

# Hardware Upgrade Guide

## Technical Guide

### Upgrading a Desktop PC

A step-by-step guide to the intelligent upgrade.

With today's ever increasing advancement in computer technology, two or three years old may be considered ancient in the world of personal computing. By that time most PC's are ready for the scrap heap. However, today's after market distributors of computer parts and peripherals may make upgrading a desktop PC not only a smart decision but economical as well. These guidelines may offer a customer several ways of delaying a PC's obsolescence.



*Whether building from scratch or updating a component or two, these are some of the parts that might find their way into a computer upgrade.*

Adding or upgrading a hard disk, sound card, RAM, modem, or network interface is pretty easy, and it helps you create a PC the customer really wants. An office user may want more speed while multitasking; a gamer, faster graphics; and an audiophile, better sound and huge amounts of storage. All of these enhancements are possible via simple upgrades for a fraction of the cost of a new PC. Whatever the customer's inclination, these instructions will show how to upgrade a desktop PC.

You'll learn about four types of upgrades:

- Motherboard, CPU, and RAM
- Graphics and Sound
- Hard Disk and Removable Storage
- Modems and Networking.

Each section in this guide suggests what parts to use, discusses problems to look for, and provides instructions for performing the installation. Trying to decide how far to go can be tough. The chart "Upgrade Recommendations" lists some of the more effective upgrades for different types of PCs.

One of the most effective upgrades is also among the least expensive: Beefing up the system's RAM costs less than 25 cents a megabyte. If the system currently has 64MB or less of RAM, upgrading will almost certainly boost the system's performance significantly and may result in fewer application crashes.

Graphic interface cards are a good deal too. If the customer doesn't want to spend lots of money on a top-of-the-line gaming card (though many gamers wouldn't think twice about doing so), a little over \$100 fetches a capable 3D graphics card and (perhaps) one with high-end features like multi-monitor support. On the other hand, the competitive environment also makes it a good time to buy a new PC. And let's face it: An upgrade isn't always the best choice.

If the customer is looking for a big performance boost, a new PC--thanks especially to its up-to-date CPU and motherboard--may be the most economical solution. PCs more than a few years old may lack support for desirable technologies such as AGP (for the fastest graphics board interface), and they may have no USB ports.

<b>Upgrade Recommendations</b>		
<b>Objective</b>	<b>Current System Specifications</b>	<b>Recommendation</b>
<b>Improved general computing performance</b>	Less than 128MB of system RAM	Upgrade to 128MB or more of system RAM.
	Less than 500MB of free disk space	Add a bigger hard disk; a constricted swap file can slow overall performance.
	An early Pentium II or older CPU	Upgrade to a low-cost Pentium III, Celeron, or Duron system.
	Pentium or early Pentium II	Upgrade to latest motherboard sporting the best affordable microprocessor.
<b>PC Network and Internet Connection</b>	No modem or one slower than 56K BPS	Install the fastest modem the market provides.
	One PC and one laptop located near each other; USB ports available	Install a peer-to-peer USB network.
	Multiple PCs located in different rooms, each room shares a common phone line	Install a phone-line, wireless, or Ethernet network.
<b>Create a Quality Multimedia System</b>	A Pentium II or older CPU	Buy a new system with the fastest CPU affordable.
	Less than 128MB of RAM	Upgrade to more than 128MB of RAM or as much more that's affordable.
	A software MPEG decoder	Install a new graphics card with a built-in MPEG decoder or a separate decoder card.
	A CD-ROM drive	Obtain both a DVD-ROM drive for loading video clips and a CD-RW or DVD-R drive for long-term storage.
	A hard disk with less than 20GB of free space	Purchase the fastest and biggest drive affordable.
<b>Improve Gaming Performance</b>	Integrated graphics, or and old graphics card with less that 32MB of RAM	If possible, upgrade to a new AGP graphics card with 32MB or more of memory and a good 3D processor.
	Less than 64MB of system RAM	Upgrade to 128MB or more of system RAM.
	A Pentium II - 233MHz or less-powerful CPU	Try a CPU upgrade or buy a new system; even the lowliest Celeron or Duron based PC will provide stellar improvements.
	An old, cheap sound card with a pair of mediocre speakers	Add a new sound card that supports Dolby 5.1 surround sound and a good pair of four channel speakers; even an inexpensive subwoofer will add tremendous presence.
	Any 56-kbps modem, including a V.90 model	Upgrade to DSL or cable modem service this can vastly improve online games.

## Motherboard, CPU, and RAM

Let's start with the basics. The motherboard, processor, and RAM are so integral to PC performance that they always make likely upgrade targets.

### Some Things to Consider about the CPU First

When a customer wants a faster PC, they often ask for a faster microprocessor (CPU). Though the CPU is important, PC performance depends on all the PC's components, so upgrading to a CPU that runs at twice the speed of the current processor won't come close to doubling the system's performance. A 10 to 20 percent boost is more realistic.

It's also important to note that you just can't drop any CPU into the motherboard; to do the job right, the customer will probably have to buy an upgrade kit from Intel, Evergreen, or PowerLeap. Kits range in price from under \$100 to over \$400. So have the customer carefully weigh the expense versus the probable increase in speed. They shouldn't buy a kit unless it at least doubles the current clock speed or bumps it up an entire CPU class (from Pentium II to Pentium III for instance).

The CPU upgrade may also require the replacement of the motherboard. For instance, there's no way to make a Pentium IV microprocessor to work with a Pentium II motherboard. It won't even fit in the old microprocessor socket. The same is true for the old memory. It may not fit into the mounting sockets and if they do, they may simply be too slow for the new microprocessor.

There are plenty of decent motherboards available for less than \$100. However they're unpopulated, meaning they don't come with a microprocessor or memory. It's also likely that the new motherboard will require a different type of power supply. An ISX motherboard will not work with an AT power supply for example. The more expensive motherboards sometimes include on-board video and sound circuitry. This may save money since they don't have to be purchased separately. Ultimately... If the customer is budgeting around \$400 for an upgrade, they may get a better deal by upgrading other components like the motherboard, or even putting the money toward the purchase of a new system.

### Memory – The Best Bang for the Buck

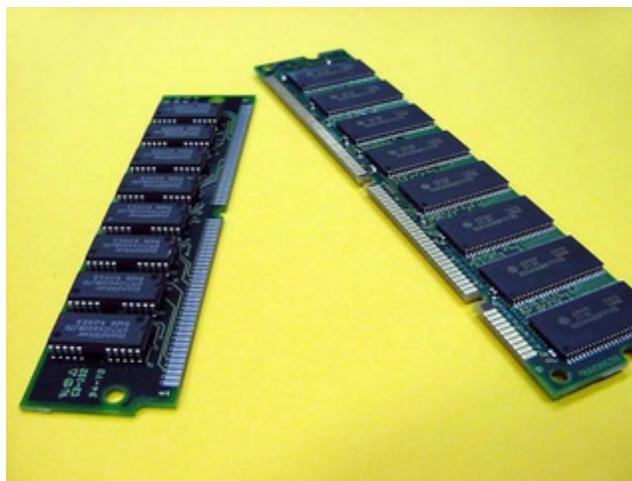
Adding memory to a PC is the most cost-effective way to increase its performance. Now that 256MB PC133 DIMMs now available for around \$50, that's never been truer. If the system is running Windows 98 or later there will be noticeable performance gains if memory is upgraded to 128MB or more, especially when running several applications at once. Fortunately, adding RAM is a fairly easy process. In fact, the hardest part of the upgrade consists of finding modules of the right type and size for the PC. For the correct RAM specifications, check the user manual or motherboard manual that came with the computer.

Most systems purchased in the past several years use SDRAM, which comes in several varieties (PC66, PC100, PC133, and on newer... often AMD systems--DDR SDRAM). Older machines may use FPM or EDO DRAM; and some newer, pricier models use relatively expensive Rambus DRAM (RDRAM, or RIMMs).

This is usually not a mix-and-match situation; it's important to use the same type and speed of RAM already in the PC. Memory vendors like Crucial and Kingston have excellent web based tools for matching RAM to specific PC models or motherboards.

The technician must also determine whether the motherboard uses SIMM or DIMM RAM modules. Most systems made in the past three years use DIMM modules, while many older PCs use SIMM modules (which are shorter and must be installed in pairs). A few PCs can take both but often they run on only one type at a time.

Make sure that there are open RAM slots on the motherboard and that the motherboard will accept the upgrade module. Sometimes RAM slots must be filled in a certain order or with a module of a certain capacity. Finally, don't use generic, budget memory. Paying a few extra dollars for DIMMs or SIMMs from a company like Kingston or Crucial can save hours of frustration and troubleshooting.

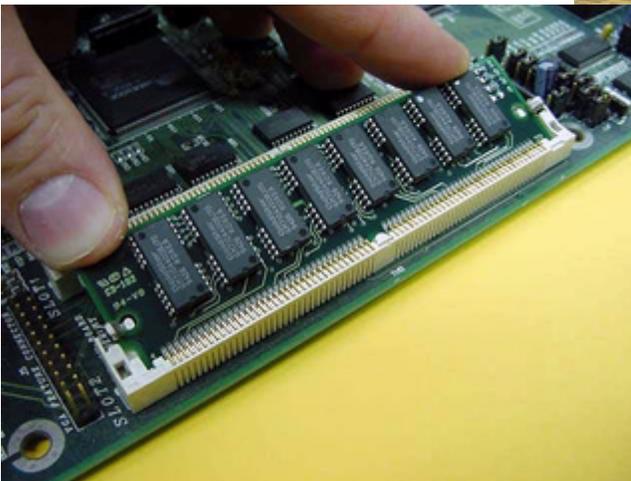


*The SIMM (Left) is physically smaller than the DIMM (Right) and has fewer contacts and only one notch for a key.*

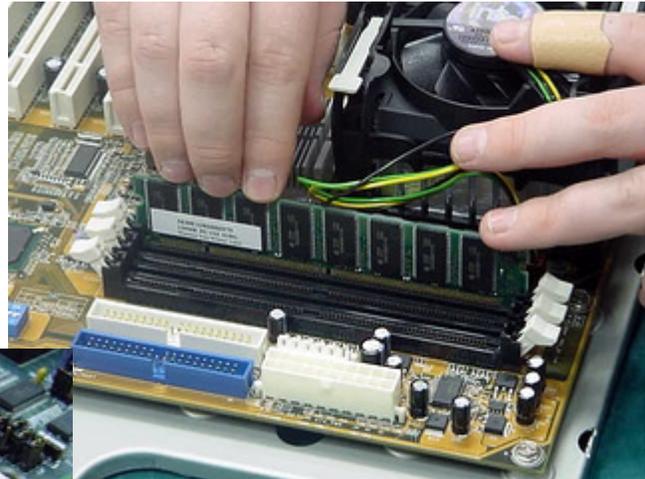
## Beefing Up The RAM

1. **Open the case.**
2. **Get grounded.** Use an antistatic wrist strap--available at any local electronics or computer store--or at the very least, touch the frame of the PC while it's still plugged in. Then unplug it.
3. **Pick up the module.** Always hold RAM modules by their side edges. Avoid touching the flat surfaces or the contacts along the bottom edge.
4. **Insert it.** For DIMMs, lower the module into the slot and press carefully. The module should seat itself, and the clips on both sides of the module should snap into place. If they don't, the module isn't properly seated.

For SIMMs, orient the module to match the others in the system, insert the module at a 45-degree angle, and rotate to the vertical. If done right, you should feel the snap of the two supporting clips closing into place.



*SIMMs are installed at an angle and the tilted until they snap into place.*



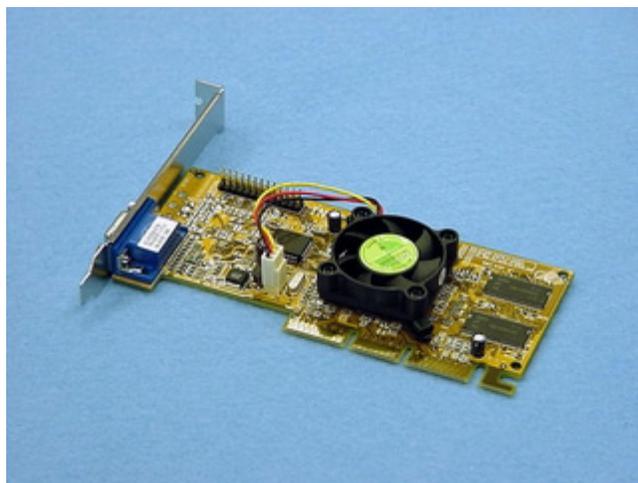
*DIMM installation takes a bit of effort pushing straight down until the clips on both sides lock in place. Make sure the keys are aligned before installation.*

5. **Power up.** Turn the system on and watch the screen for the RAM test during boot-up. The BIOS will confirm that the PC recognizes the additional RAM. If an error message is displayed, beep error sounds, or if the system locks up, remove and reinstall the new modules.

## Graphics & Sound

The latest graphics cards offer various technologies: not only more-sophisticated processors, but also specialized features, such as dedicated video RAM, TV tuners, and MPEG-2 decoder hardware (great for watching DVD movies). But many of these cards are also very expensive. The customer should expect to pay about \$400 for a card sporting the latest video chips and 64MB of DDR Video RAM--more RAM than found on some budget PCs. But if the customer isn't a die-hard gamer, there are plenty of lower-cost alternatives.

Before ordering a part, be sure to check the PC. Some older or budget systems lack the AGP slot used by most of today's graphic cards. If the system doesn't have one, the only



*You can tell what this is by the edge connector and output plug... it's an AGP Video Adapter. This card contains 32MB of video RAM and features a cooling fan for the processor.*

other option is to use a PCI board and settle for a relatively modest performance boost.

The graphics subsystems of many budget systems sold in the past few years including many based on Intel's 810e chip set aren't upgradeable. These systems come with both graphics and audio support built into the motherboard. They also use a portion of the system RAM for graphics duties. Check the back of the PC: If the monitor connector is grouped with the keyboard, mouse, and USB connectors and isn't in an expansion card slot, the system probably has an integrated sound and graphics. If the system doesn't have an AGP slot, you won't be able to upgrade without installing a new motherboard.



*The Video Capture Interface allows the computer to digitize both motion and still images from a VCR or video Camera. Some of these cards also include a TV and radio tuner.*



*The Sound Card allows the computer to play and record audio files. It also includes a combination MIDI/game port adapter.*

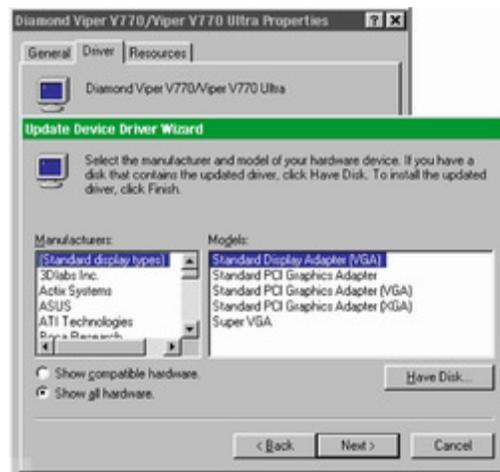
### Fine-Tuning

In many of today's fast-moving games, winning depends on hearing competitors as well as seeing them. If the customer is just making do with the garden-variety sound card that accompanied the PC, they may consider moving up to a card that supports the latest Dolby processing.

A top-of-the-line card offers stunning 3D sound thanks to its support for five speakers, subwoofer, plus special effects. These cards sell for around \$200, but other Dolby cards are available for as little as \$100. A great sound card is only as good the speakers attached to it. A first-class rig will run around \$300. However, budget-minded audiophiles can find a comparable system with excellent sound for half the price.

## How to Change an Interface Card

1. **Get the most recent version of the card's drivers** from the vendor's Web site. It's not uncommon for vendors to update their drivers shortly after putting the final product on the market.
2. **Read the installation instructions** that come with the card or with any driver downloaded from the vendor's site.
3. **If replacing an existing card**
  - Remove the current card's driver in Windows.
    - First go to *Add/Remove Software* in Control Panel, and remove any software.
    - Then go to *Device Manager*, select the device, and click the *Remove* button.
  - If swapping graphics cards, you can't remove the driver. But you can replace it with Windows' standard VGA driver.
    - Open *Device Manager*
    - Double-click *Display Adapters*



*The hardware installation Wizard in Windows guides the technician through the installation, configuration, and upgrade of hardware and hardware drivers.*

- Double-click the card's entry
- Click *Driver*, *Update driver*, *Next* when the Update Device Driver Wizard comes up.
- Select *Display a list of all the drivers*, click *Next*, and then select *Show all hardware*.
- Under *Manufacturers*, select *(Standard display types)*; then under *Models*, select *Standard Display Adapter (VGA) (A)*.

4. **Shut down the PC and open the case.** Make sure you're electrically grounded.

5. **For sound cards,** you'll need to remove any internal audio connectors such as those from your CD-ROM or CD-RW drive.

6. **Gently remove the old card.** Don't lose the screw that fastens the card to the chassis. Be sure to retrieve any screw or other metal parts that fall on the motherboard or other circuit cards. Such items could cause a short when the power to the system is turned-on and destroy the circuitry.



*Removing an interface card is easy. Remove the mounting screw and then gently rock the board back and forth while pulling.*

7. **Remove the new card from its packaging.** Be careful not to touch the flat surfaces or bottom edge of the card. Align the connecting edge with the expansion slot, and push evenly across the top of the card, increasing pressure until the card is seated fully in the slot. Fasten the card to the chassis with the screw you removed in step 6.

8. **Reattach any internal connectors** (sound cards) or pass-through cables (graphics cards). **When you restart your PC,** Windows should automatically recognize the new card and guide you through installing the driver.

## Getting the Latest Drivers

The computer's operating system talks to each hardware devices through a program called the driver. If the driver you have installed is for the wrong operating system or doesn't match the hardware... the device will not work properly and could cause larger problems for the computer. The OS typically comes with the most popular (and authorized) drivers available. However, hardware manufactures also supply driver software with their products. The one you should use will depend on which one is the most recent. Hardware manufactures publish new driver software to correct bugs and maintain compliance with application software and OS upgrades. To insure the reliability of the computer system, all hardware drivers should be frequently updated. Here are the three basic steps to keep your driver current. Although these instructions are written specifically for Windows 2000 they should apply to most operating systems. **Before you get started... Make sure you're logged in with administrative rights.**

1. **Inventory Your Hardware and the Drivers:** You can't go searching for a driver until you know what you're looking for. Generally, there are six drivers you need to keep updated. To find the right driver you'll need collect the following information:

HARDWARE INVENTORY			Operating System:	
Device	Manufacturer	Model Number	Driver Version	Driver Date
Video Card				
Sound Card				
Network Card				
Modem				
Motherboard				
BIOS				
Other...				

There's a couple ways you can determine what you have installed in your computer without cracking the case open.

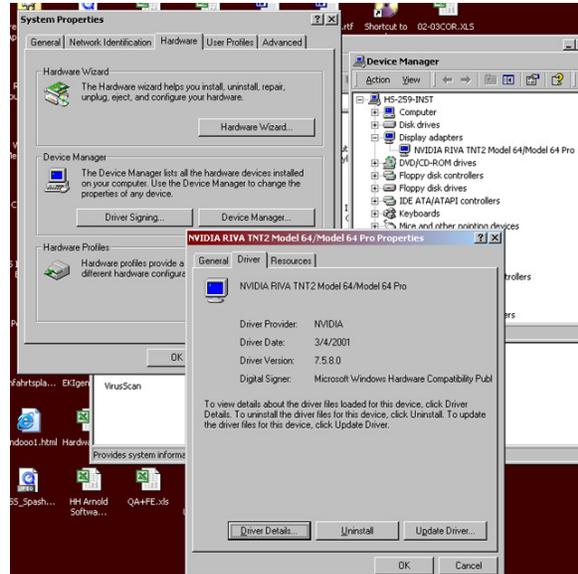
- **Watch the screen messages during boot-up.**  
Many manufacturers of interface cards program them to display their name and the model of the card during the first couple seconds of the boot-up operation. This is useful if the operating system isn't working because of a defective or incorrect video driver.
- **Use the *Device Manager* utility in the OS.**

All operating systems have a software tool used to configure the hardware that's attached to the computer.

Windows's *Device Manager* can be found by right-clicking **My Computer** on the desktop and then selecting **Properties**. You can do the same thing by clicking the **Start** button, then **Settings**, then **Control Panel**, and then **System**.

Once in the **System Properties** utility click on the **Hardware** tab and then **Device Manager**.

Next... Select the **device type** from the list and then expand the item to reveal the actual **device**. Double-clicking on the item will show the **properties** of the device. Finally, clicking on the **Driver** tab will give you everything you need to fill out the Hardware Inventory table above. It's a good idea to file the table for later use.



- **If all else fails...** Open the system up and inspect the components. The manufacturer and model number are sometimes silk-screened onto the board. Otherwise, there might be a sticker or something to identify the board.

2. **Download the Driver** Now that you have the essential information it's time to hit the web. There are plenty of sights out there that compile the latest drivers. Some of them are gleaned from manufacturer web sites while others are home brewed by computer hacks. The general rule of thumb is to get the driver from a trusted source. Always use the manufacturer's web site or the OS publisher's site before using a compilation site like [www.driversRus.com](http://www.driversRus.com). Most importantly... Make sure you retrieve the right driver for the right operating system. The wrong choice will disable the computer. Use your favorite search engine to locate the manufacturer's web site. Finding a driver depends on the site... It's different from site to site. Try looking in the Tech Support section or perhaps Downloads. Search around... They're there... You've just got to find them.

Many files downloaded from the internet are compressed into Zip files. This reduces the file size and in-turn the download time. Zip files can contain many individual files and must be expanded before you can use them. A good idea is to copy the Zip file into a folder all by itself and then double-click on it to start the extraction. When asked where to extract the files to... select the same folder the Zip file is in. That way you have the driver files and the Zip file in one location. It makes things easier to find. If the file doesn't extract, you probably don't have WinZip installed on the computer. You'll need to download that program and install it.

Once you've collected the driver updates it's a great idea to save them to removable media or a network drive in separate folders. It's much faster to update computer drivers from either a CDROM, Zip Disk, or network drive than downloading and installing drivers each time you need them. Additionally, manufacturers sometimes offer both bare-bone software drivers or complete

driver downloads. The big difference between them is the file size, download time, and the way the driver is installed. Bare bone drivers get installed through the Device Manager where as the complete package comes with its own installation utility.

- 3. Install and Test the New Driver** Now that you've got the driver it's time to install and test it. The easiest way to install drivers is to download the complete driver installation file from the manufacturer's web site. To install, you simple double-click the Setup program for the driver and you're home free. You just follow the on-screen instructions. Installing just the driver all by itself is another thing entirely.

If the download doesn't include a Setup utility, you'll have to install the driver all by itself. To do this, follow the instructions listed above "**Use the Device Manager utility in the OS**" first. Then in the **Properties** window under the **Driver** tab there's a button at the bottom of the window that says **Update Driver**. Click on this to launch the **Upgrade a Device Driver Wizard**. Click **Next** until you can select the option to **Display a list of known drivers to select from**. In the **Select a Device Driver** window click on the **Have Disk** button no matter what's listed in the selection box (These are the old drivers). Direct the wizard to use the driver that you downloaded early by browsing to the drive and folder you have it saved in. Follow the rest of the on-screen instructions which include rebooting the computer.

## Hard Disk & Removable Storage

If the customer is working with an older PC equipped with a modest 10GB or smaller drive, they may already be experiencing the need for additional space. Operating System software like Windows 2000 or XP (which alone uses at least a gigabyte of space) and MPEG, JPEG, or MP3 files simply consume the hard disk.



*SCSI bus cards can drive many SCSI devices at once. This Ultra Wide card features an external connector for a peripheral like a SCSI scanner and an internal connector for hard disk or CDROM drive.*

A reliable 30GB or 40GB drive from a manufacturer like IBM, Maxtor, Seagate, or Western Digital costs less than \$150 if you shop around. An additional \$50 to \$150 buys a 60GB to 80GB drive that runs at 7200 rpm and supports the ATA/100 (or Ultra DMA/100) interface. To reap the full benefits of an ATA/100 drive, the PC must also support ATA/100. Check the PC's user manual. If it doesn't, an updated interface via an ATA/100 expansion card can be added. Unless the customer constantly moves extremely large amounts of data, they probably won't see much of a performance difference from using an ATA/100 drive on an ATA/66-capable PC. If the need for speed is paramount, the customer may want to consider a faster, more expensive SCSI hard drive, which requires purchasing and installing a SCSI bus card in addition to the drive.

Alternatively, the customer can buy a DVD-R or CD-RW drive and use it to store music, video, or other data files on discs. Such a drive provides a nice backup option and allows the customer to burn audio CDs to their heart's content. CD-RW drives can be purchased for \$150 to \$250.

### Pick a Port

Installing a hard disk or CD-RW drive is much easier than it used to be. Most hard drives come with installation software to simplify the



*The white connector plug on the back of this hard drive is called a strap. All EIDE and SCSI devices must be strapped differently to operate correctly. EIDE is either Master or Slave and SCSI is Device 1, 2, 3... Most drives include labels that show how to strap the drive by moving the plug.*

process of partitioning and formatting the drive. Discount versions of some hard drives (or bare drives) come packaged in an antistatic bag with no box and may lack installation software.

Physically installing the drive can be challenging. First... find an unused drive power connector and an open EIDE port. Almost all recent PCs come with primary and secondary EIDE channels built into the motherboard. Each channel supports up to two drives on a single cable. Jumper settings define each drive as "master" or "slave." The hard disk holding the operating system should always be set as the master drive on the primary channel. Typically the primary channel is used for up to two hard drives, and the secondary channel for CD-ROM, CD-RW, or other removable-media drives. If the customer needs more than four drives, you'll have to install an add-in card, one that features an additional EIDE port.

## How to Add a Hard Disk

1. **Read the installation instructions**, and run any installation software that must be launched before you begin installing the hard drive in your system.
2. **Shut down the PC and open the case.** Make sure you're electrically grounded.
3. **Set the jumpers** on the drive to the desired master or slave setting.
4. **Attach the hard drive to the case** and connect the power and EIDE cables to the drive. Take care to attach pin 1 on the motherboard to pin 1 on the drive. One edge

of the cable should be colored to help you keep track. Sometimes the manufacturer includes a notch and key on the plastic connectors to prevent misalignment.

5. **Restart the PC and enter the CMOS setup program.** This usually involves hitting *Delete* or *F1* at the start of the boot process. Find the auto-detect menu and confirm that the system recognizes the new drive. Save the settings and reboot.
6. **Follow any directions from the installation software** to partition, format, and copy data to the new drive. No installation software? Then the installation must be performed manually.

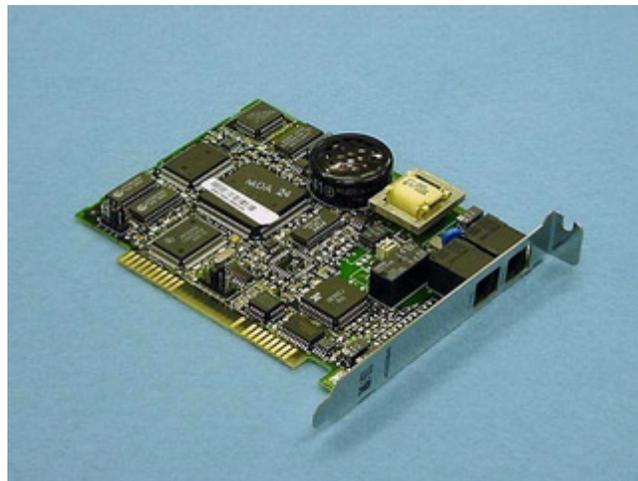


*All drives need to be connected to both the power supply and drive controller. Data cables are flat ribbon cables that usually connect to the main board. They're keyed so they can be inserted in only one direction. The same is true for the white power connector.*

## Modems and Networking

For more than two decades the only way of remotely connecting one PC to another computer has been through the use of modems. Since their invention, the primary drawback of using modems has been their transmission speeds. Modems have improved significantly from the 110 Bits Per Second (BPS) at their birth to the current 56KBPS. Also, special features such as FAX and telephone messaging have been added. Ultimately, today's modem transmission limitations are not due to modem technology as much as the quality of telephone lines and telephone switching stations.

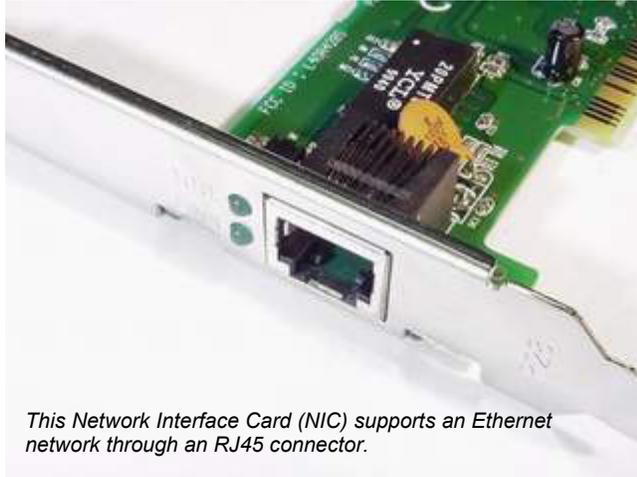
Since top-of-the-line modems are pretty inexpensive and essential to most



*Typical modem featuring a line jack to connect to the wall outlet and a phone jack that connects directly to the*

customer needs, today's computer systems usually include a modem. For older computers that feature an out-of-date modem or no modem at all, installing one is just as easy as installing any other interface card. Simply install the card and then the latest software drivers for the operating system on the computer.

Connected PCs also means no more fighting for an open phone line to check e-mail or surf the Internet. Two or three people can share a 56KBPS connection without much discomfort. The customer can also opt for a broadband Internet connection like DSL or cable modem service so everyone on the network can enjoy the faster downloads. Like other networks, it's also possible to share network resources like a common drive or network printer.



*This Network Interface Card (NIC) supports an Ethernet network through an RJ45 connector.*



*Twisted pair Ethernet cable connects the NIC to a network hub or router.*

## Network Installation is Getting Easier

Installing a small network has gotten easier. That's *easier*, not *easy*. For that reason, it's important to keep things as simple as possible.

Two PCs sitting near each other or a desktop near a laptop can be networked using a USB adapter network. It's slower than an Ethernet network, but it's cheaper and simpler to install. If there's a need for Ethernet speed and sophistication, there are several products to choose from. All involve adding a card or USB adapter to each PC and then connecting them by different methods. Proven phone-line networking kits are faster, easy to set up, and affordable. Their biggest drawback: The customer needs to have a phone jack near each PC on the network. If you're short on phone-line connections or you move around the house a lot with a laptop, a wireless network may be the best bet. The latest wireless kits based on the 802.11b standard can broadcast through walls and outside as far away as 500 feet (though speed diminishes with distance). Although wireless communication is currently not as fast as phone-line or Ethernet, the transmission speed really is quite good and does facilitate a great degree of portability.

Finally, if there are a number of PCs in one room, the customer might consider a network using traditional twisted-pair Ethernet cable and network hubs. As with wireless, setup is not for novices and the cost of running the cables through walls can restrict how far apart the PCs can be placed.

## Installing a Network

1. **Install the network cards** in each system.
2. **Make the network connections.** For phone-line networks, plug the cable into both the back of the PC and the phone jack. If the customer already uses the phone jack for a phone or fax machine, they'll need to insert a line splitter for sharing the jack.

Wireless adapters may require attaching or adjusting an antenna.

3. **Turn the system back on.** Windows should recognize the new hardware and prompt for the appropriate driver software, which should be on a floppy disk or CD-ROM that came with the adapters.
4. **Follow all the instructions** that came with the hardware to install and configure the networking software. Setting up a network can be tough; if you have problems, call tech support or visit the vendor's tech support web site.
5. **Set up the Internet sharing software.** Most kits come with software that lets multiple systems share a single connection. If this system doesn't, you can use the built-in connection-sharing software in Windows 98 SE, Me, 2000, XP: Go to *Start, Programs, Accessories, Internet Tools*. (You may have to install the software from the Windows CD, using *Add/Remove Programs* in Control Panel.)

## Useful Research and Resource Links

### Microprocessors and CPU Upgrade Kits

AMD	<a href="http://www.amd.com/">http://www.amd.com/</a>
Intel Home Computing	<a href="http://www.intel.com/">http://www.intel.com/</a>
Evergreen Technologies	<a href="http://www.evergreennow.com/">http://www.evergreennow.com/</a>
PowerLeap	<a href="http://www.powerleap.com/">http://www.powerleap.com/</a>
Intel Processor Spec Finder	<a href="http://processorfinder.intel.com/">http://processorfinder.intel.com/</a>

### Motherboards

Intel Home Computing	<a href="http://www.intel.com/">http://www.intel.com/</a>
Chaintech	<a href="http://www.chaintech-excel.com/">http://www.chaintech-excel.com/</a>
Giga-Byte	<a href="http://www.giga-byte.com/">http://www.giga-byte.com/</a>
Shuttle	<a href="http://www.shuttleonline.com/">http://www.shuttleonline.com/</a>
Motherboards	<a href="http://www.motherboards.org/">http://www.motherboards.org/</a>

### RAM

Crucial	<a href="http://www.crucial.com/">http://www.crucial.com/</a>
Kingston	<a href="http://www.kingston.com/">http://www.kingston.com/</a>

### Graphics Card

ELSA Gladiac 920	<a href="http://www.elsa.com/">http://www.elsa.com/</a>
ATI Radeon 64MB DDR	<a href="http://www.ati.com/">http://www.ati.com/</a>
Nvidia	<a href="http://www.nvidia.com/">http://www.nvidia.com/</a>

### Sound Card

Sound Blaster Live Platinum 5.1, Creative	<a href="http://www.creative.com/">http://www.creative.com/</a>
Santa Cruz, Turtle Beach	<a href="http://www.turtlebeach.com/">http://www.turtlebeach.com/</a>

### Speakers

ProMedia 4.1, Klipsch	<a href="http://www.klipsch.com/">http://www.klipsch.com/</a>
FPS2000, Creative	<a href="http://www.creative.com/">http://www.creative.com/</a>

### Hard Disk

Maxtor DiamondMax Plus 60	<a href="http://www.maxtor.com/">http://www.maxtor.com/</a>
Seagate Barracuda ATA III	<a href="http://www.seagate.com/">http://www.seagate.com/</a>

### SCSI Interface

Adaptec	<a href="http://www.adaptec.com/">http://www.adaptec.com/</a>
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### Modem

US Robotics	<a href="http://www.usr.com/">http://www.usr.com/</a>
Zoom Telephonics	<a href="http://www.zoom.com/">http://www.zoom.com/</a>
Xircom	<a href="http://www.xircom.com/">http://www.xircom.com/</a>

### Networking

Linksys BEFW11S4 EtherFast Wireless AP+	<a href="http://www.linksys.com/">http://www.linksys.com/</a>
Adaptec	<a href="http://www.adaptec.com/">http://www.adaptec.com/</a>
Net Gear	<a href="http://www.netgear.com/">http://www.netgear.com/</a>
RealTek	<a href="http://www.realtek.com.tw/">http://www.realtek.com.tw/</a>



# Hardware Upgrade Guide

## Technical Manual

### Exercise 1 –

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Exercise Objective:

Discussion of Fundamentals:

Name:	
Period:	
Date:	

Research Resources:

Company	Web Site	Description
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Required Materials:

Procedure:

Conclusions: