



Your System, Your Way

by Sheldon Leemon

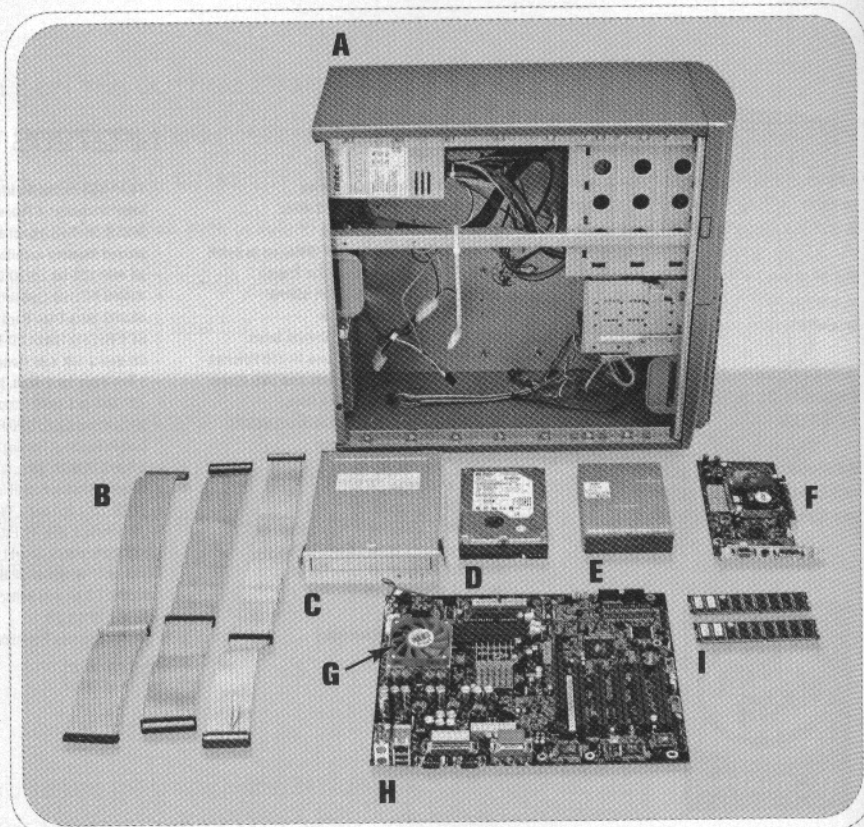
Building a PC requires patience, the right parts, and a few household tools. This month, we concentrate on the parts; next month, we'll put them all together.

Sure, you can order custom configurations from most system manufacturers these days, but with many models, your choice of CPU and other components is limited. And if you want to give the salesperson a good chuckle, try explaining that you plan to use your current operating system and hard drive, and that you won't be needing these items with your new PC.

The build-your-own approach lets you choose exactly what you want, and pay for only what you need. And once you've assembled a PC, you'll be better prepared to upgrade your system in the future and to fix it should something go wrong.

Building a computer hardly requires a degree in engineering: PCs consist of a few standard components designed for easy assembly. All you need is a little patience, a few tools, and the components that will make up your new system. (See our feature "The Complete PC Tool Kit" for tips on tools.)

In this two-part series, we'll walk you step-by-step through the process of building a PC. This first part will focus on choosing the components. Next month, we'll show you how to assemble them.



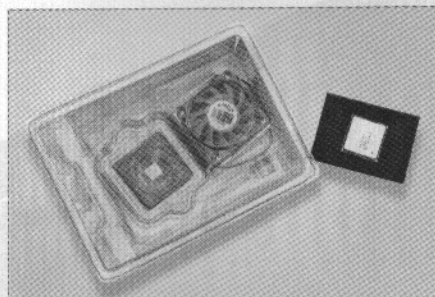
All you need to build your own PC, besides a few household tools, are a case (A), which includes one or more fans and a power supply, an optical drive (C), a hard drive (D), a processor with heat sink and cooling fan (G), a motherboard (H), and memory (I). You may also want to include a floppy drive (E) and a separate AGP graphics card (F). Ribbon cables (B) come with the drives.

1 CHOOSE A CPU

The CPU you choose will have a huge effect on the cost and performance of your new system. Value-price chips such as the Intel Celeron and AMD Duron can be a good choice if low cost is crucial. But if top performance is key, you'll want to go with the Intel Pentium 4 or AMD Athlon XP. You may also want to look for a faster front-side-bus (FSB) speed, which indicates

how fast the CPU can communicate with the rest of the system.

To get the best deal, keep in mind that clock speed indicates only relative performance: A 3GHz system, for example, won't perform twice as fast as a 1.5GHz system, but it may cost two to three times as



Unlike a bare OEM chip (right), a boxed CPU includes a heat sink and cooling fan.

much. We chose an Athlon XP 2100+, which cost us less than \$100.

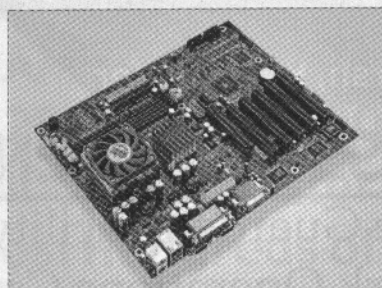
Unless you have good reason not to, go with a boxed CPU rather than a bare OEM chip. A boxed CPU may cost a bit more, but it should include a heat sink and fan, mounting instructions, and a three-year warranty.

2 PICK A MOTHERBOARD

CPUs from Intel and AMD require different motherboards, so your first task when selecting a motherboard will be to limit yourself to models that will support your CPU. Look for Socket A support if you'll be buying an AMD CPU, and a Socket 478 interface if you'll be using an Intel Pentium 4 or recent Celeron. You'll also need to restrict yourself to boards that can support the specific clock speed and front-side-bus speed of the processor you've chosen. Expect to pay \$50 to \$175 for a motherboard.

To ensure compatibility with today's system cases, make sure you buy a motherboard that uses the ATX form factor. (Most do.) Also make sure it has an AGP slot, USB 2.0 ports, and four or five PCI slots for future expansion. And if you need serial and parallel ports for legacy equipment, make sure the motherboard provides them, too.

Popular motherboard makers include Abit, Asus, Gigabyte, Intel, MSI, Soyo, and Tyan. We selected Soyo's midrange SY-KT333 Dragon Plus, which features three DDR SDRAM memory slots, USB 2.0, built-in sound, and LAN support.



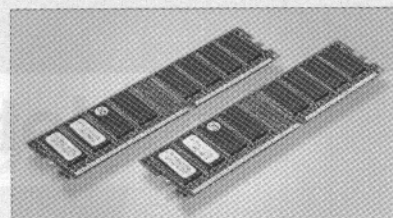
Choose an ATX motherboard that supports your CPU of choice and provides four or five PCI slots.

3 ADD RAM

The memory of choice today in high-speed desktop systems is double-data-rate (DDR) SDRAM, because it combines high speed and a reasonable price. Typically, motherboards can adapt, with varying performance levels, to a range of RAM speeds, but PC2100 (266MHz) is a good choice for most systems. If you're using a CPU with a 533MHz front-side bus, you may want to pay extra for PC2700 (333MHz) memory. Get at least 256MB of

memory—512MB, if possible—if you're running Windows XP.

The standard packaging for DDR memory is a 184-pin DIMM. Good RAM is vital to system stability, so stick to a brand-name product with a lifetime warranty, and buy from vendors that will make an exchange if you get the wrong part. We used two 256MB PC2100 modules from SimpleTech.



The pins on DDR SDRAM (left) and SDRAM modules are keyed differently, so you can't insert the wrong kind.

4 BUY A CASE

Don't skimp on your system's case. Your choice will affect how good your system looks, how solid it feels, and how easy it is to expand. The case also provides the system's power supply.

Standard ATX cases come in tower and desktop models. Towers range from mini to server size; midtower cases provide the right combination of size and expandability for most users.

Look for a power supply in the 300- to 400-watt range, and if

Hunting for Parts

Shopping for the right components at the right price can be half the fun of building a system. Most system components are easy to find at the usual retailers, such as Office Depot, Staples, Best Buy, and Circuit City. And you'll probably even find a good selection of core components locally if you live near a major metropolitan area. Computer specialty stores such as CompUSA, Fry's Electronics, and Micro Center stock a variety of computer parts. But you may be able to find better bargains online.

Online sources with large selections include AccessMicro.com (www.accessmicro.com), ComputerGeeks.com (www.compgeeks.com), Motherboard Express (www.motherboardx.com), Motherboards.com (www.motherboards.com), Outpost.com (www.outpost.com), and TC Computers (www.tccomputers.com). In general, the more the company focuses on core-component sales, the more likely you are to find bundle deals and OEM versions of Windows.

To find the best prices for a given component, try comparison-shopping sites such as CNET Shopper.com (shopper.cnet.com), PriceGrabber.com (www.pricegrabber.com), and Price Watch (www.pricewatch.com). (CNET Networks is Computer Shopper's parent company.) Also keep in mind that large Internet vendors often run weekly or even daily promotions. To track these specials, check out deal sites such as SlickDeals.net (www.slickdeals.net), Spoofee.com (www.spoofee.com), and Techbargains.com (www.techbargains.com).

For the latest news and reviews from the world of motherboards, CPUs, memory, and other components, start with Motherboards.org (www.motherboards.org). Some great general-purpose hard-core tech sites include AnandTech (www.anandtech.com), ExtremeTech (www.extremetech.com), Sharkyextreme.com (www.sharkyextreme.com), and Tom's Hardware Guide (www.tomshardware.com). For thorough, up-to-date resources on hard drives, pay a visit to StorageReview.com (www.storagereview.com).

Manufacturers' Web sites such as Intel's (www.intel.com) and AMD's (www.amd.com) can also be great resources. To find the right memory for your new motherboard, check out the memory-selection guides of memory manufacturers such as Crucial Technology (www.crucial.com) and SimpleTech (www.simpletech.com), or try out the excellent memory configurator at Shopper.com. Follow the configurator link for a handy primer on system memory.



Choose a chassis that has a 300- to 400-watt power supply and leaves room for growth.

mods, are big now, and lots of Web sites offer them. Even mainstream manufacturers are getting into it. Antec, for instance, offers cases with see-through panels and LED fans. For ideas, reviews, guides, and forums on case mods, check out www.twistedmods.com. To buy one, check out www.exoticpc.com and www.pcmuds.com, or search the Internet for "case mods."

5 CHOOSE A HARD DRIVE

Just about any ATA hard drive will do the job, but a 7,200rpm drive should give your system a little extra pep for minimal added cost. A 40GB hard drive will probably do, but if you can get a 60GB or 80GB drive for a few dollars more, you may as well. Don't get hung up on the dif-



Any 7,200rpm drive should deliver excellent performance.

Shopping List

Whether you save money by building your own system depends on how you shop (see the sidebar "Hunting for Parts") and what you buy. You could probably build a competent office and Internet system for a few hundred dollars, if you're willing to keep it simple, but most of us will splurge on at least a component or two, as we did with the hard drive and DVD writer we procured for our system.

Here's a list of the components we gathered, along with their average selling price as we worked on this article. We left out the 3.5-inch floppy drive, keyboard, and mouse because we opted to salvage these items from an existing system. Keep in mind prices probably will be lower by the time you read this.

CPU AMD Athlon XP 2100+ (boxed)	\$93
Motherboard Soyo SY-KT333 Dragon Plus	\$88
Memory Two 256MB SimpleTech PC2100 DDR SDRAM modules	\$146
Case Antec Performance Plus660AMG	\$114
Hard Drive Western Digital WD Caviar Special Edition (80GB)	\$121
Optical Drive Toshiba SD-R5002 DVD-RW combo drive	\$256
Graphics Card PNY Verto GeForce4 Ti 4200	\$145
Operating System OEM version of Windows XP Home Edition	\$95
TOTAL	\$1,058

you'll be installing a Pentium 4 motherboard, make sure the power supply explicitly supports the Pentium 4. Also check that the chassis will accommodate the drives you need while leaving at least a little room for growth. We selected the Antec Performance Plus660AMG, a midtower case with a 330-watt power supply and front-panel connectors for USB and FireWire ports.

Tip: Modified cases, or case

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ference between ATA/100 and ATA/133 interface speeds. Either will do just fine.

Like CPUs, hard drives come in retail boxed versions, with a cable, instructions, and utility software, or as bare OEM units. Check warranty periods before you buy. For our project, we chose Western Digital's 80GB WD Caviar Special Edition, a 7,200rpm drive with an 8MB cache.

6 BUY OPTICAL AND FLOPPY DRIVES

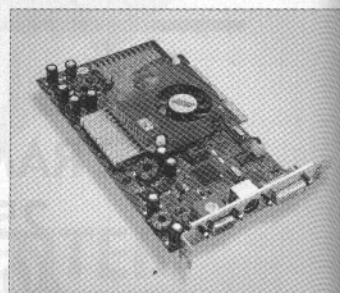
A CD-ROM drive is a necessity, but this is one item that can often be salvaged from an old system, as can a 3.5-inch 1.44MB floppy drive. If you don't have a CD-ROM drive in the 40x or higher range, buy an internal CD-RW drive, which should cost little more than a plain CD reader. We opted for the \$349 Toshiba SD-R5002 DVD-RW combo drive, which reads and writes both CDs and DVDs. The downside is it's beige, so it won't match the case. But then, neither did our \$10 floppy drive.



Excellent optical-drive choices include 40x CD-ROM drives, CD-RW writers, DVD/CD-RW combo drives, and DVD writers.

7 CHOOSE GRAPHICS AND SOUND CARDS

Almost all motherboards have built-in sound capabilities that meet the basic requirements, and some have built-in graphics as well. But for 3D-gaming performance, you'll want a fast AGP video accelerator. The two most popular lines are ATI Technologies' Radeon, and boards based on nVidia's GeForce graphics controllers. Each includes boards that range from less than \$100 to more than \$400; the best value can usually be found in boards around the \$100 mark. We chose the PNY Verto GeForce4 Ti 4200, with 64MB of DDR SDRAM and stuck with integrated sound.



For improved graphics performance, get an AGP card rather than settling for a graphics controller integrated onto the motherboard.

8 GATHER ACCESSORIES

You'll also need a keyboard, mouse, monitor, and speakers. You can always scrounge them from an old system, but brand-new ones are very inexpensive. If you do buy a new keyboard and mouse, you'll have to decide whether to buy USB models, which are a bit more convenient but also more expensive.

9 CHOOSE YOUR OS

You'll need an operating system for your new PC. You can legally install the version on your existing system if you won't be running the old system afterward. If you'll be buying a new copy of Windows, you can save money by buying an OEM copy at the same time you purchase your hardware. Vendors frequently offer OEM versions bundled with motherboards, CPUs, or other hardware. ▼

Blueprint

by Sheldon Leemon

FOR PC BUILDERS

Last month we took you on a shopping trip for **all the parts you need to build a PC**. Now it's time to put them all together and fire up your creation.

BUILDING YOUR OWN SYSTEM IS A GREAT way to realize your PC dreams, whether you want a souped-up speedster or an eco-friendly workhorse. Last month we focused on gathering the components. Now it's time to put them all together.

Before you start, choose a spot where you'll have ample room to work comfortably and lay out your components. Then gather a few tools. Wearing an antistatic wrist strap is a good idea. Otherwise, be sure to touch metal, such as the sides of the case, before you touch any components. You may also need Phillips- and flat-head screwdrivers, needle-nose pliers, and a small flashlight.

The building process should take no more than a couple of hours, but allow yourself an extra hour or two for software installation and possible troubleshooting.

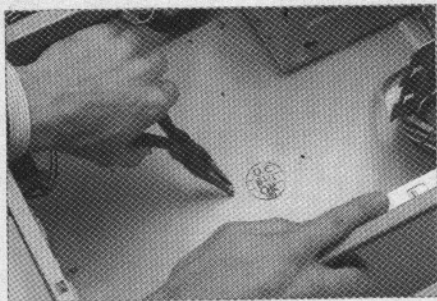


Here are the tools you'll need to build this Athlon-powered tower system: Phillips- and flat-head screwdrivers, needle-nose pliers, and a small flashlight.

1 PREPARE YOUR CASE

Lay your chassis on its right side and open the left panel. If your motherboard has built-in connectors for sound or networking, as did our Soyo SY-KT333 Dragon Plus, you may need to knock out some scored metal panels for these connectors.

Now look through the bag of hardware that came with your



Insert a standoff in the system case for every hole in the motherboard.

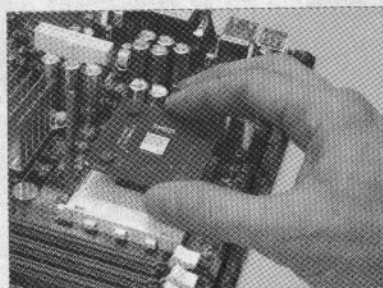
chassis to locate the standoffs—short posts with screw holes on top. Carefully remove your motherboard from its antistatic bag and match the holes in the case with the holes in the motherboard. Set the motherboard on top of its antistatic bag on your work surface. Screw a

standoff into each hole in the case, tightening it with pliers.

2 INSTALL THE CPU

Raise the lever next to the board's CPU socket by moving it to the side and then straight up. Line up the CPU and lower it into the socket. Move the lever back down to lock the processor into place.

Tip: Don't force the CPU into the socket. If it doesn't drop in, check its alignment.

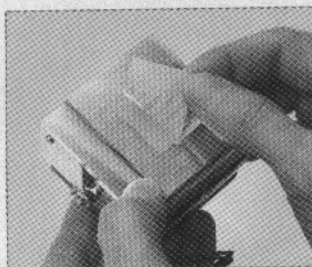


Raise the lever next to the CPU socket, place the CPU in the socket, and lower the lever to lock the chip into place.

3 ATTACH THE HEAT SINK AND FAN

Some heat-sink and fan assemblies require the application of thermal compound; ours already had a square of thermal material on the heat sink. Remove the tape covering this material, being careful not to touch or smudge it. Position the heat-sink fan on the CPU, taking care not to move it once it's in place. Then lock it down. Athlon heat sinks lock with metal clips that fit over plastic tabs on the socket. With our Athlon XP 2100+, we had to apply a fair amount of force with a screwdriver to attach the clip.

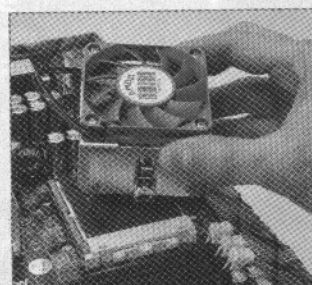
Now, connect the fan to the motherboard by attaching its electrical connector to a three-pin plug near the processor socket.



Attach the heat-sink fan to the CPU by removing the cover over the thermal material on the heat sink and placing it flat against the CPU...

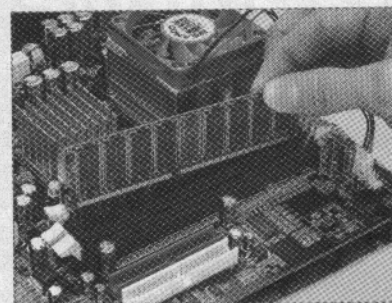
4 INSTALL THE RAM

Some motherboards accept memory modules in any socket, but with most you should start with the lowest-numbered slot. On our Soyo



...then connect the fan to the motherboard.

motherboard, the slots were labeled DIMM1, DIMM2, and DIMM3. Push the plastic latches on the side of the sockets outward, position each module so that its notch aligns with the notch in the socket, and press it down until the latches click into place.



Insert the memory modules into the sockets, starting with the lowest-numbered slot.

5 MOUNT THE MOTHERBOARD

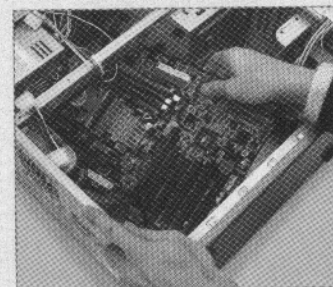
Place the motherboard in the case, positioning the port connectors in the openings on the chassis' back panel. The holes on the motherboard should line up over the standoffs you inserted in step 1. Tighten each screw a little as you insert it, then tighten all screws securely.

You'll also need to connect some wires from the case to the motherboard. Most prominent is the power-supply ATX cable that plugs into the large white socket on the motherboard. Pentium 4 motherboards also have a smaller, four-pin power cable you must attach. Next, connect the smaller leads coming from the front of the case for the speaker, the power and reset switches, and the power and hard drive LEDs. These connect to a double row of pins on the edge of the motherboard. This is where a flashlight comes in handy. If you still can't make out the labels, check your motherboard manual to see where each one goes.

Our case provided front-panel USB ports, which attach to the motherboard via a cluster of nine connectors. We connected all nine pins to the port labeled USB 20 1, consulting the manual to determine which pins went where.

Finally, if the case has additional cooling fans, connect them to the power supply.

Tip: Power and hard drive LEDs are polarized. If they don't light during testing, reverse the leads.



Place the motherboard in the case, lining up the holes in the board with the standoffs.

Micro-Size It

Options are growing for build-it-yourself types who need big power in a small box. Most motherboard and case manufacturers now offer MicroATX or FlexATX system boards and chassis, which trim a few inches off the standard ATX form factor.

To go even smaller, you'll have to enter the realm of small-form-factor (SFF) PCs. The EPIA series of Mini-ITX motherboards from Via Technologies (www.viavpsd.com) are among the most popular. A little less than 7 inches square, they include all the usual inputs and outputs, plus audio, video, TV out, LAN, and FireWire. Their embedded C3/Eden processors are only on par with 500MHz to 600MHz Pentium III chips, but they should prove amply fast for most uses. A number of companies make custom enclosures for these inexpensive (under-\$150) boards.

For more power in a small package, consider the XPCs from Shuttle Computer Group (www.shuttleonline.com), which house full-featured motherboards in nifty 7x8x1 1-inch boxes. Priced around \$300, they support the latest and most powerful Pentium 4 and Athlon XP processors, and, despite their tiny size, squeeze in AGP and PCI expansion slots and 200-watt power supplies.

6 INSTALL THE VIDEO CARD

Remove the cover from the bracket behind the AGP slot. If your motherboard has a locking mechanism on the slot, slide it into the "open" position. Insert the card into the slot and push down until it seats firmly. Reengage any locking mechanism, and screw the back bracket down to the frame.

7 TEST THE SYSTEM

Before you install any drives, power up your system and test it. Connect a monitor to the video card, and plug a power cable and keyboard into the system.

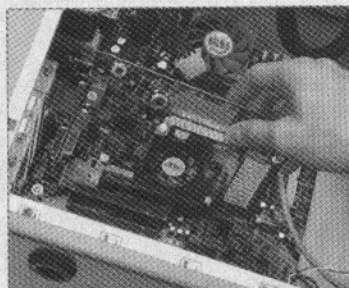
As you push the power button, make sure the fan on top of the CPU starts spinning. If it doesn't, pull the power cord immediately. Assuming all goes well, startup messages will appear within a few seconds. If the wrong processor type or speed is displayed, specify the processor settings manually in the BIOS-setup routine.

If the system doesn't work, check the power connections. The motherboard manual may also have troubleshooting instructions. When all is working, turn off the system and unplug the power cord.

8 MOUNT THE HARD DRIVE AND FLOPPY DRIVE

Remove the front faceplate and pry off the plastic covers for the drive bays you're going to use. The hard drive usually mounts in a removable cage using two screws on each side. Our floppy screwed into a bracket. Before you install the hard drive, make sure its jumper shunt is in the "master" position. If you ever add a second drive, set the new one to "slave." Install the drive at the bottom of the cage for better access, cable routing, and ventilation.

Next, attach an interface cable to each drive. Most hard drive cables have a blue connector on one end. Attach that end to the motherboard. The connectors are usually notched so you can't insert them the wrong way. If they're not, line up the cable's red stripe with Pin 1 on the drive—usually the one closest to the power connector. Most floppies don't have clear markings for Pin 1, but if you plug the floppy cable in backwards, the drive-activity light will stay on continuously

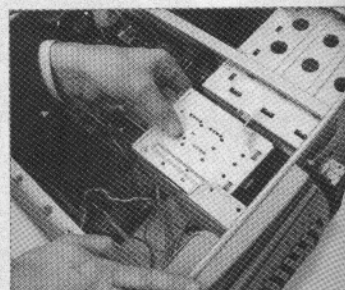


Slide back the locking mechanism before inserting the AGP card. Make sure it's seated firmly, then screw the bracket down to the frame.

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when you turn on the computer. If that happens, reverse the cable.

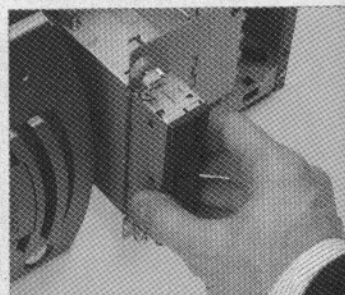
After you've attached the cables, replace the hard drive cage and insert the floppy through the front of the case, fastening the two front screws. Attach the other end of each cable to the appropriate motherboard connector, as indicated in your manual; use the first ATA channel—IDE 1—for the hard drive. Then attach a power cable from the power supply to each drive. The hard drive gets one of the large four-pin connectors, while the floppy gets one of the smaller ones.



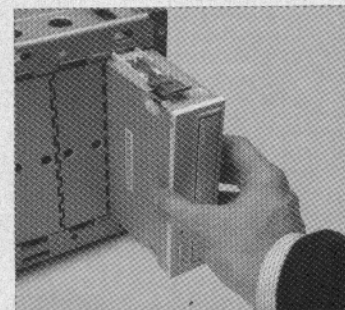
With the hard drive in its cage, return the cage to the case.

9 INSTALL THE OPTICAL DRIVE

Installing your optical drive—in our case, a DVD-RW/CD-RW combo drive—may require attaching rails provided with your case. If so, screw them into each side of the drive. Position the jumper shunt in the "master" position, then attach the drive's interface and sound cables. Slide the drive into the bay through the front of the system until the latches on the rails click into place. Connect the interface cable to the motherboard's second ATA channel, and the sound cable to one of the CD IN connectors. (It fits only one, depending on your cable.) Plug one of the large four-pin connectors from the power supply into the drive.



Insert the floppy drive assembly through the front of your system.



Slide the optical drive into the case until it clicks into place.

10 INSTALL WINDOWS

Plug in the power cable, monitor cable, mouse, and keyboard. Then power up the system. Startup messages should indicate the presence of the hard drive, CD-ROM drive, and

floppy drive. Insert the Windows CD and reboot. After the system restarts, it will lead you through the process of partitioning and formatting the drive and installing the operating system.

Tip: If your system won't boot from the Windows CD, check the boot-device order using your motherboard's setup routine. ▼

Building Sites

There's no such thing as having too much information when it comes to putting together your own system. For a good foundation, start with AMD or Intel, depending on the CPU you chose. AMD offers complete building guides at www.amd.com/us-en/Processors/TechnicalResources/0,,30_182_869_4348%5E1065,00.html, and Intel provides information about configuring Pentium 4 systems at www.intel.com/support/processors/pentium4. Of particular interest is the overview of CPU installation at www.intel.com/support/processors/pentium4/intnotes478.htm#integrating.

For additional step-by-step building guides, check out Tom's Hardware Guide (www.tomshardware.com/howto). For help from real live users instead, try one of the many technical forums. AMD builders will find areas devoted to every conceivable subject at www.amdforums.com, and for general help, look to heavily used technical forums such as the one on the Sharky Extreme site, at www.sharkyforums.com.

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