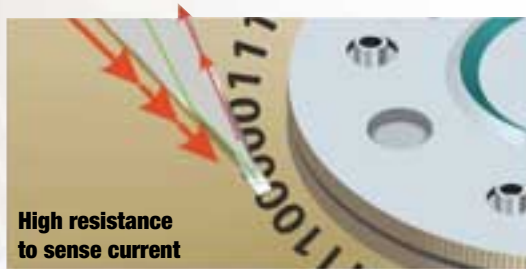# How Hard Drives Work

A hard drive stores information much like a diskette drive does; a read/write head creates magnetic patterns on a disk, which it can also read later to reproduce the information. But hard drives are much more spacious and reliable than diskette drives. Hard drives contain several platters (or hard disks) as opposed to one plastic "floppy" diskette, and they can store and retrieve information many times faster. Since hard drives are self-contained, with no removable cartridges, they are usually hidden in the computer's case instead of exposed like diskette drives.

Data passes serially into and out of a hard drive in five main steps: input, processing, writing, reading, and output.

Incoming data is encoded and translated from a digital signal to an analog one. This analog signal travels to the write head, which creates a tiny magnetic field above the correct spot on a platter. The hard drive's electronics (mounted on a printed circuit board, or PCB) tell the actuator arm where to move the read/write heads for storage and retrieval of the information. The retrieved information is converted back into digital data and sent back to the computer—all in thousandths of a second.

Controller Electronics

Low resistance to sense current

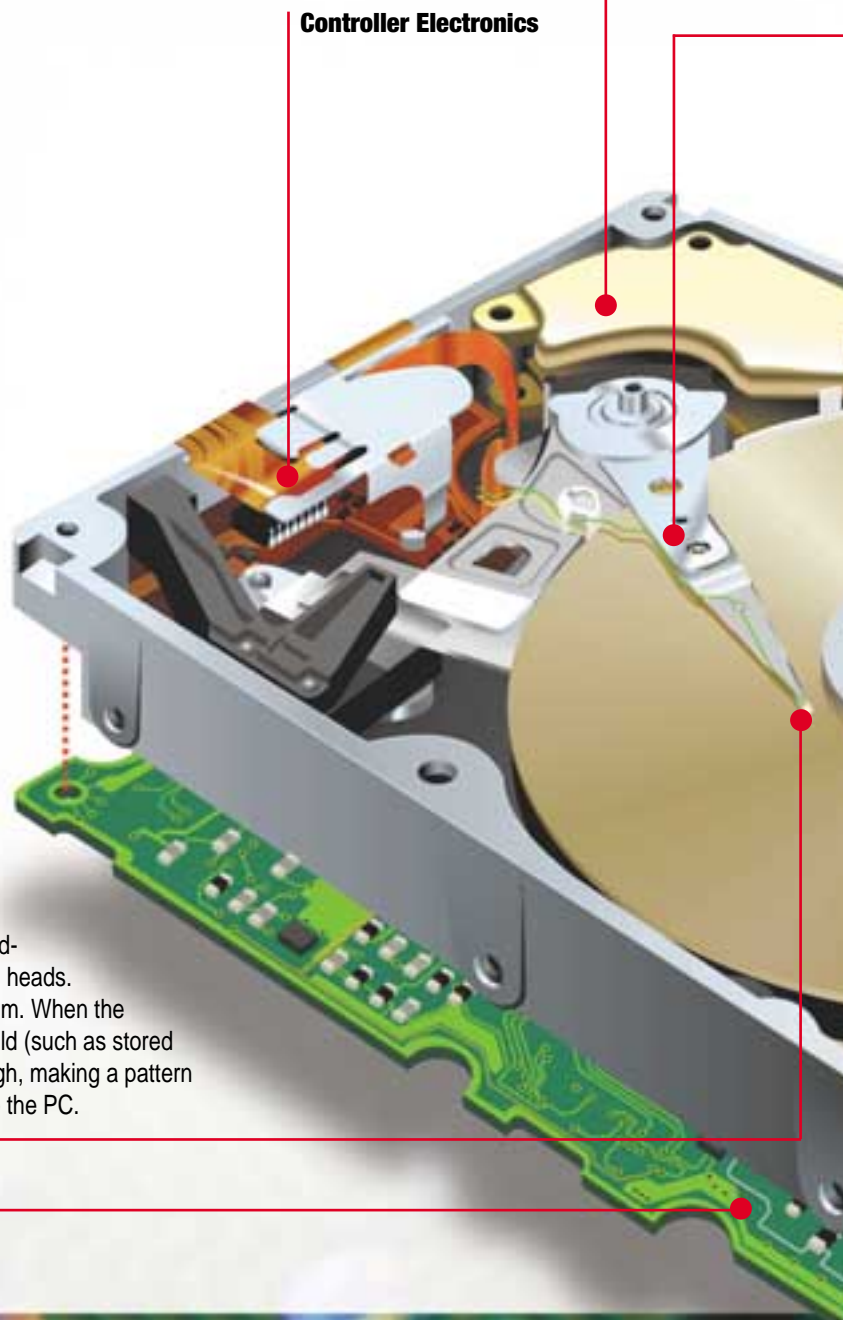**High resistance to sense current**

This simplified drawing illustrates that a change in the magnetic orientation of the data (from a 1 to a 0, for example) affects the resistance of the head. The hard drive interprets the changes in the sense current to re-create the data.

Heads

The write heads (very tiny electromagnets, usually the **thin-film inductive** type) record data to the platter by creating brief magnetic fields directly above them. For reading, modern drives employ magnetoresistive or giant magnetoresistive heads. Both types have a nominal sense current passing through them. When the MR or GMR read heads pass over a change in a magnetic field (such as stored data on the platter), they let more or less sense current through, making a pattern for the PCB's read channel electronics to decode and send to the PC.

Printed Circuit Board
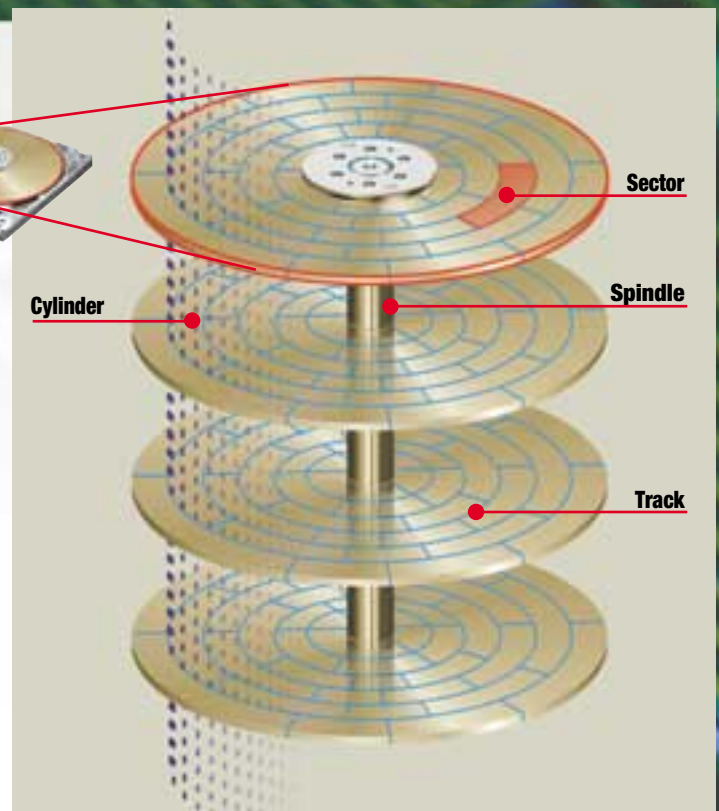
Sector

Spindle

Cylinder

Track

Voice Coil Servo

The voice coil servo, so named because it resembles a speaker's electromagnet, moves the actuator arm assembly and heads across the platters. The hard drive's controller sends precise amounts of voltage to the servo's wire coils. This creates an electromagnetic field that either attracts or repels the nearby magnets, causing the actuator arm to move back or forth.

Actuator Arm Assembly

The actuator arm actually has many "arms": two for each platter, each of which carries a read/write head. It must be very rigid, yet have a low mass to let it be moved quickly by the voice coil servo. The combination of the arm's reach and the spinning motion of the platters allow the heads to reach any sector and read its data in milliseconds. Modern actuator arms incorporate connections from the heads to the hard drive's circuitry, avoiding the bulk and drag of external wires.

Each platter is electronically formatted into tracks (concentric rings, numbered from the outermost) and sectors (sections of each track). A cylinder is an imaginary connection of the same numbered track on all the platters.
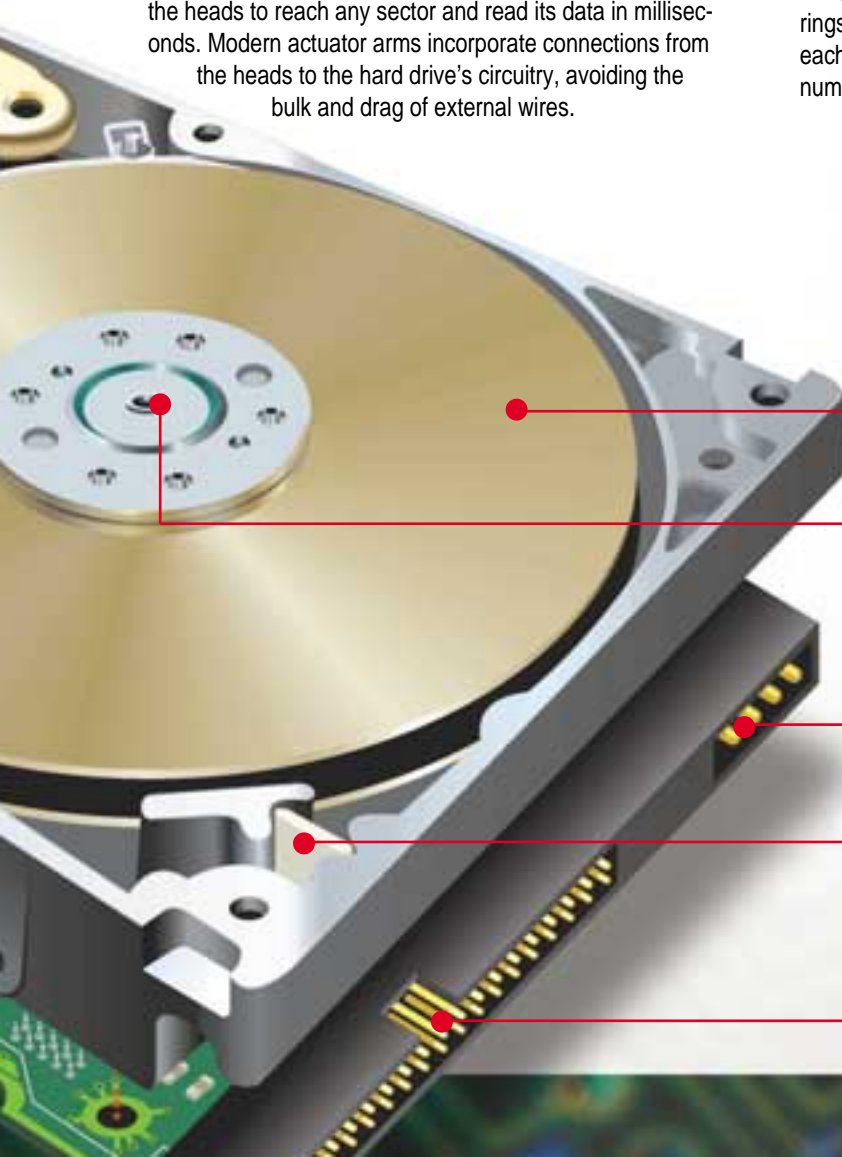
Platters

The platters are the "hard disks" in the drive. One or more aluminum or glass platters are mounted on the spindle, which may spin at 5,400 to 15,000rpm (revolutions per minute). One or both sides of each platter are used to store information.

Spindle

Power Input

Filter

Data Input

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