Hardware Autopsy

uced in 1971, the Kenbak-1 is gene

Join us in the Maximum PC OR as we unveil what makes your PC's innards and peripherals tick

Here at *Maximum PC* we still remember quite vividly, and very fondly, those special and rare times in grade school when we got to take things apart—not only with adult permission, but with their supervision as well. We were actually handed a screwdriver and *told* to dismantle something—usually a broken toaster, vacuum cleaner, radio, or whatever else was donated to enhance our understanding of the world around us. How cool is that when you're like seven or eight years old! (Unfortunately, it took us a while to understand that we were *not* supposed to do the same thing at home with the family TV and Dad's old screwdriver...)

To this day we still take great joy in dismantling electronic equipment with the goal of trying to figure out what makes it— videocard, LCD, power supply, iPod, etc.—tick. Sometimes, we can even put our "victim" back together, but usually we perform our particular brand of surgery on hardware that has died of natural causes (or perhaps a bit prematurely due to our rigorous testing methods).

We call these procedures "hardware autopsies" and unlike the alien variety, there's no debate about their authenticity. Join us in the *Maximum PC* OR as we put on our scrubs and gleefully take apart the latest bits of dead or dying hardware that we could get our hands on. In the process we'll learn a little more about what makes our PC—and its peripherals—work. Who said learning wasn't fun?

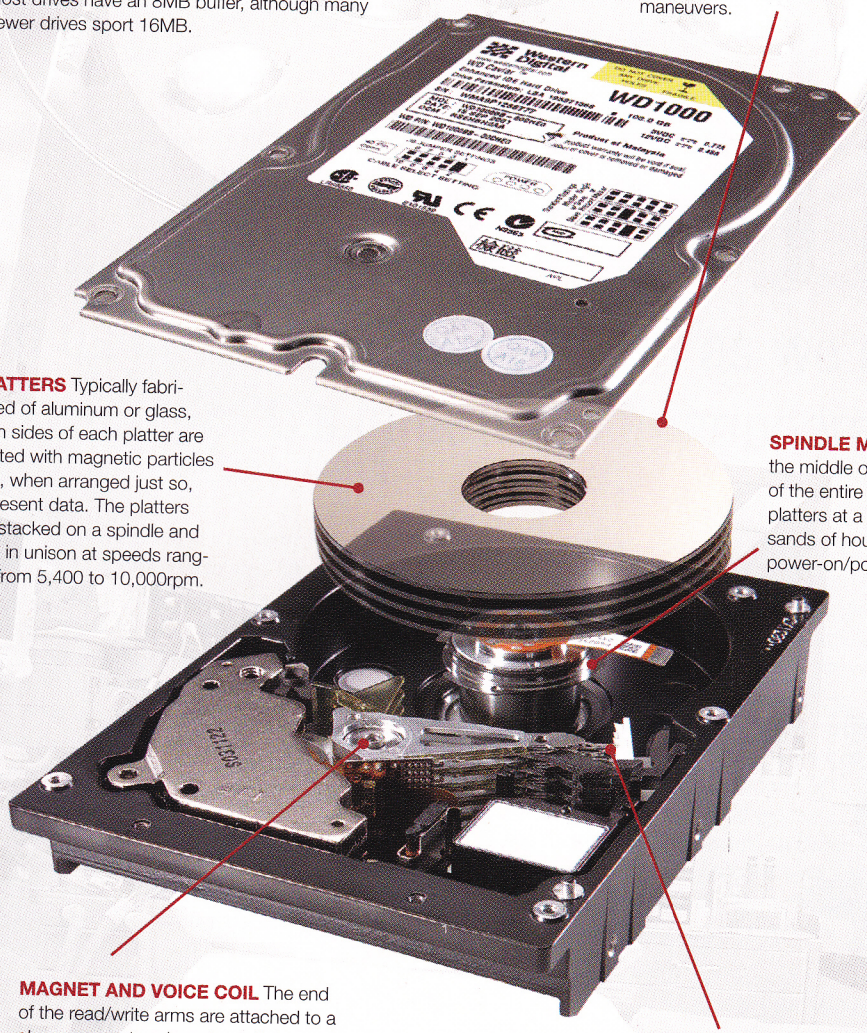
BY MAXIMUM PC **STAFF**

Anatomy of a Hard Drive

Your hard drive looks boring on the outside, but peel back its unassuming cover and you'll discover technology that's breathtakingly beautiful

BUFFER A cache of local memory in which the most recent data read from the hard drive is stored. If the computer requests the same data again and it's still resident in the buffer, it can be delivered from here much faster than if the read heads have to find it on the drive's platters. Most drives have an 8MB buffer, although many newer drives sport 16MB.

HEAD-LANDING ZONES These are tracks on the disk that contain no data. When the drive spins down, the read/write heads gently land on these surface areas, which are engineered to withstand contact during landing and takeoff maneuvers.



PLATTERS Typically fabricated of aluminum or glass, both sides of each platter are coated with magnetic particles that, when arranged just so, represent data. The platters are stacked on a spindle and spin in unison at speeds ranging from 5,400 to 10,000rpm.

SPINDLE MOTOR This circular shaft in the middle of the drive is the workhorse of the entire operation. It must spin the platters at a constant velocity for thousands of hours and withstand countless power-on/power-off cycles.

MAGNET AND VOICE COIL The end of the read/write arms are attached to a strong magnet and a voice coil. When a charge is supplied to the voice coil, it creates a magnetic field that uses electromagnetic attraction and repulsion to move the read/write head over the platters extremely quickly.

READ/WRITE HEAD ASSEMBLY These tiny arms extend over both sides of each platter to read and write data. The heads glide over the platters at speeds in excess of 50mph on a cushion of air just 15 nanometers thick.

LOGIC BOARD Located beneath the drive, this printed circuit board serves as an interface between the host bus adapter and the operating system. When these PCBs first appeared on drives, they became known as IDE (integrated drive electronics).

The word "computer" was first used to describe a mechanical calculating device in 1897.

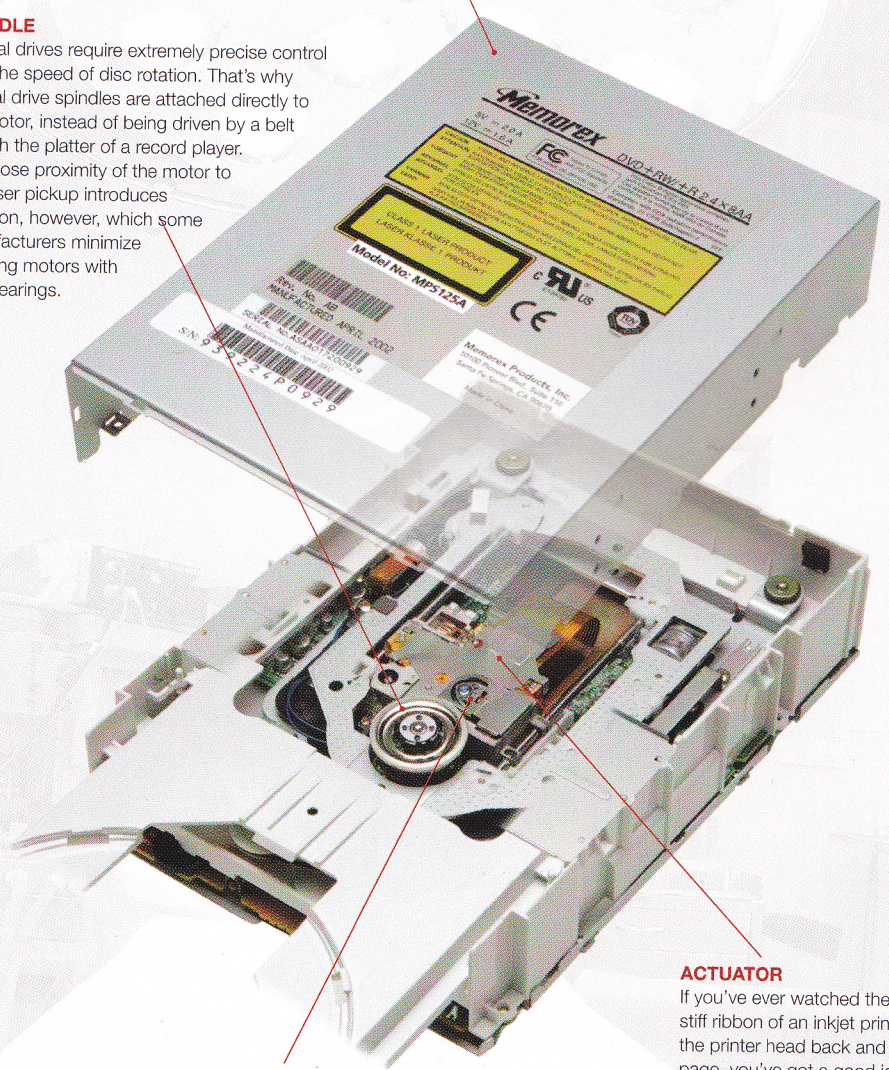
Anatomy of an Optical Drive

From CD-ROMs to double-layer DVD burners, optical drives pack some wicked technology in those ugly little metal enclosures. And let's face it: Everybody loves lasers!

CHASSIS
The sticker on the chassis contains the usual technical yadda yadda, but take a moment before you install the drive to jot down the drive's model and serial numbers and file them somewhere accessible. That way you won't have to pry open your case if you need to contact technical support later.

CLAMP
The clamp rests on the unprinted inner hub of optical media for additional stabilization. Big whoop, right? Well, if you were a polycarbonate disc spinning at 10,000rpm millimeters above a plastic tray, we think you'd take all the stabilization you could get!

SPINDLE
Optical drives require extremely precise control over the speed of disc rotation. That's why optical drive spindles are attached directly to the motor, instead of being driven by a belt as with the platter of a record player. The close proximity of the motor to the laser pickup introduces vibration, however, which some manufacturers minimize by using motors with fluid bearings.



LASER PICKUP ASSEMBLY
The pickup assembly is a little throne where the laser squats beneath a system of lenses, shining a laser on the underside of optical discs to read the "pits" and "lands" stamped on the disc. These pits and lands are the physical manifestation of the digital ones and zeroes that make up your data. Some players and burners use two separate lasers for CD and DVD work, while others use a single laser that is capable of modulating its wavelength between both formats.

ACTUATOR
If you've ever watched the flat, stiff ribbon of an inkjet printer yank the printer head back and forth across the page, you've got a good idea of how the actuator in an optical drive works. It's attached to the laser pickup assembly, which is in turn mounted to lubricated rails that run parallel to the sides of the drive. The actuator moves the pickup assembly quickly back and forth beneath the spinning disc, reading the data before it's reconstituted into Word documents, video clips, or pictures of humiliated cats wearing fake antlers on Christmas Eve.

Deep Blue was the first computer to defeat a world champion chess player, Garry Kasparov, in 1997.

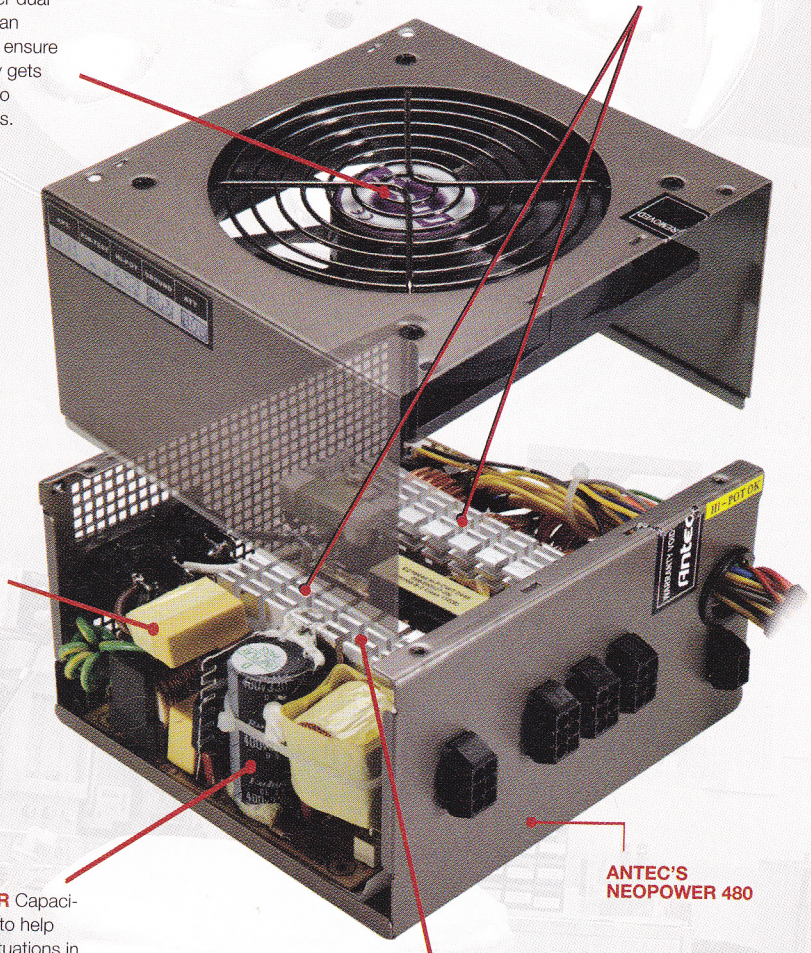
Anatomy of a Power Supply

Curiosity has killed uninitiated cats who tinkered with their PC's power supply. These devices retain lethal voltages, even when unplugged, so we don't advise opening them. Besides, we've safely done it for you!

At the time of its original release, Microsoft's Windows 98 operating system contained approximately 18 million lines of code.

FAN The fan draws the hot air radiating from a heatsink out of the power-supply enclosure. High-end power supplies typically have either dual fans or one large fan (typically 12cm) to ensure your power supply gets maximum airflow to maintain low temps.

HEATSINKS Transistor switches provide high-frequency power to transformers, and diodes resolve AC power to DC power. Both processes generate heat, which—if not managed—will reduce the power supply's efficiency. Heatsinks increase the surface area over which heat can be distributed and radiated, which helps keep the power supply cool.



EMI FILTER EMI (electromagnetic interference) is electrical noise—spikes in the power spectrum—generated by the switching action of the power supply. An EMI filter attenuates the amount of EMI that is reflected back into the power line.

ANTEC'S NEOPOWER 480

INPUT CAPACITOR Capacitors store electricity to help compensate for fluctuations in power coming from the outlet. The input capacitor kicks in a little extra juice if the incoming power dips below spec. The bigger the capacitor, the better.

OUTPUT CAPACITOR (beneath heatsink) A power supply must be able to react to sudden power draws from PC components, such as when two hard drives spin up at the same time. The output capacitor stores electricity and metes it out so that all devices receive a steady supply of current, regardless of load.

POWER FACTOR CORRECTION (not shown) Power factor is a measure of how efficiently electrical power is being used, and is expressed as a value between 0 and 1. The closer the power supply comes to delivering the ideal power factor of 1 (where 1 volt-ampere produces 1 watt), the more efficient the power supply will be and the less strain it will place on your PC's wiring. Power factor correction (PFC) is a process that boosts an electrical device's power factor closer to 1, using one of two techniques: passive or active. Passive PFC uses a simple capacitor, but this technique typically increases the power factor to between just 0.75 and 0.80. Active PFC employs a more complex circuit and is much more effective—it can increase the power factor to 0.90 or higher.

Laser Mouse

The very first computer mouse was fabricated from a block of wood, and the typical mouse remains about as responsive and accurate. Laser mice changed everything, so we gutted this one to see what makes it tick

Apple Computer launched its new Macintosh computer with a $1.5 million commercial during the 1984 Super Bowl.

SHELL You'll spend many hours manipulating a mouse, so it's crucial that the shape of its outer shell fit comfortably in your hand. Button placement is equally important. The design of this laser mouse is ambidextrous, in order to be comfortable for both right- and left-handed users.

BUTTONS There's not a lot of mystery behind a mouse's buttons, but the best ones strike the perfect balance between having a short throw (for rapid response) and sufficient resistance (so they're not triggered by the simple weight of your fingers). The rubber-coated buttons on this mouse are also programmable.

LASER Lasers have displaced LEDs in high-performance mice. Both technologies bounce light off the surface and onto a CMOS sensor, but lasers detect more surface details, even on black or reflective surfaces. The higher the laser's resolution, the more precisely the mouse will pick up the mouse's motion. This one delivers a max resolution of 2,000dpi.

LIGHTING STRIP Interior tubing channels LED light from its source to the non-slip side rails of the mouse. Lighting effects don't serve any function other than to add a "cool factor" to the product.

CMOS SENSOR This device captures the laser light bounced off the surface and sends it to a digital signal processor (DSP). The DSP examines the patterns in each image and compares them with the previous image captured, in order to determine how far the mouse has moved in the interval. The corresponding coordinates are then relayed to the host PC, which moves the cursor across the screen.