant we spent a whole day just trying to get the damn thing to work. When we did finally get it running, the Neon coughed up horrible visual defects and low frame rates.

Match Results: In our benchmarks, the Neon was beat down by every card but the Permedia3 Create!. Since the Permedia3 is the 98-pound weakling of the group, that isn't much of an honor. *Received a 4 verdict in the January 2000 issue.*

$170; Imagination Technologies (Videologic);
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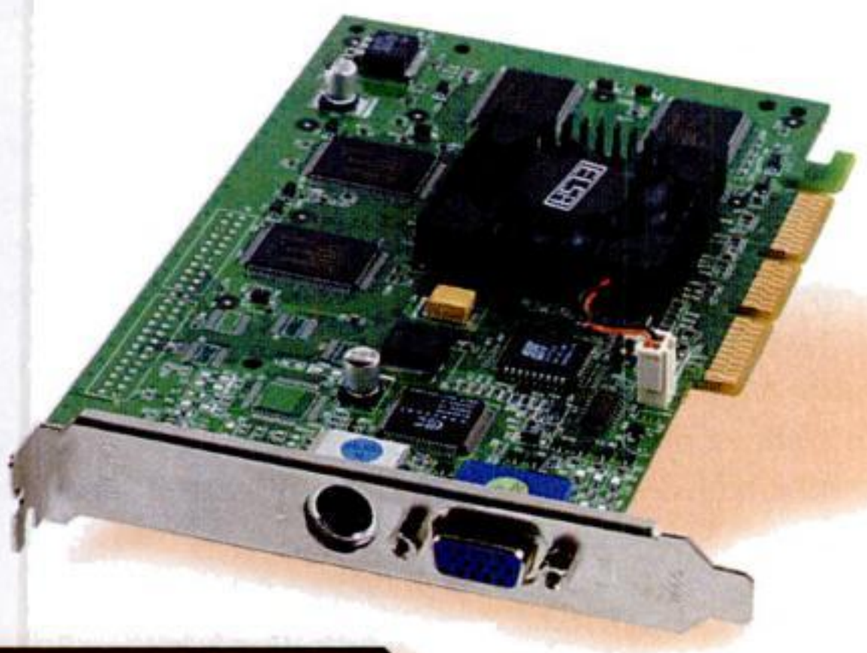
NEON 250 BENCHMARKS	
Quake III demo001	22.6fps
Quake III quaver	29.3fps
MDK2 demo	N/A
Expendable demo	47fps
3DMark2000 game 1, 16-bit	16.4fps
3DMark2000 game 1, 32-bit	14.1fps
SYSmark2000 Graphics Apps	559

See page 48 for benchmark settings.



ERAZOR X²

Equipped with nVidia's popular graphics processor, the Elsa Erazor X² represents the GeForce DDR team in this match. Since most 32MB GeForce DDR boards, including Creative's Annihilator Pro and the Hercules 3D Prophet DDR-DVI, closely follow nVidia's reference design, any one of them could easily stand in the Erazor X²'s place.

nVidia has packed its 23-million-transistor chip with a burly rendering architecture, and enough advanced 3D features to keep it ahead of the gaming curve—perhaps a little too far ahead. As the first consumer graphics processor to accelerate geometry transform and lighting, the GeForce is primed and ready to handle next-generation games that take advantage of this feature to increase polygon counts. Those games have been slow in coming—but, as the only graphics processor with a four-pixel pipeline, the GeForce is still a worthy contender. Unfortunately, high fill rates contribute to the chip's insatiable need for bandwidth. That's why cards such as the Erazor X² mate the GeForce with DDR memory. Double data rate (DDR) memory can transfer data twice each clock cycle, doubling the memory bandwidth between the graphics processor and local memory. Using DDR memory, the GeForce was King of the Ring until the GeForce 2 and Voodoo5 arrived.

Strengths: Quad-pixel pipelines give the GeForce the rendering versatility it needs to run single texture and multitexture games, at 32-bit and 16-bit color, with aplomb.

Weaknesses: The GeForce's fill rates saturate the memory bus at higher resolutions and color depths, which is why it needs DDR memory in order to reach its full potential.

Match Results: There wasn't a single card that matched the pile-driving force, blow for blow, of the Erazor X², but the Rage Fury Maxx managed to stay in the ring the longest. While the Erazor X² dominated the other boards in our *Quake III* and *3DMark* benchmarks, the Rage Fury Maxx managed to knock it down a peg in both *MDK2* and *Expendable*.

Received a 9/Kick Ass in the April 2000 issue.

$275; Elsa; SeeMeBuyMe.com | 877.751.7467 | ID#0807

ERAZOR X² BENCHMARKS	
Quake III demo001	43.7fps
Quake III quaver	49.2fps
MDK2 demo	63.2fps
Expendable demo	72.5fps
3DMark2000 game 1, 16-bit	53.2fps
3DMark2000 game 1, 32-bit	30.9fps
SYSmark2000 Graphics Apps	586

See page 48 for benchmark settings.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

VIDEO CARD SMACKDOWN

STEEL CAGE MATCH

PERMEDIA3

Powered by 3DLabs' own Permedia3 graphics processor, the Create simply lacks the fill-rate muscle needed to run anything but the simplest game at playable frame rates. The Create's dual-pixel pipeline is clocked at a pathetic 73MHz, and its 32MB of local memory runs at a bargain-basement 110MHz. But the Create does have a few tricks up its sleeve.

During each clock cycle, the Create's multitexturing engine can perform three separate operations on two different textures. That means it can pull off such fancy feats as dot product bump mapping in a single pass. It also has a unique virtual texturing feature that allows the chip to load just the parts of a texture that are visible in each frame, rather than loading the entire texture. This means less memory reads for each screen update and more efficient use of large high-quality textures, without bogging down the AGP bus with excess traffic.

The Create is here to remind us that we do other things with our videocards besides play games. With its strong OpenGL support and virtual-texturing versatility, the Create is really designed to be a graphics app accelerator. It's able to read portions of extremely large graphics in and out of memory as virtual textures, which keeps apps such as *Photoshop* from constantly shuffling data to and from the hard drive.

Strengths: The Create's innovative virtual texturing and versatile drivers make it an excellent choice for artistic types.

Weaknesses: Its excessively wimpy rendering engine pumps out fill rates that are woefully inadequate for today's games.

Match Results: Every card in the match took turns walking over the Create in our OpenGL and Direct3D benchmarks. That changed when we ran our *SYSmark* content-creation benchmark; the Create got a nice trophy to hold while it licked its wounds.

Received a 6 verdict in the December 1999 issue.

$159; 3DLabs; SeeMeBuyMe.com | 877.751.7467 | ID#0808

PERMEDIA3 CREATE! BENCHMARKS

Quake III demo001	10fps
Quake III quaver	13.3fps
MDK2 demo	15.4fps
Expendable demo	27.3fps
3DMark2000 game 1, 16-bit	14.7fps
3DMark2000 game 1, 32-bit	11fps
SYSmark2000 Graphics Apps	593

See page 48 for benchmark settings.

G400 MAX

The Millennium G400 Max is showing signs of age. Don't get us wrong, Matrox's G400 is an innovative graphics processor that delivers decent frame rates and excellent visuals. It just isn't powerful enough to keep up with the GeForces. The card's dual-pixel pipelines are clocked at 150MHz, providing just enough fill rate to remain somewhat competitive.

The Millennium does have some moves that no other card can match—namely, dual-display support and environment-mapped bump mapping (EMBM). EMBM increases surface detail through an extra "bump" layer that adds tactile effects, such as grains and grooves, to a texture. Its advantage over other bump-mapping techniques is that additional details aren't distorted when multiple light sources hit them, because all the height, depth, and light calculations are pre-calculated in the bump layer on a per-pixel basis, resulting in texture details you can almost reach out and touch.

The Max also supports independent output to two displays. Matrox pulls this off by rigging the G400 with two separate CRT controllers that fetch display data independently from the frame buffer. In conjunction with multiple display support from Windows 98 and Windows 2000, the Millennium can extend your desktop view across two monitors.

Strengths: The Millennium renders excellent visual quality and razor-sharp colors. Combined with the versatility of dual display support and the added detail of EMBM, the Millennium does its job in style.

Weaknesses: The G400's year-old architecture doesn't hold a candle to the latest cards from nVidia, ATI, or 3dfx.

Match Results: Matrox has put a lot of work into its OpenGL drivers, and it shows. Unfortunately, the card isn't fast enough to hold off the brute fill rates of the Erazor X^2 and Rage Fury Maxx. The Millennium held the middle ground in all of our benchmarks, but was the master of none.

Received a 9/Kick Ass in the September 1999 issue.

$209; Matrox; SeeMeBuyMe.com | 877.751.7467 | ID#0809

G400 MAX BENCHMARKS

Quake III demo001	22.9fps
Quake III quaver	30.7fps
MDK2 demo	57.2fps
Expendable demo	53.6fps
3DMark2000 game 1, 16-bit	30.4fps
3DMark2000 game 1, 32-bit	21fps
SYSmark2000 Graphics Apps	588

See page 48 for benchmark settings.

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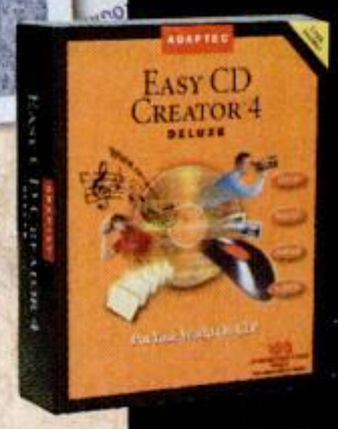

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VIDEO CARD SMACKDOWN

MAIN EVENT

The Voodoo5 and the GeForce 2 meet in a brutal grudge match to prove who's the boss of whom when it comes to visual quality and frame rates.

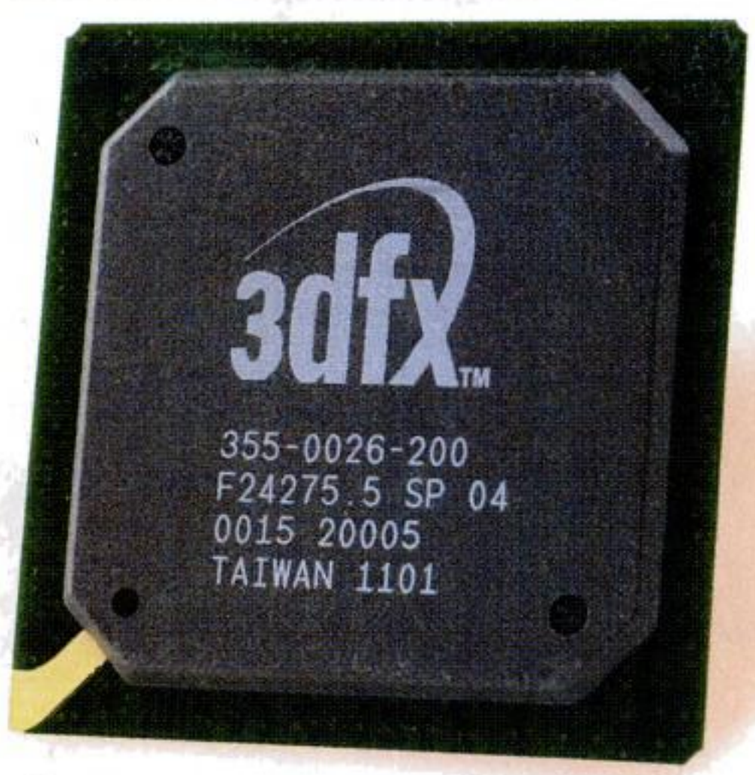
GEFORCE 2

As heir apparent to the King of the Ring title, the GeForce 2 fully realizes nVidia's GeForce architecture. nVidia prepared its new pixel-pushing powerhouse by dropping down to a 0.18-micron manufacturing process, allowing the GeForce 2 to run a faster core clock with a smaller die size and less power consumption. For all those GeForce owners who've struggled with motherboards that don't supply enough AGP voltage to power their monsters, the GeForce 2's reduced power consumption is a godsend. Unlike its predecessor, the GeForce 2 should be compatible with both Athlon and Pentium III motherboards.

The GeForce 2's 0.18-micron die runs at a 200MHz clock—a huge increase over the GeForce's 120MHz clock. The speed increase should translate into smooth frame rates, regardless of how complex a game's lighting effects and textures get. The faster clock also aids the GeForce 2's geometry processing power, doubling the T&L engine's triangle rate from 15 to 30 million triangles a second. Of course, the dearth of games that take advantage of hardware T&L means the GeForce 2's new geometry engine could go underused for a while.

That's why nVidia upped the transistor count of its new chip to 25 million, and added additional texture units. nVidia touts the GeForce 2's four pixel pipelines—each of which sports two texture units—as a gigatexel shader. And while the payoff from the new engine is huge in multitexturing environments such as *Quake III*, we have our doubts about the GeForce 2's texel shader capabilities. Programmable shaders allow game developers to specify the texture, illumination, or geometry of an object by writing a routine that calculates those characteristics on the fly. In order to handle these routines, a texel shader must have enough texture units available to do any combination of rendering operations in a single pass. Since the GeForce 2 is still limited to two operations per clock cycle for most mapping and blending functions, it's a bit less flexible than a true texel shader should be. Still, it's a definite step in the right direction, since programmable shaders are where 3D is headed.

VOODOO5



With 3dfx's enormous name recognition and retail popularity, the Voodoo5 is a shoe-in as the next people's champion. Built around 3dfx's new VSA-100 graphics processor, the Voodoo5 finally addresses the limitations of the Voodoo3—namely, its lack of support for 32-bit color and for large textures. Hopefully, 3dfx's next generation will address the limitations of the Voodoo5—namely, its lack of support for geometry acceleration.

The VSA-100's 366-megapixel fill rate isn't potent enough to power competitive next-generation videocards, so 3dfx has developed an incredibly flexible technology that allows several chips to work together on a single board: Voodoo Scalable Architecture (VSA) uses two chips in the Voodoo5 5500, and four chips in the 6000, to provide the kind of horsepower that secures the company's standing as frame rate King.

VSA is also capable of novel tricks in the form of programmable Scan Line Interleave (SLI) and T-buffer effects. As a more advanced form of the Voodoo2's SLI, programmable SLI allows each chip to render entire bands of one to 128 scanlines. Since the load can be dynamically adjusted for each graphics processor, programmable SLI results in more efficient use of each chip.

The T-buffer effects made possible through VSA are even more exciting. The T-buffer's full-scene anti-aliasing (FSAA) abilities vastly improve the look of any existing Direct3D, OpenGL, or Glide game. The T-buffer renders two to four samples of a scene, jitters them on the subpixel level, and blends them to eliminate the jagged stair-steps, broken pixel lines, and shimmering polygons that mar your gaming experience.

The adverse side effect of VSA is that it relegates the Voodoo5 to existing as a PCI part in an AGP formfactor. Sure, it can sit on the PCI bus and pretend that it's AGP compliant, but the AGP protocol doesn't support multiple devices. The Voodoo5 can only move data at PCI speeds, and it can't do AGP texturing. This isn't terrible in light of the current crop of games, since they don't push around enough data to make you miss either feature, but it certainly limits the Voodoo5's lifespan.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

RAW PERFORMANCE

The Voodoo5 5500 went toe-to-toe with the Annihilator 2, the Creative Labs GeForce 2 board that we chose to represent nVidia's finest because it has excellent drivers and costs less than other GeForce 2 videocards.

Sporting radically different rendering architectures, the Voodoo5 5500 and Annihilator 2 are well matched, nonetheless. Both are capable of propelling more pixels than the average game can use. The Annihilator 2 just happens to be faster—it dominated the Voodoo5 in all but one of our raw performance benchmarks.

The match began with *Quake III*, the most extensive test of a card's OpenGL features and texturing performance. Neither card floored the other in frame rates; both ably handled the thousands of polygons and shader effects that *Quake III* dished out.

But after that, the Annihilator 2 nailed the Voodoo5 with an *MDK2* clothesline. *MDK2* heaves tons of textures around every scene and takes advantage of hardware T&L, which played into the Annihilator 2's strengths. We thought the Voodoo5 would counter in *Expendable*, which is just a simple multitexturing Direct 3D game, but a quirk kept us from running the benchmark on the Voodoo5 at our default settings. We're not sure whether the problem was with the Voodoo5 Direct 3D drivers or with the *Expendable* benchmark's ability to identify the Voodoo5's supported resolutions. In any case, the Annihilator 2 took the *Expendable* round by default.

The Annihilator 2's finishing move came during *3DMark2000*, when it powerbombed the Voodoo5 with its high-resolution Direct3D performance. We were concerned by the major performance hit it took when going from 16- to 32-bit color, but the Annihilator 2 still emerged from the Main Event victorious.

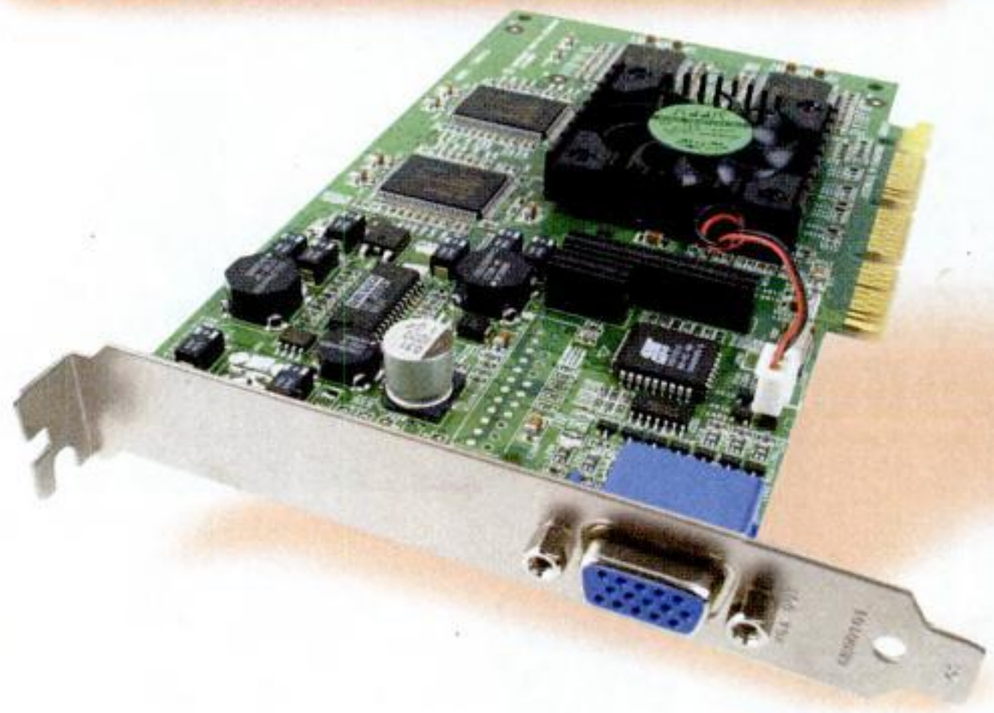
VIDEOCARDS	ANNIHILATOR 2	VOODOO5 5500
Driver Version	5.22	5.43
Quake III demo001	**53.8fps**	51.2fps
Quake III quaver	54.6fps	**54.8fps**
MDK2 demo	**76.5fps**	61.3fps
Expendable demo	74.9fps	NA[1]
3DMark2000 game 1, 16-bit	**67.7fps**	46.9fps
3DMark2000 game 1, 32-bit	**37.9fps**	30.1fps
SYSmark2000 Graphics Apps	**593**	590

[1] We were unable to set the color depth and resolution to 32-bit at 1024x768 in *Expendable* on the Voodoo5.

See page 48 for benchmark settings.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

FSAA PERFORMANCE



Full-scene anti-aliasing does a lot for the visual quality of 3D games. It cleans up all the edges and visual anomalies that crop up during the rendering process. It also causes a huge performance hit, cutting frame rates in half in most games. We pitted the Annihilator 2's limited anti-aliasing support against the Voodoo5's T-buffer and got some interesting results.

The Voodoo5 supports both two-sample and four-sample anti-aliasing, and the Annihilator 2's FSAA only works properly in two-sample mode. While four-sample FSAA makes games absolutely gorgeous, it also drops frame rates to a barely playable level. Two-sample FSAA delivers a decent mix of image quality and speed. When comparing the two-sample FSAA scores of the Annihilator 2 and Voodoo5, keep in mind the superior visual quality that 3dfx's T-buffer delivers. nVidia's FSAA is still a little buggy, and introduced visual anomalies in both *3DMark2000* and *Expendable*.

The thing to remember about FSAA is that it's only important for lower resolutions, since high resolutions do a lot to clean up the jaggies by pushing more pixels onto the screen. FSAA also generates too powerful a performance hit for games to remain playable at high resolutions. For flight-sim and role-playing-game freaks, FSAA is a must-have feature. For everyone else, high resolutions and frame rates are more important.

VIDEOCARDS	ANNIHILATOR 2 2-SAMPLE FSAA	VOODOO5 5500 2-SAMPLE FSAA	VOODOO5 5500 4 SAMPLE FSAA
Quake III demo001	41.8fps	32fps	14.8fps
MDK2	53.9fps	33.5fps	16.1fps
Expendable demo	72.9fps	55.7fps	22fps
3DMark2000 game 1, 16-bit	25fps	50.7fps	29.6fps
3DMark2000 game 1, 32-bit	7.4fps	35.1fps	14.4fps

All FSAA benchmarking was done at 800x600 in 32-bit color.

ANNIHILATOR 2 — 9
$299 | Creative Labs
Buy www.SeeMeBuyMe.com
877.751.7467 ID#0810

VOODOO5 5500 — 8
$299 | 3dfx
Buy www.SeeMeBuyMe.com
877.751.7467 ID#0811

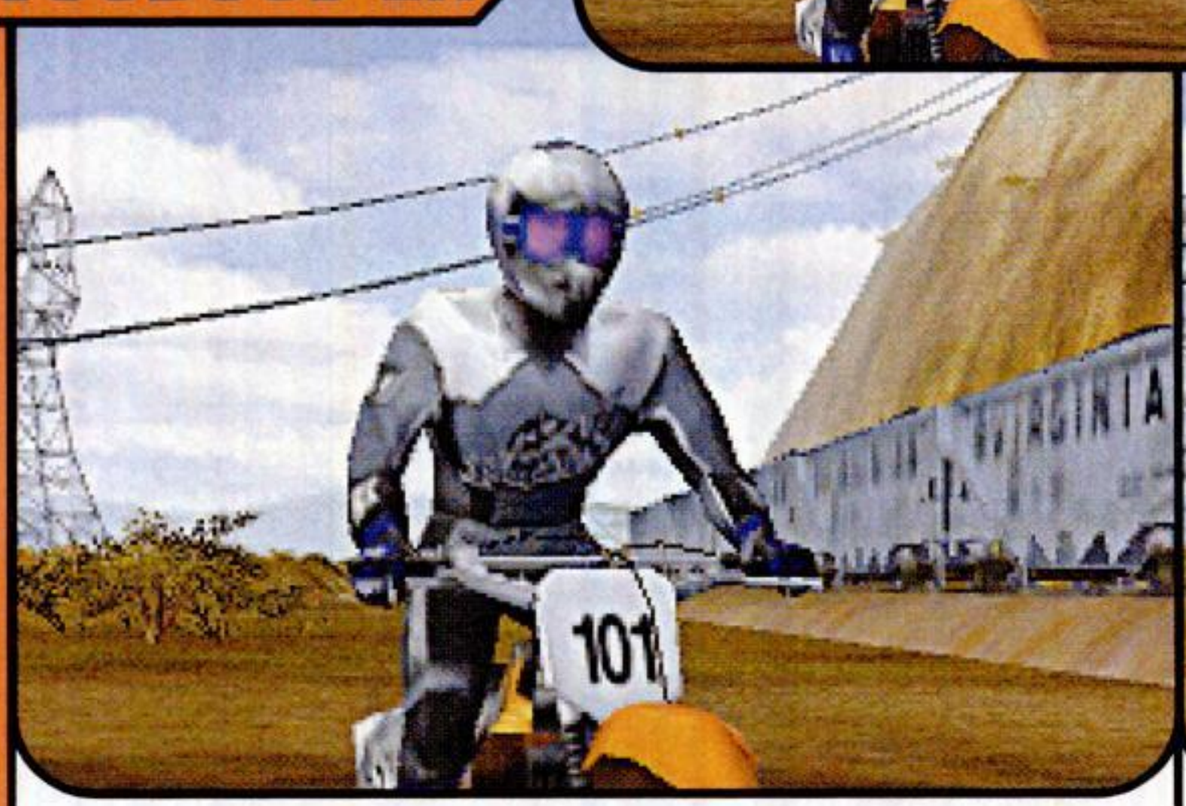
VIDEO CARD SMACKDOWN

MAIN EVENT: Visual Quality

If you want the best visual quality from your games, full-scene anti-aliasing (FSAA) is the way to go. It smoothes out image defects that appear onscreen when not enough pixel information is available to properly render minute details. We ran *Motocross Madness 2* at 800x600 to illustrate the differences between the FSAA capabilities of each card, and how they compare to non-FSAA at the same resolution (top picture), and at an ultra high resolution (bottom right).

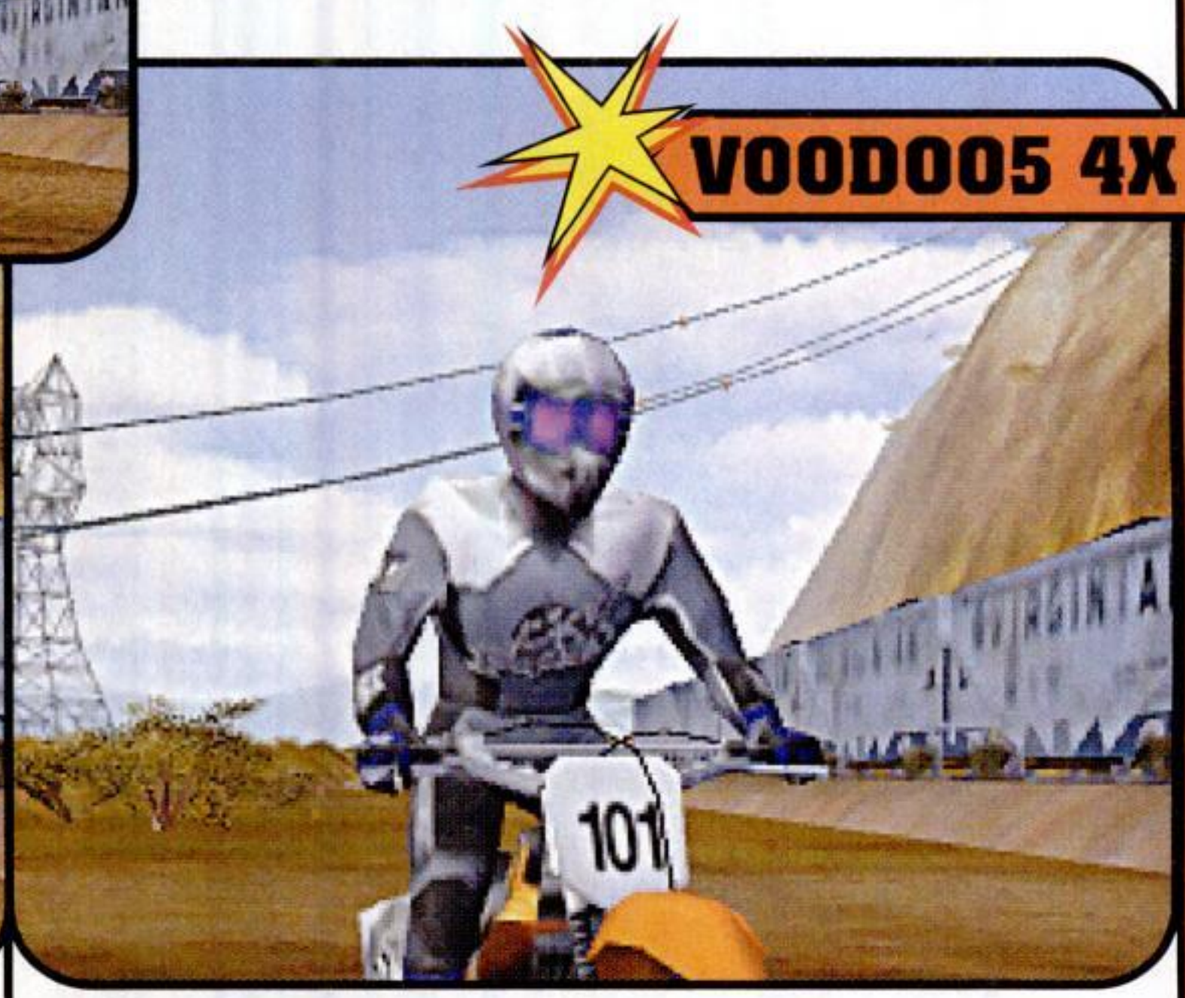
NON FSAA

VOODOO5 2X



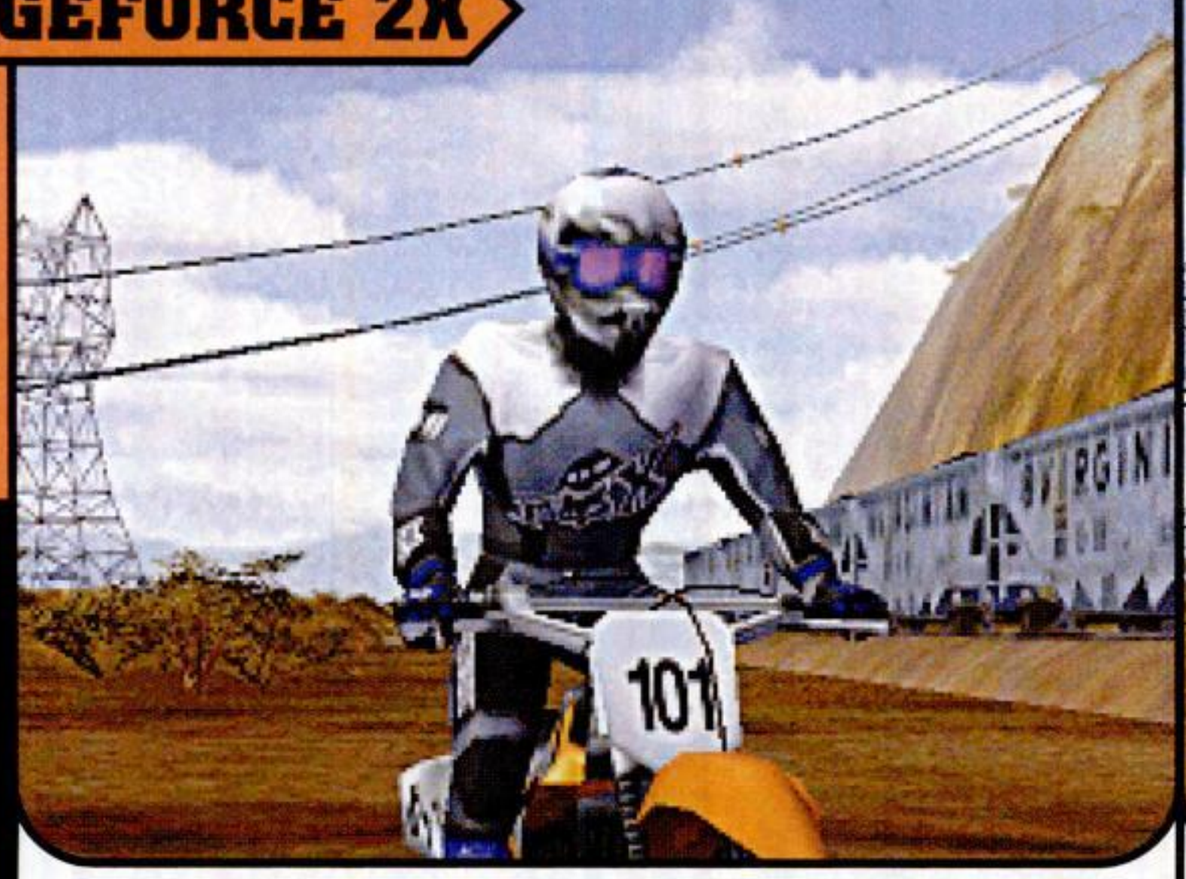
The Voodoo5 cleans up the jaggies by rotating T-buffer image samples to find a more flexible way to blend them with the final image. While two-sample FSAA on the Voodoo5 doesn't get rid of all the rough edges, the card's texture filtering does a much better job of smoothing than the GeForce 2's filtering techniques do.

VOODOO5 4X



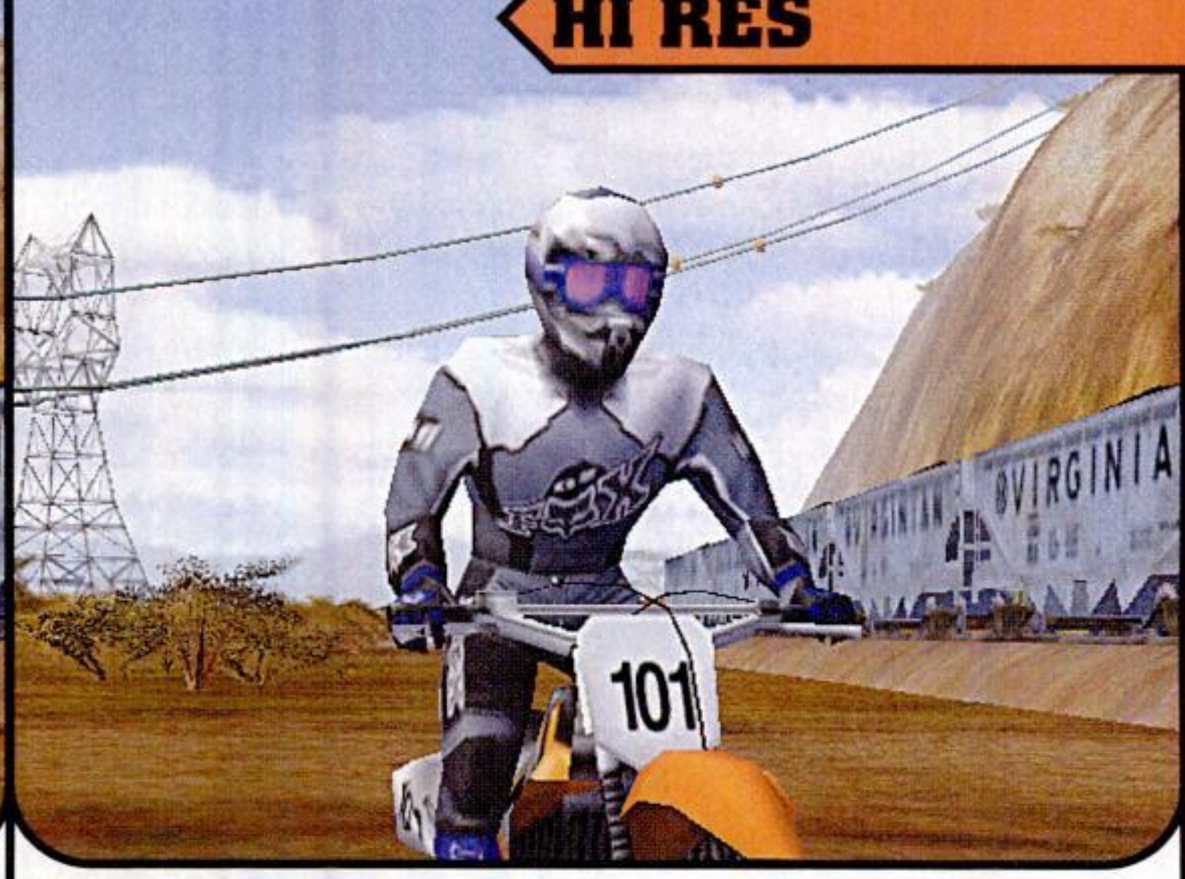
Four-sample FSAA shows how well the Voodoo5's jittered sub-sampling increases the overall crispness of an entire scene, and decreases the texture shifting, pixel popup, and stair-stepped lines that mar standard 3D rendering. Four-sample FSAA yields the best quality of any setting.

GEFORCE 2X



The GeForce 2 works its FSAA mojo by rendering the scene at a higher resolution, then blending the sub-samples around the original pixel. This takes care of jagged polygon edges, but it doesn't address the pixel popping and texture shimmering that crop up in the polygon surfaces and background scenery.

HI RES



As this 1600x1200 screenshot shows, there's no substitute for throwing more pixels onscreen to increase image sharpness. While this augments the detail of our scene, it doesn't address texture anomalies. We still prefer to run our games at the highest resolutions possible, but concede that FSAA does have its advantages.

Dang. Forgot the racing stripes.

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KENSINGTON

Smart design at work.

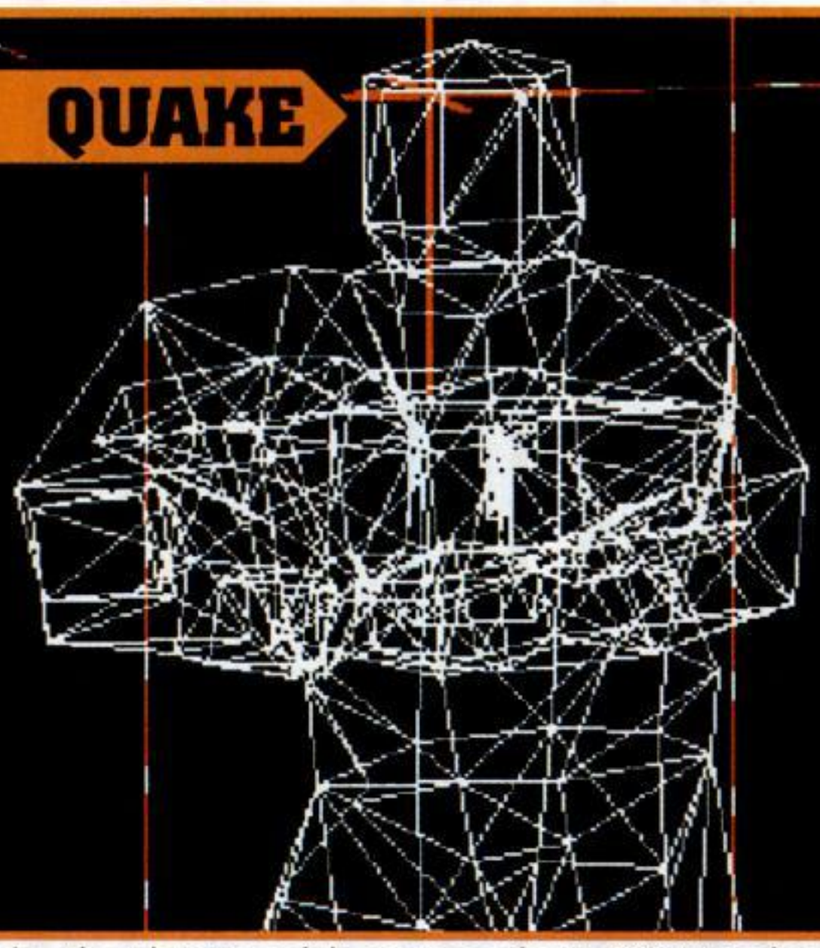
VIDEO CARD SMACKDOWN

THE POLYGON PROGRESSION

The more polygons a game can put onscreen, the more detailed the gaming environment will be. High-poly models make the difference between a block on top of another block and a well-defined head with a neck connecting it to a torso. Of course, high poly counts also require a lot of horsepower. As CPUs and videocards advance in power and new features, games have been able to crank up the detail without relying on texturing tricks.

Take id Software's *Quake* series as an example. Each version pieces together more and more polygons to build more intricate models. *Quake*, *Quake II*, and *Quake III: Arena* aren't designed to be modeling showcases—they move too fast for that. Rather, they're carefully balanced to push as much detail as possible and maintain ultra-fast frame rates. Pushing too many polys would bog down the fast, deathmatch-style gameplay that the series is built on.

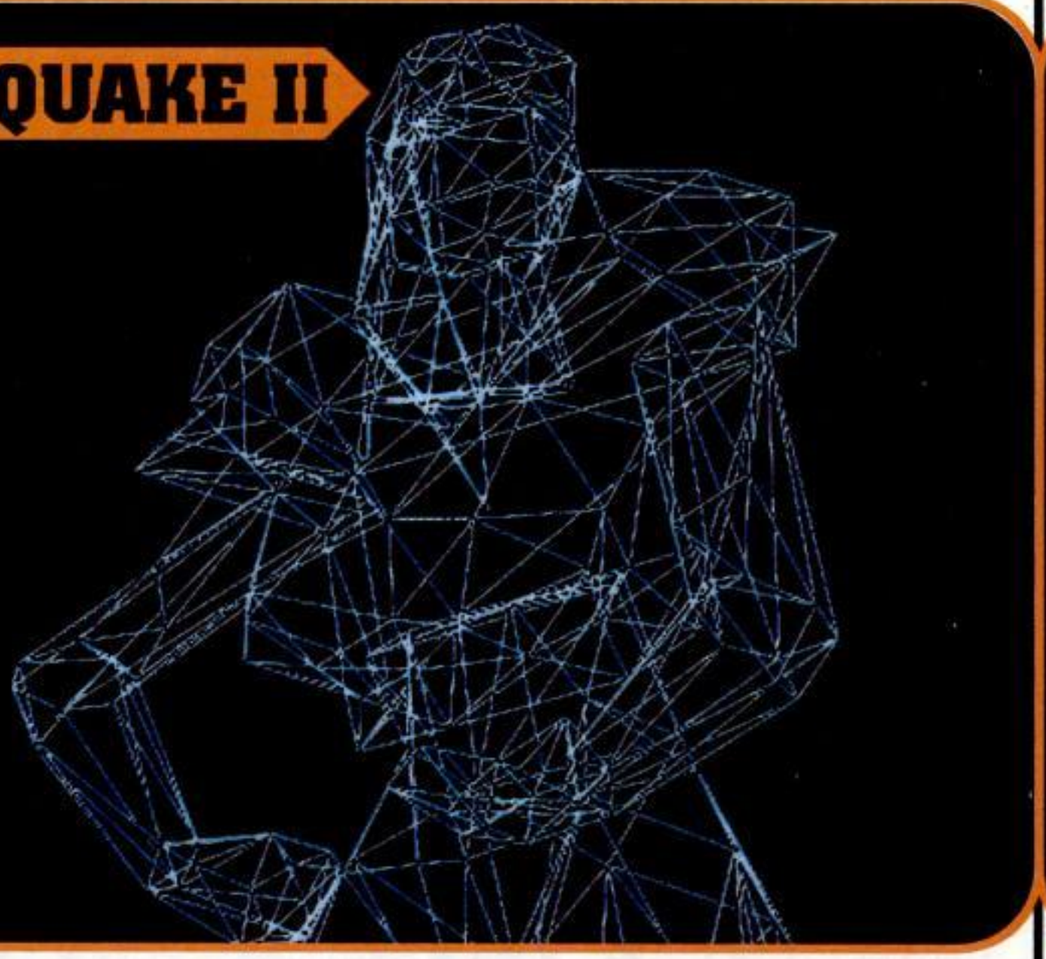
QUAKE



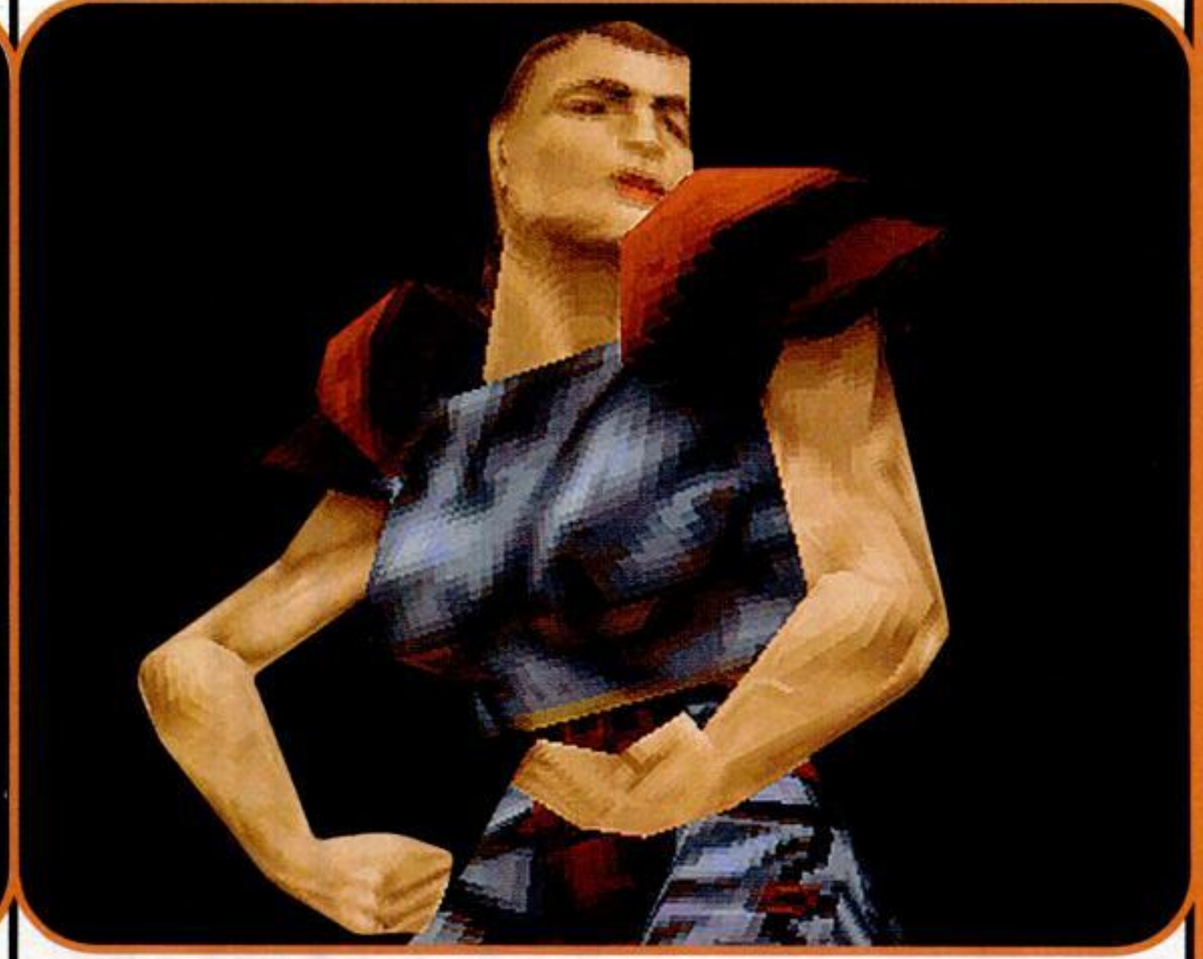
In *Quake*, the player models average about 400 triangles, which provide enough detail to make them look like a grown-up version of a Lego figure.

GLQuake introduced hardware support for 8-bit palletized textures, filtering, and environment maps, but it wasn't designed to leverage the hardware for more meticulous models.

QUAKE II



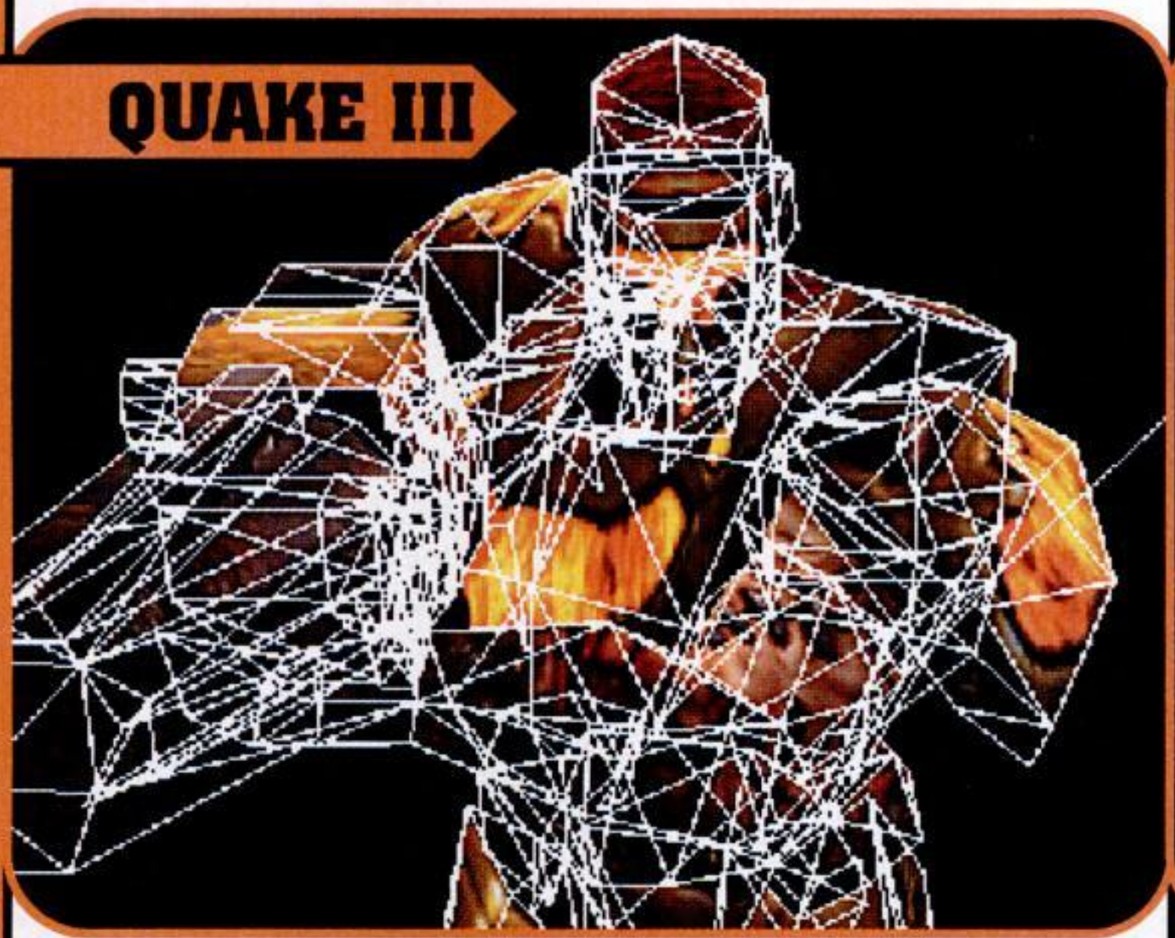
Quake II models averaged 650 triangles each, allowing necks, muscles, and other body parts to appear more fully formed.



Using more textures per model and advanced mapping techniques, *Quake II* was designed with hardware support in mind. It upped the color level to 16-bit.

THE POLYGON PROGRESSION

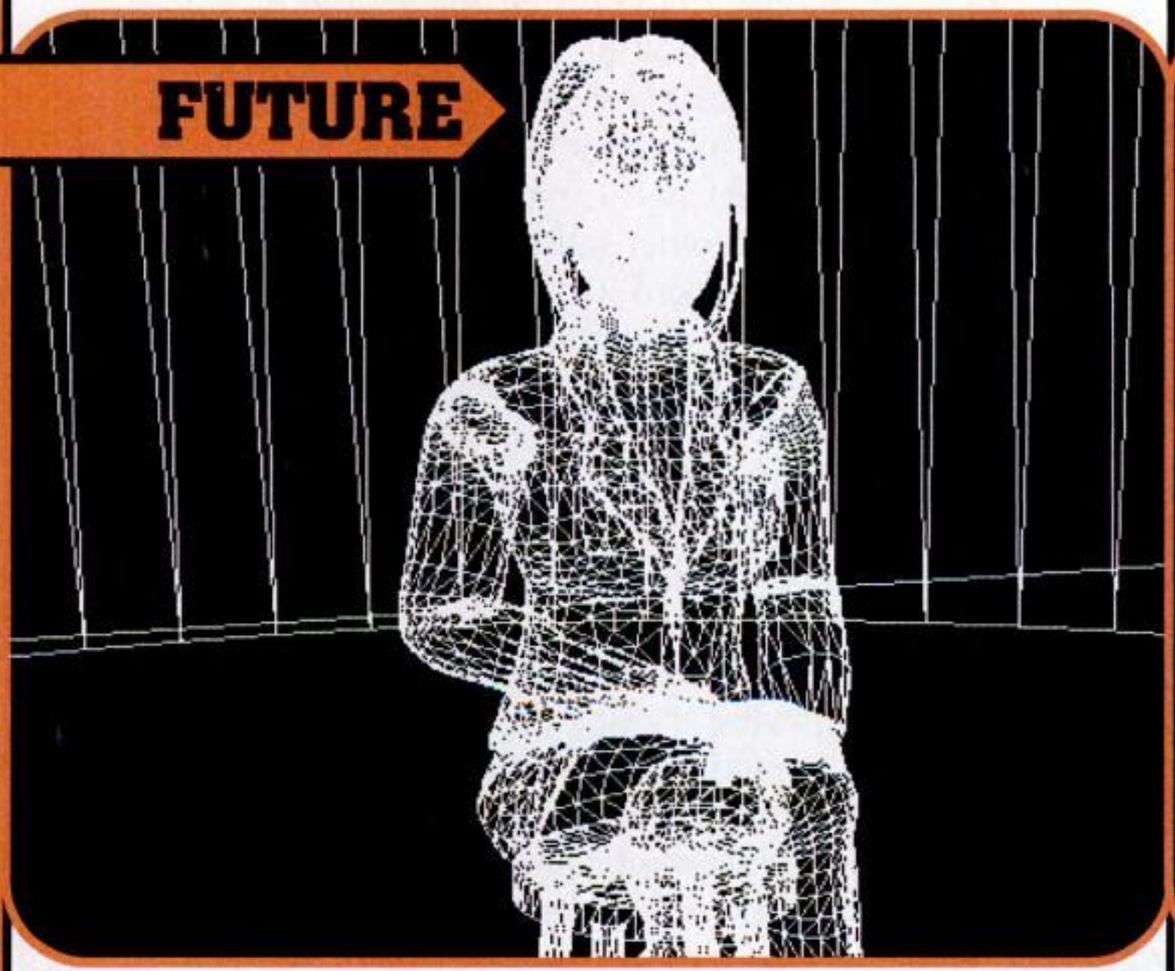
QUAKE III



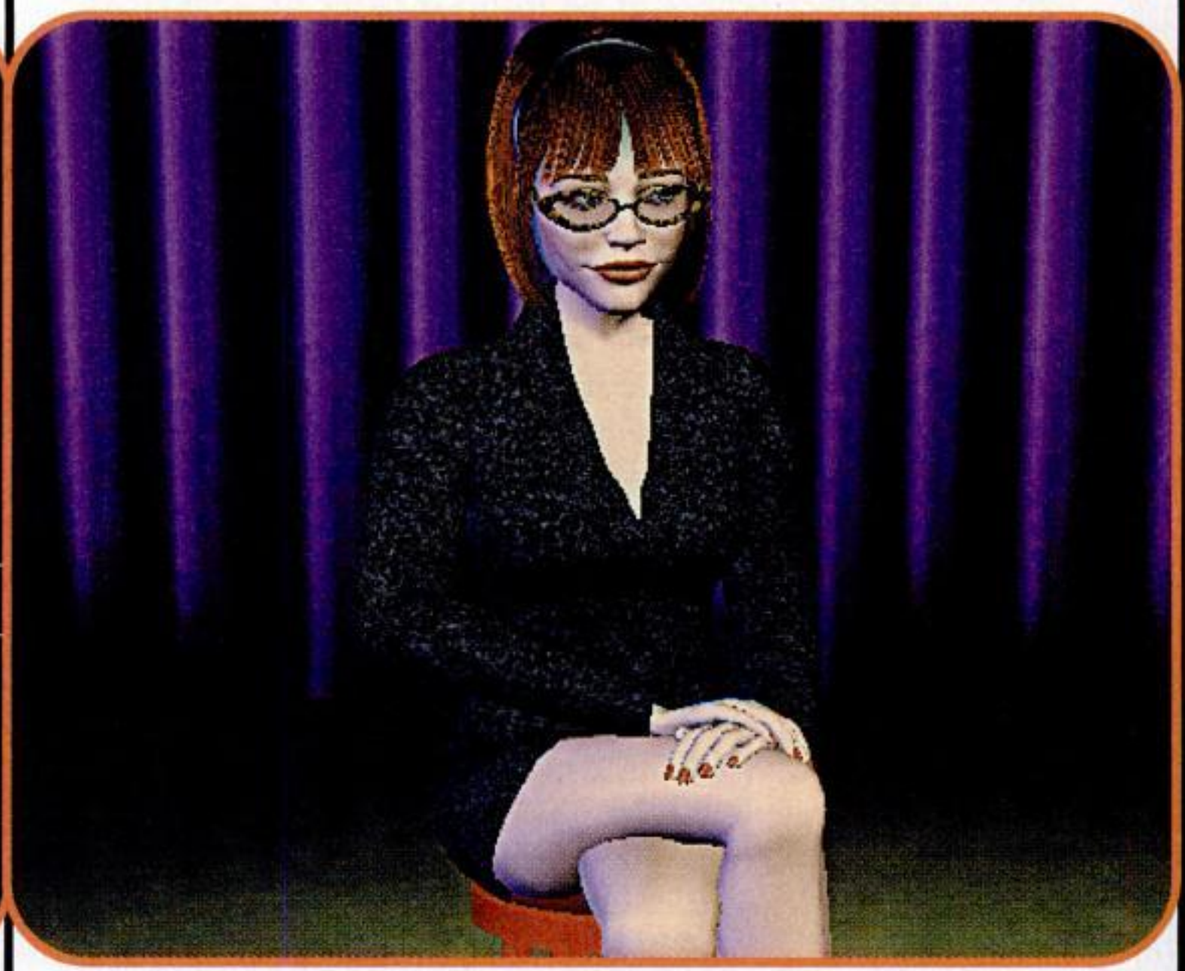
While the most-hyped feature of *Quake III* was curved surfaces, the 1,000-triangle-count models benefited from the advanced triangle tricks that id built into the engine.

All the artwork in *Quake III* was created in 24-bit color, which, combined with more textures per model, produces more visually appealing characters.

FUTURE



This nVidia tech demo shows where 3D game models are headed. The woman in this scene is made up of over 75,000 triangles, resulting in a closer approximation of hair strands, fingers, and even eyelashes.



The high polygon counts mean the woman in this scene doesn't need a lot of fancy textures to make her appear more realistic. If you could look into the future, you would see an even more impressive-looking model coming from id Software in whatever game they decide to make next.

A FRAME IN THE LIFE OF A POLYGON

One-sixtieth of a second deep inside a GeForce 2

By Chris Dunphy

When you play *Quake III*, you're hooked up to a 75Hz strobe of pure adrenaline. With a few flicks of the wrist, you orchestrate a symphony that fuses silicon and your senses. The body count is rising, and your frame rate is pegged.

But pull back the curtain on this silicon wizardry, and you'll see that the magic behind the pixels is almost as interesting as the action on the screen. The newest graphics chips are now just as complex as the CPUs that feed them, and even more crucial to great performance.

An advanced graphics processor, such as the GeForce 2, is functionally split in half, and each hemisphere is concerned with a different type of data. The transformation and lighting (T&L) half of the chip concerns itself with the basic building block of all 3D objects: the vertex. Vertices are points identified by X, Y, and Z coordinates in 3D space. Since three vertices combine to define a triangle, it takes thousands of vertices to describe a reasonably detailed 3D world, even though many triangles can share the same vertex. The T&L half of a graphics processor performs millions of mathematical transformations and calculations based upon vertex data per second. Most graphics chips leave this work to the CPU, but the GeForce, and some other next-generation chips armed with geometry acceleration, bravely take on the load.

The second half of a graphics processor concerns itself with pixels. After the vertex data has defined the spans that must be filled in, the pixel pipelines go to work applying and filtering texels from texture maps. The pipelines then combine the texels with myriad other inputs to produce output pixels destined for the screen. While the result is visually stunning, the work behind the scenes is still just a lot of math that's happening really, really fast.

All of this fast math wouldn't amount to much without a sizable amount of fast memory to satisfy the GeForce 2's ravenous appetite for bandwidth. The 32MB of DDR SDRAM found on a typical GeForce 2 is allocated to at least four important regions: two frame buffers, the front buffer and back buffer; a z-buffer; and texture memory.

Frame buffers hold in memory a direct representation of what you see on the screen. A 16-bit frame buffer allows for a 65-thousand color display; a 32-bit frame buffer uses 24 bits for color, yielding a 16-million color output. More color values used to represent a scene means less likelihood of annoying color banding and dithering problems. The extra eight bits in a 32-bit frame buffer are used as an "alpha channel." Game engines rely on rendering algorithms to use these extra bits for transparency-related effects.

The front and back frame buffers are used to smooth the transition between frames. A device called the RAMDAC owns the front frame buffer, grabbing the analog data stored there and converting the digital information into an analog signal out to the monitor. While the front buffer data goes onscreen, output from the pixel pipelines is written to the back frame buffer. When the next frame is ready to go up, the buffers are flipped, and the back seamlessly replaces the front.

The z-buffer must be the same size as the frame buffer, and on the GeForce 2, both must be the same depth—16 or 24 bits deep. As the pixel pipelines draw spans into the back buffer, they calculate the depth (distance from the viewer) for each pixel before they draw it, and compare the calculated value with the Z value already stored. If the new pixel would end up behind a pixel already drawn in that location, it is discarded. If not, the new pixel is drawn, and the z-buffer and frame buffers are updated.

The more bits the z-buffer uses, the greater its precision in depth calculations. A 24-bit z-buffer used with the GeForce 2 is padded out to be 32 bits deep, by the addition of an 8-bit stencil buffer. The stencil buffer serves as a convenient scratch pad that developers can use to implement very realistic shadows and other special effects.

The rest of the onboard RAM is put to use as texture memory. This is where all the texture maps that color your 3D world are stored. Everything from the bricks on the walls to the grin on your enemy's face is stored here as bitmaps. If more textures are needed for a given scene than can fit in available memory, the remainder must be sucked over the AGP bus once every frame, drastically reducing performance. To avoid this, the GeForce 2 supports texture compression, to squeeze more textures into the available space.

To understand what's going on behind the scenes, we'll follow in the footsteps of a simple box as it goes from the instructions to the graphics engine to a fully-rendered model. The following eight steps trace our box's ride through a GeForce 2, on its way from the CPU to your screen.

While we're showing you all the steps that go into a single frame, bear in mind that the videocard's work is never done; by the time you see one frame, your graphics chip is already hard at work filling the back buffer up with the next. The whole process must be repeated at least 60 times a second to create an appearance of fluid motion.

It's repetitive work, but some chip has got to do it...

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

1 Scene Generation

The CPU running Quake III calculates the way our box and the rest of the objects in the scene relate to each other at a particular snapshot in time, according to the mechanics of the game engine. As these relationships are calculated, OpenGL calls send drawing instructions to the graphics driver. The driver takes these instructions, formats them for the GeForce 2, and sends them over the AGP bus for rendering. In English, the relevant instructions might look like this: Draw the box in front of the player that's being lit by a red light from above.

2 Transformation

The next challenge is to transform the multiple 3D models referenced in these instructions, so that they all exist in the same screen space. The GeForce 2 does this by using a dedicated transformation engine to process millions of matrix calculations per second. Those calculations mathematically spin, scale, twist, and rotate a 3D object to the proper screen orientation. The output from the transformation process is a stream of screen-space vertices (points located in 3D space) that define the edges and traits of every polygon that makes up a scene. This is where our 3D model gets shrunk down to fill a few inches of screen space, and planted firmly onto a surface.

3 Lighting

Next, the GeForce 2 turns the lights on. Each model that the CPU delivers to the GeForce 2 can be lit by up to eight hardware-accelerated lights, though most games (including Quake III) still do a lot of their advanced lighting by using "software" techniques such as light-maps. Even in carrying out just these basic light calculations, the GeForce 2's lighting engine helps unload an overworked CPU. The lighting engine uses the color, type (ambient, directional, point, or spotlight), and location of each enabled light to calculate the amount and color of the illumination reaching each vertex. These calculated values are stamped onto the vertices as they flow by. Once the work of the lighting engine is complete, our fully lit box is handed off to the setup engine.

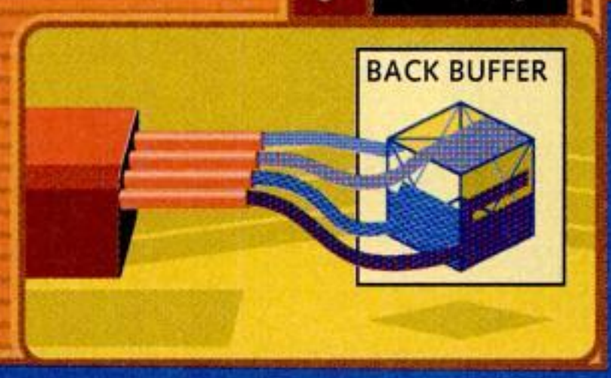
4 Triangle Setup

At this stage, each vertex has a number of properties associated with it, such as its base color, its degree of transparency, and its calculated light color and intensity. The triangle setup engine takes each polygon defined by these vertices and shreds it into strips, called spans. It interpolates the properties defined at the corners of the triangles to calculate the ends of each span. Think of it as putting a triangle through a paper shredder. The shredded hash strips are divided up and fed into the four pixel pipelines. Our model's vertices have now been torn down as far as we can take them. Now begins the task of reassembling him as pixels on the screen.

5 Texturing

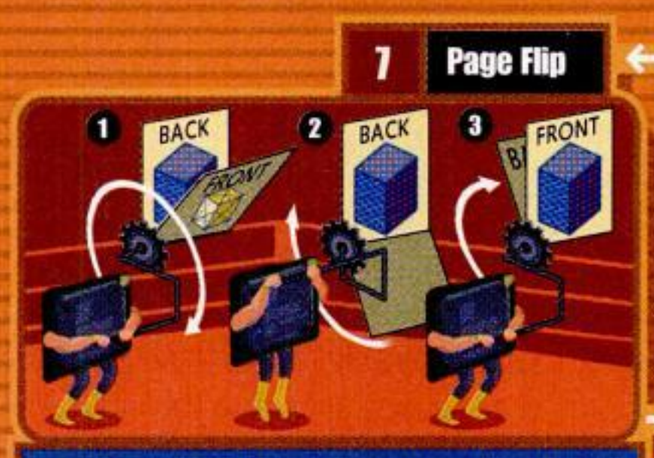
The GeForce 2 has four pixel pipelines. In parallel, they digest the spans provided by the setup engine, processing one pixel at a time. Each of these pipelines contains two texture engines, allowing for very impressive eight-way texturing parallelism. These texture engines are responsible for calculating the texels that fill in the span being processed, but this is rarely as simple as directly grabbing a few chunks straight from a texture map. To achieve a less blocky and more realistic look, advanced filters are applied to average the color of several texels and generate a single output pixel. In addition to the now-familiar bilinear filtering, which requires four texels per pixel, the GeForce 2 supports trilinear filtering (eight texels per pixel), and even 16-tap anisotropic filtering (you guessed it, 16 texels per pixel). Filtering gives the smooth, "3D accelerated" look, and avoids the pixelation of software-rendered games. These texel reads require a massive amount of memory access; fortunately, on-chip texture cache avoids repeated round trips to texture memory.

6 Rendering



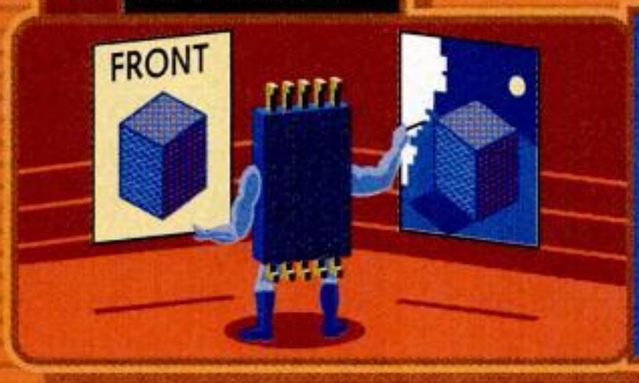
Now that our textures are calculated, it's time for the pixel engine to combine our inputs and generate a final pixel for output to the frame buffer. This stage is very flexible. Depending on the instructions provided by the application, the calculated textures could be combined with the ambient and specular lighting components, a computed fog value, a constant color, or each other, in various complicated ways. The possibilities enabled by this flexible texture-combining architecture go well beyond the now-common multitexture light-map effects. One of the most interesting uses of multiple textures in the GeForce 2 involves using one texture as a "normal map" that, when combined with a base texture, allows for per-pixel lighting and realistic bump mapping. More radical uses of the texture combiner are possible, including even cartoon-style shading. For maximum speed, these operations can be carried out within a single pixel pipeline. For more complicated effects, multiple pixel pipelines work together to generate a single output pixel based upon more than two textures' worth of input. We are now left with up to four calculated pixels per cycle. The final step is to write them to the frame buffer—first performing a z-buffer check and then drawing (or blending, if the pixels are transparent) into the back buffer. At last, our model is on its way to the screen, a pixel at a time.

7 Page Flip



All the spans have been rendered, and our box is sitting in the back buffer waiting to be displayed. The graphics processor now waits for the RAMDAC (RAM Digital to Analog Converter) to pause, then swaps the front and back buffers. The old front buffer is recycled as a new back buffer, and the new front buffer is handed off to the RAMDAC to be drawn to the screen.

8 Screen Refresh



While the rest of the chip begins drawing the next frame into the back buffer, the RAMDAC is busy turning the front buffer into an image on your screen. It reads through the entire buffer one line at a time, 60 to 120 times a second, like a crazed speed-reader on overdrive. Each passthrough pumps an analog signal straight to your monitor, drawing the image that you see. And finally, our trip is done. The frame is drawn. Our box is on the screen. And in a few more frames, it will be history.

VIDEO CARD SMACKDOWN

UPCOMING CONTENDERS

This bout is over, but the action will heat up again this fall as a new breed of brawlers step into the ring. Here's a quick scorecard of the upcoming graphics processors to watch.

▶ **ATI** At 30 million transistors, ATI's Radeon 256 is primed to take the GeForce 2's spot as the most complex graphics processor ever mounted to a PCB. With a dual-pipeline pixel engine that boasts three texture units per pipeline, the Radeon is ready to tackle complex multitexturing and blending operations in a single pass.

While the Radeon will fall a little short of the GeForce 2's massive fill rates, ATI plans to close the gap with its HyperZ technology, which combines lossless data compression with aggressive on-chip caching techniques to enhance fill rate performance by about 20 percent. And with support for advanced features such as 3D textures, projective texturing, and dot-product and environment bump mapping, ATI is positioning its chip as the best choice for people who want to get the most special effects out of their games.

If you don't count S3's failed attempt at geometry acceleration, ATI will be the second company to bring hardware T&L to consumer-level boards. The Radeon's geometry engine is more powerful than nVidia's, pushing 30 million triangles per second and supporting advance character modeling features such as vertex tweening and four-matrix vertex blending. Of course, much of this technology will go unused until developers release hardware T&L games with more intricate character models.

ATI has had some delays getting the Radeon out the door. Since the card was initially announced, ATI has dropped the clock speed and memory on their new 0.18-micron chip to 183MHz. Another factor that could possible affect the Radeon's success is whether ATI can pull together drivers capable of squeezing every drop of performance out of its new hardware. Boards based on ATI's Radeon are expected to arrive in September.

▶ **3dfx** It's unfortunate that the delay of Voodoo5 6000 prevented it from making it into the Main Event, because the card boasts the kind of firepower that could put all others to shame. Four VSA-100 chips, 128MB of SDRAM, and an external power supply make the Voodoo5 6000 the most powerful—and outrageously oversized—videocard you could possibly fit into your PC. With the 6000's 1.4-gigapixel fill rate, 3dfx's four-sample FSAA would actually be useable, making the card both the fastest and best-looking 3D renderer on the planet. We can't wait to get this thing in the Lab.

▶ **Matrox** Granted, Matrox's new G450 chip isn't actually all that new. It's essentially a die-shrunk G400—from 0.25- to 0.18-micron—with integrated support for digital displays and TV-out. The G450's most interesting trait is its smaller memory interface. Matrox made the call to ditch the 128-bit memory interface in favor of a 64-bit interface, and to use DDR memory to make up the bandwidth difference. The G450 should clock in at around Millennium G400 Max levels. That means it won't hold a candle to the Voodoo5 or GeForce 2, but at around $150, G450-based boards will be a hell of a lot cheaper. The Millennium G450 and Millennium G450 DVI should be out by the time you read this.

▶ **nVidia** Next up for nVidia is a midrange chip, based on the GeForce 2 core, that's targeted for corporate users. Clocked at 150MHz, the GeForce MX chip will be faster than GeForce but slower than GeForce 2. The GeForce MX also differs from its predecessors in that it's equipped with only two pixel pipelines, not four. It will most likely be mated with 166MHz SDR memory. While it may sound like little more than a neutered GeForce 2, the GeForce MX does offer some innovation. Working through two onboard CRT controllers, the GeForce MX will be able to drive dual monitors and, with integrated digital display support, dual flat panels.

The GeForce MX will fill a variety of roles, appearing in low-cost desktop boards and even Mac videocards. nVidia is also basing its mobile chip on the GeForce MX, for all those notebook users looking for some geometry acceleration in their *Solitaire* games. You should see GeForce MX-based boards in September.

Following the pattern it has established with the TNT and GeForce, nVidia will unveil its next-generation chip, the NV20, sometime around November. We aren't going to speculate on NV20's feature set at this point, but we will go out on a limb and say that nVidia will embed some memory into their next-gen chip. ✹

Benchmarks

Every videocard was benchmarked on our Dell 733MHz Pentium III test system using the latest public drivers. We leave the sound and networking on in all games, and don't disable v-sync in any of our benchmarks except *3DMark2000*. Both *Quake III* benchmarks are run at 32-bit color with texture and geometry set to high, and with compressed textures disabled. We run demo001 at 1024x768 and quaver at 800x600. For *MDK2*, texture quality is high, color depth is 32-bit, and hardware T&L is enabled for any card that supports it. *Expendable* is run at 1024x768, 32-bit color. *3DMark2000* testing done at 1280x1024 and the *SYSmark2000* graphics apps test is done at 1600x1200. For more information on our benchmarks, as well as a how-to on running each one, go online to **www.maximumpc.com/benchmarking**.

OEM

System Builders On the Hotseat

It's nighttime in the city. Most law-abiding citizens sleep soundly, unaware of the seething underworld raging in their neighborhoods—or in their homes.

It's a world in which people commit the premeditated building, with willful intent and malice, of personal computers. It's an addictive practice—and just when you think you're out, it pulls you back in.

Of course, PC building isn't limited to small-time, home operations. Huge organizations, running as legitimate businesses, supply a mostly unknowing public with systems they've built. Often, even a person who knows enough to build his own PC feels like one of these "OEM families" can make him a system he can't refuse. But many believe that what you're really paying for from an OEM is a fancy brand-name.

The truth is that system makers follow a detailed methodology when they design a rig. The way an OEM builds its systems can actually help you when you're building your own PC.

We hauled in "consigliores" from four major OEM families, and successfully goaded them into revealing the ways they keep their PC-building operations up and running. We probed their methodology for selecting new parts, their expertise at troubleshooting hardware conflicts, and their techniques for dealing with power and case-airflow issues. Our detainees included:

- **Brian Zucker**, Technology Evangelist for **Dell Computer**: Formerly played a large role in selecting components for Dell PCs. Zucker is now responsible for educating people inside and outside "the family" on the merits of new technology.
- **Lewie Newcomb**, Director of Desktop Engineering for **Compaq**: Oversees the engineers who select and spec Compaq PCs. Newcomb was accompanied by two bodyguards: **Mark Vena**, Director of Configure-To-Order Sales, and **Brett Faulk**, Director of Retail Build-To-Order Sales.
- **Eric Bone**, Senior Worldwide Product Manager for **Hewlett-Packard**: Résumé includes the massive, air-cooled 1GHz PC that *Maximum PC* recently acquired after a high-speed pursuit.
- **Nelson Gonzalez**, proprietor of **Alienware**: With his gang of thrill-seeking PC builders, he has offered such illegal rigs as dual Voodoo2 machines. At one time, Alienware tried to unleash Wicked3D's highly addictive PGC technology on an unsuspecting public.

Interro

PHOTOGRAPHY BY JACK HUTCHESON

By Gordon Mah Ung

Holiday gift guide

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nVIDIA
GeForce2 GTS

Scream like a maniac!

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ELSA's screamin' next-gen 3D gaming board with NVIDIA's new *GeForce2 GTS™* GPU, has the ultra-firepower to annihilate the competition. Insane textures with super-realistic shading effects deliver cinematic 3D. Raging power with twice the speed and performance of other boards. Plus a new video-in/video-out feature with HDTV support. Smokin'!

ELSA's Smart Refresh™ and Smart Resolution™ software lets you adjust for sharp, flicker-free visual assaults. Add *ELSA 3D REVELATOR™*, and gaming goes where only a lunatic would thrive. If you dare, check out *GLADIAC* at your favorite retailer or go to www.shopelsa.com.

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ELSA

MPC: All right, wiseguy. Do you consider users' future upgrade options when you're putting together a system?

Newcomb Compaq:
They're very important to us. A lot of that comes back to the motherboard. When we're designing a motherboard and a system, we look for the technologies that we're sure will work going forward. We actually know what won't work, and it's usually not something we can design to. For example, you know Willamette is going to be on the market shortly. You can't design and ship a box today that will work with Willamette. We understand that going forward, that that architecture is all brand new. But every Coppermine and every transition that Intel has made in the microprocessor—all of our designs will work with them going forward, with the exception of any electro-mechanical changes, such as socket to slots. Of course, that was a challenge for everybody. But we design forward in the box.

Lewie Newcomb, Director of Engineering, Compaq Computer Corp.

The only thing you should have to change is the BIOS. And the BIOS is the microcontroller code that you don't have until they're ready to give it to you. We release BIOSes on our web site on a pretty regular basis, and they basically include all the microcontroller code and all the video BIOS necessary to run future stuff.

Gonzalez Alienware:
We have our own policy, which most manufacturers don't have: We upgrade the system for a customer free of charge. In other words, they can send back a system and, provided that they buy the parts from us at a wholesale cost, we will install the components for them. We'll benchmark it, we'll install the drivers, we'll re-image the whole machine, and we'll send it back out to the customer again.

The crowd that we deal with needs to know that they have the best upgrade options available to them. Most gamers upgrade within six months to a year's time, anyway, so it is very, very important, now more than ever.

However, we're seeing that technology is moving so fast at this point, we're being very honest with customers. We tell them, "Listen, we don't know how long this system is going to last you at this point. We could almost guarantee you a year, but anything after that is speculation, because things are moving at a very fierce rate, especially between the likes of AMD and Intel." It used to be that if you had a BX or LX motherboard, it would last you a while. Now, you have different chipsets for DDR, you've got Rambus support, you have AMD that has DDR support, you've got VIA—there's just too many different animals at this point. And it's a little bit tough for us to tell a customer, "Hey, this system is going to last you this long," because we're very honest over here and, at the expense of losing a sale, we tell them how it is.

MPC: You spend a lot of time trying to get your company's goods into people's homes. What PC do you have at home?

Zucker Dell:
It's definitely a Dell machine! Actually, it's a couple of Dell machines on a network with a broadband modem. The main machine is a 700MHz P-III on a 440BX with a GeForce card, a 19-inch Trinitron monitor, and 128MB of RAM on Windows 98. It's about time for me to upgrade.

Bone HP:
I'm running a P-III 500 with 256MB of RAM, a 20GB Maxtor, a Sound Blaster Live! Platinum, and a 32MB DDR GeForce 2 GTS. I get the latest and greatest games, too, even before they're announced, so that's kind of my benchmark. When do I need to go from 500 to 733? When that stuff starts bogging down. I try and find a game that breaks everything, or at least bogs down that latest-and-greatest stuff.

Gonzalez Alienware:
AMD 800 with a GeForce 2 GTS, 256MB of RAM, Sound Blaster Live!, and Klipsch ProMedia speakers. Those puppies are actually beautiful. My wife can't stand the speakers, but they're there.

Newcomb Compaq:
I just got a K7 900MHz with 128MB of RAM. I have two hard drives, the first is 30GB, the second 40GB, and a CD-RW drive, stuffed into a mini-tower case. I'm running some very high-quality JBL speakers as well. I actually have five PCs at home.

MPC: So, when you get your mitts on a new product—say, a CPU or a videocard—how do you decide whether to put it in one of your systems?

Newcomb Compaq:
Over the last 15 years, Compaq has developed a set of intense, low-level tests that we call the Meat Grinder. The Meat Grinder really brings out design margins and design depth, and it tells us whether or not the design that we're looking at will be compatible and reliable going forward.

That test of an overall system lasts well over 1,000 hours—not every part gets 1,000 hours of testing, but that's the first step. It's a hardware, firmware, and software layer of testing that essentially goes across the entire PC. We can segment it into very focused areas,

MPC: How long should an innocent man have to wait on hold for live tech support?

Zucker Dell:
Zero is the maximum time they should be on hold, but there's a balancing act that we have to play. If we hire everybody in the world, we have to pay for them—and that's going to increase the cost of each individual PC. So it's a balancing act. We're going to make sure that we have support people in place that can handle all the calls that we have coming in, but at the same time, from the development side, we're trying to reduce the need for people to call.

How to achieve true Twain.

By Glenn Meadows of Masterfonics, Nashville

Top recording artists such as Shania Twain depend on the audio masters we create at Masterfonics. The masters we cut are used to make critical judgments about music that will eventually go out to millions of people worldwide. They must be of the highest quality. To find a cutter that offers that caliber of recording, I did a study testing various blank media with different brands of writable drives.

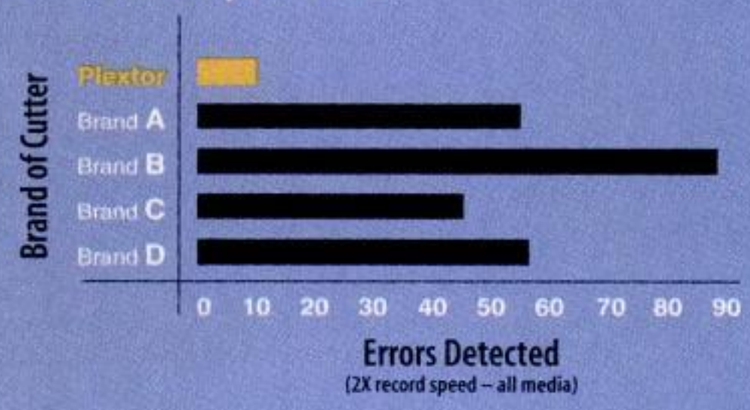
My results?

There's a huge difference between cutters.

You can hear the difference, and see it with a CD verifier. Plextor® CD drives have the lowest number of errors of any cutters I've found.

A master cut on a Plextor drive sounds like the original session—whether the cut is played back in real time, 2X or even 4X. That's because Plextor has designed cutters that control all the variables to help produce spectacular audio.

See and hear for yourself.



Take a look at the chart I created of my results. Want more proof? Pick up Shania Twain's *Come On Over* CD, the best-selling country album of all time. It was mastered by our studio on a Plextor drive.

For the best cutter, I suggest you come on over to Plextor. Call **800.886.3935** for the dealer nearest you, or visit their Website at **www.plextor.com**.

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OEM Interrogation

like processors, memory, IDE devices, and I/O devices. It's really the lowest-level thing we do, and it has to happen first—after the business of marketing and all that stuff is done—but at an engineering level, that's the first thing we do.

We like to get as much of a safety margin as possible into every test, so we don't fail an audit. The big difference between building a million computers a month and building 10 computers a month is really the responsibility level you have to various worldwide agencies. And certainly, there's a financial impact from any mistake you may make.

The Meat Grinder is our golden egg in a lot of ways. It's the thing that Intel, AMD, VIA, and those guys like to come in for and use. Of course, we don't let them do that unless we're evaluating their products.

Zucker Dell:
Well, interestingly enough, we don't usually get surprised by a company coming in and saying, "Hey, here's our new product. Go ahead and start using it." We actually tend to get way more upstream with our vendors, whether it's Intel, Microsoft, or anybody else. So we already know what the performance level should be—if we know a high-end processor is coming from Intel, we plan where it will fit in our product line-up. We know specifically what the benchmark should be. And eventually, we'll confirm those benchmarks. It's not like they knock on our door and say "Hey, here's our new processor; here's our new graphics card. Go benchmark it and tell us if you want it." It's more like, "We've known for six months this is coming. OK, now we've got our first samples in..." At that point, we go into our lab, run the benchmarks, and say, "Whoa! This thing is performing like a dog and something is wrong. Please tell us what's wrong and how it's going to be fixed."

Performance is just one aspect, though. We'll also talk about how [a vendor will] meet our quality levels, and about goals that we require, and about defective parts per million. We talk to them about pricing. We talk to them about volume. Given Dell's size, we've got to make sure [a vendor has] factories and capacities and plans in place to support our volume needs. Sure, they can support 100 percent of what we're asking for, but what if we need a 20 percent upsize? You have to plan for that, too, because nobody is perfect in planning. You've got to have upsizing capabilities.

If it's a new vendor—one we haven't dealt with in the past—we look at their test methodology and their design practices: How do they do their design? What's their test process? How do they perform on a daily basis, and what's the overall schedule like?

Brian Zucker,
Technology Evangelist,
Dell Computer

Gonzalez Alienware:
With a videocard, such as nVidia's GeForce 2, we'll qualify the product extensively a few months before it's ever released. Why do we use nVidia? Well, it's obvious that nVidia, right now, is ahead in the performance arena. We've also talked to 3dfx, but we haven't seen their latest product because of a few problems they're having.

We've used various benchmarks [to test videocards], such as *3D Exerciser*, *3DMark2000*, *Quake III Arena*, Rage's *Expendable*, and *Half-Life: Opposing Force*. So, OpenGL and Direct3D matter to us as well. But because nVidia's product is so ahead of the game, they're the ones that set the benchmarks at this point. The GeForce 2 is a perfect example. Running at 1024x768 at 32-bit color on an AMD 1GHz, we were getting in excess of 72 frames per second. So right now, that is the minimum we would include on a 1GHz-based machine, whether it's Intel or AMD.

MPC: Good, keep talking. What about motherboards? How do you decide on a system's mobo?

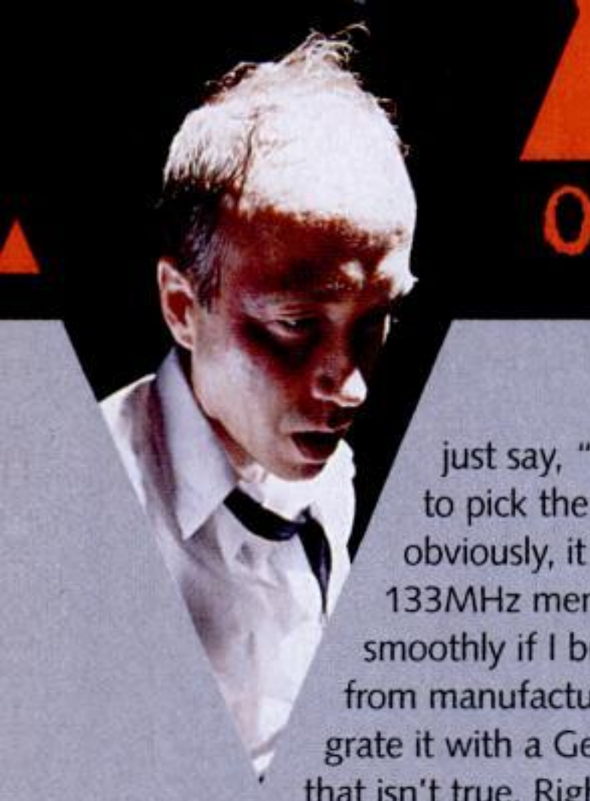
Newcomb Compaq:
We actually design our own motherboards with joint cooperation from a motherboard vendor, and we write most of our BIOSes from the ground up. For all the compatibility testing that we do, and all the memory testing that we do, it requires a lot of iterations to get it right. And when you've got that external vendor, sometimes it's very difficult to get cooperation. Those companies aren't used to responding like that. Any motherboard company has to have an internal BIOS team. I have a team of engineers working with a team of engineers in Taiwan. Our engineers own the design here, and they're responsible for the design, but a lot of the work is being done in Taiwan. So, we don't buy boards off the shelf, we don't spec them and say, "Go build us a motherboard." I use this quote all the time internally: "We don't ship motherboards. We ship systems." Everybody talks about their motherboard because it's the heart of the system, but the system quality, the system tests for compatibility, reliability—that's where our time is spent. And I think that's where our value-add comes into play.

Gonzalez Alienware:
The integration of a videocard with a new motherboard or new chipset can be problematic. A perfect example is the KX133 and the GeForce 2 GTS. A lot of people out there would

MPC: Convince me to buy from you instead of building my own PC—I dare you.

Bone HP:
HP can achieve better value, based on the volume pricing that we get, than you can. Now, I cannot combat the pure joy that you get by ripping things apart and putting them together and having difficulties and overcoming them. I can't match that; that's not where I add value. I add value from the standpoint of giving you the best performance and feature set you can receive at the price you're willing to spend. I can also give you the guarantee that we will be behind it for much longer than most of the individual component people out there.

HP also provides further knowledge—we have evaluated everything in the marketplace and are choosing the most reliable vendor. So there's price/performance, there's reliability, there is the guarantee of HP as a company—I'm not going away tomorrow. And I can get you a chassis. If industrial design is important to you, I can get you something that hopefully is a lot sexier than anything you can build by yourself.



OEM Interrogation

just say, "Well, I'm going to pick the KX133 because, obviously, it has support for 133MHz memory. All should go smoothly if I buy a motherboard from manufacturer X and I integrate it with a GeForce 2." Well, that isn't true. Right now, out of our testing, the only motherboard that's really been favorable—not to knock any of the other manufacturers—is the Asus board. It's proven to be the most stable of the KX133s in combination with the GeForce 2. That's because of the AGP Pro 50 slot.

Zucker Dell:
Recently, we've gone with one [motherboard] vendor over another simply because they were able to meet our cost targets and prove that they could maintain the same quality level. During development, we audit [the vendor's] development process. We have a team of supplier-quality engineers that go onsite and look at the vendor's fab process to make sure that it's compliant with what we need.

And that's done even after production. It's not just looking at the product. It's actually looking at [the vendor's] entire factory and their process. And it's excruciating detail we go through to make sure that their common practices and the way they do things is uniform. Who is notified if they decide to change the capacitor value? What's the process for making sure that people in Austin—where we maintain an engineering team—are notified if, one month into production, [the vendor] decides to change from a one percent capacitor to a five percent capacitor? It's not just sampling the motherboard to see if that motherboard matched the previous 10. It's, if there is a change or if there's a deviation, how is that handled? And how is volume upsize handled, and what do they do to increase volume, and what do they do to maintain equipment? There's a huge checklist of things to keep an eye on.

MPC: We knew you'd sing like a canary. Now, tell us how you develop a system's cooling strategy.

Zucker Dell:
We actually have people whose jobs are dedicated to doing thermal design. We use specific tools to model the thermals of a system, using a motherboard, a hard drive, a chassis, and all the other pieces that go into a system. These tools do simulations of the airflow and show in detail where the hot spots are. Using that information, we can design the total system. That includes the heatsink, and all the other sub-devices that need to be in place—how you direct airflow, how big your fans should be, where they should be located, how big your heatsink should be and where it should be located.

In general, we focus on trying to get passive heatsinks [to work well]. There's a good reason for that. A fan, being mechanical, is one of the least reliable devices in the PC. And if you can remove your least reliable device, your overall system MTBF goes up. So, adding CPU fans is really a bad thing.

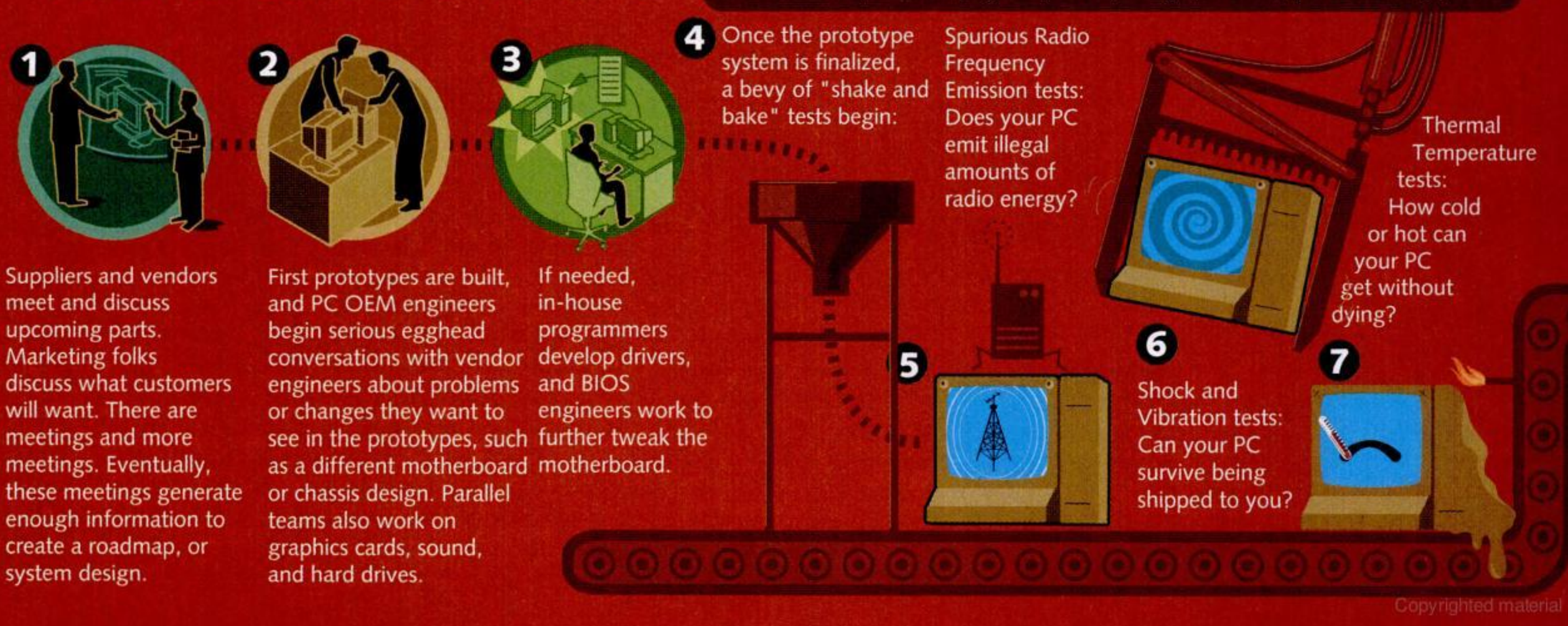
Another negative of adding a fan is that you carve out a whole bunch of metal and reduce the surface area where the heat can be dissipated. It's kind of a Catch 22—sure, you can go and force-cool it with a fan, but then you have to have that fan running at a certain speed to get that air out of there, because you've got less surface area. Conversely, if you hadn't put that fan in to begin with, you'd have more surface area, or more heatsink mass, to work with. Basically, if you can get the same thermal characteristics with a passive heatsink [that you can get with a fan], it's a better thing to do.

Newcomb Compaq:
I wish we were still making the decision between active and passive, but it's all active cooling now. We simply test. We look at specs. We tie thermal couples down next to the silicon we stick in our thermal chambers, and we look at what happens as ambient temperature rises.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

THE MAKING OF A PC

A PC design isn't molded in clay and tested in a wind tunnel like a Plymouth, but the development steps go beyond opening up a catalog and ordering parts.



OEM Interrogation

We do analysis of altitude against the ambient temperature, to ensure we design that thermal solution to meet a worldwide margin.

Today, if you don't lock the thermal design into the [system] design—in other words, down to the material, the gook between the heatsink and the processor, and then the heatsink itself—if you don't do that, these processors will fail and stop. And my gut feeling is that there's going to be a lot of people building computers with these microprocessors from AMD and Intel that are getting so hot, and they won't know how to design just the thermal solution itself. There's two pieces [to that solution]. One piece of it is getting the heat off the processor itself; the other is evacuating the heat from the box. You have to design the entire thermal solution.

Bone HP:
Heat gets ugly when you start getting into gigahertz and increased wattage. You might as well just have a light bulb in there. We have engineers that work only on the thermals, and on whether you should use copper, or active versus passive. We also have to make it cost-effective, yet have a thermal envelope that the customer can upgrade with. What customers keep telling us is that they want smaller size with the same functionality. Well, that's a problem,

Eric Bone,
Senior Worldwide Product Manager, Hewlett-Packard

right? So we plan chassis strategies where we see that happening. Our 1GHz box with the big fan was specifically developed with HP and Intel.

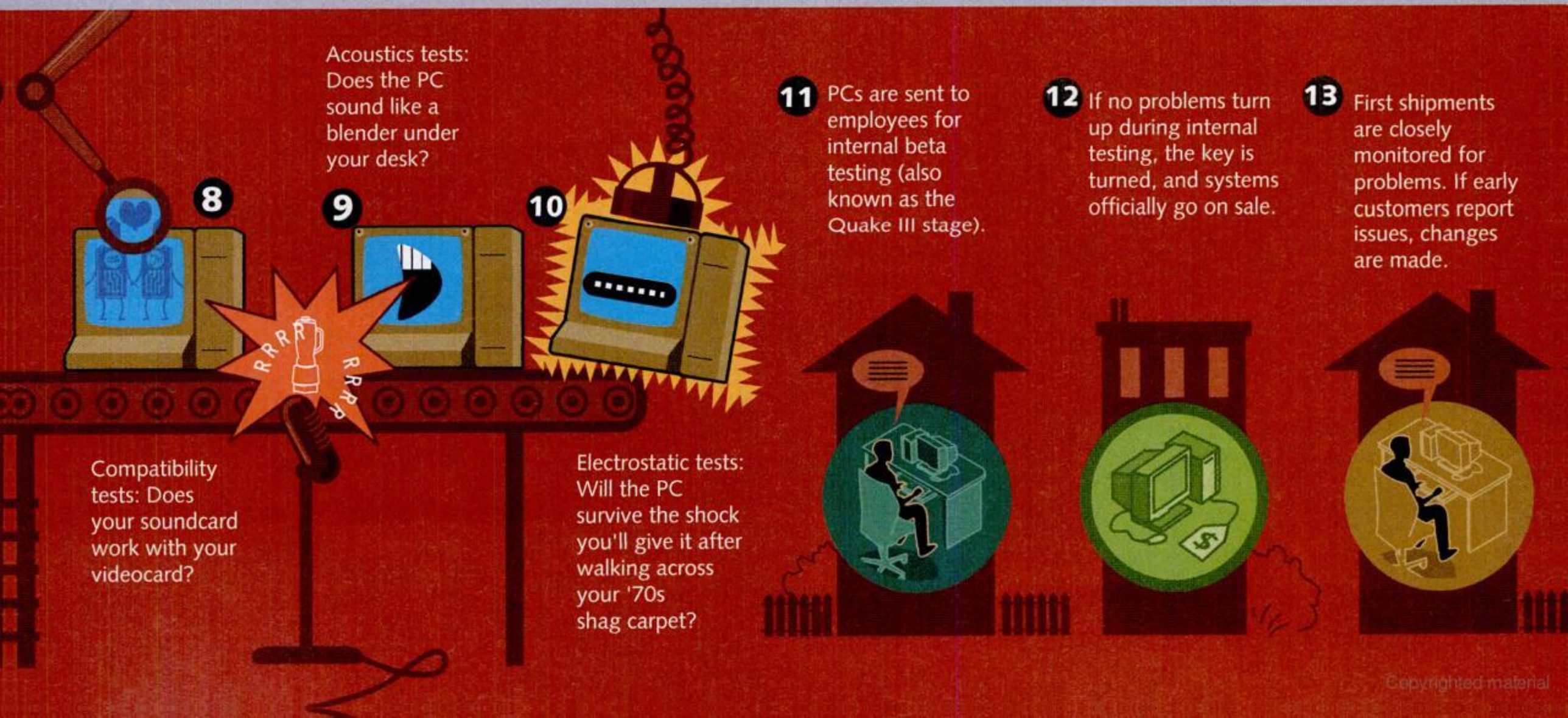
MPC: So what about power supplies, punk? Aren't OEMs just being cheap when they spec 200 watt power supplies instead of 300 watters?

Zucker Dell:
There are specifications for how much maximum power the processor will have, how much the memory system will have, how much the motherboard itself will have, and how much for each PCI slot. If you added all that up, it would be above 200 watts. That's where you get your consumer or your reader saying, "Hey, they don't know how to design boxes." But we're not saying, "Hey, we're just going to take the average and go send it out there and, hopefully, 90 percent of those units will be okay." No, we want 100 percent of our users to have no power supply problems. So that's our goal—100 percent of the people who buy our machines will not have power supply problems from an under-specification of the power supply. We use practical measurements. We don't use typical measurements. We actually look at the maximums and then start working in realistic design criteria. These things are designed for 200 watts of sustained power. There's also peak power consumption and there's processor efficiency calculations that have to go into effect.

We believe we're doing the right things when we design the power

MPC: How much mark up is there on your systems? Don't make me ask you twice.

Zucker Dell:
We have a specific margin we work with that's publicly known, which is about seven percent, but as pricing drops, we pass on savings to our customer. And that, you can quote me on.



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"UNDO"

The only four-letter word you'll use around

YOUR COMPUTER

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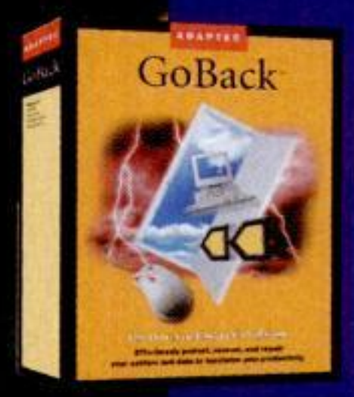
Immediately undo PC problems with GoBack™

Computing has never been trouble-free. You accidentally over-write or delete a file, your computer crashes for no apparent reason, or new software wreaks havoc on your system.

Now there's a simple solution for everything from minor PC annoyances to major computing disasters: Adaptec's GoBack software. Once installed, GoBack tracks every move on your hard disk and allows you to return your system to a point in time when it worked.



GoBack is also the only recovery software that allows you to start your PC when Windows® won't boot — no diskette required. Which makes getting up and running again extremely easy.

Let's face it — you're human and you make mistakes. But computing without Go Back shouldn't be one of them.

Adaptec®

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supply to meet the needs of 100 percent of our users. And we have data that shows that we're not getting any phone calls about inadequate power supplies.

Newcomb Compaq:
It's the myth versus the reality. For one thing, the power supply labeling has been very confusing of late. When you say 300 watts or 250 watts, that's the total power delivered by all rails in the power supply. We deliver a power supply that may be 250 watts, but there's a spec on it that shows [the wattage of] just the five-volt rail as 150, and some people get really confused by that.

We go through an analysis of our box—how we're delivering our box, how many ports. *Maximum PC*'s recommendation of 300 watts is usually pretty good, but in a lot of cases, 250 will be enough. We actually run through the math, though. Fill all the PCI slots, load all the bays, run USB out, run IEEE 1394 out, max the memory out. It comes back to picking quality parts—there's hundreds of suppliers out there and we disqualify a lot of them. That's because a lot of these guys take shortcuts and they don't deliver the power continuously or they don't deliver that power at all the thermal specs. You've got to be careful. As much as the wattage is important, so is the supplier.

Gonzalez Alienware:
Well, we use only 300-watt power supplies on all of our systems. And the 300-watt Antec has done a beautiful job for us. A lot of it has to do not only with stability and performance, but also with zero returned merchandise. We don't get a lot of RMAs for power supplies. I know some people say, "Well, I'm building my own system. I'll just get this generic 300-watt power supply." The truth is that after testing a slew of different power supplies, we saw that the Antec was probably the best one, with both Intel and AMD systems.

Nelson Gonzalez, Proprietor, Alienware Computers

MPC: One word, punk: Rambus.

Newcomb Compaq:
The Rambus interface allows for a lower pin count in the northbridge, and can certainly help optimize integration for lower-end products like Timna. And so, from that standpoint, it's a great design. Also, if you really look at the architecture going forward, it really helps system balance. The memory interface is one of the gates to the performance of the box. And Rambus' intention, or Rambus' implementation, certainly was done to solve that.

But Rambus is really a business issue. From a technical standpoint, it's a little harder to implement because of the speed. You expect that going forward, even on DDR. But it's really just a business issue. Today, the only thing I'll say is that the consumer division of Compaq does not ship any Rambus products.

Zucker Dell:
Rambus has definite advantages; unfortunately, they can't be seen with today's software, so it's a bit ahead of its time. The question for down the road that I know everybody wants answered is, how does Rambus compete with DDR? I think both of them are solving a problem, which is memory bandwidth and memory performance. Processor speeds are scaling much faster than memory speeds, so there's a huge disconnect. Both Rambus and DDR look to solve that problem going forward. And so, would I say we shouldn't be shipping Rambus? No, not at all. We have Rambus today, and that's great for customers who are buying it today, because for the next three or four years, over the life of their PCs, they're not going to have the bottleneck problems that other SDRAM systems have. If they're performance users, they've got great investment protection and will have the performance capabilities moving forward. DDR is not available today. So, should we have waited a year? I don't think so.

Gonzalez Alienware:
Rambus stock prices are great. To be honest with you, I think it was very, very promising, and still is very promising. It's just quite expensive at this point. If Rambus from the get-go would have been a little bit more competitively priced, I think people would have opted to go that way.

Right now, we're hoping DDR will come to fruition because it seems to be a more viable alternative to Rambus than Rambus itself. I mean, Rambus is a great performer, but the pricing is just way out there. And until that price comes down, it's difficult for us to market that. As far as performance, it's a great performer, no doubt. But you've got DDR neck-and-neck with it and at half the price, so it's a no-brainer, at least from a system manufacturer's point of view.

MPC: Front or rear? Ports, that is.

Zucker Dell:
You're seeing a lot of stuff on the retail shelves where things are coming out the front. That's interesting. It's almost gimmicky. Anybody that's ever had a desktop or tower in actual use knows that the last thing you want are USB ports, or 1394, or any type of cable hanging out the front while [the case is] sitting on your floor in front of your desk. You really want to kind of route that stuff out the back, out of the way. But going forward, we'll probably have

MPC: How nitty-gritty do you get about the parts that go inside a PC?

Gonzalez Alienware:
We specifically order a certain grade of CD audio cables. Believe it or not, screws are a challenge for us as well. I have my material guy always saying, "Hey, try to find a specific screw." That's how hardcore these guys are. We need to find a certain grade, a certain fit, and a certain height. You would think companies use a generic screw, but to be honest, that's not so. They're the same way about getting the right thermal paste.

OEM Interrogation

both, because some people want it out the back and some people want it out the front. So we'll have to start looking at meeting the needs of everybody, versus trying to force peoples' usage models.

Bone HP:
I have a real love for our chassis strategy, and the front I/O is an important factor in every chassis. The one thing that all of the major OEMs have over some of the lesser-known names—the second- and third-tier vendors—is that we have this great ability to do what we need to do whenever we need to do it. We can give you the front access panel that you can't get from some other vendors. Compaq got it right and we've got it right. Front I/O is all about temporary connections. It's all about just plugging something in and yanking it back out because you don't want all the extra clutter, whereas the rear is all about permanent connections. Things along the lines of digital imaging or digital video—things like that are kind of temporary in nature. And as the PC evolves, the way customers use it evolves.

Brett Compaq:
We absolutely pioneered I/O from the standpoint of front I/O, delivering four USB ports standard. We've been doing that—two in the front, two in the back—well before anybody was thinking about it. We also have FireWire 1394 standard on our ATX formfactors.

MPC: What are the minimum system specs a law-abiding citizen should get in a PC he's buying today?

Bone HP:
It's hard to speak for HP on this, but I've always believed that CPUs aren't your bottleneck, it's the other stuff. So for me, I think whatever price point you choose, I would say that it's probably 733MHz. You don't really need Gigahertz unless you're doing something as intensive as digital video. With Windows 2000, you could use two processors, but that's going over the top. You really get bang for your buck in a great soundcard and a fantastic videocard, so save the $700 on your processor and get a 7,200rpm hard drive and a hardware-accelerated 3D soundcard. I'd say that the minimum videocard would be a TNT2 Pro.

Gonzalez Alienware:
For a gamer, the minimum should be a 600MHz CPU, either AMD or Intel; 128MB of RAM; a GeForce card, or a 3dfx card, now that they support 32-bit color; and a 20GB hard drive. Also, a mid-tower case for good ventilation, and the videocard and CPU must have a good cooling solution.

Newcomb Compaq:
Obviously, a microprocessor beyond 600MHz is minimum. At least 64MB of RAM, with the ideal being 128MB. Most of your readers could use a 250-watt power supply and they'd be fine, but 250 would be the minimum. If you're buying the lesser-value boxes—the boxes down at lower price points—145 watts will work with any Celeron. The hard drive should be a minimum of 10GB, although I have to admit I have more than 60GB of music on my PC at home—and of course, I own the originals. ✹

MPC: What can a good guy do to prevent the electromagnetic interference (EMI) that PCs put out, which interferes with your TV and radio?

Newcomb Compaq:
Leave in the blanking plates on the drive bays and make sure the cards you add are well grounded. You should also keep the air gaps tight. Think about water flowing through the box. At any point that water would flow through, you can get EMI emissions. You notice when you buy a PC from an OEM that, a lot of times, the empty drive bays have metal plates over them. You might ask yourself why that plate is there. That plate is put there to prevent EMI emission. We want to keep those contained in the box and mitigated through the ground planes.

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RATED AWESOME NEWMEDIA MAGAZINE

VIDEO Platinum Award Outstanding Achievement

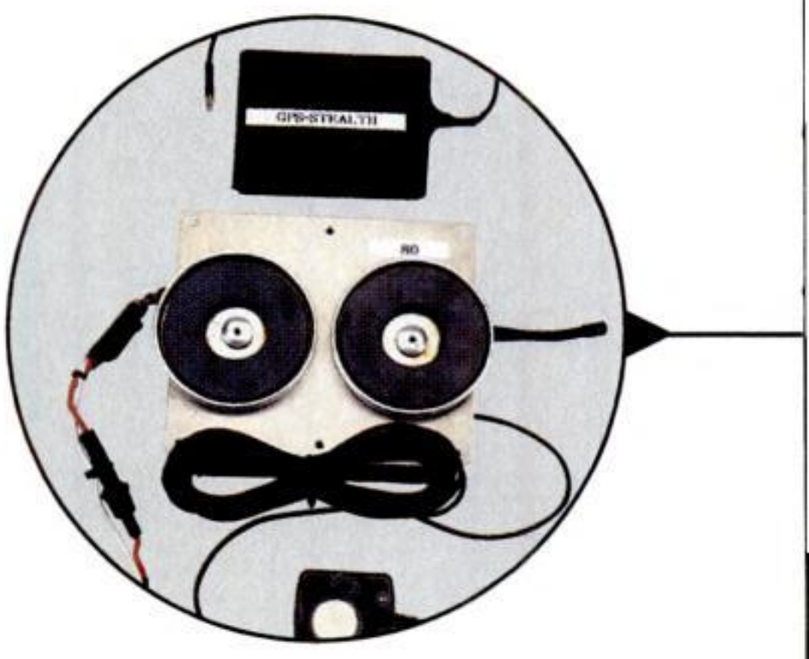
PCG&V Highly Recommended '96 PC Graphics & Video

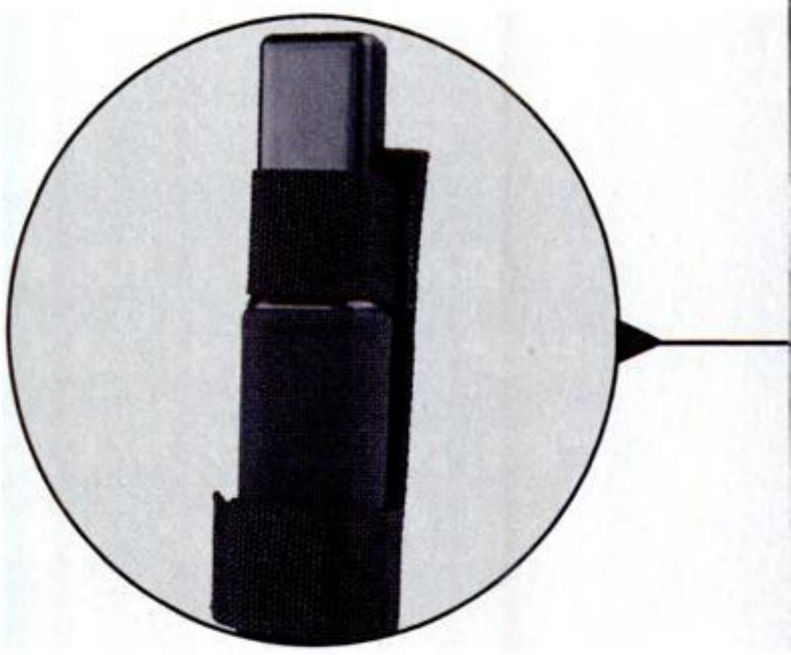
boot KICK ASS! PRODUCT

FamilyPC Review Score Recommended

UNDER

Whether you're checking out your next-door neighbor's eating habits or planning to topple your local town council, you'll want to use the highest-tech equipment for your espionage exploits. Here's everything you'll need to properly outfit yourself for your next foray into the field. This magazine will self-destruct in five seconds...





By Geoffrey Visgilio

Photography by Aaron Lauer

CANON DIGITAL ELPH S-100 MINI-DIGITAL CAMERA

Small enough to slip into a pocket, purse, or catsuit, the Canon Digital ELPH is the tiniest, quietest digital camera on the market. Measuring a mere 2.5-inches across and weighing in at just over an ounce, the ELPH is perfect for surreptitiously snapping photos of fine art and documents marked "Top Secret." Its 2.11-megapixel CCD and 2x optical/4x digital zoom guarantee that no detail will be missed. The ELPH's 8MB CompactFlash card holds 30 to 40 images, depending on resolution, and the camera's close-up range of just 8 inches means it's easy to quickly capture information on the sly. **$700; Canon**

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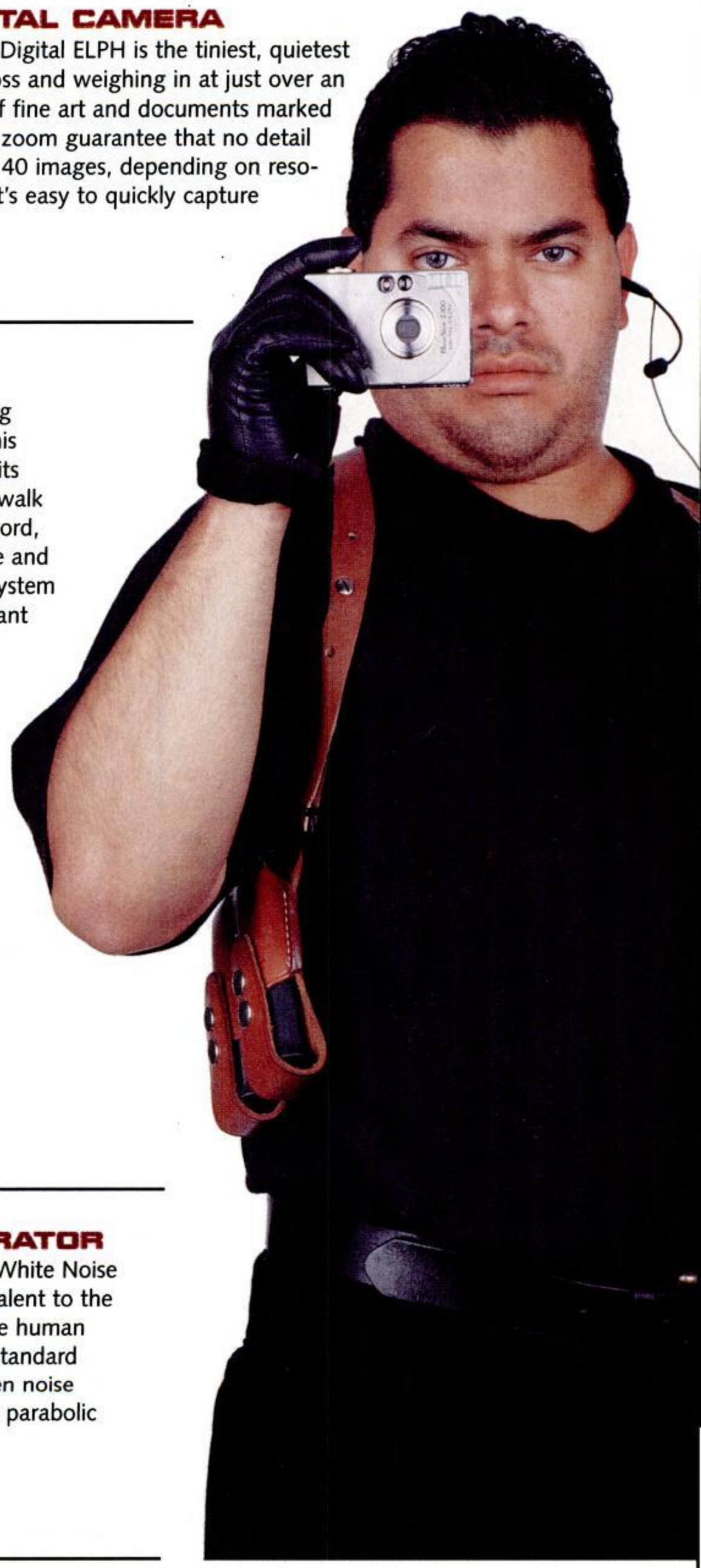

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The Men In Black might balk at the fact that their vehicle tracking system has been dummied down for civvies and private dicks. This powerful signal transmitter is housed in a magnetized case that fits quite nicely beneath a car—just add a battery pack and casually walk away. With Internet access and the correct user name and password, you can track that car anywhere. Find out where it's been, where and when it stopped, and how long it stopped for; the built-in GPS system transmits all activity in realtime. Ideal for keeping tabs on important operatives, tracking hostages, and following couriers back to headquarters. **$2500; Spycompany.com**

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This pinhole camera can get the goods under the most covert of conditions. Roughly the size of a quarter, it has a 5mm focal length and a full 380 lines of resolution, and can operate in light conditions as low as 0.2 lux—far less than even candlelight. It comes ready for hookup to a television, VCR, or camcorder, and it's small enough to swallow, in a pinch.

$120; Spycompany.com

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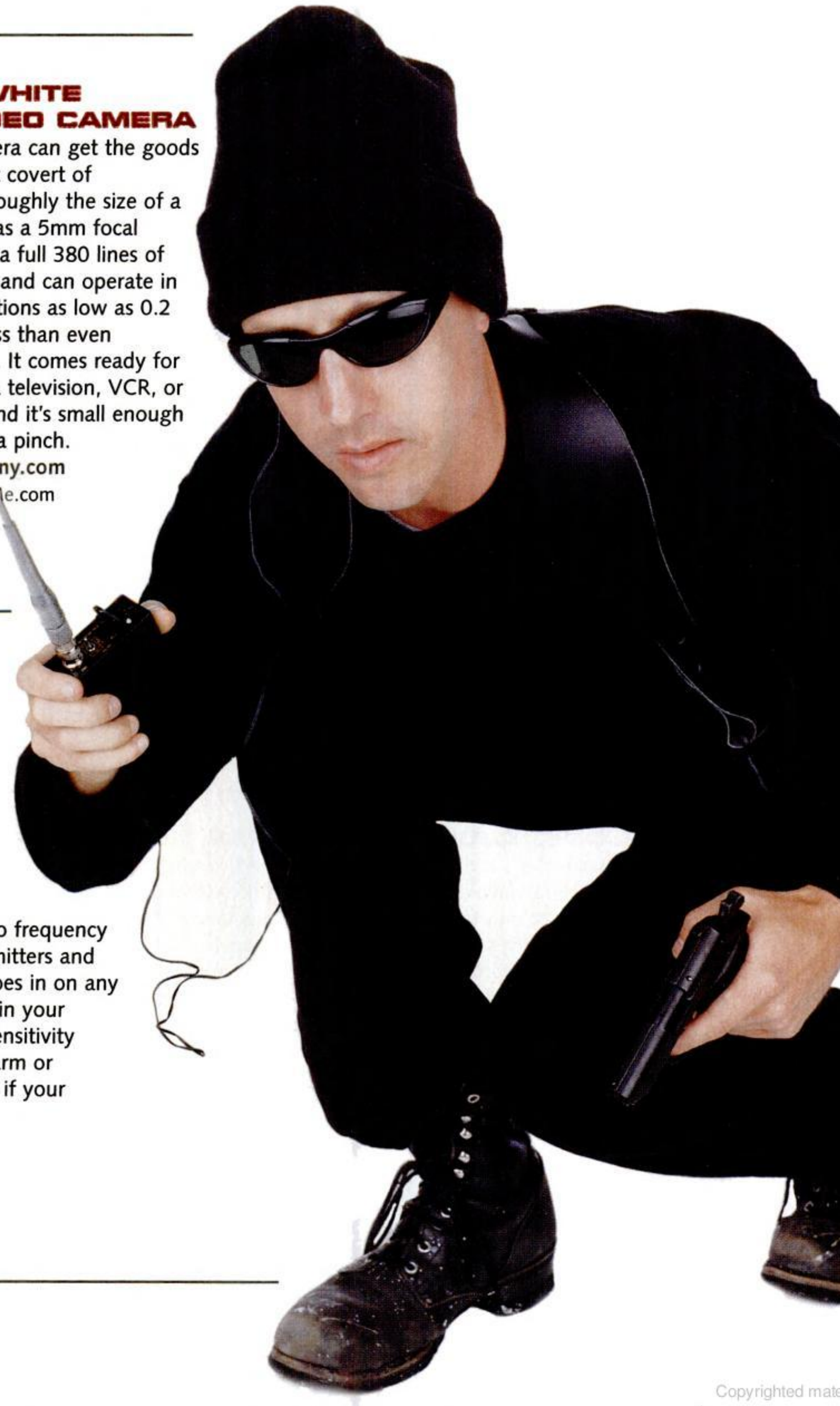

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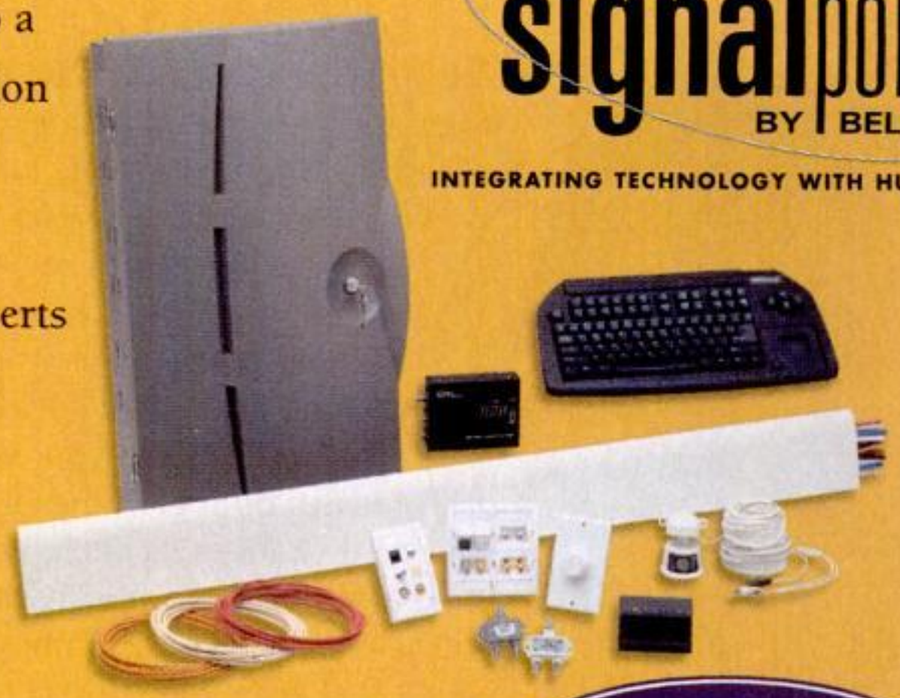

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Silent Running

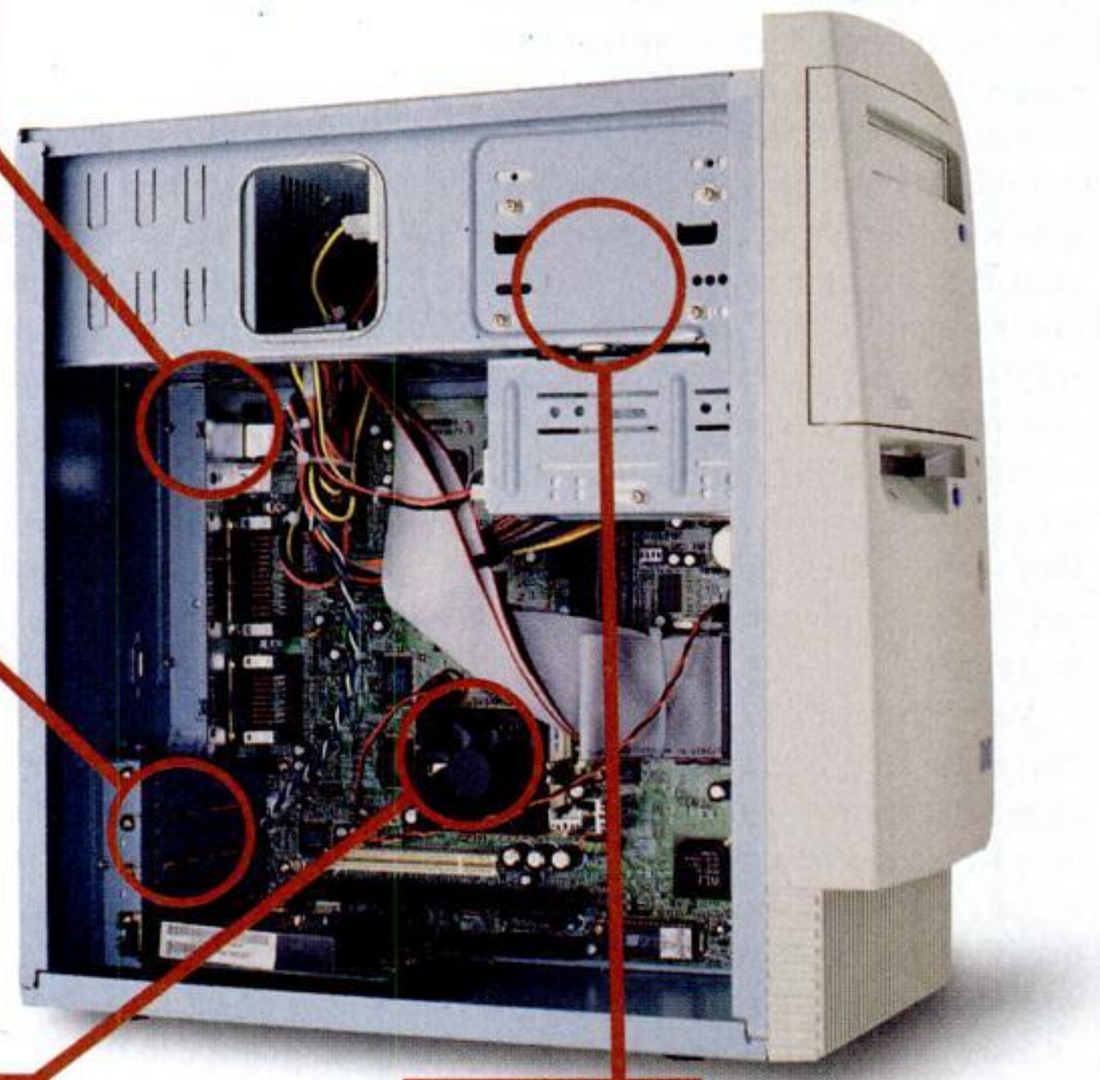
HOW TO RIG YOUR PC FOR FULL-ON STEALTH

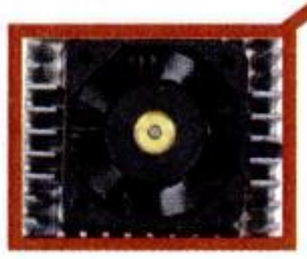
Silence is golden, and there's no need to sacrifice yours in the name of PC power. We outfitted a few of the Lab's noisier PCs with the latest in noise-silencing technology. To test the effects, we rigged up a simple sound meter and measured the decibel level produced by each PC before and after our silencing effort. Nothing will completely quiet the workings of your rig, but a few minor alterations can mean the difference between an awful din and relative quietude.

—Chris Dunphy

Replacing our old power supply with a 275W PC Power & Cooling Silencer hushed our PC by 7.9dB

The Sparkle Power "low-noise" case fan we used in place of our old clunker reduced the overall noise level by 5.5dB.





Swapping out our K6 fan for a PC Power & Cooling CPU-Cool Z1-HS netted us 11.8dB.

Ripping out the clamorous old hard drive and putting in a Fujitsu XV10 brought us 6.2dB closer to our goal.

When we decided to retire our K6-2 box as an always-on Linux server, we rigged it for ultimate silence by replacing its old noisy components with quieter alternatives. The system went from a disruptive 49.1dB down to an acceptable 34.6dB.

Tweaking your PC to get near-silent running is at least as challenging—maybe even more so—than overclocking to get maximum speed. There are numerous arcane measures you can take in an attempt to shave off just one decibel of unwanted noise. But silencing your machine doesn't need to be a complex operation. A few simple steps and some smart upgrading decisions can easily decrease your PC's noise by half, without affecting performance.

Sound is measured in the unit known as decibels (dB), on a logarithmic scale that ranges from the 0dB edge of human perception to the 130dB threshold of pain. To the human ear, a difference of as little as two decibels can be quite noticeable, and a 10dB increase in magnitude will generally double a sound's perceived loudness. The background noise in a typical household ranges from 30 to 40dB. Your goal should be to reduce your PC's sound to that ambient noise level or below.

There are a variety of sensitive, often expensive devices you can use to measure the sound that your PC is producing, but one in particular is best suited for the job: your ear. For our comparative measures, we needed to be a bit more scientific—so we used some cheap equipment we picked up at the local Radio Shack.

A Sound Level Meter isn't sensitive below 50dB, but it works wonderfully as a calibrated microphone when hooked up to a PC and combined with spectrum analysis software such as *SpectraLAB* from Sound Technology (**www.soundtechnology.com**). Using *SpectraLAB* and our mic/meter contraption, we were able to take "snapshots" of sound waveforms that could be compared to one another.

The key to accurately measuring sound is to minimize as many variables as possible. We set up a test bench as far from external noise sources as possible, and placed our Radio Shack Sound Meter on a nearby tripod. Every device was tested in the same location and orientation, and before testing each device, we measured the existing background noise, to ensure a level playing field.

Our test subjects were an aging AMD K6-2 300 and a tweaked-and-overclocked dual Celeron. The K6-2 300 rattled and thumped so much, it scared the author's cat. The Cellie cruised at 1.1GHz, but was far from quiet about it. Each machine was retrofitted with parts specifically designed to run quieter than the average cacophonous components. The upshot? We were able to cut the roar of each machine almost in half.

COMPONENT HUSH SQUAD

If you really want to quiet your noisy PC, you've got to do more than just muffle the source of the racket—you've got to minimize it altogether. The target areas are:

Power Supply: Turning the 120V AC current coming from your wall outlet into the smooth, strong DC juice that keeps your PC humming is tough, hot work. The more wattage your power supply provides, the more heat it generates, and the louder the fan that's needed to cool it.

To minimize noise, find a supply that provides enough juice to drive your system, but not so much that you'll be listening to its fan at all times. And don't skimp on the quality of your power supply, because higher quality equates to lower noise levels. Do, however, beware of marketing claims of low noise. We tested a Sparkle supply that was specifically marketed as a quiet component, but it turned out to be the loudest power supply we looked at.

For an excellent balance of power and acoustics, we found PC Power & Cooling's Silencer line of power supplies

CONT | 68 ▶

to be the best choice for any machine.

Cooling Gear: A cheap CPU or case fan can sound like a jet engine. Again, quality is paramount. And, again, marketing materials don't always tell the truth. We tested two seemingly identical "low noise" case fans, and one generated sound nearly 10dB louder than the other.

Also, consider the fact that turbulence is loud—suction sucks for silence. You'll get smoother airflow and less noise if your fans blow air out of the case. And don't forget to carefully arrange the cables within your case to minimize any interference with airflow.

Finally, look for "thermal control" fans equipped with a built-in temperature sensor. These fans speed up—and get louder—only when your case starts to get hot.

We replaced the noisy suction case fan on our Celeron box with a Sparkle fan rigged for rear exhaust, and heard a major improvement. We replaced all the CPU fans in both cases with special low-noise models manufactured by PC Power & Cooling, and were rewarded with sweet (relative) silence.

Hard Drive: Hard drives generate noise in a couple of different ways. The "idle" noise is an almost constant, high-pitched whine caused by the discs rotating—the faster the rotation, the louder the whine. The "seek" noise is a clicking that's caused when the drive head moves to access data.

Hard drive makers have become much more noise-conscious, so newer hard drives make noticeably less noise in both the idle and seek modes. In fact, each of the five major hard drive manufacturers with whom we spoke promised even quieter drives in the near future. The Fujitsu XV10 drive we tested is an example of where hard drives are headed: Fujitsu's fluid dynamic bearing (FDB) technology all but eliminates idle noise by replacing mechanical ball-bearings with a liquid equivalent. (Not all XV10s feature the FDB technology—look for a "-T" in the part number.)

Another technology appearing in many new drives trades a tiny bit of seek performance for a softer "click." Known by a variety of names, such as Silent Drive or Soft Seek, this feature will be accessible via a utility program or through the BIOS, so users can toggle between "quiet" mode and "performance" mode.

Older hard drives are louder by design, and tend to grow even louder with age, as their bearings wear. But don't consign your old drive to the junk heap without first checking out the Silent Drive kit distributed by New England Digital (**www.nedcomp.com**). For just $35, Silent Drive swaths your old clunker in a layer of foam, metal, and plastic. It managed to bring the loudest drive we tested, a Seagate Medallist, down from a deafening 46.2dB to a more agreeable 34.1dB. However, heat issues make the Silent Drive an option for only 5400rpm drives.

We replaced the Medallist in our AMD box with the 5400rpm Fujitsu XV10, which was so quiet already that equipping it with Silent Drive hardly made a difference. The old IBM drive in our Celeron gave way to a Barracuda that dramatically decreased the machine's overall whininess, and increased its performance.

BEFORE & AFTER

Without resorting to extreme measures, we managed to significantly dampen the roar of our two test machines. The K6-2, which initially screeched along at a crushing 49dB, was hushed to a barely audible 34.6dB. And the dual-CPU Celeron's roar was lowered from 46dB to 37dB, with a dramatic decrease in the high-frequency whine.

Before you dive into dimming your PC's noisy trouble spots, consider that the easiest way to quiet your machine is to get it off your desk. Moving your machine under your desk interrupts the sound waves' direct line to your ears. In fact, it can result in as much as a 6-to-8dB drop.

Another seemingly obvious but often overlooked fix is to put the cover back onto your PC's case. The extra three minutes it takes to open up your PC can spare your ears a noticeable 2 to 3dB. And a closed case actually provides better ventilation (see this month's Ask the Doctor for an explanation of why).

DARE TO COMPARE: HARD DRIVES

MAKER	Model	Size	Idle Noise	Price	Speed	URL
Seagate	Medallist 2132	2.11GB	46.2dB	Old	4,500rpm	www.seagate.com
IBM	Deskstar DJNA-371800	18GB	38.8dB	Old	7,200rpm	www.storage.ibm.com
Western Digital	Caviar WD205BA	20.5GB	35.0dB	$158	7,200rpm	www.westerndigital.com
IBM	Deskstar 75GXP	45.1GB	34.1dB	$320	7,200rpm	www.storage.ibm.com
Quantum	Fireball lct10	30GB	33.6dB	$208	5,400rpm	www.quantum.com
Maxtor	Diamond Max VL30	30.1GB	32.9dB	$179	5,400rpm	www.maxtor.com
Seagate	Barracuda ATA II	20.4GB	32.6dB	$195	7,200rpm	www.seagate.com
Fujitsu	XV10 MPF3102A-T	10.2GB	30.8dB	<$100	5,400rpm	www.fcpa.com

DARE TO COMPARE: POWER SUPPLIES

MAKER	Model	Watts	Noise	Price	URL
Sparkle Power	FSP250-61GN	250W	44.0dB	$39	www.sparklepower.com
Power Man	FSP300-60GT	300W	43.2dB	—	OEM only
PC Power & Cooling	Silencer 400	400W	41.2dB	$199	www.pcpowercooling.com
PC Power &Cooling	Silencer 275	275W	36.1dB	$99	www.pcpowercooling.com
Power Man	FSP235-60GI	235W	35.2dB	—	OEM only

DARE TO COMPARE: COOLING GEAR

MAKER	Model	Part	Noise	Price	URL
PC Power & Cooling	CPU-Cool Z1-HS	K6-2/3	40.3dB	$19	www.pcpowercooling.com
PC Power & Cooling	CPU-Cool Z1-CS	Socket 370	40.4dB	$19	www.pcpowercooling.com
PC Power & Cooling	Silencer	Case	36.2dB	$12	www.pcpowercooling.com
Sparkle Power	DF1208BB-3	Case	35.6dB	$15	www.pcpowercooling.com
Fry's Generic	PA-FAN8B3	Case	44.4dB	$20	—

NOTE: Best scores are indicated in red. All benchmarks were done on our Dell 500MHz Pentium III system.

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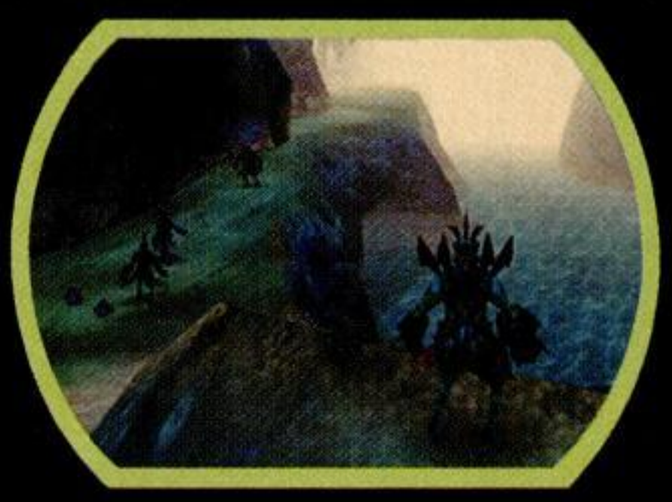

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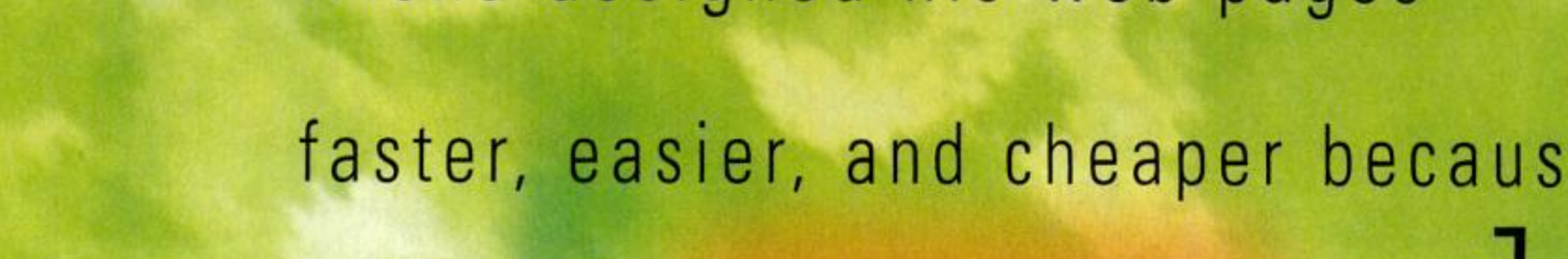

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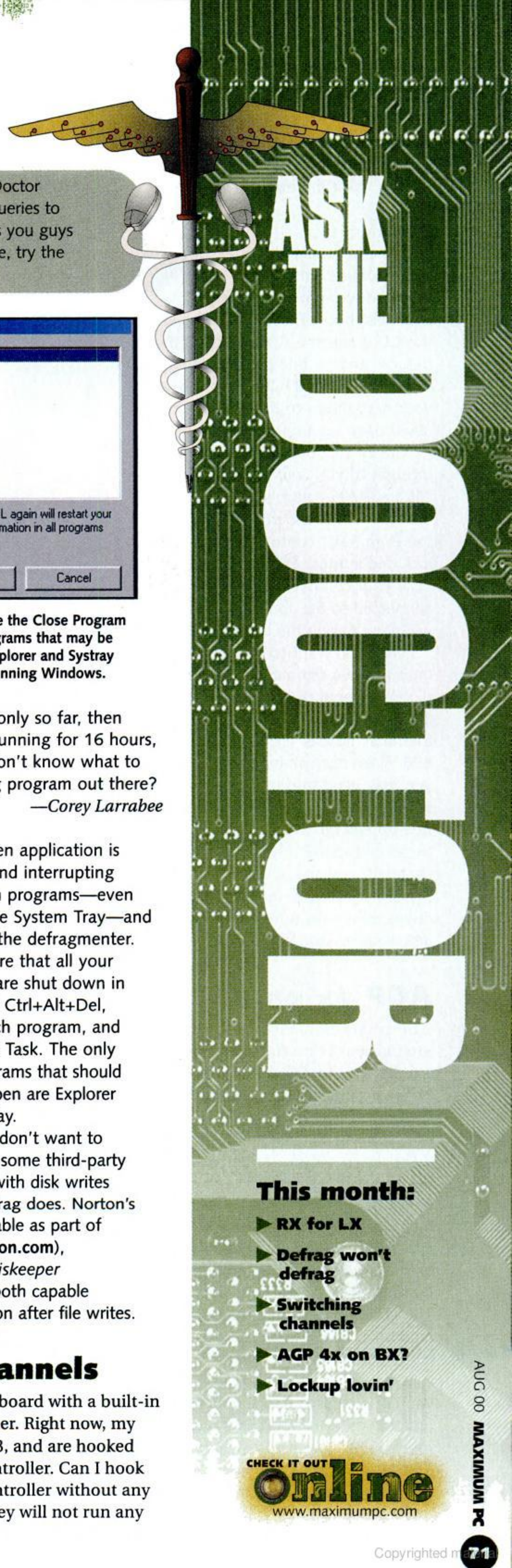


Rx for LX

I am the owner of an Asus P2L97-S motherboard with onboard SCSI. I've heard the mobo can support Celerons up to 533MHz. I'm currently running a Celeron 333MHz overclocked to 375MHz, but I'm wondering if my motherboard will accept a Pentium III. Can I use a P-III if I underclock it (i.e., 500MHz= 5x100MHz, underclocked to 5x83MHz= 415MHz)? Will the voltage be a problem?

—Joseph Wong

Your P2L97-S is based on Intel's old LX chipset, which means it won't officially support any frontside bus (FSB) speed other than 66MHz. In fact, no Pentium after the P-II 333MHz will officially work in an LX board. If you want something that you know will be supported, your best bet is the Celeron 533 (or lower), since it uses a 66MHz FSB speed. Or, you could just purchase a new mobo that supports the CPU of your choice.

Now that you've been warned, we'll tell you that an original Katmai-based Pentium III *could* work in your LX mobo if you underclock the frontside bus speed down to 83MHz. However, in our experience, clocking the frontside bus on an LX board to 83MHz is a bust. Changing the frontside bus speed, of course, changes the speed of every bus on your mobo, and in this case, that change may not be for the better: An AGP 1x bus isn't happy running at 83MHz, and iffy PCI cards can get a whole lot iffier on 42MHz buses. Even a frontside bus speed of 75MHz is a little sketchy on an LX board.

"No Pentium after the P-II 333MHz will officially work in an LX board."

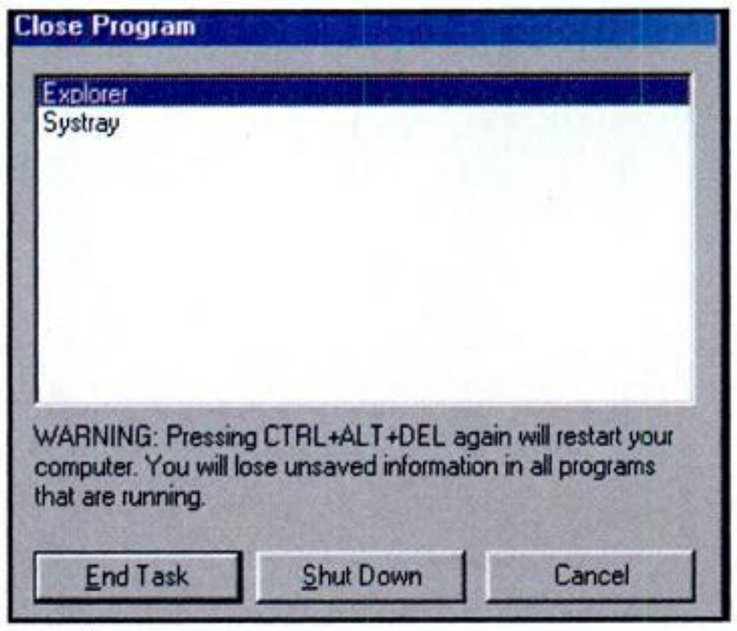
As for P-III Coppermines, they use a lower voltage than your old mobo can provide, and won't last long in that board. You'll know these procs because they have an E after their speed rating (i.e., P3-600E).

Frankly, we recommend that you get a 533MHz Celeron, or cough up a few more greenbacks for a shiny new mobo *and* a shiny new processor.

Defrag won't defrag

I have a new Gateway PC with a 15GB hard drive. When I run the disk defragmentation utility in Windows, it gets only so far, then starts over. Once, I left it running for 16 hours, and it still didn't finish. I don't know what to do. Is there a better defrag program out there?

—Corey Larrabee



If Defrag isn't defragging, use the Close Program dialog to shut down any programs that may be writing to your hard drive. Explorer and Systray are the bare necessities for running Windows.

It sounds as though an open application is writing to your hard disk and interrupting defrag. Try closing all open programs—even those in the System Tray—and rerunning the defragmenter.

To ensure that all your programs are shut down in Win98, hit Ctrl+Alt+Del, select each program, and press End Task. The only two programs that should remain open are Explorer and Systray.

If you don't want to fool with all that, there are some third-party alternatives that can cope with disk writes better than Microsoft's Defrag does. Norton's *Disk Doctor*, which is available as part of *Norton Utilities* (**www.norton.com**), and Executive Software's *Diskeeper* (**www.diskeeper.com**) are both capable of resuming defragmentation after file writes.

Switching channels

I have an Abit BP6 motherboard with a built-in ATA/66 hard drive controller. Right now, my two hard drives are ATA/33, and are hooked up to the onboard IDE controller. Can I hook them up to the ATA/66 controller without any problems? I realize that they will not run any

This month:

- **RX for LX**
- **Defrag won't defrag**
- **Switching channels**
- **AGP 4x on BX?**
- **Lockup lovin'**

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faster, but I would like to split my two CD drives among the ATA/33 controllers.

—Christopher Thompson

For performance reasons, we applaud you for wanting to move your optical drives onto separate channels, but we recommend giving the CD drives the ATA/66 lovin' they deserve and putting the hard drives onto the default ATA/33 channels. Hooking your hard drives to the ATA/66 controller could open up a hornet's nest of issues.

The BP6 mobo's ATA/66 channels are brought to you courtesy of a High Point Ultra ATA/66 controller that's soldered onto the motherboard. Unfortunately, the High Point controller's drivers aren't included in most OSes, so if you try to boot your computer from a drive that's connected to the controller, the machine will hang during the OS initialization.

Since you want to put your hard drives onto the two onboard IDE channels, and plug your optical drives into the remaining two ATA/66 controllers, you'll need to enable all four IDE channels on the BP6. Since each channel requires an IRQ, you may need to disable some unused serial or parallel ports in the BIOS to free up enough IRQs. If you do manage to get all the IDE devices onto separate channels, you should experience a nice performance increase from all of your drives, especially during simultaneous disk accesses and disk-to-disk copies.

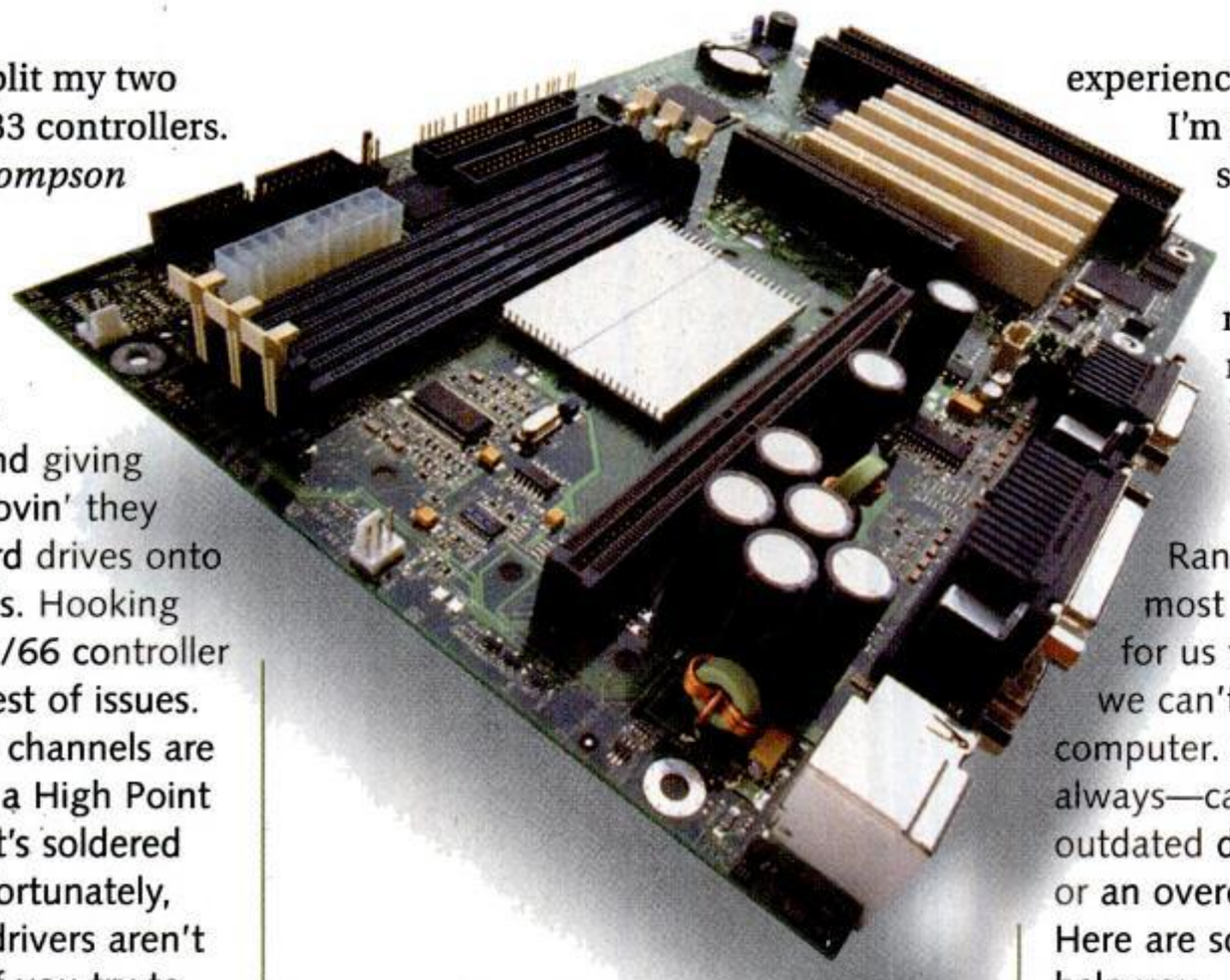
AGP 4x on BX?

Can you recommend a good BX-based motherboard that supports AGP 4x along with ATA/66? And will I gain a big performance difference by having 4x support for my GeForce?

—Steve Rodgers

Because Intel's BX chipset is two years old, it doesn't include support for newer interfaces such as AGP 4x and Ultra DMA/66. You won't find a BX board with AGP 4x or UDMA/66 integrated into the chipset. That's the bad news. The good news is that you have lots of choices if you want to upgrade to a board with a more advanced chipset.

If you want AGP 4x support and you dig Intel processors, you have two options: the VIA Apollo Pro 133A or Intel's i820. Both chipsets support a 133MHz frontside bus, Intel's new Coppermine processors, AGP 4x, and ATA/66. The only real difference between the two chipsets is that the Apollo Pro 133A supports 133MHz SDRAM, while the i820 requires RDRAM for maximum performance.



Motherboards with Intel's BX chipset don't support AGP 4x, but before you upgrade, keep in mind that most games on the market don't push even the AGP 2x spec to its limit.

The catch is that the RDRAM RIMMs are very expensive. 128MB of RDRAM is about five times more expensive than 128MB of PC133 SDRAM. Wowsa! While a memory translator hub for the i820 allows the use of standard SDRAM, the resulting performance is lackluster—not to mention that this configuration is currently being recalled by Intel.

> **"Bear in mind that upgrading just your motherboard may not actually provide you with a performance increase."**

Bear in mind that upgrading just your motherboard may not actually provide you with a performance increase. While more bandwidth is always better, very few current games take full advantage of the AGP 2x bus. If you're grappling with that uncontrollable urge to upgrade something, grab a faster processor to go with that new mobo, or get a new videocard. Since your GeForce is still pimpalicious, we suggest you get yourself a new proc.

Lockup lovin'

I've got a Pentium III 450MHz machine with 256MB of RAM and an overclocked TNT2 Ultra. My problem is that I've been experiencing random lockups when I'm playing 3D accelerated games such as *Unreal Tournament,* and when I'm doing things in Windows such as checking my e-mail. I built my system myself about a year ago. Please help!

—Marty Atkins

Random lockups are among the most difficult computer problems for us to diagnose, mainly because we can't sit down in front of your computer. Lockups are often—but not always—caused by heat buildup, bad or outdated drivers, a flaky power supply, or an overclocking attempt gone awry. Here are some general tips that may help you.

Whenever you encounter stability problems, the first thing you should do is set any overclocked peripherals to their default speeds. Though many people have great success with overclocking, stability is often sacrificed for the swanky speed boost.

If clocking everything down doesn't fix your problem, look for temperature issues. System manufacturers precisely measure the heat generated by each component in a machine, so they can optimize airflow through the PC's case. To check the temperature inside your case, use your motherboard's onboard temperature-sensing hardware, or even better, pick up a temperature probe that can be mounted at different locations inside the case. While many people remove the side from their case in hopes of increasing airflow, this isn't always a good idea; often the cover helps to create a vacuum that actually increases airflow.

If you manage to reduce the temperature inside your case and the crashing subsequently stops, it's time to invest in a new fan, or possibly to re-route the airflow through the case—usually, front-to-back and bottom-to-top is the most efficient airflow path.

If you haven't upgraded your video drivers since you bought your computer, it's a good idea to do that, too. Grab reference drivers from either your chipset provider or your manufacturer's web site.

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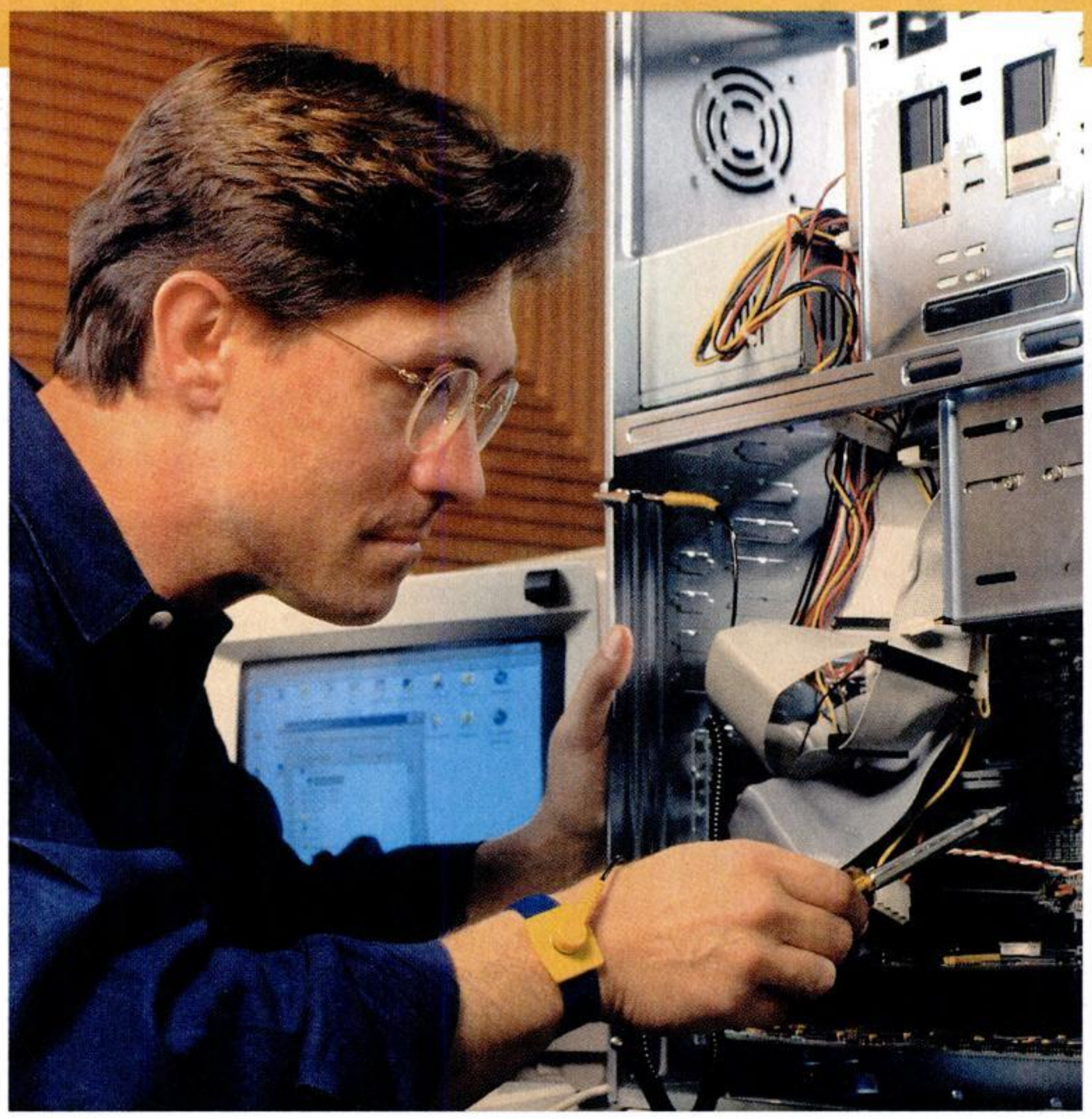

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REVIEWS

WHO needs a 75GB Hard Drive?

We know the average reader will answer this question with an enthusiastic "I do!," but this month's 75GB hard drive from IBM left even the *MPC* staff scratching its collective head. Realistically, nobody needs a hard drive this big. Granted, it would be fun trying to fill it by, for example, ripping our entire music collection into WAV format. But come on, who has enough warez, porn, or MP3s to make 75GB worthwhile?

On second thought, don't answer that.

We're not advocating the minimization of one's PC experience—just taking a break from our regularly scheduled boosterism for a reality check. The IBM drive did, in fact, receive a high verdict because it's not only the highest capacity drive we've ever tested, but also the fastest. It may be overkill, but we were impressed.

—JOSH NOREM, REVIEWS EDITOR

BEHIND THE BENCHMARKS

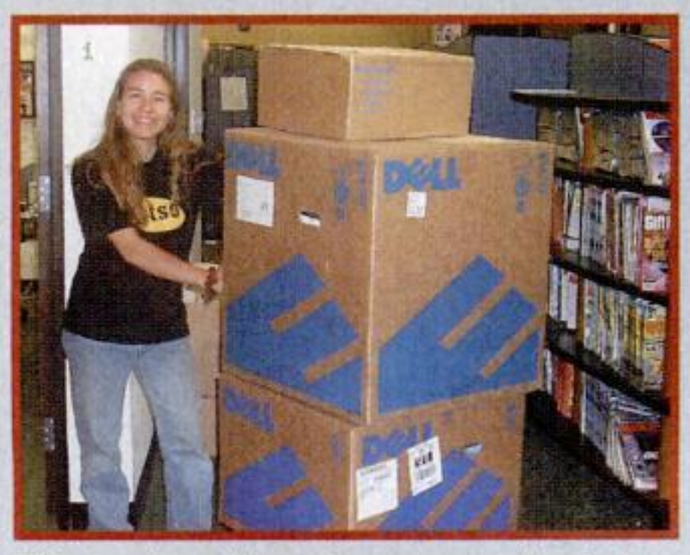
This Month: Speakers

Different folks expect different strokes from their speaker systems, and we consider that when conducting reviews in the Lab. To test game acoustics, we run the system through a round of *Unreal Tournament* (it's hard work, we know). To test DVD playback capabilities, we rely on the Normandy Beach segment of *Saving Private Ryan*. In both cases, we pay close attention to the sounds of whizzing bullets and violent explosions.

To test for the sound that hardcore audiophiles want, we play CD tracks that are known to put speakers to the test: Jaymz Bee's cover of the Crash Test Dummies' "Superman's Song," and a Chopin piano track that really stresses high-end audio reproduction at high volumes. Overall, we run what amounts to a phalanx of tonal tests that gauge frequency response break-offs and crossover levels. When it comes to speakers, we don't mess around.

System reviews, exposed!

An integral part of any *Maximum PC* editor's job involves reviewing systems from OEM vendors. They send us their very best; we put them through our paces, and we report on the outcome here in the magazine.



This is where the reviews process begins. A system is delivered to the Imagine Media mailroom via Federal Express. Ellen, the mail guru, drops all of the hardware off at our Lab.

The system is assigned to an editor, and testing begins almost immediately. The machine is run through an eight-benchmark gamut, and the scores are published in the magazine along with an editor's commentary.

The review process is completed with the "clubhouse" benchmark—it's about as "real world" as our testing gets. This clubhouse would have garnered a Kick Ass award, were it equipped with a cootie shield.

A behind-the-scenes look at the Maximum PC Lab and the gearheads who work in it.

17 PRODUCTS REVIEWED!

RIGHTEOUS LINK: HTTP://GRC.COM

Steve Gibson Research's web site is packed with useful information, shareware programs, and best of all, a personal firewall tester. Called *Shields Up*, the firewall program runs from the web, and delivers a report card on the overall security of your Internet connection. This program gives everything from commonly available ports to NetBios the rubber glove treatment. And if that's not enough, a more thorough port probe can be conducted upon your request.

Shields UP! is checking *YOUR* computer's Internet connection security . . . currently located at IP:

206.57.18....

Wind Tunnel CPU Testing

This month, we decided to test the effectiveness of wind tunnels in CPU cooling. Using an older Dell P-III 500MHz test machine, we began our test by loading *CPUburn*, a freeware program (**http://users.ev1.net/~redelm**) designed to "load x86 CPU's as heavily as possible for the purposes of system testing." After removing the wind tunnel from the Dell's proc, we loaded the program and watched the CPU's temp go up... and up... and up. After several minutes, it leveled off at 130 degrees Fahrenheit. We re-attached the plastic windtunnel contraption, and watched in disbelief as the temperature

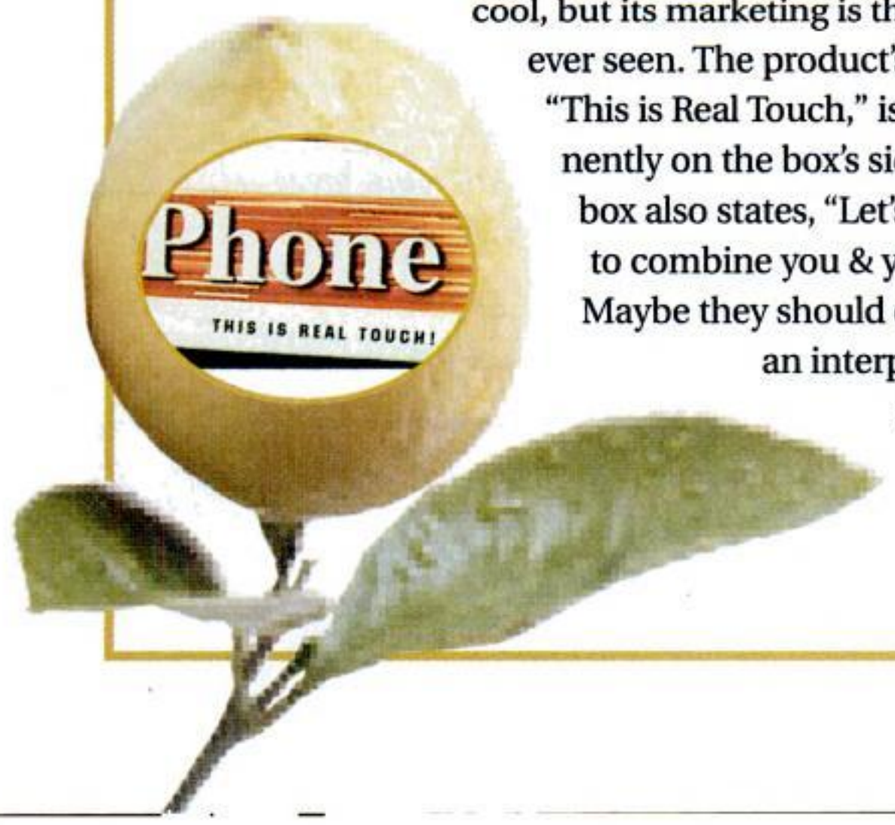
plummeted to 80 degrees Fahrenheit in the space of just one minute! Repeated testing yielded similar results—using the windtunnel resulted in a fifty-degree drop in temperature, on average.

We were so delighted with these results that we decided to remove the heatsink from the chip, to see if we could get the temperature hotter than 130 degrees and take the testing to another level. Unfortunately, removing the heatsink mysteriously broke the chip, putting an end to our testing altogether. The dead chip is pictured here: Feel free to e-mail eulogies to josh@maximumpc.com.

Lemon of the Month

Mouse Phone Marketing

The mouse phone featured in PV this month is pretty cool, but its marketing is the worst we've ever seen. The product's catchphrase, "This is Real Touch," is printed prominently on the box's side. Huh? The box also states, "Let's use mouse to combine you & your life closer." Maybe they should combine an interpreter with the marketing copy.



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Hardware Photography by **AARON LAUER**

Hewlett-Packard Pavilion

SMALL CASE, BIG POWER

Under the guise of a simple DV studio system, HP slipped us a powerful rig that screamed through our digital video benchmarks with impunity.

"Instant gratification" best describes the Pavilion 8700I P3-933, Hewlett-Packard's first foray into the digital video arena (www.hp.com). In addition to stacking the Pavilion with a fast processor, ample RAM, and a wish list of killer components, HP makes the DV capturing and editing process painless. Boot this rig up and you're ready to go—instant gratification.

The DV portion of the package centers on Pinnacle's *Studio DV*, which is one of the easiest and most intuitive movie-making suites we've ever used. A novice could get the *Studio DV* software package up and running in only a few hours, yet it still delivers robust features, such as the ability to add fades and transitions to movies, and competent sound editing and soundtrack creation tools. *Studio DV* also has a Smart Capture feature that intelligently breaks footage into segments each time you stop and start recording.

The Pinnacle card offers three FireWire ports, two external and one internal. The internal connection is designed to be connected to a FireWire hard drive, but HP has taken the liberty of allowing access to it from the front of the case via a connecting cable—a nice touch indeed. It's annoying to have to give your PC a reach-around every time you want to pump video into it.

Although the Pinnacle FireWire card and *Studio DV* software are both fine products, their inclusion in this system is actually what prevents it from winning a Kick Ass award. The two components only work with one another—you can't pair either of them with any other product. So if you wanted to use, say, Adobe *Premiere*, you'd be out of luck unless you upgraded to a *Premiere*-compatible card. Bah!

As any DV enthusiast will tell you, digital video creation and editing require a lot of speed, power, and storage. The Pavilion antes up all three. Its 40GB Maxtor hard drive is more than sufficient for holding multiple copies of movies, and its 933MHz Coppermine processor and 256MB of PC133 RAM ensure that you won't be waiting forever for your video to crunch.

Capture card notwithstanding, every other component in this system is at the top of its class. Everything, from the 32MB DDR GeForce 2 videocard to the 40GB Maxtor hard drive to the Pioneer 16x DVD-ROM, is superb. That's a good thing, since upgrading would be most difficult given the cramped case this equipment is housed in. For example, you have to remove the power supply in order to unearth the PCI cards, and the tangle of wires within is more daunting than the jungles of 'Nam.

We expected this to be a fairly competent DV system, and found it to be a whole lot more. As we said before, we don't approve of the Pinnacle product tying, but for DV purposes, this rig is fast, easy to use, and equipped with a veritable dream list of parts. In fact, it boasts nearly the same components as the Alienware system we reviewed in July, yet it costs $900 less! Well done, HP.

—Geoffrey Visgilio

UNDER THE HOOD

THE BRAINS	
CPU	Intel Pentium III 933MHz
L2 Cache	256K on-die
RAM	256MB PC133 SDRAM (1536MB max)
Motherboard	Asus CUV-NT, VIA Apollo Pro 133a chipset
Drive Bays	Three 5.25-inch (one free), two 3.5-inch
I/O Ports	Four USB I One FireWire One serial I One parallel I Two PS/2
DISPLAY	
Video	Asus V7700 GeForce 2 GTS 32MB DDR SDRAM
Monitor	19-inch HP D6433A M90, 18-inch viewable, 0.26 dot pitch
Refresh@ Max Res	85Hz@1600x1200
STORAGE	
Hard Drive	40GB Maxtor 54098U8, ATA/66, 7200rpm
DVD	16x Pioneer DVD-115 DVD-ROM
CD-RW	Hewlett-Packard CD-Writer Plus 9100I (8/4/32)
Removable	Floppy
NETWORKING	
Fax/modem	MSP3880U 56K Modem
NIC	HP EN1207D-TX PCI 10/100 Fast Ethernet Adapter
SOUND	
Soundcard	Sound Blaster Live! Value
Speakers	Polk Audio AMR2 multimedia speakers

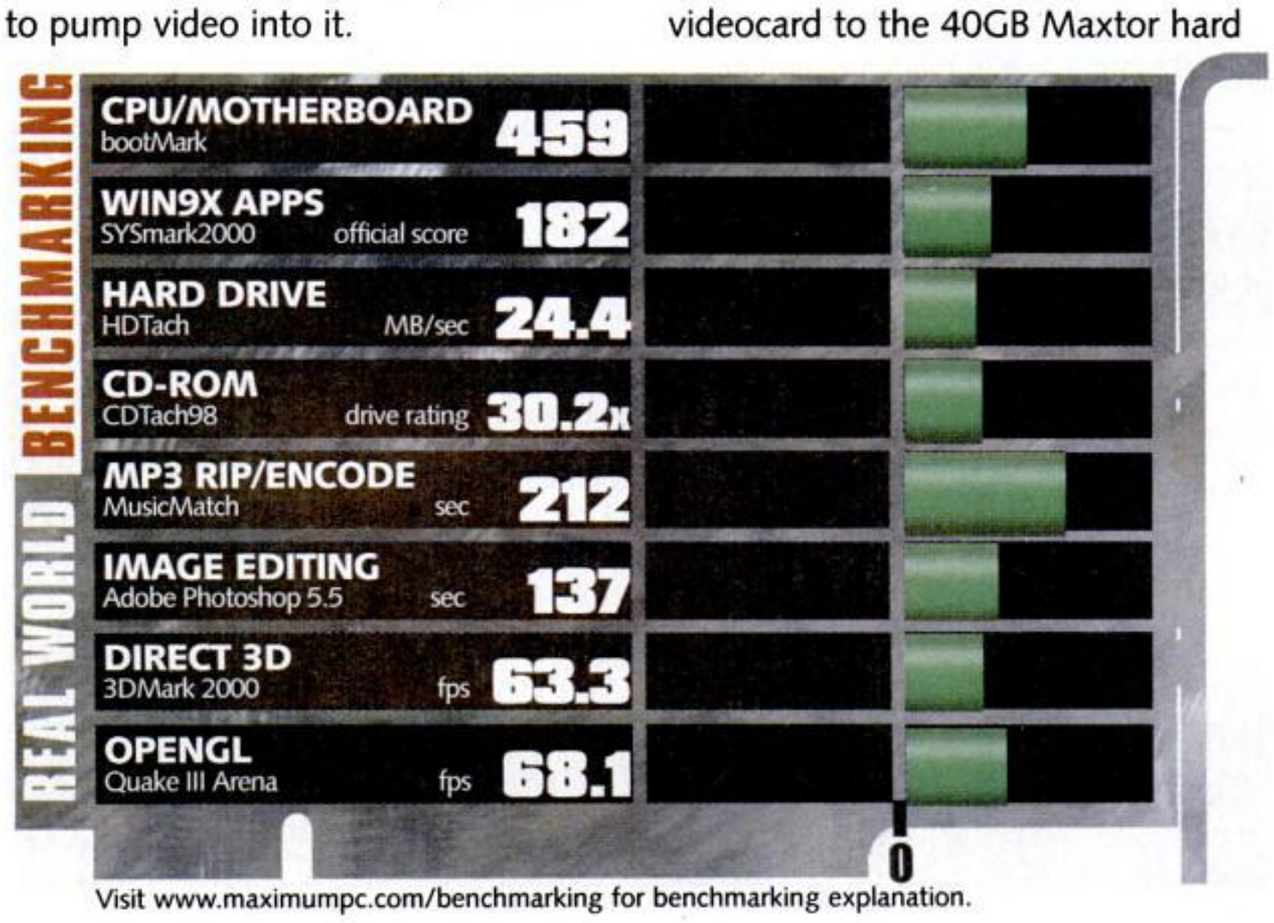
THE BUNDLE

Pinnacle's *Studio DV* I Adaptec's *Easy CD Creator 3.5* *Quicken 2000* I Microsoft *Works* I Microsoft *Money*

BOOT 1:04 DOWN 0:06

PLUSES
- Instant DV gratification
- Top-notch components
- Relatively inexpensive

MINUSES
- Cramped case
- No Zip drive
- No camera included
- Advanced users will want to swap out the capture card



Visit www.maximumpc.com/benchmarking for benchmarking explanation.

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EXPANSION NOTES

The HP Pavilion is chock-full of goodies, but there isn't much room for growth. To get to the proc or the memory or the PCI slots and bays, you have to remove the power supply and slip out the drive bay chassis in a feat of acrobatic agility.

EXPANSION MAP

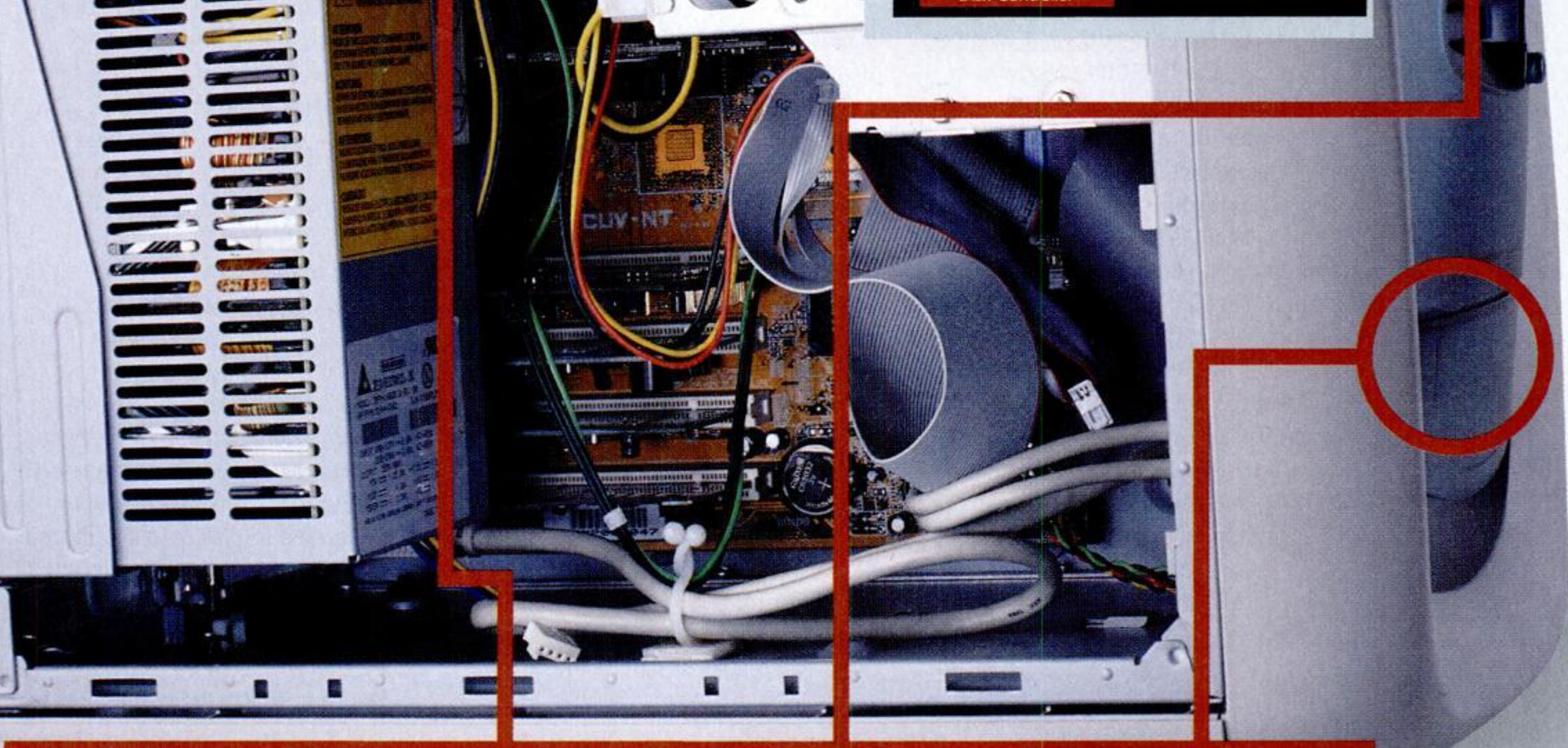
AGP:	DDR GeForce 2
PCI:	Sound Blaster Live!
PCI:	Modem
PCI:	NIC Card
PCI:	Pinnacle FireWire Capture Card

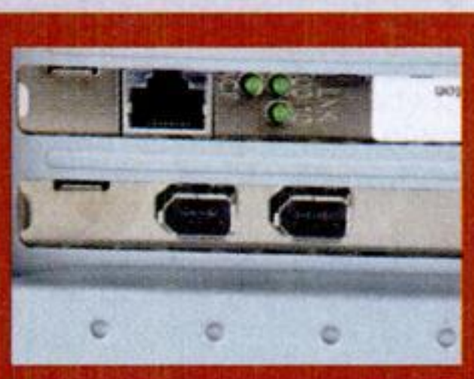
IRQS

00 System Timer	Controller/PCI to USB Host Controller
01 Keyboard	**10** Modem/IRQ Holder
02 Interrupt Controller	**11** SB Live!/Geforce 2 /IRQ Holder
03 COM 2	**12** PS/2 Mouse
04 COM 1	**13** Num. Data Proc
05 10/100 Fast Ethernet Adapter/IRQ Holder	**14** Primary IDE Controller
06 Floppy	**15** Secondary IDE Controller
07 Printer (LPT1)	
08 System Clock	
09 IEEE 1394	

DMAS

01 SB16 Emulation	**04** DMA Controller
02 Standard Floppy Disk Controller	**05** SB16 Emulation





This is what you're paying for. Pinnacle's FireWire card offers zippy transfer rates and pipes video right into the editing software, for easy movie making.

Is it me, or is it a little cramped in here? You could slip a Zip drive and another DIMM inside, but that's about it. The good news is that you don't need much else—HP really stacked its DV system.

Is this an HP or a Nokia? It's as though an iMac and a Nokia cell phone fought for control of HP's new color scheme.

FireWire in front—say Hallelujah! There's nothing worse than having to fumble behind your machine every time you want to pipe in video. HP offers FireWire up front, where it should be.

Digital Camera Conundrum

DIGITAL CAMERAS STRUGGLE BETWEEN BEAUTY AND BRAWN

KODAK

PLUSES
- Rugged
- Big controls for big hands
- Great images
- Amazing fill flash
- CompactFlash

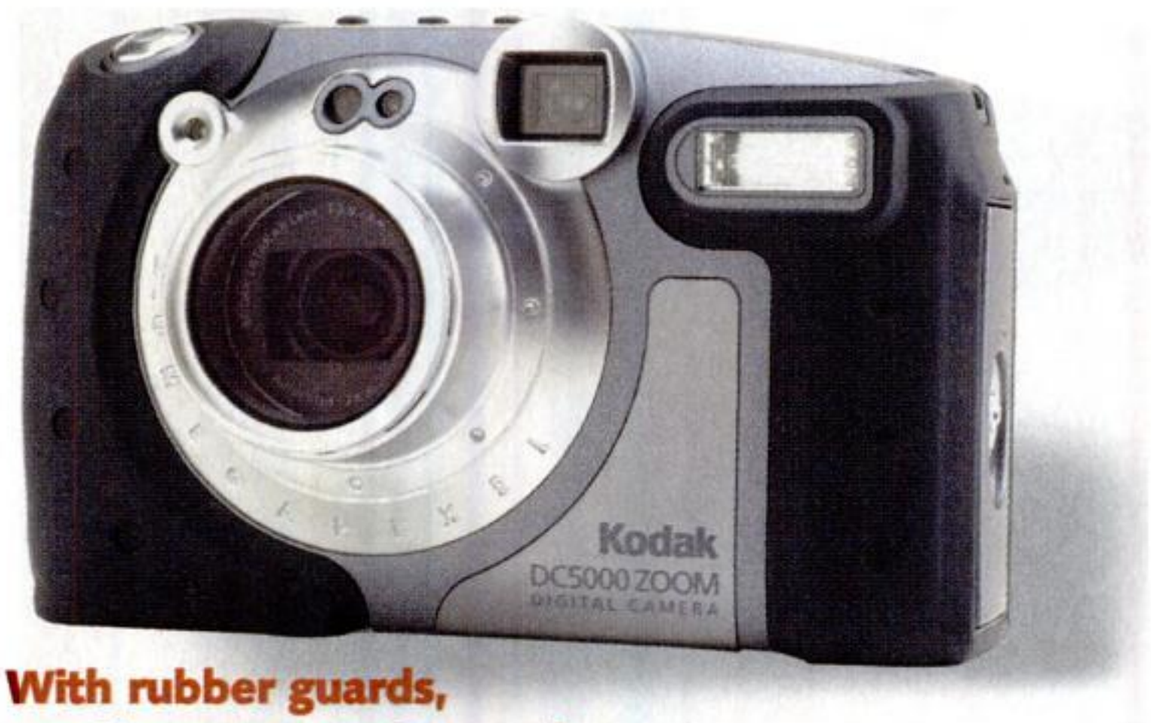
MINUSES
- Only 2.1-megapixel
- No Digita scripting
- No gamepad-style controller

OLYMPUS

PLUSES
- 3.34-megapixel CCD
- 15 res/compression settings
- Quality lens assembly
- External flash sync
- Custom settings mode

MINUSES
- SmartMedia only
- Proprietary external flash sync
- No battery charger

Back in the early days of digital photography—say, six months ago—all digital cameras were pretty much the same. One might have delivered a few more pixels of resolution, or another might have added a new feature, but really, it was a one-size-fits-all world. Times have changed, and today's cameras are emerging to serve niche markets. To celebrate the diversification of the species, we've collected a trio of cameras ranging in appearance and in features. No matter what your photographic needs are, one of these very distinct cameras should offer just what you're looking for.



With rubber guards, weatherproof casing, and big burly controls, Kodak's DC5000 is ready to go anywhere that you are.

Kodak DC5000 Zoom

In a vehicle analogy, the Kodak 5000 is a Hummer **(www.kodak.com)**. Housed in a black, rubber-encased hard shell that offers class-4 weather-proofing, the DC5000 weighs in at over one pound.

Under the armor beats a "true" 2.1-megapixel CCD—no interpolation here—that spits out some of the prettiest 1760x1168 pictures we've seen, with bright, pleasing colors and ample detail. The fill flash is particularly impressive, producing studio-quality portraits in open-shade settings.

But the 5000's biggest disappointment is the lens. Although it comes equipped with a threaded protective filter that should ship with all digital cameras, its specs are pathetic. The relatively slow f3.0 lens zooms out to only 2x, and though the digital zoom reaches 3x, it's like any other digital zoom—that is, utter crap.

Images are saved as JPEGs; unfortunately, the uncompressed TIFF option present in Kodak's DC290 series cameras is missing. We hear that firmware upgrades could enable it down the road. Another missing feature that's been included in previous Kodaks is Digita's *FlashPoint* scripting. Offsetting these glaring omissions are special effects such as sepia and black-and-white modes. There's also a cheesy borders option that should be ignored at all costs.

Images are loaded onto CompactFlash, thankfully, but the bundled card is a wimpy 8MB. Pictures can be siphoned off with a standalone CF reader or piped directly into a PC, via USB, at a startlingly zippy 500K/sec.

The Kodak DC5000 is a very impressive camera. It's as rugged as a buck knife, and takes pictures that are just as sharp. All that's missing are the software features Kodak bundled with previous cameras, which would be icing on the cake.

THE SPECS

KODAK

SENSOR
66-inch CCD, 2.1 megapixel (1760x1168)

ISO EQUIVALENT
100

LENS
(35mm equivalents) 30-60 mm f/3.0

ZOOM
2x optical (3x digital)

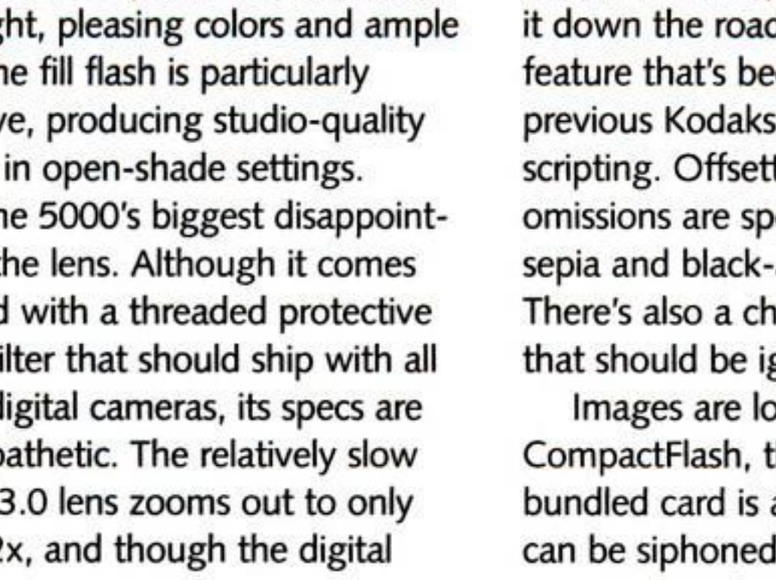
STORAGE
CompactFlash card, 8MB card included

FILE FORMAT
JPEG

LCD SCREEN
1.8-inch TFT

VIDEO OUT
NTSC/PAL

WEIGHT
1 pound (without battery)



The Olympus 3030Z sports a black case in lieu of its predecessor's silver coat. It actually looks like the gag cameras that disguise a squirt gun.

Olympus 3030 Zoom

Olympus's 3030 Zoom **(www.olympus.com)** is a beefed up version of the consumer-level 2000 Zoom, which scored an 8 verdict last October—in terms of functions, the 3030Z shares more in common with the Kick Ass 2500L we reviewed in March. But, while the 3030Z is a good camera, it's not great.

Under the 3030Z's ebony hood beats a capable 3.34-megapixel CCD that spits out spacious 2048x1536 images. Credit for this goes to Olympus' legendary 8-element, all-glass, spherical lens, which produces detailed pictures that are crisp, with nicely saturated colors. However, we found that shots taken in open shade tended to pick up a significantly blue cast. It's easily corrected in any image-editing app, but better recognition of shade in the camera's white balance would solve the problem.

The best 3030Z images are produced by the uncompressed TIFF mode included in the 15-plus resolution/compression combinations the camera offers. And the JPEG compression algorithms are exceptionally smooth, producing only nominal artifacting. Beyond the myriad capture combinations, the 3030Z also sports intriguing alternative modes, including sepia tone and a copy mode for text.

Image size is an important factor with this camera, since Olympus has reverted to using a SmartMedia slot rather than the CompactFlash option

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

of the 2500L. SmartMedia capacities continue to lag behind those of CF, making file sizes a serious consideration. The departure from CF is particularly tragic given the pro-caliber features included with the 3030Z, such as a diopter adjustment for the optical viewfinder, a custom mode that memorizes your favorite settings, and an external flash sync—a proprietary 5-pin configuration designed to accommodate only Olympus's own FL-40 speedlight.

Other bells and whistles abound, such as a QuickTime movie capture mode (320x240 pixels,15fps) and Olympus's trademark wireless remote control. A few simple gadgets, such as a lens-cap holder and the requisite battery charger shipped with most of Olympus's recent offerings are, oddly, MIA.

Overall, the 3030Z is a commendable camera with superb image quality and an abundance of amenities, and its 3.34-megapixel CCD is the highest uninterpolated CCD in this grouping. But our enthusiasm for the 3030Z was tempered by its use of SmartMedia and exclusion of several features we'd expect to see in a camera of this caliber.

FujiFilm FinePix 4700 Zoom

Hot on the heels of Fuji's compact MX-2700, which received a 6 verdict in the October 1999 issue, comes the FinePix 4700 Zoom **(www.fuji.com)**. This latest incarnation of Fuji's consumer-level camera is packing more muscle in its petite magnesium-alloy frame, but with mixed results.

The most hyped addition to the 4700 is Fuji's new "high-res" CCD. Using a technology called SuperCCD, it interpolates a relatively meager 2.4-megapixel image up to the camera's 4.3-megapixel (2400x1800) output. The results? Predictably crappy. While color balance and exposure are accurate, the interpolation produces soft, splotchy results when viewed at full size. In images sent to a good photo printer, the defects are barely visible, but the problems are clear when the images are viewed on a computer monitor. A 1600x1200 output would have been better for the 4700's CCD.

Is that a camera in your pocket or are you happy to see me? The Fuji 4700 Zoom is teeny tiny.

The 4700's most noticeable improvement over previous models is a decreased lag time between shots. It's been shortened from nearly five seconds to just over one second, making the shooting process much more natural. Unfortunately, the camera's buffer is still too small, so write times slow to five seconds after you've taken two pictures.

The 4700's interface is vastly improved over its predecessor's. Instead of blinking lights surrounding the gamepad-style controller, easily-read LCD controls identify each of the buttons. Using these controls in lieu of the 2-inch color LCD helps conserve precious battery life, which, with only two AAs, can be very short. The LCD also indicates that you're ready to shoot by changing colors—brilliant.

The 4700 can capture over a minute of 320x240 AVI video, with sound, at a somewhat-watchable 10fps. However, the built-in mic is iffy and there's no external mic jack. And while optical zoom is disabled during video capture, digital zoom is possible but not encouraged, due to nasty pixelation.

We were especially put off by the 4700's ergonomics. It's convenient that the 9-ounce formfactor fits in the front pocket of all but the tightest pants, but actually holding the vertically oriented camera is a chore. Its small size is particularly impossible for those with big mitts. And providing just a small rubber thumbpad on the camera's slick metal shell makes it an accident waiting to happen.

We're also curious about Fuji's decision to go with SmartMedia over CompactFlash, considering SmartMedia's incompatibility issues that range from voltage problems to device recognition troubles.

Overall, the FinePix 4700 Zoom is a dubious choice for your digital imaging needs.

—Brad Dosland

FUJI

PLUSES
- Pocketable
- Nifty LCD interface

MINUSES
- Awkward to use
- So-called SuperCCD isn't so super
- Really only 2.4 megapixels
- SmartMedia

KODAK DC5000 ZOOM — 9
$699 | Kodak
Buy www.SeeMeBuyMe.com
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OLYMPUS 3030 ZOOM — 8
$1000 | Olympus
Buy www.SeeMeBuyMe.com
877.751.7467 ID#0626

FUJIFILM FINE PIX — 6
$800 | Fuji
Buy www.SeeMeBuyMe.com
877.751.7467 ID#0625

THE SPECS

OLYMPUS

SENSOR
1/1.8-inch CCD, 3.34 million pixels(2048x1536)
ISO EQUIVALENT
100, 200, 400
LENS
(35mm equivalents): 32-96mm f/2.8
ZOOM
3x optical (2x digital)
STORAGE
3.3V SmartMedia 16MB card included
FILE FORMATS
JPEG, TIFF (non-com pressed), *QuickTime* Movie (Motion JPEG) with sound, wave audio
LCD SCREEN
1.8-inch wide angle, color TFT LCD monitor with 114,000 pixels
VIDEO OUT
NTSC/PAL
WEIGHT
10.7 ounces (without battery)

THE SPECS

FUJI

SENSOR
1/1.7-inch CCD, 2.4 million pixels (2400x1800)
ISO EQUIVALENT
200, 400, 800
LENS
(35mm equivalents): 36-105mm f/2.8
ZOOM
3x optical (2x digital)
STORAGE
SmartMedia 3.3v, 16MB card included
FILE FORMATS
JPEG, *QuickTime* movie (Motion JPEG) with sound, wave audio
LCD SCREEN
2.0-inch, color TFT, active-matrix with 130,000 pixels
VIDEO OUT
NTSC/PAL
WEIGHT
9 ounces (without battery)

PRINT QUALITY

KODAK
With the smallest CCD of the pack, we had modest expectations from Kodak's DC5000. It pleasantly surprised us with beautifully balanced fill flash.

OLYMPUS
With detail to spare, the Olympus 3030Z produces beautiful images, albeit with a mild blue cast, that stand up to scrutiny.

FUJI
While well color-balanced, the Fuji 4700's SuperCCD introduced artifacts through interpolation.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

Sony VAIO Digital Studio

LITTLE, PURPLE, DIFFERENT

The Sony VAIO Digital Studio is a reasonable digital video solution, but with some old-school components and no room to grow.

Sony has always supported digital video creation with its Digital Studio line of PCs, and now makes admirable strides toward simplifying the process with the R558DS (**www.sony.com**). The PC looks sexy, has some great hardware, and is reasonably affordable. Unfortunately, our enthusiasm was dampened by its extremely cramped case, limited room for expansion, and use of inconsistent components that run the gamut from top-of-the-line to bottom-of-the-barrel.

The brawn behind the box is an 866MHz Coppermine processor and 128MB of PC133 SDRAM. The RAM allotment is sufficient, but any power PC, and especially a DV system, should have at least 256MB of RAM. Sony also includes a 40GB Maxtor ATA/66 hard drive with a free drive bay that's primed and ready to hold a backup hard drive.

We were sad to see that Sony went with an ancient TNT2 Pro videocard, which eked out an abysmal seven frames per second in Quake III. For DVD playback, Sony includes the Kick Ass Pioneer 16x DVD-ROM drive, but watching soft DVD on the TNT2 Pro is an exercise in futility.

Even worse are the atrocious onboard Yamaha sound and tin-can Sony speakers. The speakers are especially egregious, considering how important sound editing is to the DV creation process.

Sony does show some innovation by integrating both FireWire and Ethernet onto the motherboard. The FireWire, a.k.a. iLINK, port allows for supersonic DV capture, and the ability to link together multiple Sony devices. Onboard FireWire can be used with any software, unlike capture cards that must be used in conjunction with specific applications. And of course, integrating Ethernet and FireWire onto the motherboard frees up two PCI slots, though the diminutive size of the rig's case makes this more of an imperative than a plus.

Beyond the system's hardware lies an interesting software package, including a stripped-down version of Adobe *Premiere* called "LE," and a lite version of Sonic Foundry's *Sound Forge*. Though neither is a full version, the programs are very robust, and we give Sony props for actually employing software titles that aren't its own.

Of course, the rest of the software bundle is pure Sony. There's *DV-Gate*, a proprietary wizard that facilitates communication between your DV camcorder and the computer, aids movie transfers, and prepares large batch captures. There's also *Movie Shaker*, which adds fades and special effects to video clips. We appreciate *Movie Shaker's* ease-of-use, but the effects are cheesy, childish, and clearly geared toward the most novice user.

Overall, the Sony Digital Studio is a rather commonplace entry into the DV market. It has a well-rounded software package and a few choice components, but we throw our hands up at its miniscule case, and old-school sound system and videocard.

—Geoffrey Visgilio

UNDER THE HOOD

THE BRAINS

CPU	Intel Pentium III 866MHz
L2 Cache	256K on-die
RAM	128MB PC133 SDRAM (256MB max)
Motherboard	Asus CUSL-LE with Intel 815E chipset
Drive Bays	Two 5.25-inch, Three 3.5-inch (one free)
I/O Ports	Three USB | Two FireWire (one 4-pin, one 6-pin) | One Ethernet One serial | One game | One parallel Two PS/2

DISPLAY

Video	nVidia RIVA TNT2 Pro with 16MB SDRAM
Monitor	Sony 17-inch Trinitron Multiscan E200, 16-inch viewable, 0.25 grille pitch
Refresh@ Max res	100Hz@1600x1200

STORAGE

40GB	Maxtor 94098U8, ATA/66, 7200rpm
DVD	16x Pioneer DVD-ROM DVD-115
CD-RW	Sony CD-RW CRX140E (32/4/2)
Removable	Floppy

NETWORKING

Fax/modem	Lucent v.90 Win Modem | Realtek RTL 8139 PCI FastEthernet NIC

SOUND

Sound	Yamaha AC-X6 Audio Device
Speakers	Sony SRS-Z050V speakers

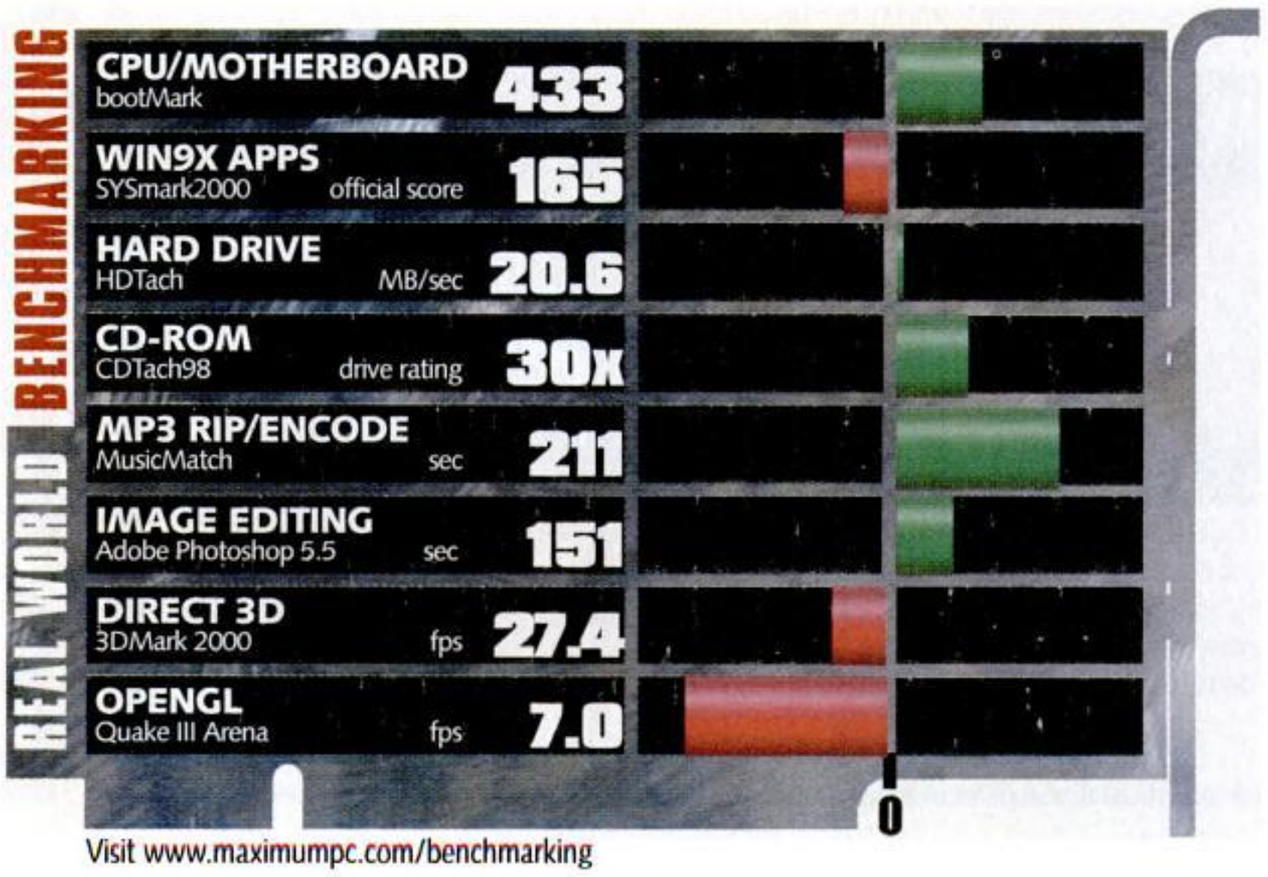
THE BUNDLE

Sony *DV Gate* | Sony *Movie Shaker* | Sony *Picture Gear 4.1* | Sony *Visual Flow 1.0* | Adobe *Premiere 5.1 LE* Adobe *Photo Deluxe 4.0 Home Edition* | McAfee *VirusScan* | *Quicken 2000* | Sonic Foundry *Sound Forge XP* | Microsoft *Word 2000* | Adaptec *Easy CD Creator 4*

BOOT **1:30** DOWN **0:06**

PLUSES
- Onboard FireWire and Ethernet
- Aperture grille monitor
- FireWire and software are independent of one another

MINUSES
- Cramped case
- No room for 3.5" drive expansion
- Speakers sound awful
- TNT2 Vanta videocard



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EXPANSION NOTES

This is truly one of the most cramped cases we've ever seen. Thanks to the two free PCI slots and the AGP slot, upgrading is possible but painful. We'd ditch the videocard, soundcard, and speakers right off the bat, and add another 128MB DIMM.

EXPANSION MAP

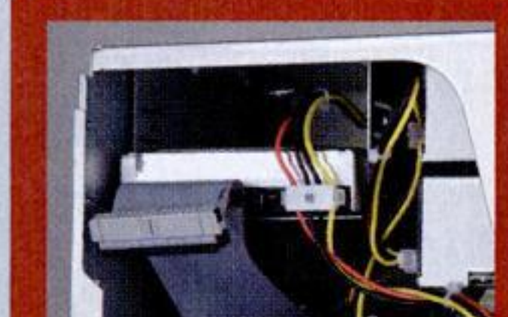
AGP: RIVA TNT2 Pro
PCI: Free
PCI: Free
PCI: Modem

IRQS

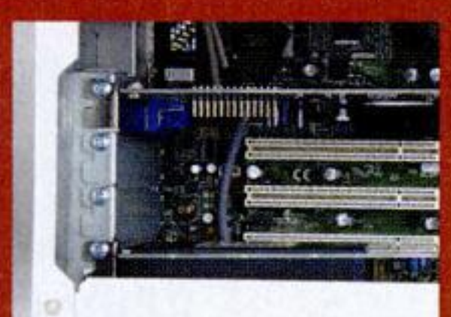
00 System Timer	**09** USB Host Ctrl/ Modem/IRQ Holder/ACPI Bus
01 Keyboard	**09** IACPI IRQ Holder
02 Interrupt Controller	**10** MPU-401 Compatible
03 Yamaha Audio Device	**11** RIVA TNT2 Pro/ IRQ Holder
03 Fast Ethernet Adapter	**12** PS/2 Mouse
03 IRQ Holder	**13** Num Data Proc
04 COM 1	**14** Primary IDE Controller
05 iLINK (IEEE 1394) Ctrl/IRQ Holder	**15** Secondary IDE Controller
06 Floppy	
07 Printer (LPT1)	
08 System Clock	

DMAS

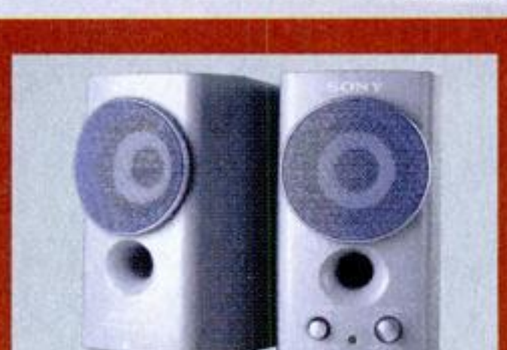
02 Standard Floppy Disk Controller	**04** DMA Controller



Double your pleasure. No, there's not much room in here, but the VAIO comes ready with a slot for a second HD to double your data storage needs.



Look, Ma, no capture card! Putting FireWire and Ethernet onboard frees two of the three PCI slots for your expansion pleasure.



Bring in da noise, bring in da junk. It's really disappointing to see a multimedia giant like Sony include such inferior speakers. We could've gotten better sound from the drive-thru-window speaker at Taco Bell.

What's cooking, good looking? Only Sony can make gray and purple look so damned sleek together.

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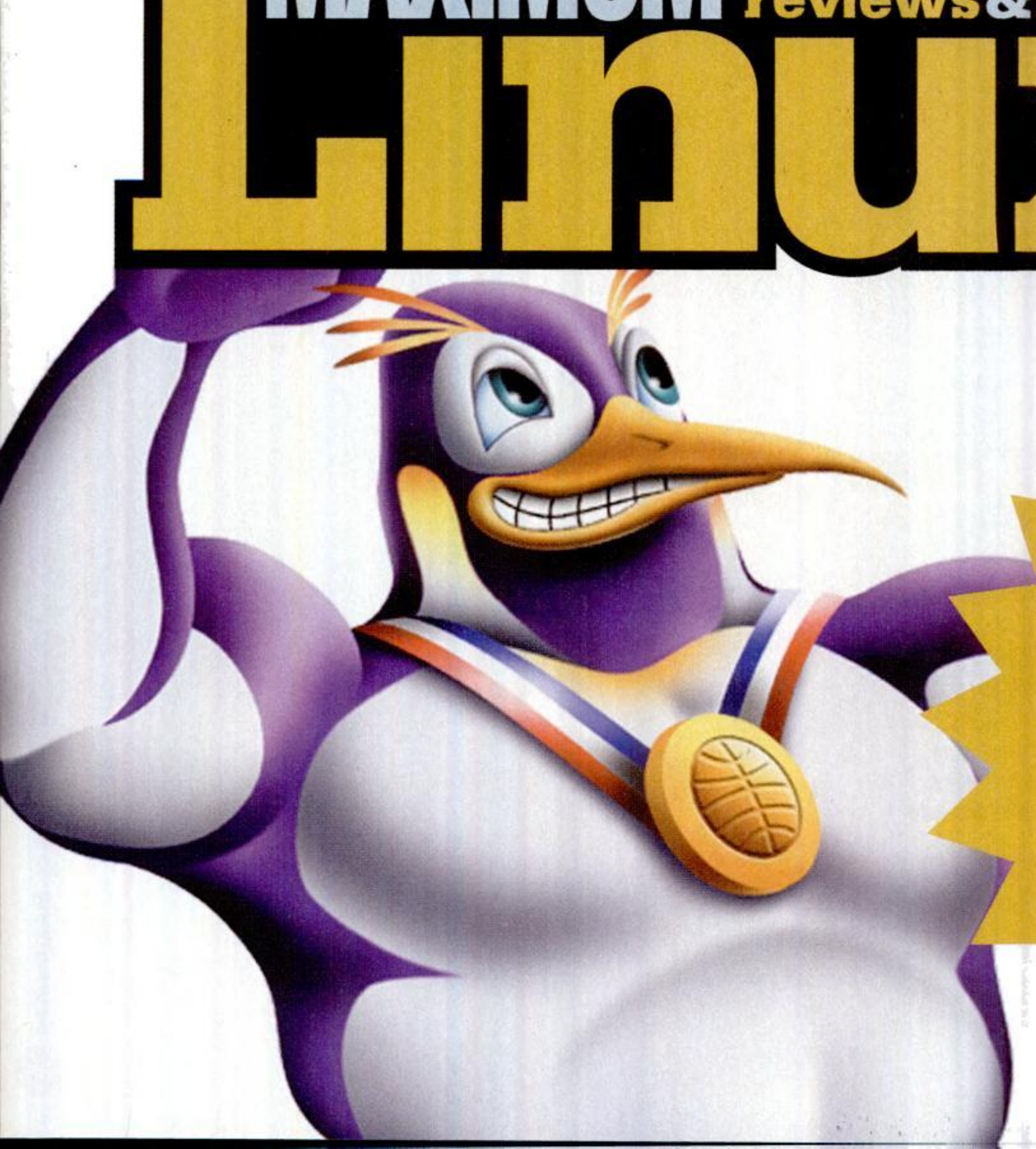

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Hewlett-Packard Jornada 548

YOU CAN'T JUDGE A PDA BY ITS HARDWARE

Invariably, any color PDA will be compared with the ubiquitous Palm IIIc, and at first glance, Hewlett-Packard's Jornada 548 (**www.hp.com**) appears to give the IIIc a run for its money: It boasts a 133MHz Hitachi processor versus the Palm IIIc's 33MHz Dragonball VZ; a 240x320 16-bit LCD versus the IIIc's 160x160 8-bit LCD; and 32MB of RAM memory (plus 16MB of ROM) versus the IIIc's 8MB. Add features that are long overdue on Palm PDAs, such as a CompactFlash slot and a stereo-out jack, and the Jornada looks like a potential Palm killer.

Looks can be deceiving.

Beneath all the hot hardware, the HP Jornada is driven by the latest rev of Windows CE, dubbed "PocketPC." Though the updated OS addresses many of the myriad flaws that rendered the previous two versions virtually unusable, it still bears the unmistakable taint of Microsoft. We experienced OS crashes, botched software installations, incredibly slow data transfer rates, and memory management issues.

While the Palm OS runs like buttah on as little as 2MB without requiring any manual configuration of memory, PocketPC requires regular memory maintenance through a series of manual controls. With proper diligence, manually allocating memory can be a powerful option, but in simple day-to-day operations, it's a hassle. And a simple "close" box would've made more sense than forcing us to hunt through the Jornada's deeply nested menus to find the exact application that must be closed in order to free up memory.

The bloated PocketPC simply makes memory more of an issue than it is with the Palm. Whereas Palm apps rarely raise the bar above 100K—in fact, most apps fall into the 20 to 40K range—Windows CE software traditionally rings in above the cruiserweight limits. Running programs in CE can take up *megabytes* of memory, resulting in feature-rich software that runs at a snail's pace.

Offsetting the OS's weaknesses is the Jornada's impressive hardware. In addition to the specs previously cited, the 548 has features that are sorely missing on the Palm. A metal-sheathed case with thumb-driven scroll controls, flashing alarm LED, and built-in speaker/microphone make the Jornada a versatile and capable tool. With one touch, the PDA takes voice memos that can be played back or copied to a PC. The CompactFlash slot can accept a small adapter that turns the PDA into a 640x480 color digital camera.

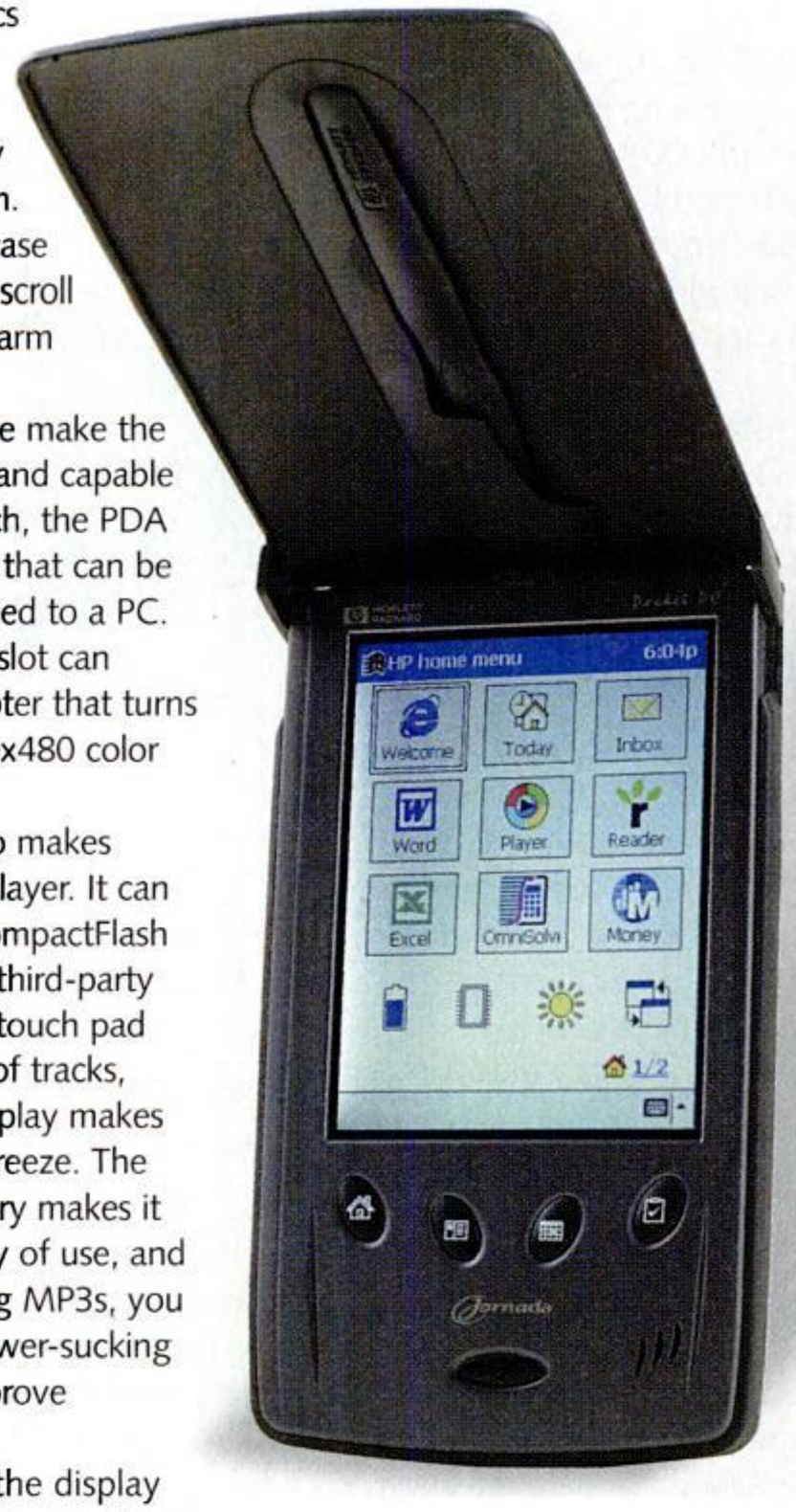
The Jornada also makes an excellent MP3 player. It can play MP3s from CompactFlash without the use of third-party software, it's got a touch pad for quick selection of tracks, and the full-size display makes editing playlists a breeze. The built-in Li-Ion battery makes it good for a solid day of use, and if you're just playing MP3s, you can turn off the power-sucking color display to improve battery life.

Unfortunately, the display is the source of other problems. HP has admitted to a manufacturing snafu that resulted in the 16-bit DAC (Digital/Analog Converter chip) being replaced with a 12-bit part, cutting the unit's available colors down to 4,000, instead of the 65,000-plus that were promised. And while the resolution is much finer and the contrast/brightness controls more robust than those of the Palm IIIc, the Jornada's screen can appear streaky.

The Jornada comes installed with some killer software, including pocket versions of Microsoft's *Word*, *Excel*, *Outlook*, and *Money*, but many of the promised features, such as image editing and MPEG playback, must be installed via third-party apps. A disc full of apps and demos is included, but getting them onto the device can be risky. Unlike the thousands of trouble-free Palm software installs we've performed over the years, every PocketPC install is a crapshoot. Will it work? Will it crash? Will it require a patch download? Throw the dice and take your chances.

If you abandoned your previous CE device in disgust, the minor improvements to PocketPC combined with the Jornada 548's killer hardware make the platform worth revisiting. But if you don't want to live on the OS edge, stick with the Palm for now.

—Brad Dosland



PLUSES
- CompactFlash slot
- Sturdy metal case
- Practical thumb button

MINUSES
- Uses CE
- 16-bit display is really only 12-bit

THE SPECS

SCREEN RES
240x320 pixels
12-bit LCD

PROCESSOR
133MHz 32-bit Hitachi processor

RAM
32MB RAM 16MB ROM

DIMENSIONS
5.2 x 3.1 x 0.6 inches

OTHER
Built-in Lithium-Ion rechargeable battery
IrDA infrared port
CompactFlash Type 1 card slot

Beneath the Jornada's metal skin beats the heart of a new and (somewhat) improved CE.

JORNADA 548 — **6**

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Freaky Fat Hard Drives

60GB AND 75GB DRIVES STRUT THEIR STUFF

The size of hard drives has been steadily increasing for some time, but news of 60GB and 75GB drives actually brought to mind the term "ludicrous proportions." These new drives offer more than just real estate—they're pretty fast, too.

MAXTOR

PLUSES
- Low price
- Excellent performance for a 5,400rpm drive
- Runs silent and cool
- Fat 2MB cache buffer

MINUSES
- Silent Store technology cannot be set by user

IBM

PLUSES
- Fastest hard drive available
- Runs silent and cool
- Utilizes glass platter technology
- Fat 2MB cache buffer

MINUSES
- Finicky during testing
- Very expensive

The IBM 75GXP is a speed demon, but performance of this magnitude comes at a hefty price.

Maxtor DiamondMax 60

The Maxtor DiamondMax 60 (**www.maxtor.com**), progeny of the Kick Ass DiamondMax Plus 40 reviewed in our April 00 issue, uses a four-disk, eight-head design, and achieves its massive 60GB size by bumping areal density to 15.3GB per platter, up from the previous 10.2GB-per-platter design. While the DiamondMax 60 comes damn close to matching the overall performance of the DiamondMax Plus 40—no small feat, considering that an extra 20GB of space typically means performance degradation—the fact remains that the DiamondMax 60 doesn't boast a 7,200rpm spindle speed. Maxtor differentiates its high-performance drives by adding the word "Plus" to their names. Astute readers will notice that the DiamondMax 60's name is not graced with that appellation, explaining the imposed speed limit of 5,400rpm.

We know what you're thinking right now—if it's not 7,200rpm, it's shite, right? Not entirely. Though faster is always better when it comes to hard drives, a lack of high-performance parts isn't necessarily a bad thing. Unless the drive is destined to run an enterprise operating system or high-end applications, reliability and longevity are what really matter.

Still, the DiamondMax 60 performs *very* similarly to the DiamondMax Plus 40, delivering scores a scant 2 to 3MB/sec slower on sequential read/write tests and matching random access times with tenths of a millisecond to spare. Essentially, Maxtor has managed to offer a low-cost, larger alternative to the award-winning DiamondMax Plus 40.

Among the DiamondMax 60's features is a technology called Silent Store, which gives PC manufacturers the option of selecting a mode in which the drive will operate. In Performance mode, the drive adopts a "seek profile" that's optimized for maximum performance. In Quiet mode, the drive's seek acoustics are held to within one decibel of its idle acoustics. The drive we tested was set to Quiet mode, and we must admit, it didn't make a peep. Much to our chagrin, however, Maxtor informed us that this setting can't be changed by end users.

The DiamondMax 60 includes a large 2MB SDRAM buffer, and comes bundled with *MaxSafe*, which automatically detects, isolates, and repairs drive problems. The drive ships with UltraDMA/66 support, and though we were initially informed that an upgrade to UltraATA/100 would be possible via firmware update, we're now told to expect that capacity out of the box.

This DiamondMax series also includes a 45GB version (model 94610U6); both kits include the *MaxBlast* drive installation utility for speeding up partitioning and formatting. While the DiamondMax 60 may not be a 7,200rpm speed demon, it's read/write speeds are still quite impressive given its immense size and low price.

IBM Deskstar 75GXP

The IBM Deskstar 75GXP (**www.ibm.com/storage**) got us hot and bothered from the start. It has a whopping 75GB capacity, and boasts the same 15.3GB per platter areal density as the Maxtor DiamondMax 60—but with the added bonus of full-blown, 7,200rpm spindle speed! We slapped the drive into the closest test machine and prepared to see an awe-inspiring performance. We weren't let down.

In the drive's first 4GB region, it delivers amazing 40MB/sec speeds. No, that's not a typo. Read speeds stay above 30MB/sec until the 35GB region, and don't dip below 20MB/sec until 65GB into the drive. In the last 15GB, read speeds manage to hover above 15MB/sec, giving the drive an average sequential read speed of 28.8MB/sec. Write speed is, on average, approximately 10MB/sec slower than that, but this drive still outperforms the latest Seagate

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

Cheetah Ultra160 SCSI drive. Of course, this kind of performance and size don't come cheap, but if you want the fastest, largest hard drive on the market, look no further.

The Deskstar 75GXP uses fifth-generation IBM GMR heads that increase track capacity 41 percent over the previous-generation Deskstar drive. And, like the latest crop of IBM SCSI drives, the 75GXP utilizes glass platters, which IBM claims are stiffer and more robust than traditional aluminum/magnesium substrate disks. IBM also says that the glass platters offer such direct benefits as a 20 percent improvement in the uniformity of the magnetic film surface, reduction in overall surface defects, a greater fly-height margin between the heads, and disks that are better able to withstand shock.

Also new to the Deskstar line is load/unload technology that parks the recording heads off the disk surface when the drive is powered down. This increases the shock resistance of the drive, while preventing the likelihood of head/disk damage if the drive is dropped. IBM also includes No-ID sector format technology that improves capacity and reliability by storing ID, or header, information in solid-state memory rather than on the disk surface. This increases the capacity of each track without impacting the linear density. Further benefits include increased data throughput, and improved access time, defect management, and power management.

Unfortunately, we ran into problems with the 75GXP during a format in Windows 2000 (NTFS). The 75GB partition we created was deemed unhealthy upon completion. Further testing yielded write problems and other errors. With Windows 2000 on the fritz, we booted to Windows 98, went into DOS, and checked the partition in FDISK, where we found more trouble: The drive size was being displayed as 7,762MB instead of 75GB (75,000MB). The problem, it seems, is an incompatibility between the drive and the standard version of FDISK. Microsoft says it has resolved the dilemma, but that the fix was sent only to OEM system manufacturers. Until Microsoft makes the fix readily available, partitioning the drive must be done using percentages of disk space.

The DiamondMax 60GB drive utilizes the latest data density technology, but is designed for reliability over performance. It lives up to its advertising, at a very affordable price.

Continuing our investigation, we downloaded IBM's *Drive Fitness Test* (DFT) software and proceeded with the diagnosis. *DFT* accesses special IBM hard drive microcode in order to identify drive problems. The test determined that bad sectors were present on our test drive. We ran the Erase Disk and Erase Boot Sector utilities, which seemed to fix the problem. But if this drive had contained data, it would have been hosed. Wary of the drive's reliability, we ran further tests on the drive after benchmarking was completed, and it fared well.

IBM's 75GXP is a monster drive for sure, with performance and size that is second-to-none. However, the presence of bad sectors on our test unit was weird, and spooked us just enough to withhold the Kick Ass.

—Sean Cleveland

DARE TO COMPARE

MANUFACTURER	IBM DESKSTAR 75GXP		MAXTOR DIAMONDMAX	
Spindle Speed	7,200rpm		5,400rpm	
Drive Size	75GB		60GB	
Buffer Size	2MB SDRAM		2MB SDRAM	
HD TACH BENCHMARKS	Win98SE	Win00	Win98SE	Win00
Average Read Speed (MB/sec)	**28.8**	**28.8**	22.3	22.3
Average Write Speed (MB/sec)	**18.8**	**18.8**	14.7	14.8
Random Access Test (tps)	**12.7**	**13.2**	14.5	14.6
Read Burst Speed (MB/sec)	**60.4**	**58.7**	53.7	52.2
CPU Utilization (%)	2.3	3.2	**1.5**	**2.3**
INTEL IOMETER				
Max Read Speed (MB/sec)	–	**35.7**	–	26.6
Max Write Speed (MB/sec)	–	**33.9**	–	26.3
Max Read I/O Rate (I/Ops)	–	**10383**	–	9381
Random Access Test (tps)	–	**73.2**	–	66.9
Avg Sequential I/O Response Time (ms)	–	**1.8**	–	2.4
Avg Random I/O Response Time (ms)	–	**13.6**	–	15.0
Total Sequential Read CPU Utilization (%)	–	3.6	–	**2.9**
Total Random Read CPU Utilization (%)	–	0.8	–	**0.7**

Note: Best scores are bolded.

MAXTOR DIAMOND 60 — **8**

$330 | Maxtor
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0831

IBM DESKSTAR 75GXP — **9**

$615 | IBM
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0830

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

Pioneer DVD-115 16x DVD Kit

THE BEST HOME DVD KIT MONEY CAN BUY

When it comes to reviewing products, we at *Maximum PC* believe in telling it like it is—and sometimes, it's really, really bad. But when it's good, we won't deny it. We've credited Pioneer in the past for its breathtaking DVD kits, and we're happy to say that the DVD-115 is no exception.

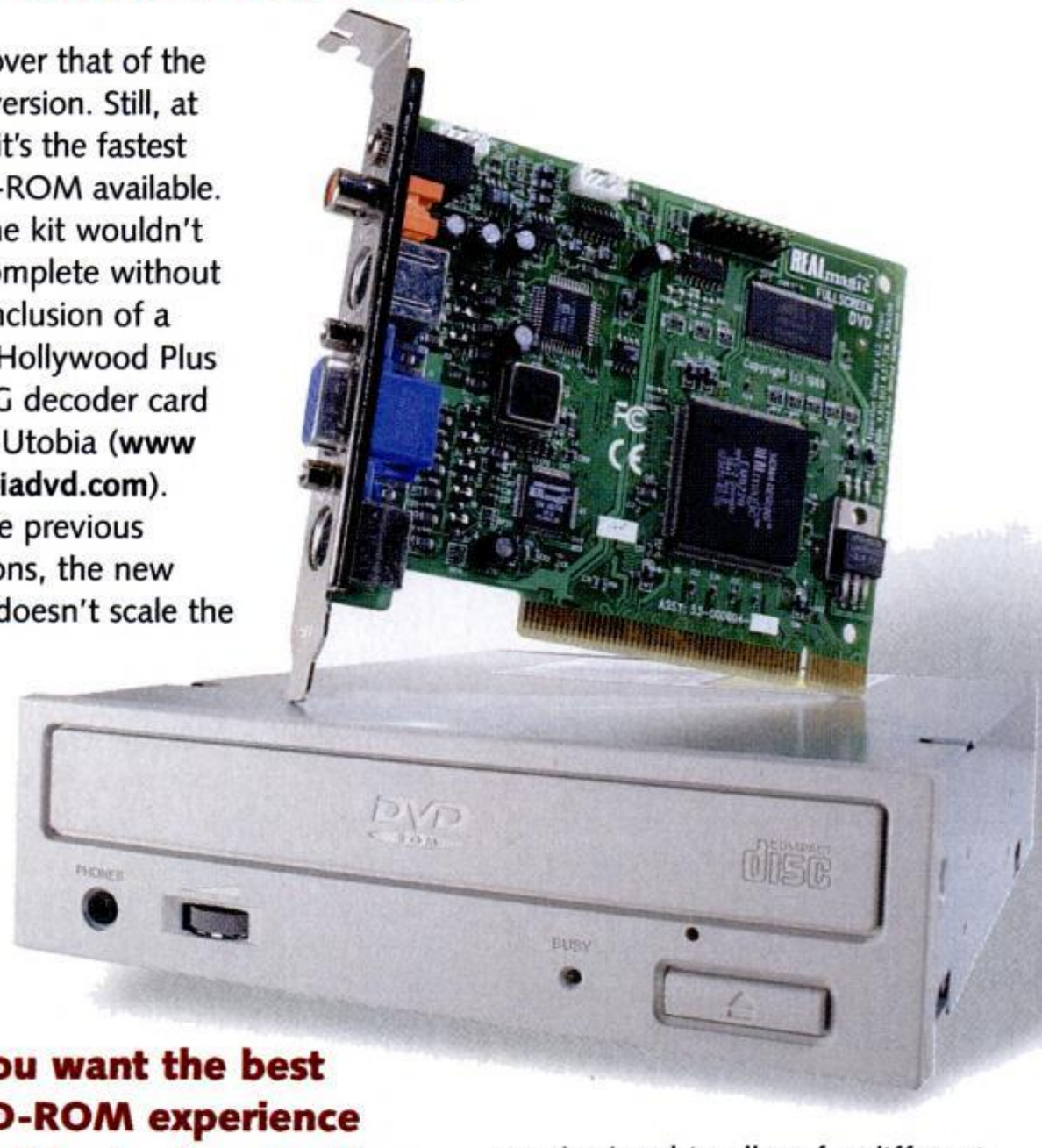
The DVD-115 (**www.pioneerusa.com**) is Pioneer's follow-up to the 10x kit we reviewed in November, 1999. As any follow-up should be, the DVD-115's overall performance is significantly better than that of the 10x kit—better, in fact, by a factor of 6x (900K/sec), thanks to an improved ASIC and pick-up assembly, and better vibration damping. In almost every DVD benchmark we ran, the DVD-115's average read scores beat those of the 10x drive by three to four megabytes per second. Granted, improved performance doesn't actually benefit the number one use for a DVD drive: movie playback. In fact, the only real advantage of the 6x speed increase is bragging rights, especially since the drive's CD-ROM performance hasn't improved one iota over that of the 10x version. Still, at 40x, it's the fastest DVD-ROM available.

The kit wouldn't be complete without the inclusion of a new Hollywood Plus MPEG decoder card from Utobia (**www.utobiadvd.com**). Unlike previous versions, the new card doesn't scale the movie signal to allow for different viewing sizes, but instead plays movies solely in full-screen mode. This translates to more screen real estate for playback, whether you're viewing on a TV or on a monitor.

During testing, we wondered whether the full-screen feature would yield weird results, since the signal is effectively "stretched" to full screen. But every movie we viewed looked fantastic, with no distortion whatsoever. Image quality on a monitor was a tad washed-out and soft at the edges, but when movies were piped to a TV using the card's composite-out, we saw greater detail and better contrast.

Rest assured, when it comes to quality, we don't mince words. The DVD-115 kit is comprised of superior products at an affordable price, and we have no problem saying so.

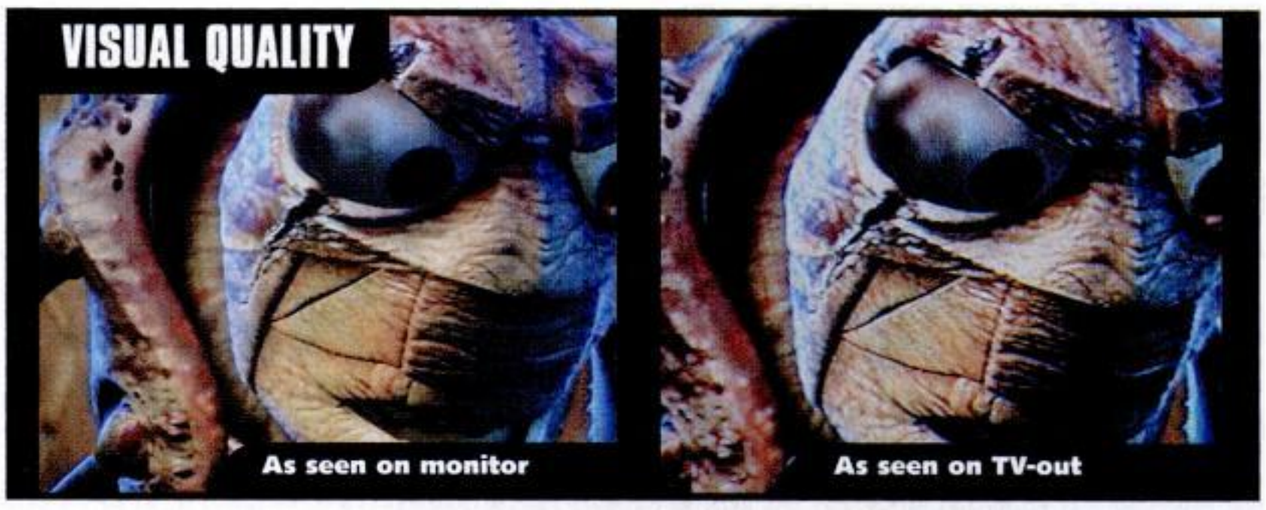
—Josh Norem



If you want the best DVD-ROM experience possible, look no further than Pioneer's 16x drive and the Hollywood Plus MPEG decoder.

PLUSES
- Fastest DVD
- Full-screen DVD is sweet
- Affordable

MINUSES
- Same CD-ROM performance
- Not much "real world" advantage over 10x drive



DARE TO COMPARE

MANUFACTURER	PIONEER 16X DVD-115	PIONEER 10X DVD-114*
DVD TACH		
Drive rating	9.6x	5.6x
Min/Max sequential read speeds (MB/sec)	8.73/17.4	5.5/13.3
Full stroke/random access times (ms)	183/102	186/95
CD TACH		
Drive rating	25.4x	23.7x
Min/Max sequential read speeds (MB/sec)	2.4/5.3	2.3/5.3
Full stroke/random access times (ms)	176/76	157/78

*Pioneer DVD-114 benchmarks from November 1999 reprinted for comparison purposes.

PIONEER DVD — **9**

$200 for entire kit; $170 for drive only; $50 for MPEG card only | Utobia
www.SeeMeBuyMe.com
877.751.7467 | ID#0832

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Samsung 900IFT Monitor

SUBLIMELY FLAT, BUT SUBTLY FLAWED

Samsung's 900IFT marries a flat screen with shadow-mask technology, with only some success.

Monitor geeks have waited a long time for the arrival of the Samsung 900IFT (**www.samsungelectronics.com**). This 19-inch display, along with its 17-inch brother, the 700IFT, represent the arrival of flat-screen technology to the shadow-mask arena. For more than two years running, if you wanted a CRT display that boasted a sheer flat plane, you had to invest in a pricey monitor that used an aperture grille tube manufactured by either Sony or Mitsubishi. But now, you have options. The problem is, the Samsung option just can't compete with the aperture grille alternatives.

Sure enough, the 900IFT addresses one of shadow-mask technology's most serious flaws: bulbous, convex screen curvature. Traditional shadow mask monitors are curved on both the horizontal and vertical axes. The 900IFT, meanwhile, is as flat as flat can be. Not only does this reduce the reflection of ambient light, but it also displays naturally flat images—such as digital photos—on a naturally flat surface, which is what the human eye is trained to expect. Indeed, upon seeing a flat CRT monitor for the first time, most computer users are blown away by the sublime elegance of the physical screen.

Unfortunately, while flat-screen monitors do, in fact, boast physically flat-screens, the technology enabling that flatness can introduce geometric distortion problems "below the surface," in the image that's actually rendered. On Sony and Mitsubishi flat screens, this is manifest in imperfect squares and circles at the extreme corners of images, where those shapes appear as vertically oblong rectangles and ovals. The Samsung 900IFT suffers from this common type of corner distortion, *and* from a nasty pincushion effect: In our review unit, the screen was noticeably pinched inward at the top edge. We tried to correct the problem with the *DisplayMate* monitor utility, but the 900IFT's onscreen controls only adjust pincushioning when the sides are bowed. We've seen scores of different monitors in the *Maximum PC* Lab, and we've never seen pincushioning quite so dramatic. Is it a by-product of Samsung's unique DynaFlat technology? Our intuition says, yes. It's likely that our eyes could eventually adjust to the distortion, but suffice it to say, it took us by surprise when we first fired up the monitor.

When we ran the 900IFT through *DisplayMate's* Obstacle Course, the monitor essentially performed on par with the Sony and Mitsubishi flat-screens in all areas but fine-detail reproduction, and, of course, general brightness and color brilliance, which are the hallmarks of aperture-grille technology. Nonetheless, the 900IFT did boast strong color convergence, and unusually good screen purity for a shadow-mask display; lesser shadow-mask displays often suffer darkening on the extreme edges of the screen. The 900IFT is also considerably cheaper than many aperture grille flat-screens, and comes with BNC inputs, if you swing that way.

While we're generally impressed with this merger of flat-screen and shadow-mask technology, we're also disappointed by our test model's pincushioning problem. It's possible we just received a bad egg, so if you're doing comparison shopping in the store, don't hesitate to give the 900IFT a look-see. But make no mistake: The 900IFT is not the pinnacle of flat-screen technology. Samsung tacitly owns up to this by selling a higher-end—and higher-priced—19-inch flat-screen monitor called the 900NF, which uses aperture grille technology, care of Mitsubishi.

—Jon Phillips

THE SPECS

DIMENSIONS
51.8 lbs.
18.4x18.3x19.0-inches (WxDxH)
18-inch viewable
REFRESH @ RES
160Hz@640x480
116Hz@1024x768
89Hz@1280x1024
76Hz@1600x1200

MAXIMUM PC VERDICT 7

$450 | Samsung
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Scanner Scuffle

FLATBED SCANNERS FIGHT DIRTY FOR THE TITLE

Canon's CanoScan FB 1200S scanner delivers speedy SCSI performance.

It may seem as though scanners are becoming obsolete in the wake of photo-printers that print directly from a digital camera's memory card. But if you're a graphic artist dealing with line art and collages, or if you're simply looking to archive summer vacation photos, a scanner is, in fact, the way to go. We rounded up three of the hottest flatbeds we could find—two USB and one SCSI—and set them loose in the Lab.

CANON

PLUSES
- VAROS image technology rocks
- SCSI card means faster connection
- Film adapter is an excellent add-on

MINUSES
- Pricey
- Unforgiving to amateur photos

EPSON

PLUSES
- ColorTrue II Imaging System puts it on par with the Canon
- Auto-feeder and transparency unit options are relatively cheap
- Best OCR of the bunch
- Friggin' fast

MINUSES
- Case won't win any beauty contests
- Occasional oversaturation of color

UMAX

PLUSES
- Legal tray makes for a larger scanning area
- 42-bit enhancement technology offers impressive output
- Easy to use

MINUSES
- Too big to fit comfortably in a home office
- Slower than the others reviewed here
- 36-bit (standard) mode is unkind to photos

Canon CanoScan FB 1200S

Of the scanners we tested, the Canon CanoScan FB 1200S (**www.usa.canon.com**) is the best option for the professional graphic arts community, because its SCSI interface means super speedy scanning. We also liked its small footprint, and the fact that it produced scans so sharp, we thought they'd cut through the paper.

The CanoScan also boasts Variable Refraction Optical System (VAROS) technology, a two-pass scanning method and pixel shift system that deliver true 1200x1200dpi resolution. Taking a unique approach to the standard scanning method, VAROS employs a scanning CCD that's about one-third larger than a standard scanning CCD. It captures 600dpi of information in an initial pass, caches it, then shifts the scan head exactly one-half pixel for a second pass that grabs an additional 600dpi of data. Included software interlaces the two passes into one image and corrects any errors or gaps. True to Canon's claims, we found that the two-pass system eliminated spotting, oversaturation of color, and the scratch and hash marks that plague most scanned images. Plus, the CanoScan is designed for low vibration, to prevent any shaking of the chassis that could lead to errors as photos are scanned.

The CanoScan is bundled with an Adaptec 2930B Fast SCSI card; add-on options include a film adapter for scanning negatives, and an automatic document feeder (ADF). Both are useful, but will set you back a bit ($280 for the adapter, $430 for the ADF).

The only problem with the CanoScan is that its software is unforgiving of older photos, pictures with bad color, and photos taken in low light. Those scans were plagued by washed-out colors, and shadowed areas were hard to discern. It's obvious that the CanoScan prefers slides, negatives, and line art, so unless you're a pro looking for a cheaper alternative to multi-pass or drum scanners, you may want to look elsewhere.

Epson Perfection 1200U

Folks, you heard it here first: The Epson Perfection 12000U (**www.epson.com**) is aptly named. We don't know how else to say it, other than "Buy this scanner." The Perfection's color-correction software brightens whites and enhances colors better than All Temperature Cheer, and the scanner spit out a standard 4x6 photo at 600dpi in 40 seconds flat. This bad boy has full 1200x2400dpi hardware resolution, precision optics that yield sharp-as-a-whip images, and the best OCR package we've ever seen.

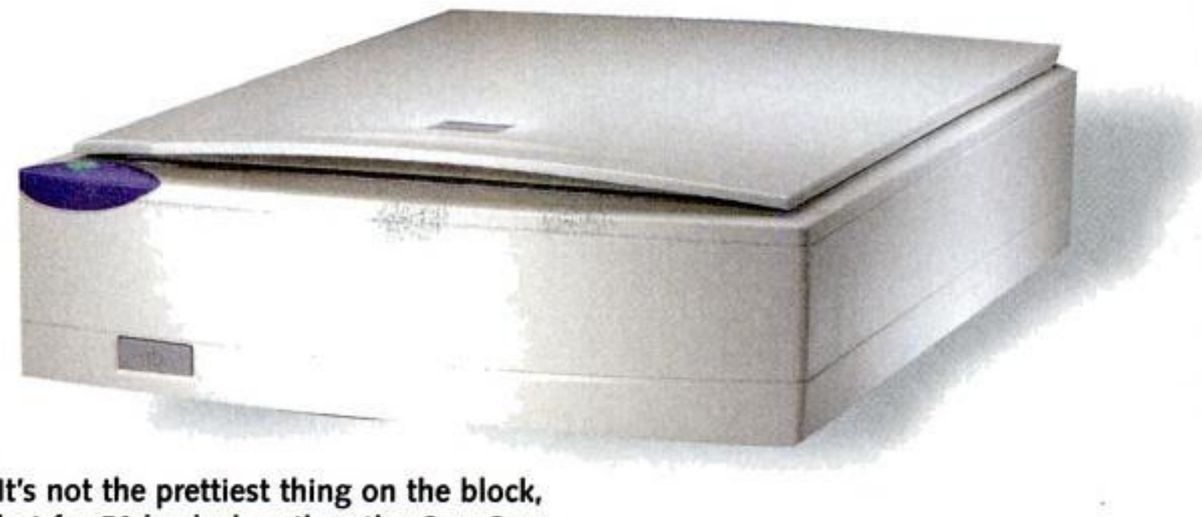
So what's the Perfection's secret? You can thank Epson's Color True II Imaging system, a combination of optics, hardware, and software processing that work cooperatively to produce fast scans of exceptional quality. The key element behind the Color True II system is the Micro Step Drive head, which contains a stepper motor that moves across the picture in exact steps, one at a time, for precise head placement, which makes for more accurate reads. Add to the equation onboard memory for caching images, a larger lens diameter for better color capture and less distortion, and a very stable TWAIN driver that makes tossing scans into *Photoshop* virtually painless, and you can see why we like this scanner so much.

And if you're in the mood to scan some text off a page, go for it. The Perfection's OCR works

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

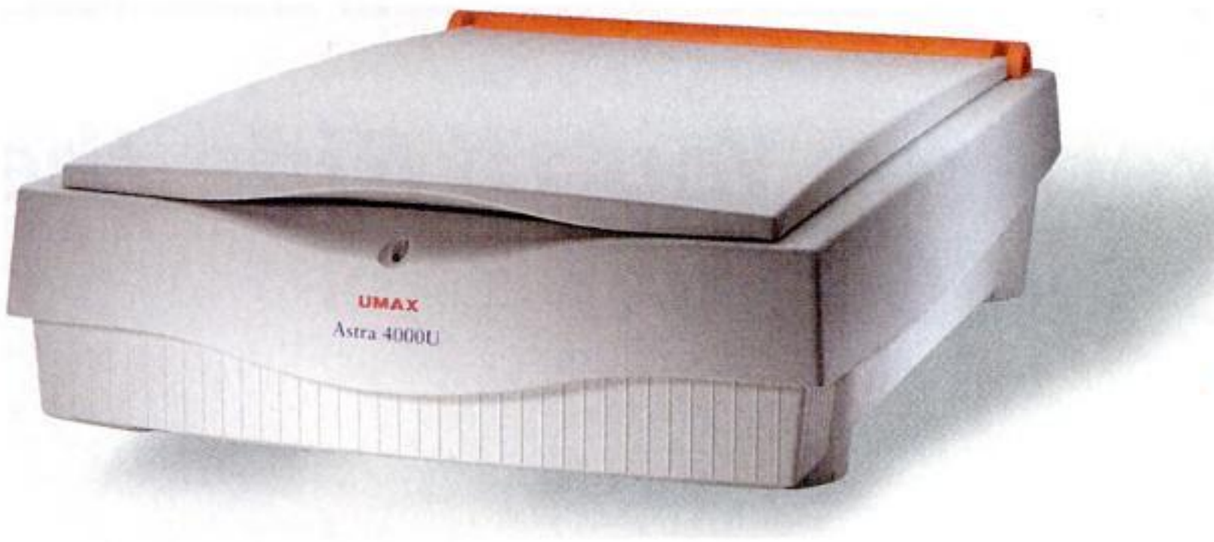
wonderfully, with Text Enhancement Technology (TET) that minimizes read errors and sharpens text that's pulled off colored backgrounds. Plus, the Perfection's Auto Area Segmentation (AAS) technology detects multiple types of media on the same page and processes graphics, text, or line art separately, eliminating the need to scan once for pictures, once for OCR, and once for art.

We have only two beefs with the Epson: Its formfactor is blocky and boring, and the automatic color enhancements provided in the software sometimes result in oversaturation, especially on photos taken in low light. But, considering the



It's not the prettiest thing on the block, but for 50 bucks less than the CanoScan, Epson's Perfection 1200U scanner dishes out the same quality.

in this roundup—but only if you use its 42-bit enhancement feature and are willing to wait. In addition to being the priciest scanner here, the Astra is also the largest—two traits that essentially make it a non-option for home users.



Remember the kid in high school who drove the big-ass car that took forever to get started? UMAX's Astra 4000U scanner is that car.

Perfection's phenomenal scanning abilities and the relatively low price tag on the optional film adapter and ADF components, we can't be swayed from recommending this scanner wholeheartedly. Plus, a SCSI version is available for about 50 bucks more. Perfection, indeed.

UMAX Astra 4000U

The UMAX Astra 4000U (**www.umax.com**) offers vibrant scans and the most accurate color reproduction of any scanner

The Astra's 36-bit scan speeds at 600dpi on 4x6 photos were comparable to those of the other scanners in this roundup. But its standard 36-bit scanning method is horribly unforgiving on regular photos, resulting in spotty color, fading in low-light photos, and terrible oversaturation, especially with reds and blues. You do have the option of employing the Astra's Bit Enhancement Technology, which boosts the bit depth from 36 to 42 using a color filter and electronic compensation similar to the digital zoom on a digital video camera. This vastly improves the overall quality of the scanned pictures, but a 4x6 photo took a full five minutes to scan in this mode—totally impractical. In fact, we suspect that UMAX included Bit Enhancement Technology as a patchy fix for the scanner's sub-standard CCD and software processing.

With legal-size document support, the Astra 4000U seems best suited to the graphics professional. But with unforgiving 36-bit scanning, bad OCR, and a footprint that's about the size of a dinosaur's, the Astra is a less-than-stellar choice.

The Final Word

Your choice in a scanner should be determined by its intended use. Both the Canon CanoScan and the Epson Perfection produce dazzling images, but the CanoScan is probably a better match for professional photographers and artists. As for UMAX? We think that poor 36-bit scanning and low-quality OCR render its scanner little more than a pain in the Astra.

—Geoffrey Visgilio

THE NEED FOR SPEED

	CANON	EPSON	UMAX
Preview Time	16 sec	4 sec	24/26 sec
Scan Time	2:02 sec	42 sec	1:18/5:01 sec

For testing, scanners were set to 600dpi and 36-bit color depth. The UMAX's additional time measures its 42-bit enhancement feature. Test media was 4x6 color photos.

THE SPECS
CANON

COLOR PROCESSING
36-bit internal
OPTICAL SCANNING RESOLUTION
1200dpi
MAX RESOLUTION
9600 x 9600dpi (adjustable)
MAX READ AREA
8.5" x 11.7"
INTERFACES
SCSI (card and drivers included)
SOFTWARE DRIVERS
Windows 95/98/NT 4.0
BUNDLE
ScanGear *Text-Bridge OCR* | ScanGear *Toolbox* Adobe *Photoshop 5.0 LE*

THE SPECS
EPSON

COLOR PROCESSING
36-bit internal
OPTICAL SCANNING RESOLUTION
1200dpi
MAX RESOLUTION
9600 x 9600dpi (with interpolation)
MAX READ AREA
8.5" x 11.7"
INTERFACES
USB
SOFTWARE DRIVERS
Windows 98
BUNDLE
Adobe *PhotoDeluxe* NewSoft *Presto! Page Manager* | Broderbund *The PrintShop Press Writer* | ArcSoft *Photoprinter 2.0* | Epson TWAIN scanning driver

THE SPECS
UMAX

COLOR PROCESSING
36-bit internal/42-bit with UMAX Bit Enhancement Technology
OPTICAL SCANNING RESOLUTION
1200dpi
MAX RESOLUTION
9600 x 9600dpi (with interpolation)
MAX READ AREA
8.5" x 14"
INTERFACES
USB
SOFTWARE DRIVERS
Windows 98
BUNDLE
VistaScan 3.5x w/TWAIN driver | Adobe *Photoshop 5.0 LE* | Caere *OmniPage LE OCR* | NewSoft *Presto! PageManager* | NewSoft *Presto! PhotoAlbum LE*

CANON CANOSCAN — **9**

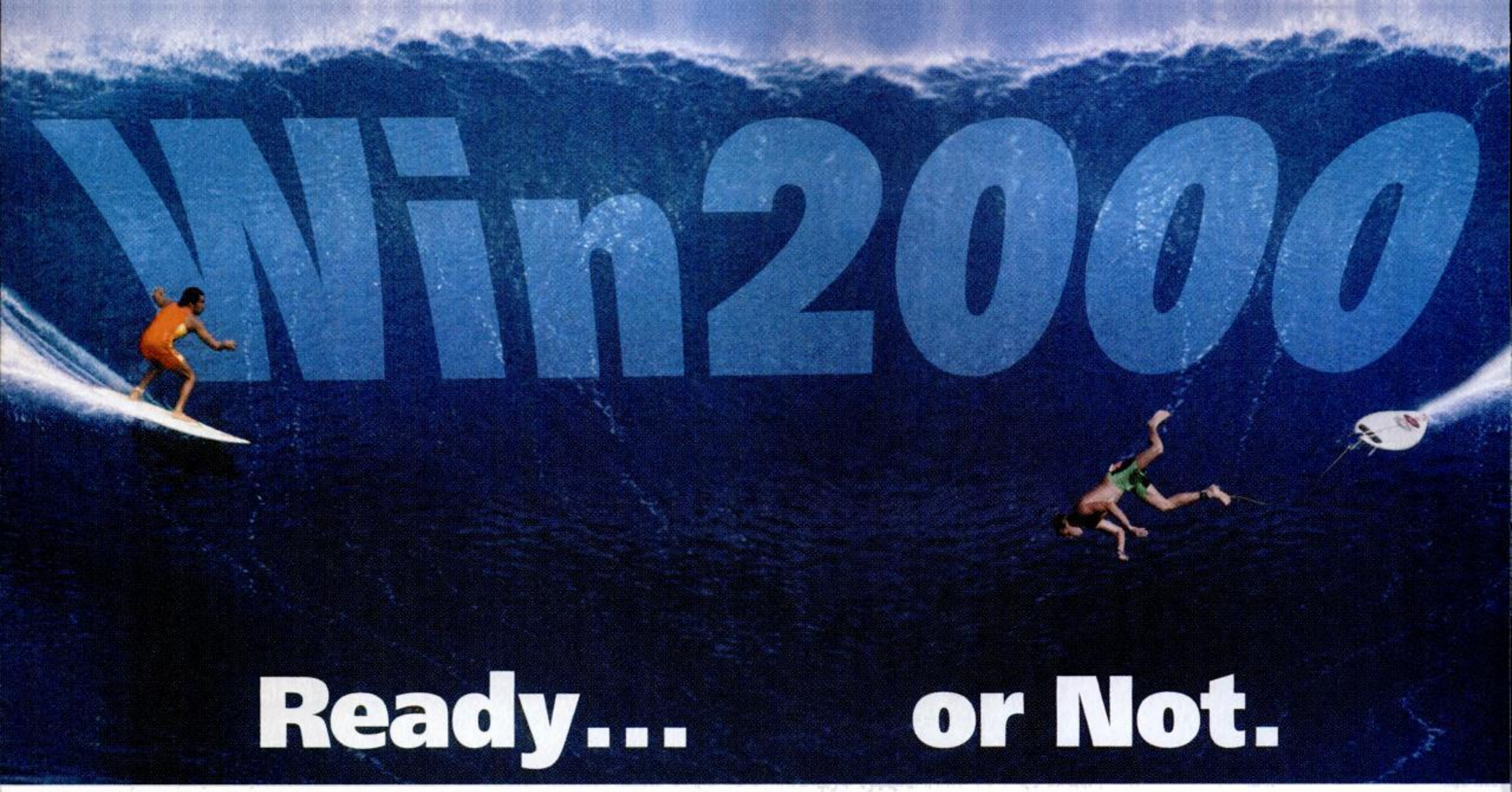
$300 for scanner; $430 for ADF; $280 for film adapter | Canon
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0834

EPSON PERFECTION — **9**

$250 for scanner; $200 for ADF; $100 for transparency unit | Epson
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0835

UMAX ASTRA 4000U — **5**

$350 for scanner; $149 for transparency unit | UMAX
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0836



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Microsoft IntelliMouse Optical

ALL DRESSED UP, BUT GOING NOWHERE

When we reviewed Microsoft's IntelliMouse Explorer in January 2000, we were unenthusiastic about its large size and inaccurate IntelliEye technology. The IntelliMouse Optical (**www.microsoft.com**) looks better on the outside than its predecessor did, but inside, it suffers from the same old IntelliEye drawbacks.

Microsoft equipped the Optical with the four customizable buttons and fifth wheel button that we liked on the Explorer, but thankfully ditched the asymmetrical silver case for one with a symmetrical design and a white matte finish. The Optical is PS/2 or USB compatible; installation was a breeze in PS/2 mode, but the USB option was troublesome because the included CD didn't contain all the necessary drivers.

The Optical's buttons, like the Explorer's, are squishy-soft and depress too readily, and moving the mouse horizontally sometimes triggers the long buttons on the mouse's side. Fortunately, these buttons can be disabled with the included *IntelliPoint* software. The IntelliEye technology—which uses a camera instead of a mouseball to track movement—is also unchanged, and we don't like it any more on the Optical than we did on the Explorer. It's passable for desktop work, but its inability to process rapid mouse movements is a problem in fast-action games.

Microsoft's IntelliMouse Optical isn't much better than the earlier IntelliMouse iteration.

Though the Optical is less expensive than the Explorer, it costs nearly twice as much as Microsoft's plain-Jane IntelliMouse with IntelliEye, and has no advantages other than a fancier shell. We give Microsoft credit for designing the Optical to better suit smaller hands and lefties, but we wish more R&D money would go toward correcting the IntelliEye's quirky nature.

—Mark Miller

PLUSES
- Sleek looks
- USB and PS/2 support

MINUSES
- Soft buttons
- IntelliEye can't track fast movements
- Installation disk is missing USB drivers

MAXIMUM PC VERDICT 6

$55 | Microsoft
Buy www.SeeMeBuyMe.com | 877.751.7467 ID#0837

Drag-and-Drop Disco

INSTANT-MUSIC PROGRAMS DUKE IT OUT

The last time Magix's *Music Maker* (**www.magix.net**) and Voyetra's *Techno eJay* (**www.voyetra.com**) mixed it up in these pages (April 1999), Voyetra took home a 9/Kick Ass and Magix made off with a 7 verdict. After retreating to their native Germany for upgrades, both programs are back to do battle once again.

Each program works in essentially the same way—original music is created by dragging short audio loops onto a grid—but *Music Maker* and *Techno eJay* are light years apart in features and user friendliness. *Techno eJay* is a cinch to play with, but offers few features. *Music Maker* provides a smorgasbord of options, but does so at the cost of stability and simplicity.

Techno eJay equips you with about 3,000 audio snippets organized into eight categories—loops, drums, bass lines, spheres (sustaining chords), seq (rhythmic pitched patterns), voices, and two groups of synthesizer effects. You can also import your own WAV files or use the Hyper Generator to create sequences of tones. The supplied sounds are mesmerizing, but rather benign. You can grunge them up with filtering, distortion, and a robot-speech algorithm, but the distortion effect sounds more like hissy static than true techno crunch. There's also an echo effect option, but no reverb, which would have helped the bone-dry drum parts sound fuller.

To create music with *Techno eJay*, simply click a category button to reveal a list of sounds, double-click on a sound to audition it, then drag it onto the track window. All sounds are in the same tempo and key, so the only way to go wrong is by combining parts that clash rhythmically. Adjust the level of each sound, as well as the pitch and speed of the arrangement, and you're done.

Music Maker's options extend far beyond *Techno eJay's*. Not only can you drop WAV files onto its track window—the program supports 32 tracks, twice *eJay's* complement—but you can include dang near anything else, too: MP3s, MIDI files, audio CDs, JPEGs, BMPs, and even AVI videos. We had a great time trawling our hard drives for multimedia detritus to turn into art—until the program started crashing on us. We experienced audio dropouts, too, which significantly hindered the creation process.

Music Maker comes with 2,000 audio loops, but many snippets are simply the same sound at eight different pitches, and they're annoyingly brief. The sound pool is further compressed by its division into eight genres, including hip-hop, big beat, dance, techno, and disco. Fortunately, this version of *Music Maker* includes a software drum machine and bass synth, which spice things up considerably.

When you're done tweaking *Music Maker's* zillions of parameters, you can export your mix as a standalone music video. However, the supplied clips are only 320 pixels high, so they look jagged on bigger screens.

Music Maker's ability to sculpt music and video is great, but its frequent crashes and obtuse manual hold it back. *Techno eJay*'s stability and ease of use make it the better choice.

—David Battino

Color-coded audio loops make *Techno eJay* simple to use. Too bad you can't fade loops in and out.

The modestly named *Music Maker* can also create multilayered videos—when it isn't crashing.

MUSIC MAKER

PLUSES
- Slick video effects
- Imports MIDI and MP3

MINUSES
- Short loops
- Bugs
- Confusing manual

TECHNO EJAY

PLUSES
- Simple to use
- Realtime pitch slider

MINUSES
- No volume envelopes
- No reverb

MUSIC MAKER GEN 5 — **7**

$50 | Magix Entertainment
Buy www.SeeMeBuyMe.com
877.751.7467 ID#0839

TECHNO EJAY — **8**

$50 | Voyetra Turtle Beach
Buy www.SeeMeBuyMe.com
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Motocross Madness 2

PREPARE FOR TAKE-OFF

Wheeee! *Motocross Madness* 2 lets you defy the laws of gravity at will.

Some games require a bit of playing time before they get fun. Not so with *Motocross Madness 2* (**www.microsoft.com/games**). This game is fun from the get-go; just open your bike's throttle, head toward the nearest incline, and squeal like a schoolgirl as you achieve escape velocity and rocket skyward. While you're up among the birds and helicopters, feel free to attempt one of sixteen possible stunts, including the Heel clicker, the Nac Nac, or our favorite, the Big Kahuna. As you re-enter the atmosphere, prepare to break almost every bone in your character's polygonal body—the crashes can be so extreme, it's hard to say what's more fun, pulling stunts or wiping out afterward.

We crashed our bike often, but that's mostly because the beautifully rendered environments include tens of thousands of static and animated objects, any number of which may be in the way as you land your motorbike. On some maps, we actually wished for less vegetation, since it makes judging the contour of the land—and therefore navigating a successful landing—a lot more difficult.

This power station is one of thousands of "real-world" objects that adorn *MM2's* highly detailed racing landscapes. Landing this Big Kahuna is going to hurt.

The stunning level of detail in each *Motocross Madness 2* environment is tessellated on the fly during gameplay, so your hardware can best manage the six million polygons that make up each map's terrain. *MM2's* 3D engine doesn't have an official name—it grew out of an internal project at Rainbow Studios called "AARDVARK," which stands for Advanced Animation Research & Development At Rainbow (the K is just for show). The engine takes advantage of hardware T&L support for every polygonal image in the game except for the terrain.

The game offers six modes of play: Baja, Stunt, Enduro, National, Supercross, and Pro-Circuit. New to this version are Pro-Circuit, which lets you build a racing career by beating opponents at many levels, and Enduro, which pits you against other racers in a real-world obstacle course. Enduro is easily the most frantic game mode available, since you not only have to follow a treacherous route through preset checkpoints, but you must also avoid traffic, trees, and other riders. Of course, the motorcyclists you compete against ride like they're hopped up on Red Bull, and every car, bush, and obstacle is strategically placed so that staying on the path is an exciting challenge, and straying even slightly can lead to a cranial-rectal inversion.

All game options are available in Practice, Event, or Multiplayer modes, so you can play by yourself, against the computer, or against opponents via the MSN Gaming Zone. Practice mode is great for just doing donuts in the dirt without the pressure of competition, or for exploring the expansive environments that stretch for miles in each direction. Online play includes all game types except Pro-Circuit, as well as a Tag mode in which the goal is to avoid being "it."

Playing *Motocross Madness 2* online is a hoot, and the single-player mode is as solid as they come. With its next-gen graphics engine and hilarious stunts, *MM2* kicks a huge, dirty rooster tail over every other dirt bike racing game we've seen.

—Josh Norem

PLUSES
- Beautiful landscapes
- Outrageous stunts
- Evil Kineival-type landings
- Tons of content

MINUSES
- Excessive trees and bushes clutter some maps

THE SPECS

3D CARD SUPPORT
Direct3D

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NUMBER OF PLAYERS
8

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1 ABERDEEN

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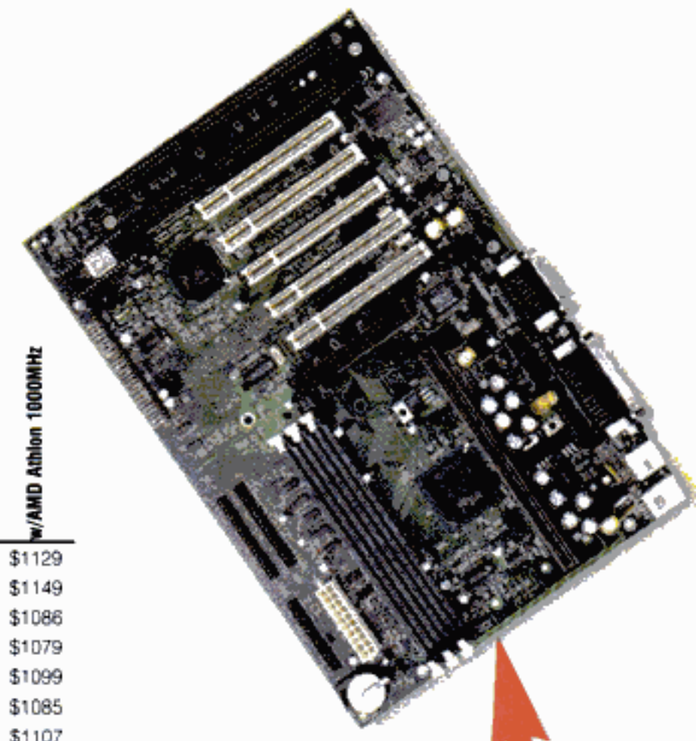
Super7™

	Part Number	Chip Set	L2 Cache (KB)	Maximum Memory (MB)	168-pin DIMM Sockets	72-pin SIMM Sockets	Flash BIOS	Integrated Audio	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/AMD-K6-2/500	w/AMD-K6-2/550	w/Intel® Pentium® MMX™ 233MHz
Asus P5A-B	MB5711	ALi Aladdin V	512	384	3		Award			3	2	1	Baby AT	1 Yr.	$95	$154	$180	$155
EPoX EP-MVP3C2	MB5406	VIA Apollo MVP3	512	384	3		Award		UltraDMA/66	4	2	1	Baby AT	2 Yrs.	$81	$140	$166	$141
EPoX EP-MVP3G5	MB5405	VIA Apollo MVP3	2048	384	3		Award		UltraDMA/66	5	2	1	ATX	2 Yrs.	$106	$165	$191	$166
FIC VA-503+	MB5211	VIA Apollo MVP3	1024	512	2	4	Award			3	3	1	Baby AT	1 Yr.	$76	$135	$161	$136
Pine VA7-AV	MB5300	VIA Apollo MVP4	512	768	3		Award	AC-97	UltraDMA/66	5	2		ATX	3 Yrs.	$89	$148	$174	$149
Shuttle HOT-591P	MB5611	VIA Apollo MVP3	512	256	2	2	Award			3	3	1	Baby AT	1 Yr.	$77	$136	$162	$137
Tyan S1590S Trinity 100AT	MB5006	VIA Apollo MVP3	1024	384	3	2	Award			4	4	1	Mini AT	3 Yrs	$95	$154	$180	$155
Tyan S1598 Trinity ATX	MB5008	VIA Apollo MVP3	2048	384	3		Award		UltraDMA/66	5	2	1	ATX	3 Yrs	$121	$180	$206	$181



Slot A

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Bus Frequency	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/AMD Athlon™ 700MHz	w/AMD Athlon 750MHz	w/AMD Athlon 800MHz	w/AMD Athlon 850MHz	w/AMD Athlon 900MHz	w/AMD Athlon 950MHz	w/AMD Athlon 1000MHz
ABIT KA7	MB7501	VIA Apollo KX133	2048	4	Award	200/133	UltraDMA/66	6	1	1	ATX	1 Yr	$169	$364	$394	$459	$549	$679	$839	$1129
Asus K7V	MB7703	VIA Apollo KX133	1536	3	Award	200/133	UltraDMA/66	5		1	ATX	1 Yr	$189	$384	$414	$479	$569	$699	$859	$1149
EPoX EP-7KXA	MB7850	VIA Apollo KX133	768	3	Award	200/133	UltraDMA/66	5	1	1	ATX	2 Yrs.	$126	$321	$351	$416	$506	$636	$796	$1086
FIC SD11	MB7401	AMD-751 VIA 686A	768	3	Award	100	UltraDMA/66	5	1	1	ATX	1 Yr.	$119	$314	$344	$409	$499	$629	$789	$1079
Microstar K7 Pro	MB7202	AMD-750	768	3	Award	100	UltraDMA/66	6	1	1	ATX	1 Yr.	$139	$334	$364	$429	$519	$649	$809	$1099
Shuttle AI61	MB7901	AMD-750	768	3	Award	100	UltraDMA/66	5		1	MicroATX	1 Yr.	$125	$320	$350	$415	$505	$635	$795	$1085
Tyan S2380 Trinity K7	MB7000	VIA Apollo KX133	768	3	Award	200/133	UltraDMA/66	6	1	1	ATX	3 Yrs.	$147	$342	$372	$437	$527	$657	$817	$1107

Socket A

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Bus Frequency	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/AMD Duron™ 600MHz	w/AMD Duron 650MHz	w/AMD Duron 700MHz	w/AMD Athlon™ 700MHz with Enhanced Cache	w/AMD Athlon 800MHz with Enhanced Cache	w/AMD Athlon 850MHz with Enhanced Cache	w/AMD Athlon 900MHz with Enhanced Cache	w/AMD Athlon 950MHz with Enhanced Cache	w/AMD Athlon 1000MHz with Enhanced Cache
FIC AZ11	MB7402	VIA Apollo KT133	1536	3	Award	200/133	UltraDMA/66	5		1	ATX	1 Yr	$132	$232	$257	$307	$327	$422	$512	$642	$802	$1092
Microstar K7T Pro	MB7203	VIA Apollo KT133	1536	3	Award	200/133	UltraDMA/66	5		1	ATX	1 Yr	$139	$239	$264	$314	$334	$429	$519	$649	$809	$1099
Shuttle MK11	MB7902	VIA Apollo KT133	1536	3	Award	200/133	UltraDMA/66	2		1	MicroATX	1 Yr	$109	$209	$234	$284	$304	$399	$489	$619	$779	$1069

Socket 370

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Integrated Audio	Integrated Video	PCI Slots	ISA Slots	AGP Slot	AMR Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Celeron™ processor 500/A MHz 128K OD 66MHz FSB	w/Intel Celeron 566 128K OD 66MHz FSB	w/Intel Celeron 600 128K OD 66MHz FSB	w/Intel Celeron 633 128K OD 66MHz FSB	w/Intel Pentium® III 667 256K OD 133MHz FSB	w/Intel Pentium III 733 256K OD 133MHz FSB	w/Intel Pentium III 750 256K OD 100MHz FSB	w/Intel Pentium III 800/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 850 256K OD 100MHz FSB	w/Intel Pentium III 866 256K OD 133MHz FSB	w/Intel Pentium III 933 256K OD 133MHz FSB
ABIT VH6	MB6511	VIA Apollo Pro 133A	768	3	Award	AC-97		5	1	1	1	ATX	1 Yr	$109	$191	$219	$244	$274	$339	$384	$424	$464	$649	$719	$939
ASUS CUBX	MB6726	Intel 440BX	1024	4	Award	AC-97		6	1	1		ATX	1 Yr	$151	$233	$261	$286	$316	N/A	N/A	$466	$506	$691	N/A	N/A
ASUS CUV4X	MB6725	VIA Apollo Pro 133A	1536	3	Award	AC-97		5	1	1	1	ATX	1 Yr	$125	$207	$235	$260	$290	$355	$400	$440	$480	$665	$735	$955
EPoX EP-3VCA	MB6854	VIA Apollo Pro 133A	768	3	Award	AC-97		4	1	1	1	ATX	2 Yrs	$105	$187	$215	$240	$270	$335	$380	$420	$460	$645	$715	$935
FIC FA11	MB6412	VIA Apollo Pro 133A	1024	4	Award			5	2	1		ATX	1 Yr	$103	$185	$213	$238	$268	$333	$378	$418	$458	$643	$713	$933
Shuttle AV14	MB6311	VIA Apollo Pro 133A	768	3	Award			5	2	1		ATX	1 Yr	$97	$179	$207	$232	$262	$327	$372	$412	$452	$637	$707	$927
Shuttle ME64	MB6310	Intel 810E	512	2	Award	Intel 810E	Intel 810E	3			1	Micro ATX	1 Yr	$116	$198	$226	$251	$281	$346	$391	$431	$471	$656	$726	$946
SuperMicro 370SEA	MB6140	Intel 810E	512	2	AMI	Intel 810E	Intel 810E	6	1		1	ATX	1 Yr	$134	$216	$244	$269	$299	$364	$409	$449	$489	$674	$744	$964
SuperMicro 370DLE (Dual)	MB6154	Reliance LE	2048	2	AMI			6	1			ATX	1 Yr	$333	$415	$443	$468	$498	$563	$608	$648	$688	$873	$943	$1163
SuperMicro 370DL3 (Dual)	MB6155	Reliance LE	2048	2	AMI			6	1			ATX	1 Yr	$536	$618	$646	$671	$701	$766	$811	$851	$891	$1076	$1146	$1366
Tyan S1854 Trinity 400	MB6018	VIA Apollo Pro 133A	768	3	Award			6	1	1		ATX	3 Yrs	$105	$187	$215	$240	$270	$335	$380	$420	$460	$645	$715	$935

Slot 1

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	168-pin RIMM Sockets	Flash BIOS	Integrated Audio	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Pentium III® 550 512K 100MHz FSB	w/Intel Pentium III 650/667 256K OD 100/133MHz FSB	w/Intel Pentium III 700 256K OD 100MHz FSB	w/Intel Pentium III 733 256K OD 133MHz FSB	w/Intel Pentium III 750 256K OD 100MHz FSB	w/Intel Pentium III 800/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 850 256K OD 100MHz FSB	w/Intel Pentium III 933 256K OD 133MHz FSB	w/Dual Intel Pentium III 550 512K 100MHz FSB	w/Dual Intel Pentium III 750 256K OD 100MHz FSB
ABIT BE6-II	MB6508	Intel 440BX	768	3		Award		UltraDMA/66	5	1	1	ATX	1 Yr	$140	$335	$370	$410	N/A	$455	$495	N/A	N/A	N/A	N/A
ABIT VA6	MB6509	VIA Apollo Pro 133	768	3		Award	AC-97	UltraDMA/66	5	2	1	ATX	1 Yr.	$88	$283	$318	$358	$363	$403	$443	$628	$918	N/A	N/A
ABIT VT6X4	MB6510	VIA Apollo Pro 133A	768	3		Award	AC-97	UltraDMA/66	5	2	1	ATX	1 Yr.	$107	$302	$337	$377	$382	$422	$462	$647	$937	N/A	N/A
Asus P2B-DS (Dual)	MB6707	Intel 440BX	1024	4		Award			4	2	1	ATX	1 Yr	$497	$692	$727	$767	N/A	$812	$852	N/A	N/A	$887	$1127
Asus P3B-F	MB6720	Intel 440BX	1024	4		Award			6	1	1	ATX	1 Yr.	$140	$335	$370	$410	N/A	$455	$495	N/A	N/A	N/A	N/A
Asus P3V4X	MB6723	VIA Apollo Pro 133A	1024	4		Award		UltraDMA/66	6	1	1	ATX	1 Yr	$125	$320	$355	$395	$400	$440	$480	$665	$955	N/A	N/A
EPoX EP-6VBA2	MB6855	VIA Apollo Pro 133A	768	3		Award	AC-97	UltraDMA/66	4	2	1	ATX	2 Yrs	$108	$303	$338	$378	$383	$423	$463	$648	$938	N/A	N/A
FIC KA11	MB6417	VIA Apollo Pro 133A	1024	4		Award		UltraDMA/66	5	2	1	ATX	1 Yr.	$98	$293	$328	$368	$373	$413	$453	$638	$928	N/A	N/A
Intel L440GX+ (Dual)	MB6917	Intel 440GX	2048	4		Intel/Phoenix		Adaptec 2-Ch U2W	6	1		ATX	3 Yrs	$559	$754	$789	$829	N/A	$874	$914	N/A	N/A	$949	$1189
Intel SE440BX-2 "Seattle"	MB6921	Intel 440BX	768	3		Intel/Phoenix			4	2	1	ATX	3 Yrs	$117	$312	$347	$387	N/A	$432	$472	N/A	N/A	N/A	N/A
Shuttle AV64	MB6309	VIA Apollo Pro 133A	768	3		Award		UltraDMA/66	5	2	1	ATX	1 Yr.	$93	$288	$323	$363	$368	$408	$448	$633	$923	N/A	N/A
SuperMicro PIIISED	MB6142	Intel 810e	512	2		AMI	AC-97	UltraDMA/66	6			ATX	1 Yr	$126	$321	$356	$396	$401	$441	$481	$666	$956	N/A	N/A
SuperMicro PIIIDM3 (Dual)	MB6153	Intel 840	4096	4		AMI	AC-97	Adaptec Ultra3/160	6		1	ATX	1 Yr.	$599	$794	$829	$869	$874	$914	$954	$1139	$1429	$989	$1229
SuperMicro P6DGU (Dual)	MB6122	Intel 440GX	2048	4		AMI		Adaptec U2W	5	2	1	ATX	1 Yr	$474	$669	$704	$744	N/A	$789	$829	N/A	N/A	$864	$1104
SuperMicro P6SBA	MB6120	Intel 440BX	768	3		AMI			4	3	1	ATX	1 Yr	$99	$294	$329	$369	N/A	$414	$454	N/A	N/A	N/A	N/A
SuperMicro P6SBU	MB6128	Intel 440BX	1024	4		AMI		Adaptec U2W	4	3	1	ATX	1 Yr	$335	$530	$565	$605	N/A	$650	$690	N/A	N/A	N/A	N/A
Tyan S1834 Tiger 133 (Dual)	MB6020	VIA Apollo Pro 133A	2048	4		Award		UltraDMA/66	6	1	1	ATX	3 Yrs	$179	$374	$409	$449	$454	$494	$534	$719	$1009	$569	$809
Tyan S1854 Trinity 400	MB6018	VIA Apollo Pro 133A	768	3		Award		UltraDMA/66	6	1	1	ATX	3 Yrs	$105	$300	$335	$375	$380	$420	$460	$645	$935	N/A	N/A

Slot 2

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Integrated Audio	Integrated Video	Integrated Controller	Integrated Networking	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Pentium III® Xeon™ 550MHz 512K 100MHz FSB	w/Intel Xeon 550MHz 1M 100MHz FSB	w/Intel Xeon 550MHz 2M 100MHz FSB	w/Dual Intel Xeon 550MHz 512K 100MHz	w/Quad Intel Xeon 550MHz 512K 100MHz	w/Intel Xeon 700MHz 1M 100MHz FSB	w/Intel Xeon 700MHz 2M 100MHz FSB	w/Intel Xeon 800MHz 1M 100MHz FSB
SuperMicro S2DM3	MB6156	Intel 840	4096	4	AMI	AC-97		Adaptec Ultra3-160m	Intel PRO/100 +	6		1	ATX	1 Yr	$676	$1776	$3006	$5016	$2876	N/A	$2076	$3026	$3046
SuperMicro S2QR6	MB6190	Reliance HE	16384	16	AMI			AIC-7899 2-Ch Ultra160	Intel 82559	8			SWTX	1 Yr	$2732	$3832	$5062	$7072	$4932	$7132	$4132	$5082	$5102

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- Master & target drives can be of different size, brand and model
- Master drive can hold up to 24 partitions
- Selective partitions: select one, some or all
- Bi-directional data transfer for forensic applications
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1 Source → 1 Target

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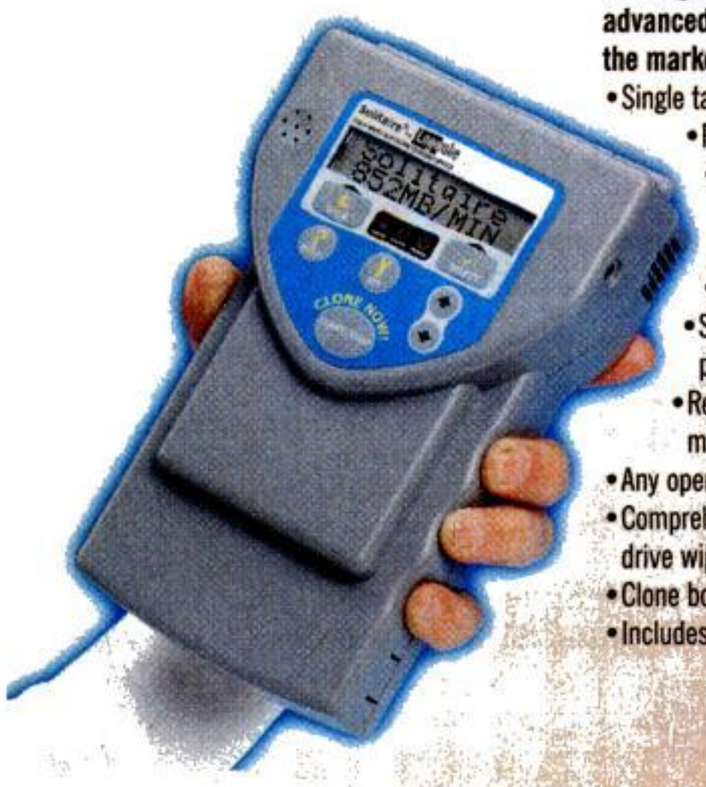

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- Single target, IDE hard drive to hard drive duplication
- Portable—Smallest unit on the market
- Data transfer speeds exceed 800 MB/min
- Master & target drives can be of different size, brand and model
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- Reverse data transfer - clone from target to master
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features - data recovery, drive wipe, and scanning
- Clone both ways thru a parallel port connection
- Includes carrying case, tools, cables, manual

$845
HDP500

1 Source → 2 Targets

OMNICLONE REPLIQUE 2

The OmniClone Replique 2 is the most portable way to copy to two native target drives.

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- Compact—Smallest unit on the market
- Data transfer speeds exceed 800 MB/min
- Durable design—Metal case and heavy-duty removable hinge
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features—data recovery, drive wipe, and scanning
- Removable lid for easy use
- Easily upgraded to Replique 5 with the Replique 2 Expansion Station (Targets 3,4 & 5) *(HDP502)* for $1795.00

$1,995
HDP501

1 Source → 5 Targets

OMNICLONE REPLIQUE 5

The Replique 5 package is a complete one-to-five solution, just plug it in and clone!

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- Compact—Smallest unit on the market
- Data transfer speeds exceed 800 MB/min
- Durable design—Metal case and heavy-duty removable hinge
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features—data recovery, drive wipe, and scanning
- Modular—If one unit fails, you still have a 1 to 2

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HDP503

3 Sources → 15 Targets

OMNICLONE REPLIQUE 15

OmniClone Replique 15 clones up to 15 drives at once. The units can be detached and reassigned to fit workload needs. Comes with space saving docking station with sliding ball-bearing shelves.

- Fifteen target, three master, IDE hard drive to hard drive duplication
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- Data transfer speeds exceed 600 MB/min
- Durable design - Metal case and heavy-duty, ball bearing slides
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features—data recovery, drive wipe, and scanning
- Modular—If one unit fails, you only lose two targets

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HDP505

OMNICLONE SOLITAIRE

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Replique 5 OmniDiagnose *HDP515*	$395.00
Replique 5 Clone Pack (includes all options and carrying case) *HDP516*	$1295.00
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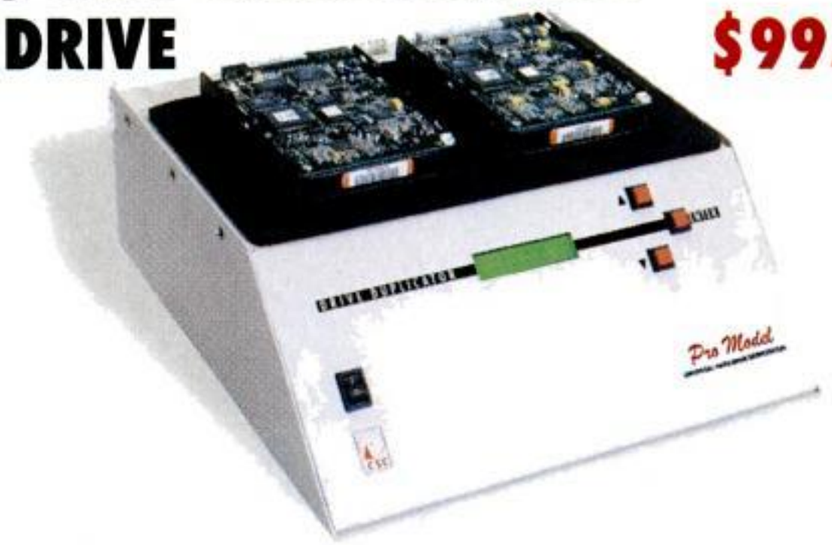

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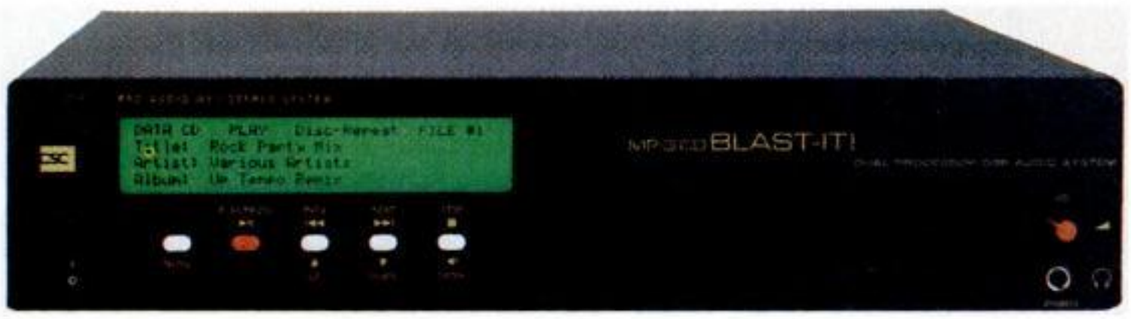

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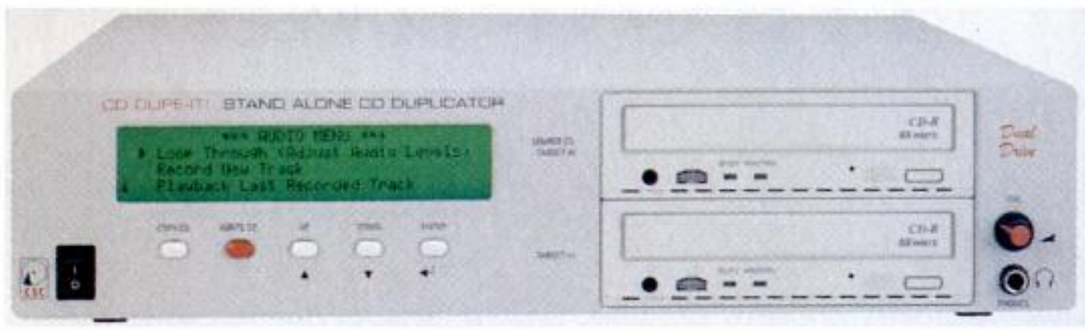

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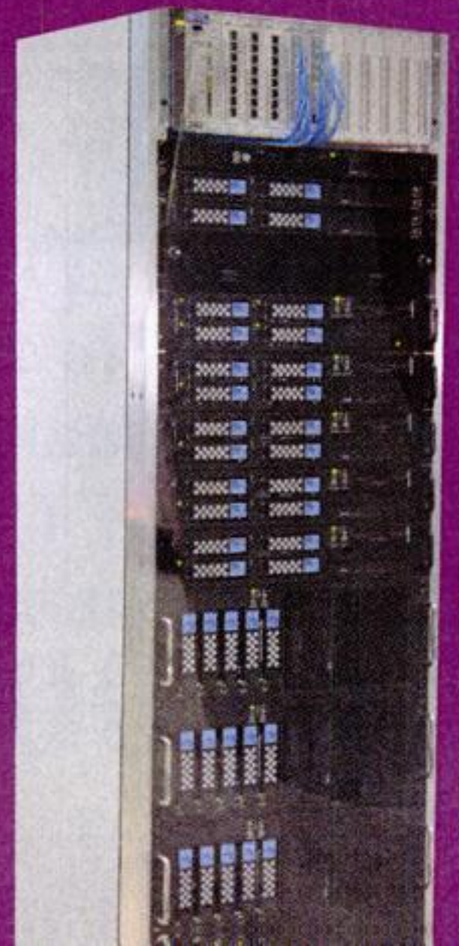

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The Daily Glitch

by Josh Catone

Apex of Accuracy, Paragon of Truth * Monday, August 3, 2000

Hell to Offer Free PCs, Eternal Suffering

Hell Inc., the troubled Internet start-up (Nasdaq: HELL), will soon begin distributing free computers in hopes of boosting membership. Applicants must buy a three-year subscription to Hell's Devilnet ISP, a wholly owned subsidiary of AOL, to receive a free PC.

"Recent free-PC ventures have basically tanked, but we thought, 'What the hell? Let's give it a shot,'" said Hell CEO Satan. "We see free PC distribution as a great way to set right Hell's bad name."

Microsoft has also made a pact with Satan—each Cerberus 400 PC that Hell gives away will be loaded with $1,500 worth of Microsoft software. "We're really excited about entering this untapped market," said a Microsoft spokesperson. "The deal will undoubtedly put Microsoft products on the computers of every damned PC user. That's a population we've never been able to reach before."

The first 100,000 people to take advantage of the offer will also receive a deluxe cherry coffin with a satin interior. A subscription to Hell costs just one soul and a lifetime of eternal damnation.

Boston Propellerheads Whomp Frisco Geeks

In a semifinal match of the National Programming League, the Boston P-Heads beat the San Francisco Geeks by a score of 1101 to 0111. Boston seized a commanding lead when San Francisco realized it was calling the same function twice, and took five precious minutes to correct the error. The Geeks fought back by eliminating 25 lines of unneeded code, but ultimately could not equal the P-Heads dominating use of relational expression.

P-Heads coach Bobby Burns was diplomatic after the victory, simply repeating the clichéd truism, "Abstract declarators put fans in the seats, but clean syntax wins the game."

Net Pen Comes of Age

Useless Innovations, Inc. has just announced Internet Pen 2001, an information appliance that the company claims will "usher in a new era of idle doodling."

Internet Pen 2001 looks like an ordinary pen, but contains a tiny 9600bps satellite modem that automatically connects to the Internet and orders ink whenever you run out. Even with the slow four-minute ordering time and hefty $750 price tag (plus a $15.95 monthly service fee), the pen is considered to be a great deal. It ingeniously solves the tedious problem of having to purchase new ink cartridges or $5 six-packs of one-time-use pens.

Last year, Useless Innovations released the Information Light Bulb, a $45 product that, when screwed into the proper lamp or ceiling fixture, provides ambient light for a limited vicinity.

MYST Linked to Sociopathology

It's official: *MYST* sucks. A group of MIT graduates, working out of a tiny Palo Alto-based lab, has proven that *MYST* is, in fact, one of the most boring computer games ever made, and can spur otherwise healthy people to commit violent acts.

The scientists divided 20 test subjects into two groups of 10. One group was made to play the game *Quake II* for 12 hours, while the other group played *MYST* for the same amount of time. While the group that played *Quake II* showed no signs of mental instability, nine out of 10 *MYST* players displayed acute sociopathic behavior at the end of the 12-hour stint. The one healthy *MYST* participant had been given a copy of *PYST*, a *MYST* parody, by mistake.

"The research proves two things," said scientist John Bullock. "First, that *MYST* is indeed one of the most excruciatingly boring games ever, and second, that it is not violent games that make people kill other people. Rather, it is *crappy* games that drive people to violence."

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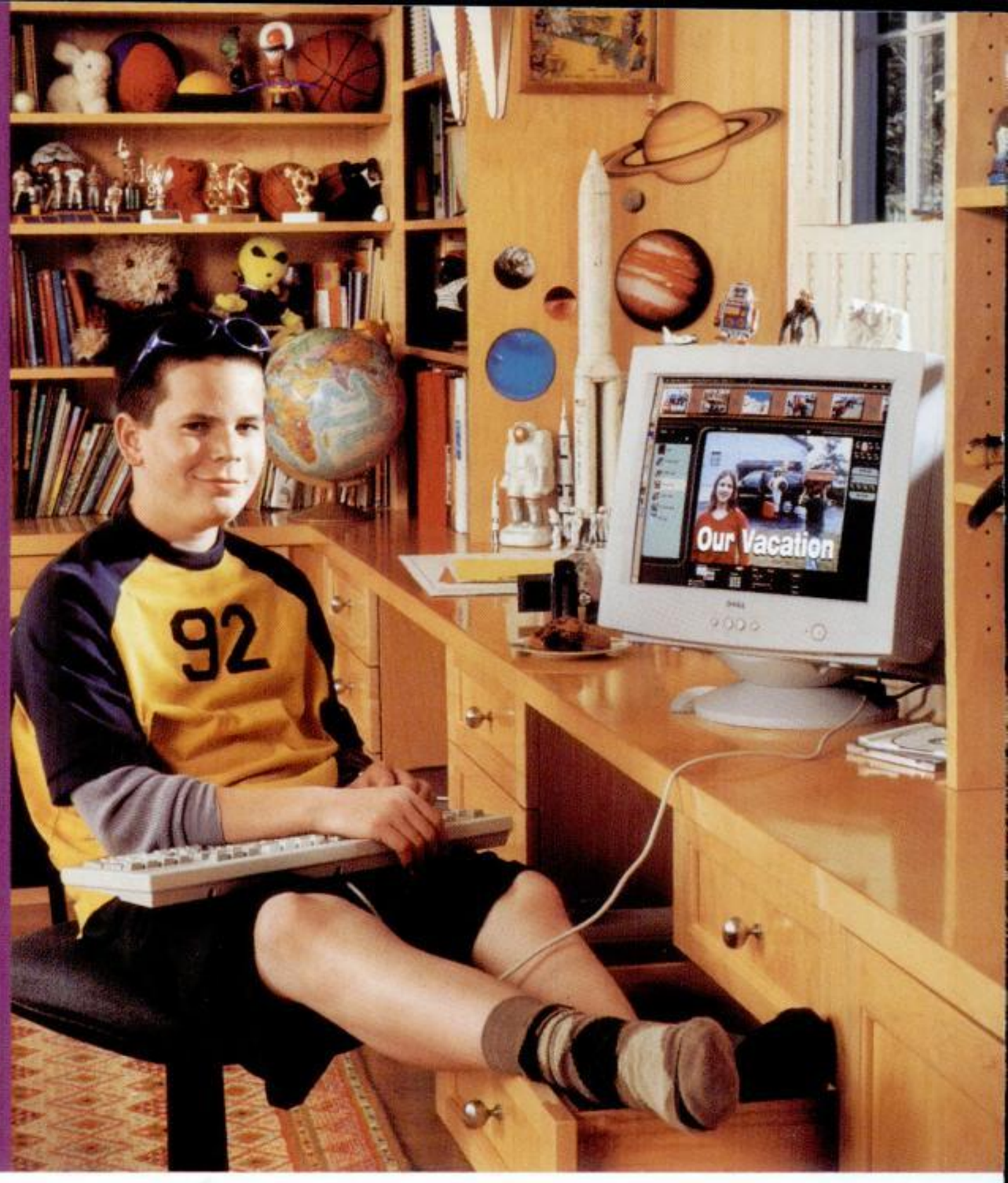

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