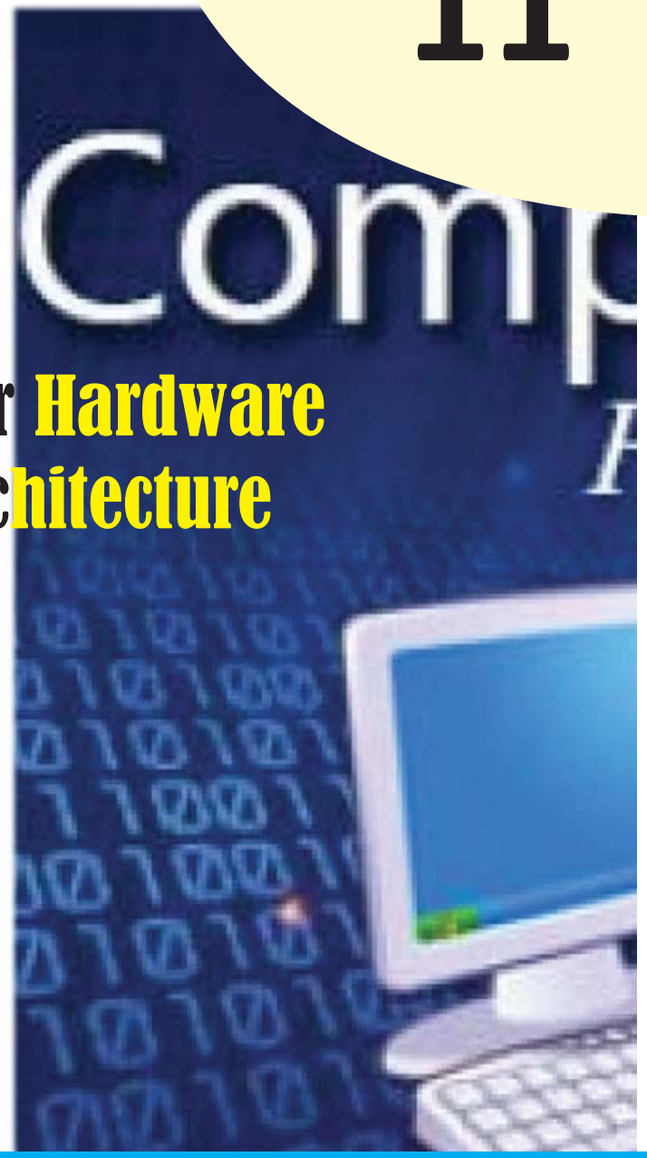
Computer Engineering

11

PRACTICAL MATERIAL

Computer Hardware and Architecture



Government of Nepal
Ministry of Education, Science and Technology
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Technical and Vocational Stream
Practical Material

Computer Hardware and Architecture
(Grade 11)

Secondary Level
Computer Engineering

Government of Nepal
Ministry of Education, Science and Technology
Curriculum Development Centre
Sanothimi, Bhaktapur

Publisher: Government of Nepal
Ministry of Education, Science and Technology
Curriculum Development Centre
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Layout by Khados Sunuwar

Preface

The curriculum and curricular materials have been developed and revised on a regular basis with the aim of making education objective-oriented, practical, relevant and job oriented. It is necessary to instill the feelings of nationalism, national integrity and democratic spirit in students and equip them with morality, discipline and self-reliance, creativity and thoughtfulness. It is essential to develop in them the linguistic and mathematical skills, knowledge of science, information and communication technology, environment, health and population and life skills. It is also necessary to bring in them the feeling of preserving and promoting arts and aesthetics, humanistic norms, values and ideals. It has become the need of the present time to make them aware of respect for ethnicity, gender, disabilities, languages, religions, cultures, regional diversity, human rights and social values so as to make them capable of playing the role of responsible Citizens with applied technical and vocational knowledge and skills. This practical material for Computer Engineering has been developed in line with the Secondary Level Computer Engineering Curriculum so as to facilitate the students in their classroom based practicum and on the job training by incorporating the recommendations and feedback obtained from various schools, workshops and seminars, interaction programs attended by teachers, students and parents.

In Bringing out the practical material in this form, the contribution of the Director General of CDC Dr. Lekhnath Poudel and Pro, Dr. Subarna Shakya, Bibha Sthapit, Kumar Prasun, Anil Barma, Dr. Sanjiv Pandey, Romakanta Pandey, Dinesha Khatri, Trimandir Prajapati, Jonsan Khadka is highly acknowledged. The book is written by Shankar Yadav and the subject matter of the book was edited by Badrinath Timalsina and Khilanath Dhamala. CDC extends sincere thanks to all those who have contributed to developing this practical material.

This book is a supplimentary practical material for students and teachers. In addition they have to make use of other relevnt materials to ensure all the learning outcomes set in the curriculum. The teachers, students and all other stakeholders are expected to make constructive comments and suggestions to make it a more useful practical material.

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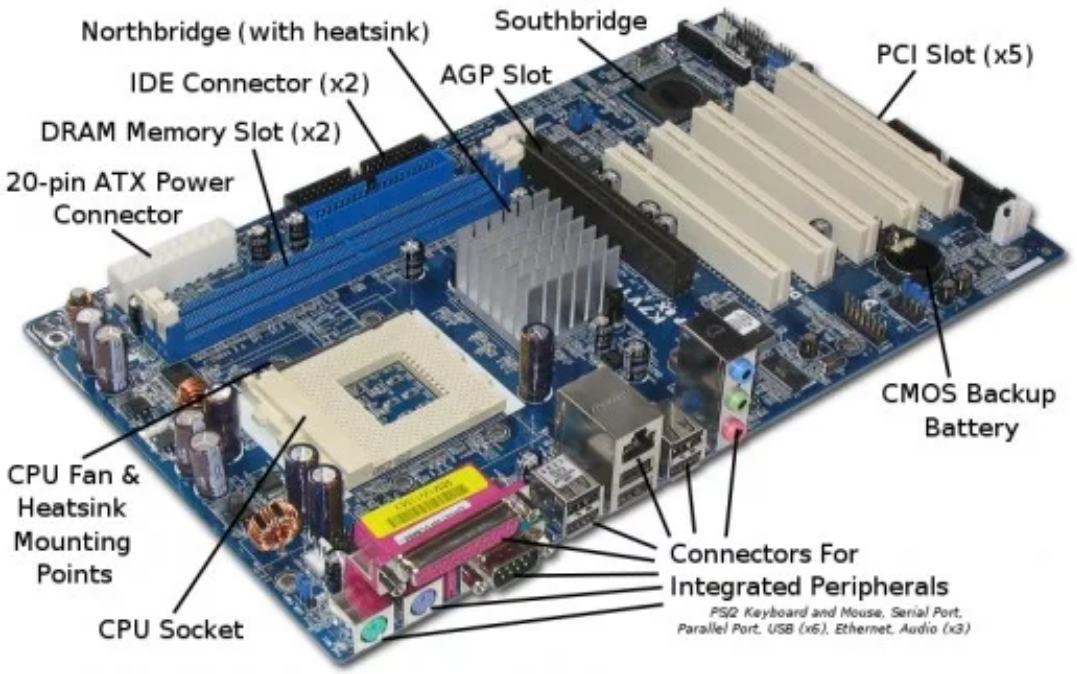


CPU fan and Heatsink Mounting points

A heat sink and fan (HSF) is an active cooling solution used to cool down integrated circuits in computer systems, commonly the central processing unit (CPU). As the name suggests, it is composed of a passive cooling unit (the heat sink) and a fan

Northbridge/Southbridge

In Northbridge/Southbridge chipset architecture designs, the Southbridge is the chip that controls all of the computers I/O functions, such as USB, audio, serial, the system BIOS, the ISA bus, the interrupt controller and the IDE channels. In other words, all of the functions of a processor except memory, PCI and AGP.

AGP Slot

(**A**ccelerated **G**raphics **P**ort) :An earlier hardware interface from Intel for connecting a graphics card (display adapter) to a PC. Introduced in 1997 and superseded by PCI

Express in the late 2000s, a single AGP slot on the motherboard provided a direct connection between the card and memory. AGP was introduced as a higher-speed alternative to PCI, and it freed up a PCI slot for another peripheral device.

PCI(Peripheral Component Interconnect x5)

A Peripheral Component Interconnect (PCI) slot is a connecting apparatus for a 32-bit computer bus. These tools are built into the motherboards of computers and devices in order to allow for the addition of PCI devices like modems, network hardware or sound and video cards.ISA (Industry standard Architecture):

ISA is a type of bus used in PCs for adding expansion cards. For example, an ISA slot may be used to add a video card, a network card, or an extra serial port.

RAM Slot

A memory slot, memory socket, or RAM slot is what allows RAM (computer memory) to be inserted into the computer. Most motherboards have two to four memory slots, which determine the type of RAM used with the computer.

EIDE Connector

Enhanced integrated drive electronics (EIDE) is the hard drive interface that succeeded integrated device electronics (IDE), also known as ATA or ATA-1. The interface acts as an intermediary between the computer and a mass storage device. EIDE provides much faster transfer rates than IDE.

Socket 7 CPU

The socket 7 is an intel processor socket with 321 –pin (a few used 296 pin) holes in 37x37 rows and ran between 2.5 and 3.5 volts. It is the first and only socket to support processor from different manufacturers. One of the biggest changes to the socket 7 socket was not the socket , but VRM (Voltage Regulator Module) found on any motherboard using this socket . some of the processor the socket 7 supported include the Intel Pentium 75 MHz – 233MHz, ADM K5- K6

20-pin ATX power connector

In 1996 PC makers started switching to the ATX standard which defined a new 20 pin motherboard power connector. It includes a 3.3 volt rail which is used

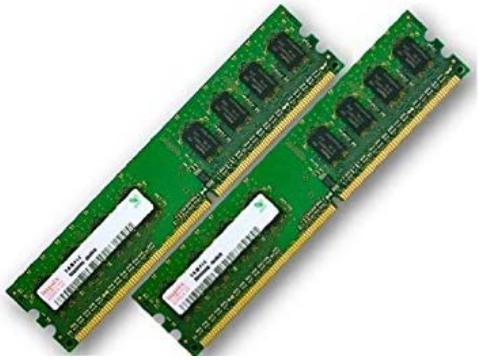
to power newer chips which require a lower voltage than 5 volts.

CMOS Battery

CMOS RAM, CMOS is short for complementary metal-oxide semiconductor. CMOS is an onboard, battery powered semiconductor chip inside computers that stores information. This information ranges from the system time and date to system hardware settings for your computer. The picture shows an example of the most common CMOS coin cell battery (Panasonic CR 2032 3V) used to power the CMOS memory

Experiment-2

Demonstration of computer primary memory



It is also called main memory. Primary memory holds only those data and instructions on which computer is currently working. It has limited capacity and data is lost when power is switched off. It is generally made up of semi-conductor devices. Example: RAM.

The main function of Random-access memory or RAM is to act as a temporary storage of data and program instructions that can be accessed quickly by the CPU when required. RAM is used as a main memory of the computer. It is considered to be the volatile memory as the information stored in the RAM may lose when there is no power. RAM is used by the CPU (Central processing unit) of the system when the computer is running to store information and to access it quickly. It doesn't store any information permanently. In today's technology, RAM devices use integrated circuits to store the information. It makes it relatively expensive form of storage but it allows quick access to data. Unlike non-random-access storage types where it read and write data in predetermined order, RAM can read or write information from the memory in a random manner. In other words, it has a random access to any location(cell) on your memory if you know the "address" of that location. This helps you speed up data retrieval as the CPU can access any location without starting each time at the first location and go through the whole data until it finds the correct one. This method is called "Serial Access".

There are various types of RAM present in our computer System

1. SRAM(Static RAM)
2. DRAM(Dynamic RAM)

SRAM

The SRAM memories consist of circuits capable of retaining the stored information as long as the power is applied. That means this type of memory requires constant power. SRAM memories are used to build Cache Memory. SRAM or Static Random Access Memory is a form of semiconductor memory widely used in electronics, microprocessor and general computing applications. This form of semiconductor memory gains its name from the fact that data is *held in there in a static fashion, and does not need to be dynamically updated as in the case of DRAM memory. While the data in the SRAM memory does not need to be refreshed dynamically, it is still volatile, meaning that when the power is removed from the memory device, the data is not held, and will disappear.*

DDR3 RAM

"Double Data Rate Type 3." DDR3 is a type of SDRAM that is used for system memory. It is available in both DIMM and SO-DIMM form factors. DDR3 RAM is similar to DDR2 RAM, but uses roughly 30% less power and can transfer data twice as fast. The DDR3 standard allows for chip capacities of 512 megabits to 8 gigabits, effectively enabling a maximum memory module size of 16 gigabytes. The DDR3 standard allows for chip capacities of 512 megabits to 8 gigabits, effectively enabling a maximum memory module size of 16 gigabytes

DDR4 RAM

DDR4 SDRAM is the abbreviation for "double data rate fourth generation synchronous dynamic random-access memory", the latest variant of memory in computing. DDR4 is able to achieve higher speed and efficiency thanks to increased transfer rates and decreased voltage.

The DDR4 standard allows for DIMMs of up to 64 GiB in capacity, compared to DDR3's maximum of 16 GiB per DIMM.

Standards: DDR4-1600 (PC4-12800); DDR4-1...

Type: Synchronous dynamic random-access ...

Predecessor: DDR3 SDRAM

Clock rate: 800–1600 MHz

Advantages of DRAM

- Very dense
- Low cost per bit
- Simple memory cell structure

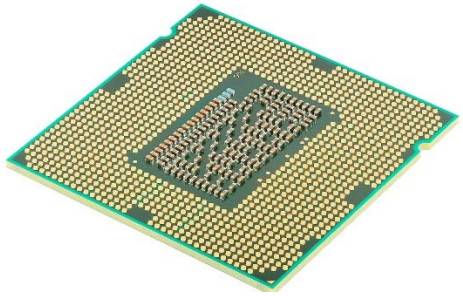
Disadvantages of DRAM

- Complex manufacturing process
- Data requires refreshing
- More complex external circuitry required (read and refresh periodically)
- Volatile memory
- Relatively slow operational speed

Experiment -3

Identification of computer processor in motherboard

Definition of: **Core i9**. **Core i9**. A family of 64-bit x86 CPUs with up to 18 cores from Intel. Introduced in 2017, the **Core i9** became the top model in the **Core** "i" series. Also part of the Intel **Core** X-series brand, the first **i9 CPU** (7900x) is based on 14 nm process technology and the Skylake-X microarchitecture.



Developed and manufactured by **Intel**, the **Core i5** is a computer processor, available as dual-**core** or quad-**core**. It can be used in both desktop and laptop computers, and is one of three types of processors in the "i" series (also called the **Intel Core** family of processors)

The core i5 processor is available in multiple speeds, ranging from 1.90 GHz up to 3.80 GHz, and it features 3 MB ,4MB or 6MB of cache. It utilizes either the LGA 1150 or 1155 sockets on a motherboard. Core i5 processors are most often found as quadcore, having four cores. However, a select few high end core i5 processors features six cores.

The most common type of RAM used with a core i5 processor is DDR3 1333 or DDR3

1600.

Power usages varies for the core i5 processors:

Slower speeds(1.90 GHz to 2.30 GHz) use 11.5 W of power.

Mediamspeeds(2.60GHz to 3.10 GHz) use 15W, 25W,28W 37W.

Faster speeds(3.20GHz to 3.80 GHz) use 35W ,45W, 47W of power.

Intel Core i7:

Intel core i7 is a line of intel CPUs which span eight generations of intel chipsets. They feature either four or six cores, with stock frequencies between 2.6 and 3.7 GHz. The first i7 processors were released in november 2008.Variatons of the i7 processors are manufactured for a variety of personal computing devices. Some high performanmce i7 processors for desktop computers, such as the i7-8700k, are unlocked for over clocking.high – effeciency i7 processor which conserve energy as much as possible, at the expense of some performance) are manufactured for desktop computers , laptops and mobile devices. The i7 processors is marketed pramarily to gaming enthusiasts and digital artists such as film makers and animators the i7 processors

Experiment -4

Demonstration of different storage devices

USB2: The USB 2.0 data port is used to connect a variety of peripheral devices such as mice, keyboards, printers, scanners, external hard drives, video game consoles, digital cameras, mobile devices and network adapters. Another widespread and convenient USB device is the flash drive or memory stick.

USB3:**USB 3.0** is the latest revision of the Universal Serial Bus standard released in 2008. This new standard offers increased transfer rates up to 4.8Gbps, increased maximum bus power, improved power management, and new connectors and cables that facilitate the higher transfer speeds and additional power.

SSD Drive: An SSD (solid-state drive) is a type of nonvolatile storage media that stores persistent data on solid-state flash memory. Two key components make up an SSD: a flash controller and NAND flash memory chips. The architectural configuration of the SSD controller is optimized to deliver high read and write performance for both sequential and random data requests. SSDs are sometimes referred to as flash drives or solid-state disks.

Hard disk: A hard disk drive (HDD) is a non-volatile computer storage device containing magnetic disks or platters rotating at high speeds. It is a secondary storage device used to store data permanently, A hard disk drive is also known as a hard drive.

Characteristics of Hard disk Memory

- These are magnetic and optical memories.
- It is known as the backup memory.

- It is a non-volatile memory.
- Data is permanently stored even if power is switched off.
- It is used for storage of data in a computer.
- Computer may run without the secondary memory.
- Slower than primary memories.

USB Flash Drive:A USB flash drive is a data storage device that includes flash memory with an integrated USB interface. It is typically removable, rewritable and much smaller than an optical disc. USB flash drives are often used for storage; data back-up and transfer of computer files. Compared with floppy disks or CDs, they are smaller, faster, have significantly more capacity, and are more durable due to a lack of moving parts.

PATA: Parallel ATA (Parallel Advanced Technology Attachment or **PATA**) is a standard for connecting **hard drives** into computer systems. As its name implies, **PATA** is based on parallel signaling technology, unlike serial ATA (SATA) devices that use serial signaling technology.

PATA Cable

SATA:**SATA** stands for Serial Advanced Technology Attachment. It is a type of rewritable mass storage device, or **hard drive**, that transfers data to a computer by means of serial signaling technology. **SATA** replaced Parallel ATA (PATA) and is known for its excellent storage capacity and solid transmission speed.

Advantages

The primary reason SATA is used over PATA is because of the increased data transfer speeds with that SATA. PATA is capable of data transfers speeds of 66/100/133 MBs/second, whereas SATA is capable of 150/300/600 MBs/second. The speed differences are due to the various flavors of PATA and SATA, with the fastest speeds

being the latest version of each currently available. You'll notice that SATA's slowest speed is still faster than PATA's fastest speed. The improved speed of SATA allows for programs to load faster, as well as pictures large documents.

SATA Cable

Experiment -5

Demonstration of different input and output devices

An input device is any hardware device that sends data to a computer, allowing you to interact with and control it. The most commonly used or primary input devices on a computer are the keyboard and mouse. However, there are dozens of other devices that can also be used to input data into the computer.

Mouse:A computer mouse is an input device that is used with a computer. Moving a mousealong a flat surface can move the cursor to different items on the screen. Items can be moved or selected bypressing the mouse buttons (called clicking). A computer mouse with the most common features: two buttons (left and right) and a scroll wheel, which can also act as a third button.

Keyboard: A computer keyboard is one of the primary input devices used with a computer. Similar to an electric typewriter, a keyboard is composed of buttons that create letters, numbers, and symbols, as well as perform other functions.

The standard selection of keys can be classified as follows:

Alphanumeric keys: the standard letters and numbers.

Punctuation keys:the comma, period, semicolon and similar keys.

Special keys: this includes the function keys, control keys, arrow keys, caps lock key and so on.

Scanner: A scanner is an electronic device which can capture images from physical items and convert them into digital formats, which in turn can be stored in a computer, and viewed or modified using software applications.

A scanner or optical scanner is a hardware input device that optically "reads" and image and converts it into a digital signal. For example, a scanner may be used to convert a printed picture, drawing, or document (hard copy) into a digital file which can be edited on a computer.

A scanner can be connected to a computer using many different interfaces although today is most commonly connected to a computer using a USB cable.

Joystick: The joystick is mostly used when there is a need to perform a direct pointing or when a precise function is needed. There are different types of joysticks such as displacement joysticks, hand-operated joysticks, finger-operated joysticks, thumb/fingertip-operated joysticks, hand-operated isometric joysticks, etc.

Similar to the mouse in movement and usage, joysticks also include buttons, sometimes known as triggers. The difference between the mouse and the joystick is largely based on the fact that the cursor/pointer continues the movement in the direction of the joystick unless it is kept upright, whereas the mouse prevents the cursor from further movement until it is moved.

One of the noticeable advantages of the joystick is its ability to provide fast interactions, which are much needed in gaming applications. The joystick provides a much-needed gaming experience, which is better in quality compared to that provided by other input devices. It has a simple design and is easy to learn and use. It is often inexpensive.

The joystick, however, is not as easy to handle when selecting options from a screen and is not a preferred input device in such cases. Some joysticks limit the direction of movement to forward, left,right and backward, and do not offer diagonal or lateral movements. Again, the joystick is not as robust as other input devices, and, sometimes, users find it difficult to control compared to other input devices such as the mouse.

Output devices: An output device is any piece of computer hardware equipment which converts information into human-readable form. In brief, output unit is responsible for providing the output in user readable form. It can be text, graphics, tactile, audio, and video.

Monitor: Monitors, commonly called as Visual Display Unit (VDU), are the main output device of a computer. It forms images from tiny dots, called pixels that are arranged in a rectangular form. The sharpness of the image depends upon the number of pixels.

There are two types of monitors.

- Cathode –Ray tube
- Flat –panel Display

Cathode-Ray Tube (CRT) Monitor

The CRT display is made up of small picture elements called pixels. The smaller the

pixels, the better the image clarity or resolution. It takes more than one illuminated pixel to form a whole character, such as the letter ‘e’ in the word help. A finite number of characters can be displayed on a screen at once. The screen can be divided into a series of character boxes - fixed location on the screen where a standard character can be placed. Most screens are capable of displaying 80 characters of data horizontally and 25 lines vertically.

Flat-Panel Display Monitor

The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement in comparison to the CRT. You can hang them on walls or wear them on your wrists. Current uses of flat-panel displays include calculators, video games, monitors, laptop computer, and graphics display.

Printers: Printer is an output device, which is used to print information on paper.

There are two types of printers −

- Impact Printers
- Non-Impact Printers

Impact Printers: Impact printers print the characters by striking them on the ribbon, which is then pressed on the paper.

Characteristics of Impact Printers are the following −

1. Very low consumable costs
2. Very noisy
3. Useful for bulk printing due to low cost
4. There is physical contact with the paper to produce an image

Impact printers are of two types −

- Character printers
- Line printers

Character Printers:Character printers are the printers which print one character at a time.

- These are further divided into two types:
- Dot Matrix Printer (DMP)

- Daisy Wheel

Dot Matrix Printer: In the market, one of the most popular printers is Dot Matrix Printer. These printers are popular because of their ease of printing and economical price. Each character printed is in the form of pattern of dots and head consists of a Matrix of Pins of size (5*7, 7*9, 9*7 or 9*9) which come out to form a character which is why it is called Dot Matrix Printer.

Advantages

- Inexpensive
- Widely Used
- Other language characters can be printed
- Disadvantages
- Slow Speed
- Poor Quality

Drum Printer: This printer is like a drum in shape hence it is called drum printer. The surface of the drum is divided into a number of tracks. Total tracks are equal to the size of the paper, i.e. for a paper width of 132 characters, drum will have 132 tracks. A character set is embossed on the track. Different character sets available in the market are 48 character set, 64 and 96 characters set. One rotation of drum prints one line. Drum printers are fast in speed and can print 300 to 2000 lines per minute.

Advantages

- Very high speed
- Disadvantages
- Very expensive
- Characters fonts cannot be changed

Non-impact Printers: Non-impact printers print the characters without using the ribbon. These printers print a complete page at a time, thus they are also called as Page Printers.

Non-impact printers are of two types :

- Laser Printers

- Inkjet Printers

Characteristics of Non-impact Printers

- Faster than impact printers
- They are not noisy
- High quality
- Supports many fonts and different character size

Laser Printers: These are non-impact page printers. They use laser lights to produce the dots needed to form the characters to be printed on a page.

Advantages

- Very high speed
- Very high quality output
- Good graphics quality
- Supports many fonts and different character size

Disadvantages

- Expensive
- Cannot be used to produce multiple copies of a document in a single printing

Inkjet Printers: Inkjet printers are non-impact character printers based on a relatively new technology. They print characters by spraying small drops of ink onto paper. Inkjet printers produce high quality output with presentable features. They make less noise because no hammering is done and these have many styles of printing modes available. Color printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also.

Advantages

- High quality printing
- More reliable

Disadvantages

- Expensive as the cost per page is high
- Slow as compared to laser printer

Webcam:A webcam – short for 'web camera' – is a digital camera that's connected to a computer. It can send live pictures from wherever it's sited to another location by means of the internet. Many desktop computer screens and laptops come with a built-in camera and microphone

Headphone: Headphones (or head-phones in the early days of telephony and radio) traditionally refer to a pair of small loudspeaker drivers worn on or around the head over a user's ears. They are electroacoustic transducers, which convert an electrical signal to a corresponding sound. Headphones let a single user listen to an audio source privately, in contrast to a loudspeaker, which emits sound into the open air for anyone nearby to hear. Headphones are also known as ear speakers, earphones

Speakers: It is an output device which converts electrical energy into sound energy.

The purpose of speakers is to produce audio output that can be heard by the listener. Speakers are transducers that convert electromagnetic waves into sound waves. The speakers receive audio input from a device such as a computer or an audio receiver.

LCD Monitor

A flat panel screen that uses the liquid crystal display (LCD) technology and connects to a computer. Laptops have used LCD screens almost exclusively, and the LCD monitor is the standard display screen for desktop computers. By 2004, LCD desktop monitors outsold the traditional, bulky tube monitors (see CRT). See LCD, flat panel display and LCD TV.

LED: (Light-emitting diode)

Short for **light-emitting diode monitor**, an **LED monitor** or LED display is a flat screen, flat-panel computer monitor or television. It has a very short depth and is light in terms of weight. The actual difference between this and a typical LCD monitor is the backlighting. The first LCD monitors used CCFL instead of LEDs to illuminate the screen.

LED monitors offers many ben ifits when compared to those that are CCFL lit including

- Often less expensive
- Broader dimming range.
- Overall more realiable.

They run at lower temperature, and consume much less power, as few as 20 watt

Touch Screen:

A **touch screen** is a display device that allows the user to interact with a computer by using their finger or stylus. They can be a useful alternative to a mouse or keyboard for navigating a GUI (graphical user interface). Touch screens are used on a variety of devices, such as computer and laptop displays, smartphones, tablets, cash registers, and information kiosks. Some touch screens use a grid of infrared beams to sense the presence of a finger instead of utilizing touch-sensitive input.

Experiment-6

System Case Preparation Procedure

This procedure covers preparing the system case for the installation of a new system. You will want to perform this procedure when you are assembling a new PC, performing a major upgrade such as a full system upgrade, or moving a system to a new case. The focus of this procedure is on preparing a new system case, but the steps generally apply to an older case being reused as well. There will just be less assembly in the event of an older case (but you will need to clean the inside of the case most likely).

This procedure is geared more towards tower cases, since that is all that I use. Tower cases are superior to desktop cases for those doing their own PC assembly.

Procedure Overview

- Hardware Required: Screwdriver.
- Software Required: None.
- Preparation / Warnings:
  - Make sure the case is unplugged at all times.
  - The system case should be open before you begin. For instructions on opening the case, refer to this procedure.
  - Watch out for sharp metal edges inside the system case.
  - Cases vary widely and you may need to adjust these instructions. I use high-quality, name-brand cases but there are hundreds of designs.

Procedure Steps

1. **Inspect Case Contents:** Inspect the contents of the case to ensure that everything that should be with it, is. New or old, you will need these components.
2. **Clean Case (if necessary):** If this is an older case it probably could use a good cleaning by blowing out the whole interior with compressed air.
3. **Inspect Power Supply:** Make sure the power supply is tightly attached to the case. If this is an old case, make sure the vents from the fan are clean; if not clean them using compressed air or a vacuum. If this is a new case, double-check the

input voltage setting (110V or 220V) to make sure it is correct (or else!!)

4. **Inspect Power Switch:** Make sure the power switch is mounted securely to the front of the case and the wire going back to the power supply is intact, not pinched, and not loose.
5. **Install Feet (if necessary):** Some cases come with separate plastic feet in a bag inside the box. Put these into their holes in the bottom of the case now. You may not be able to access the bottom later on (happened to me, big waste of time pulling everything out).
6. **Install Slot inserts (if necessary):** Some cases come with the inserts that go in the expansion slots in a separate plastic bag. You can install these now (leaving out one where you think the video card and other cards will go) or install them later. Your choice, just do it at some point.
7. **Install or Remove Drive Bay Faceplates:** Some cases come with all of their drive bay faceplates (plastic covers, bezels) installed and some come with all of them loose. You will want to insert the faceplates into the drive bay positions you don't plan to use and remove them from those you are going to use. To some extent you can't finalize this until after you plan your system layout, but you can always change them later on.
8. **Install Additional Cooling Fan (optional):** Some cases come with space for an additional cooling fan. If you are going to use a second fan, install it now. For an AT form factor system, the second fan should blow into the case (advice from Enlight Corporation, major case manufacturer).
9. **Jumper LED Display (optional):** Some cases still have an LED display to show the "speed" of the system. The speed is set using jumpers inside the case; set them now if you are going to do this. If the manual doesn't tell you how to set the jumpers, you're pretty much out of luck...
10. **Detach Motherboard Panel:** Most newer tower cases today come with a detachable panel upon which the motherboard is mounted. Detach this panel now. Usually, this is done by pulling down on the U-shaped handle on the outside of the panel. It can take significant force to overcome the springs holding the panel in place. On some cases, the panel is held in place using screws.

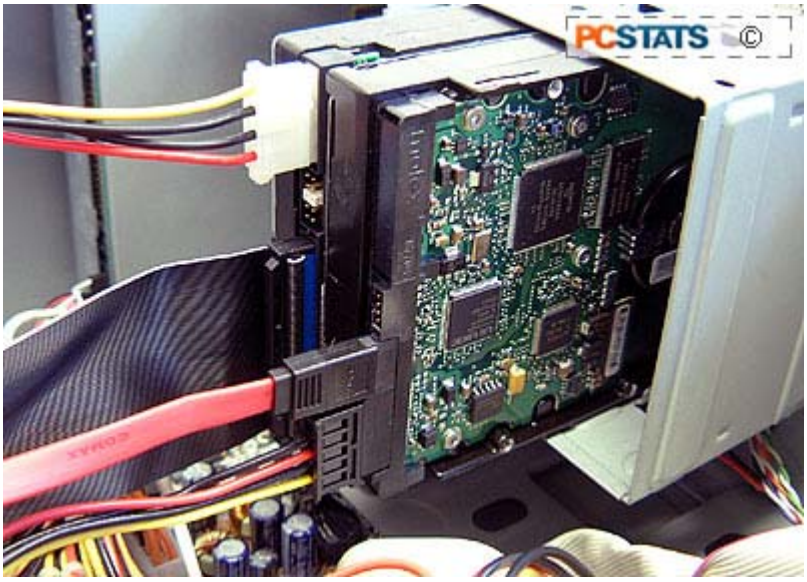
Experiment -7

Hard Disk Drive Physical Installation Procedure

This procedure provides instructions for installing a hard disk drive into a system case. Performing this installation is not that difficult as long as you follow the directions, of course. It is important to install hard disk drives correctly, because as the warehouse for your data, the hard disk is one of the most important devices in the PC. This procedure deals only with the physical installation of the drive.

Physical Installation of the SATA Hard Drive

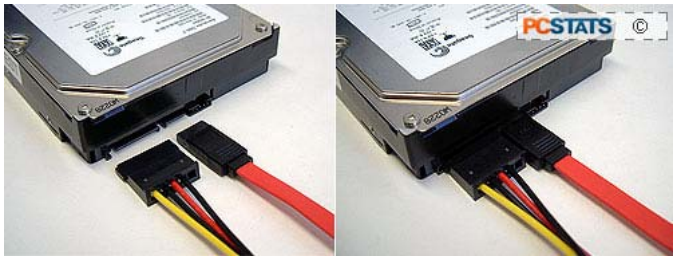
Find a free 3.5" drive bay in your case. Most computer cases will have a row of covered 3.5" drive bays directly below the floppy drive. If there is no floppy drive, they should be below the CD drive bay. Note that many 'big box' retailers like Dell place hard drives in alternate locations, so your experience may vary.



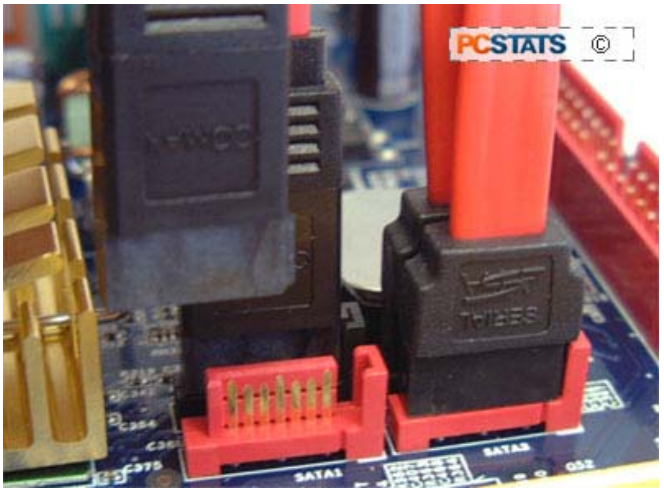
If you are installing a second hard drive, it's a good idea to leave a space between your old drive and your new one if you can afford to. Hard drives can get rather hot while operating, especially 7200 RPM drives, and this can affect their lifespan. If you are nervous about heat, or you do not have a free 3.5" bay, you can purchase a 5 ¼" adaptor kit at any computer store. This is simply a pair of metal plates that screw on to the sides of the drive and widen it to fit the larger bay size.

Slide the drive carefully into the free bay with the connector end of the drive facing into the body of the computer, and screw it in tightly on both sides. Hard drives generally use larger-threaded case screws like the ones pictured above. These are identical to the screws used to secure the body panels of most computer cases.

Now it's time to plug in the SATA power and data cables. Connect either end of your serial ATA data cable to the corresponding plug on the back of your new drive. The cable is keyed to only fit one way.



Now connect your SATA or Molex power connector to the back of the drive. Again, the cable is keyed to only fit one way.



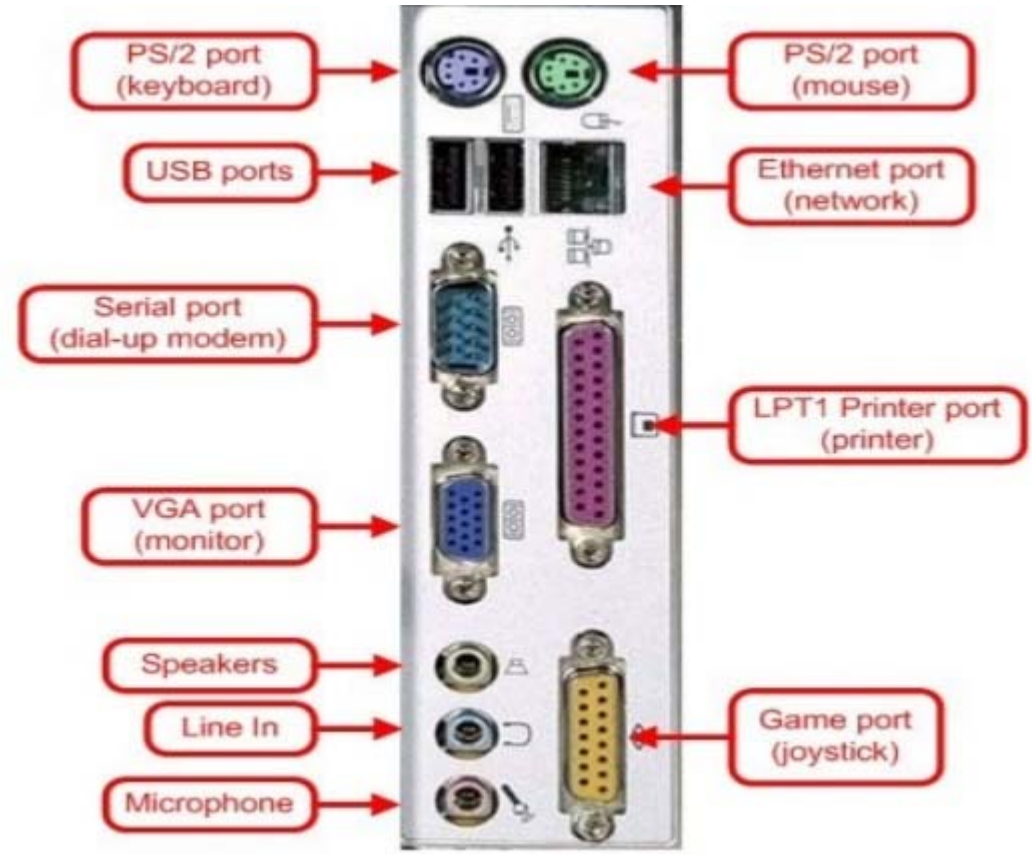
Confirming the Installation of a Hard Drive

With the drive connected, it is time to confirm that the physical installation was done correctly. There are a couple different ways to go about this, depending primarily on the operating system and age of your PC.

With the new hard drive installed, reboot the computer and watch the POST screen (the first screen you see upon restarting your computer) for your new drive's model to flash up. If you installed a SATA drive, it may appear on a different screen during the boot process also.

Experiment -8

Demonstration of different types of ports



PS/2 port mouse: The PS/2 (Personal System/2) port, also referred to as the mouse port or keyboard port, was developed by IBM. It is used to connect a computer mouse or keyboard to an IBM compatible computer. The PS/2 port is a mini DIN plug that contains six pins and is still sometimes found on all IBM compatible computers.

PS/2 port Keyboard: The PS/2 (Personal System/2) port, also referred to as the mouse port orkeyboard port, was developed by IBM. It is used to connect a computer mouse orkeyboard to an IBM compatible computer. The PS/2 port is a mini DIN plug that contains six pins and is still sometimes found on all IBM compatible computers.

USB ports: USB (Universal Serial Bus) is the most popular connection used to

connect a computer to devices such as digital cameras, printers, scanners, and external hard drives. USB is a cross-platform technology that is supported by most of the major operating systems.

Ethernet ports: Ethernet port, network connection, and network port, the LAN port allows a computer to connect to a network using a wired connection. The two led lights will blink when the port is active.

Serial ports:A port, or *interface*, that can be used for serial communication, in which only 1 bit is transmitted at a time.

Most serial ports on personal computers conform to the RS-232C or RS-422 standards. A serial port is a general-purpose interface that can be used for almost any type of device, including modems, mice, and printers (although most printers are connected to a parallel port).

VGA port: A Video Graphics Array (VGA) connector is a three-row 15-pin DE-15 connector. The 15-pin VGA connector was provided on many video cards, computer monitors, laptop computers, projectors, and high definition television sets.

LPT1 Printer port:LPT (line print terminal) is the usual designation for a parallel port connection to a printer or other device on a personal computer. Most PCs come with one or twoLPT connections designated as LPT1 and LPT2. Some systems support a third, LPT3

Audio port: An audio port on a computer is any receptacle or jack to which an audio device such as speakers, headphones or a microphone can be connected. All laptops and some desktops have built-in speakers, but for better sound or privacy, you will need to connect external audio through one of the ports.

Experiment -9

Video Card Physical Installation Procedure

This procedure describes how to install a video card into the motherboard. This is a very easy procedure, especially with newer video cards. I cover the installation of PCI, VLB, and ISA cards here (specific instructions on AGP cards will follow once I have used AGP personally; my initial impressions are that they would be installed quite similarly to PCI cards). This procedure deals only with the physical installation of the card.

Procedure Overview

- Difficulty Level: 1-2 (Very low to Low). VLB video cards can be more difficult than the others to install due to the large size of the connector.
- Risk Factor: 2 (Low).
- Hardware Required: Screwdriver and possibly one screw if it isn't already in the case.
- Software Required: None.

Preparation / Warnings

- If the card is being inserted as part of a new system build, I assume you have already planned out where you want the card to go. You may want to look at the System Layout Planning Procedure, which will provide you with tips on choosing an expansion slot.
- The system case should be open before you begin. For instructions on opening the case, refer to this procedure.
- Do not use excessive force to insert the video card into its expansion slot. Be patient, especially with the very long connector on VLB cards.
- If the motherboard is flexing excessively when you try to insert the card, it may not be physically supported properly. You may find some ideas for improving this situation by examining this procedure on motherboard installation.

Procedure Steps:

1. Identify Expansion Slot: Find an open expansion slot of the correct type for the video card. You will want to choose a slot if possible that is far away from other cards and other hardware inside the box.
2. Remove Metal Insert: Using a screwdriver, unscrew the metal insert in the case that corresponds to the expansion slot you are using. It may help to take the video card and align it to the slot. This will help you to visualize which slot goes with which system case insert (since PCI cards are opposite from ISA ones, this isn't always totally obvious.) Some cases may have simple punch-outs instead of screwed-in inserts; if yours does then remove the insert by pushing it out and/or flexing it back and forth until it comes off.
3. Insert Card: Align the pins of the video card's connector to the slot. Make sure the metal insert that goes to the back of the case is also aligned correctly. Then apply firm pressure to seat the card into the slot. You may need to rock the card back and forth to get it to go in. VESA local bus cards are the hardest to insert because their connector is so long--be patient and work slowly. Do not force the card in or press it to the point where the motherboard is flexing significantly. If you need to, support the motherboard manually with one hand while you push with the other.
4. Secure Card: Screw the video card into place using the screw you removed from the insert blank formerly in the case. You may need to supply a screw if your case is one of the el-cheapo ones that doesn't come with screws for the expansion slots.
5. Double-Check Installation: Ensure that the card is securely in its slot. The card may move from side to side slightly when wiggled but should not be loose. Make sure that the card is not interfering with anything else in the case. Make sure that the card is inserted far enough into the expansion slot.

Experiment -9

Video card physical installation procedures

The video card is an expansion card that allows the computer to send graphical information to a video display device such as a monitor, TV, or projector.

Some other names for a video card include graphics card, graphics adapter, display adapter, video adapter, video controller, and add-in boards (AIBs).

A staggering number of companies manufacture video cards, but almost every one includes a graphics processing unit (GPU) from either NVIDIA Corporation or AMD.

New video card installation steps:

- Turn your machine off.
- Open your case to get access to the expansion slots.
- Insert your new video card into an expansion slot.
- Connect the monitor to your new video card.
- Turn your machine on and boot Windows.
- Install the display drivers for your new video card.

Experiment -10

CD ROM driver installation procedure

1. Power Down the Computer

The first thing to do when you plan to work on a computer system is to make sure there is no power. Shut down the computer if it is running. After the computer has safely shut down, turn the internal power off by slipping the switch on the back of the power supply and removing the AC power cord.

1. Open the Computer

You must open the computer to install the CD or DVD drive. The method for opening

the case will vary depending upon your computer model. Most systems use a panel or door on the side of the computer, while older systems may require you to remove the entire cover. Remove and set aside any screws that fasten the cover or panel to the computer case and then remove the cover.

3. Remove the Drive Slot Cover

Most computer cases have several slots for external drives, but only a few are used. Any unused drive slot has a cover that prevents dust from entering the computer. To install the drive, you must remove the 5.25-inch drive slot cover from the case. You remove the cover by pushing tabs either on the inside or outside of the case. Sometimes a cover may be screwed into the case.

4. Set the IDE Drive Mode

Most CD and DVD drives for desktop computer systems use the IDE interface. This interface can have two devices on a single cable. Each device on the cable must be placed into the appropriate mode for the cable. One drive is listed as the master, and the other secondary drive is listed as a slave. This setting is usually handled by one or more jumpers on the back of the drive. Consult the documentation or diagrams on the drive for the location and settings for the drive.

If the CD/DVD drive is going to be installed on an existing cable, the drive needs to be set into the Slave mode. If the drive is going to reside on its own IDE cablealone, the drive should be set to the Master mode.

5. Place the CD/DVD Drive Into the Case

Place the CD/DVD drive into the computer. The method for installing the drive will vary depending on the case. The two most common methods for installing a drive is either through drive rails or directly into the drive cage.

Drive Rails: Position the drive rails on the side of the drive and fasten them with screws. Once the drive rails have been placed on both sides of the drive, slide the drive and rails into the appropriate slot in the case. Affix the drive rails so that the drive is flush with the case when it is fully inserted.

Drive Cage:Slide the drive into the slot in the case so that the drive bezel is flush with the computer case. When this is done, fasten the drive to the computer case by placing screws into the appropriate slots or holes.

6. Attach the Internal Audio Cable

Many people use the CD/DVD drives inside their computers to listen to audio CDs. For this to work, the audio signal from the CD needs to be routed from the drive to the computer audio solution. This is typically handled by a small two-wire cable with a standard connector.

1. Plug this cable into the back of the CD/DVD drive.
2. Plug the other end of the cable into either a PC audio card or motherboard depending upon the computer audio setup.
3. Plug the cable into the connector labeled as CD Audio.

7. Attach the Drive Cable to the CD/DVD

Reconnector on the IDE ribbon cable between the computer and the hard

drive and plug it into the drive. If the drive is going to be on its own cable, plug the IDE cable into the motherboard and one of the other connectors of the cable into the CD/DVD drive.

8. Plug the Power to the CD/DVD

Plug the drive into the power supply. Do this by locating one of the 4-pin Molex connectors from the power supply and inserting it into the power connector on the CD/DVD drive.

9. Close the Computer Case

Now that the drive is installed you can close up the computer. Replace the panel or cover to the computer case. Fasten the cover or panel to the case using the screws that were set aside when the cover was removed.

10. Power up the Computer

Plug the AC cord back into the power supply and flip the switch to the Onposition.The computer system should automatically detect and begin using the new drive. Since CD and DVD drives are standardized, you shouldn't have to install any specific drivers. Consult the instruction manual that came with the drive for specific instructions for your operating system.

Experiment -11

I/O Port Connector Physical Installation Procedure

This procedure describes how to install serial and parallel port connectors to the system case of a system that uses the AT form factor, and connect them to the motherboard. These are the 9-pin or 25-pin connectors on the back of the system case into which you plug the cables for your printer, modem, or other peripherals. You will generally use this procedure when installing a new motherboard or building a new system. ATX form factor motherboards have these connectors integrated onto the board and therefore do not require this procedure.

Procedure Overview

- Difficulty Level: 2 (Low).
- Risk Factor: 2 (Low). There is a slight risk of damaging the port connectors, but it's slight, and the components are not valuable.
- Hardware Required: Depends on how exactly you install the ports, but you may need one or more of the following:
    - Phillips head screwdriver, if you are going to install the ports into an expansion card slot insert.
    - Either a 3/16" hexagonal nut driver, or a pair of pliers, if you plan to mount the ports directly into the system case. I strongly recommend the 3/16" nut driver for this procedure, as it will save you a lot of time and hassle.
- Software Required: None.
- Preparation / Warnings:
    - You should have the motherboard already installed in the case before commencing.
    - The standard for I/O port connectors is one parallel port and two serial ports, and this is what this procedure assumes.
    - Be very careful when tightening the hexagonal nuts on the port connectors. If you use too much force the nut will shear right off from the threaded

screw portion and ruin the connector. When tightening with a nut driver, the sensation can change from "this feels too loose" to *snap* rather quickly.

- Make sure that you install the I/O ports that come with the motherboard being used in the system. These ports are not universal and you may have problems if you use a type that was not specifically matched to your motherboard.
- I assume that the I/O port connectors came pre-mounted into screw-in expansion slot inserts, as they do with most motherboards.

Procedure Steps:

1. Determine Install Method: There are two distinctly different ways to install the I/O connectors. The I/O connectors are normally pre-mounted into slot inserts that are meant to be placed into expansion slot bays in the back of the PC. You can insert them there if you wish. The main advantage of doing this is that it saves time and hassle. There are disadvantages however: you will end up blocking off one or more of your motherboard expansion slots; the connectors will tend to be less rigid and harder to attach cables to when installed this way (because the metal slot insert will bend when pressure is put on it); and the cables inside the box coming from the connectors will get in the way of other parts of the motherboard more. The alternative is to remove the connectors from the metal inserts they come in, and mount them directly to the system case. This takes more work.

   Note: Depending on your hardware, you may have no choice about how to do the installation. If your connectors did not come preinstalled in metal slide-in expansion card inserts, you will have to use the mounting holes in your case. On the other hand, some system cases may not have direct-mounting holes, so you will have to use the inserts in this situation. Also watch out for a mismatch in size on the second serial port connector: some motherboards ship with two 9-pin serial connectors while some cases have holes for one 9-pin and one 25-pin, and vice-versa. If you have a mismatch here, again, you may need to stick with the inserts. If you are going to leave the connectors in the metal inserts, continue with these steps:

2. Identify Slots for Installation: Choose an appropriate location for the inserts; you will usually need two of them. The best expansion slots to choose are any that don't actually line up with expansion slots on the motherboard (most systems have more inserts in the case than the motherboard actually has slots). This way you don't unnecessarily block off any expansion slots on the motherboard. You will also generally want to use slots near where the port cables connect physically to the motherboard; make sure the cables will reach.
3. Remove Slot Inserts: If there are any blanks in the slots you want to use, remove them using a screwdriver. Save them in case you ever need them again in the future.
4. Install Port Connector Inserts: Mount the connector port inserts into place and secure them using a screw for each.
5. Double-Check Installation: Check to make sure the connectors are installed properly. They should be secure in their installed location. Try attaching an external cable to one of the connectors if you wish, to verify that it works.
6. Connect Cables to Motherboard: Connect the internal cables coming from each connector to the appropriate headers on the motherboard. Refer to your motherboard manual if you need it. Be sure to line up the red wire on the cable with pin 1 on the connector. If you have one 9-pin serial port connector and one 25-pin, you will normally want to make the 9-pin the first serial port and the 25-pin the second.

If you decide to mount the connectors directly to the system case, continue here instead:

1. Identify Mounting Holes: Many cases, especially larger ones, come with many holes, more than you need to mount your connectors. Choose three holes that are the right shape to match the size of connectors you have (9-pin or 25-pin). Try to keep the serial ports together and the parallel port separate if possible, as this makes things less confusing for some users. Make sure that the cables coming from the connectors are long enough to reach the motherboard headers to which they will attach, from the location you are selecting.

2. Open Mounting Holes: Remove any metal plates blocking off the mounting holes. These are usually either held in place with screws on older cases; on newer ones the manufacturer just punches the outline of the hole and leaves the metal part connected to the case with a sliver of metal. For these, punch the metal out using a screwdriver, or bend the metal back and forth until it snaps out of the way.
3. Remove Connectors From Metal Inserts: Unscrew the connectors from the metal inserts they come in. Use a nut driver (if you have one) or a pair of pliers. Quick tip: to remove a connector you don't have to completely remove both screws. Remove one and loosen the other half-way, and the connector will slide out. Doing this saves time and makes mounting the connectors into the case easier.
4. Mount Connectors to System Case: Slide the connectors into the holes in the back of the case and then tighten the hexagonal nuts using either a nut driver or a pair of pliers. Don't leave them too loose, or they will come off when you detach a cable weeks or months later. Don't over-tighten them, or they will snap off and leave you with a mess to deal with. Also, be careful not to mount the connectors upside-down; the longer side should be up (the row of 13 pins on a 25-pin connector, or 5 pins on a 9-pin connector) and the shorter side down (the row of 12 or 4 pins).
5. Double-Check Installation: Check to make sure the connectors are installed properly. They should be very secure in their location in the back of the case. Try attaching an external cable to one of the connectors if you wish, to verify that it works.
6. Connect Cables to Motherboard: Connect the internal cables coming from each connector to the appropriate headers on the motherboard. Refer to your motherboard manual if you need it. Be sure to line up the red wire on the cable with pin 1 on the connector. If you have one 9-pin serial port connector and one 25-pin, you will normally want to make the 9-pin the first serial port and the 25-pin the second.

Experiment -12

PS/2 mouse port connector physical installation procedures

Procedure Steps:

1. Identify Slot for Installation: Choose an appropriate location for the insert. The best expansion slot to choose is one that doesn't actually line up with an expansion slot on the motherboard (most systems have more inserts in the case than the motherboard actually has slots). This way you don't unnecessarily block off any expansion slots on the motherboard. You will also generally want to use a slot near where the PS/2 port cable connects physically to the motherboard; make sure the cable will reach as it is often very short.
2. Remove Slot Insert: If there is a metal blank in the slot you want to use, remove it using a screwdriver. Save it in case you ever need it again in the future.
3. Install Port Connector Insert: Mount the connector port insert into place and secure it using the screwdriver.
4. Double-Check Installation: Check to make sure the connector is installed properly. It should not be loose; try attaching a PS/2 mouse to the connector to verify that it works.
5. Connect Cable to Motherboard: Connect the internal cable coming from the connector to the appropriate header on the motherboard. Refer to your motherboard manual if you need it. Be sure to line up the red wire on the cable with pin 1 on the connector (although some of these don't have a red wire, so be careful). The connector is usually five or six pins, though not all of the pins will necessarily have actual wires for them.

Experiment -13

Processor physical installation procedures

Introduction

The CPU, Central Processing Unit, or simply processor, is the main chip in a computer responsible for carrying out all tasks. It's responsible for telling all the other components in a computer what to do, according to the instructions it is given by the programs (software) running on that computer. Without the CPU chip, the computer simply can't do anything at all. The CPU has three sections, the Arithmetic Logic Unit, the Registers and its Control Unit.

Step-1

Determine which CPU is in your computer either by reading the start-up screen or using diagnostic software. You may also determine your CPU type and speed by removing the system unit cover and taking a good long look at the chip. Look at the label on the chip to determine its model, speed, and the manufacturer.

Note: If a Heat Sink or a Fan is installed on top of the chip, you will have to remove these components to view the CPU label.

Step-2: Turn off and unplug the system unit.

Step-3: Disconnect any components that may be in the way of removing the system unit's cover.

Step-4: Remove the screws from the rear of the case and slide the cover away from the system unit case.

Step-5: place the cover away in the safe place

Step-6: Remove any and all electrical static charge from your clothes and body by touching a doorknob or any other grounded object.

Step-7: Locate the CPU Chip. The chip will be mounted onto the motherboard in a socket and depending on the type of computer you have, the socket may be shaped in various forms.

- Note: Some CPU chips are soldered onto the motherboard and can only be upgraded by removing and installing a newmotherboard. This type of chip is referred to as the Proprietary CPU Chip.

Step-8:

Check your computer's manual to see if the CPU is Proprietary before you consider upgrading to a more powerful processor. If the manual tells you to consult will the manufacturer if you want to upgrade the processor, it's most likely a propriety Central Processing Unit.

Step-9:

Remove such components as the hard drive or an expansion slot to gain full access the

chip if necessary. Newer Tower units allow easy access by removing a couple screws and sliding the panel with the motherboard down.

Step-10:

Once the CPU is in plain view, grasp the lever on the Zero Insertion Force sockets and carefully but firmly pull the lever straight up. This lever is normally located on the side of the chip. Some chips may contain a clamp that must be removed as well. Check your owner's manual to see the components of your CPU.

Note: Some chips are covered by a Heat Sink and/or a Cooling Fan. These components will have to be removed and set aside.

Step-11:

Place the bevelled end of the chip to match the bevelled end of the socket when inserting the new chip. This was designed so that the chip can be installed in only one direction. Make note when you put the heat sink back on that you should have put thermal paste on the top your CPU(but only a very small amount)

Step-12

Confirm that the chip you buy is compatible with your system and ask if you can return the chip if there are any problems. Be sure that the upgrade will perform what you want it to do. Your computer's performance will improve with a CPU upgrade but you may need to add more ram if you want to improve your Windows programs.

- Check to see if all connections are seated firmly and properly in their sockets. This is a must as these connections do tend to work themselves loose over time and cause problems you may blame on software.
- Note: If you have been working in your system unit recently and you noticed a fault manifesting itself, you want to go back and take a look at all connections you were near. Look to be sure your fingers did not press against other connections and causing them to work loose.
- Perform preventive maintenance on your computer and keep it clean regularly. It's a good idea to open up the system unit and remove all dust that have accumulated on the motherboard as well as all other boards from time to time.


intel
ASUS

Experiment -14

How to install a system processor in a motherboard

This procedure describes how to install a system processor in a motherboard. This is a fairly straightforward process, although of course you want to be very careful when performing it due to the fragility of the component. This procedure provides steps and caveats for installation of all types of socketed CPUs. I will add instructions for installing slotted CPUs (those using an SEC package, i.e. the Pentium II) at a later time. Note that this procedure deals *only* with the physical installation of the CPU, and does not contain all of the steps necessary for a CPU upgrade, for example.

Procedure Overview

- Difficulty Level: 2-4 (Low to High). For most newer processors in modern motherboards, this is a simple procedure. For some older ones that go into older motherboards, it can actually be quite difficult to get the processor to install.
- Risk Factor: 2-3 (Low to Moderate). Despite the fragility of the processor, it's quite rare to wreck one just by trying to install it. If you insert the processor incorrectly into the socket, however, you definitely risk damaging it.
- Hardware Required: None.
- Software Required: None.

Preparation / Warnings

- This procedure assumes that the socket is already empty and does not include instructions for removing any processor that may have been there before.
- This procedure assumes that the processor has not had a heat sink attached to it yet. The instructions don't really differ that much if the sink is already attached, however.
- Make sure that the motherboard is on a flat, clean, sturdy, static-free surface.
- Do not attempt to install the processor if you cannot be sure that you have oriented the processor correctly in the socket.

Procedure Steps:

1. Determine Socket Type: The first step is to figure out if you have a ZIF (Zero

Insertion Force) socket on your motherboard. The key to this is to look for a small plastic or metal lever along one side of the socket. If you see one, it is a ZIF socket. Virtually all Pentium class or later motherboards have these, and many 486 motherboards do as well.

2. Orient Processor To Socket: The processor and socket are both square, so you have to be sure to orient the processor so that it lines up correctly to the socket. Both pieces of hardware will have a distinguishing mark in one corner to indicate where pin 1 is. On the processor, look for one of the following: a dot on the surface of the chip in one corner; a notch in one corner; a diagonal bit of gold coming from the patch on the underside of the chip; or a square-shaped gold pad where one of the corner pins connects to the underside of the chip. Typical markings on the socket are a slightly different pattern of pin holes in one corner, a "1", or a notch in the socket.

Note: Some 486-class motherboards have sockets containing four rows of pins, intended for use by a Pentium OverDrive chip. True 486-class chips have only three rows of pins, so be careful to ensure that when inserting these into a socket with four rows, to center the chip in the socket. One unused row of pins should be left all around the edge of the socket.

Note: Many newer CPUs are keyed through the use of special pins so that they cannot be inserted incorrectly (well, not without breaking off one of the pins).

3. Open ZIF Socket: Assuming that your board has a ZIF socket, open it up. This is done by grasping the lever next to the socket, and then lifting it up and pulling it back until it is vertical, perpendicular to the motherboard. On some ZIF sockets, you will have to pull the lever out away from the socket first slightly before lifting it up. This will cause the top part of the socket to shift and thereby open the socket. On some older motherboards the lever can tend to stick and it may take a bit of pressure to get the lever to get all the way open.
4. Insert Processor Into Socket: Double-check the orientation of the processor, and then place it into the socket. Follow these instructions depending on what type of socket you have:

ZIF Socket: The ZIF socket *is* appropriately named; the CPU should really drop

right into the socket and no force at all should be required. If any is, you probably don't have the socket all the way open. Lightly tap the processor into place in the socket.

Non-ZIF Socket: Older non-ZIF sockets require you to push the processor into the socket. If you do this incorrectly you can damage the CPU. The way to do it is to first put the ends of the pins into the socket. Apply light pressure all around the surface of the CPU. Then move around the surface of the processor, applying firm but even pressure over the entire surface. Go slowly; it may take a full minute or longer. Don't push too hard and make sure the pressure is even.

5. Check That Chip Is Inserted Fully: Carefully check the processor to make sure that it is fully inserted into the socket. There should be very little space between the bottom surface of the processor and the top of the socket, less than 1/16" (less than 1 mm).
6. Close ZIF Socket: Assuming that you are using a ZIF socket board, close the socket. Gently push the lever down. You may encounter some resistance while doing this, which is normal, but if you have to really lean on it then either the socket is defective or you have the processor inserted incorrectly. The lever should go all the way down and rest next to the socket, where it was before you started.

Experiment-15

Memory Module Physical Installation Procedure

This procedure provides instructions for physically installing memory modules into a motherboard. I include here instructions for installing both SIMM and DIMM packaged memory. Installing memory modules can be a bit tricky, because SIMM sockets especially are both delicate and sometimes difficult to use.

Procedure Overview

- Difficulty Level: 2-3 (Low to Moderate). Some SIMM sockets can be extremely troublesome to use and it may take some patience to get the modules to install properly. Others are easier to use. DIMM sockets are also easier to deal with.
- Risk Factor: 2-3 (Low to Moderate). It is possible to damage a SIMM socket by trying to force a module into the socket incorrectly (but only if you are impatient and force it). I have also received reports indicating the possibility of a damaged motherboard if a module is inserted incorrectly.
- Hardware Required: A small, thin, flat-bladed screwdriver may be handy in some cases.
- Software Required: None.

Preparation / Warnings

- This procedure assumes that the sockets are already empty and does not include instructions for removing any modules that may already be present.
- Make sure that the motherboard is on a flat, clean, sturdy, static-free surface.
- Make sure that you are using the correct type of module for your system.
- For Pentium-class or later systems, 72-pin SIMMs must be used in identical pairs to make up a bank; 168-pin DIMMs are used individually. For 486-class systems, 72-pin modules are used individually and 30-pin modules in groups of four to make up a bank.
- This procedure assumes industry-standard SIMM sockets that are mounted to the motherboard so that when properly installed, the SIMMs will be perpendicular to the motherboard. There are some motherboards that have

different types of sockets and the instructions below would have to be improvised to suit these.

Procedure Steps:

1. **Identify Installation Socket(s):** Determine which memory module sockets you are going to use for these modules. As usual, the best way to do this is to consult your motherboard documentation; most motherboards will also physically label the modules with numbered identifiers. For a new system, you will normally want to use the first bank of memory on the motherboard, which normally means the lowest-numbered socket(s). If you are installing more than one module, be sure to install them in the correct order. This should be obvious by looking at the orientation of the sockets on the motherboard. If you install them in the wrong order then you'll block off the second socket with the first SIMM in most cases, and you'll have to remove and then reinstall them in the correct order.

Warning: SIMM and DIMM sockets are sometimes numbered staring with zero. This means that on a motherboard that takes SIMMs, the first bank of memory may be "SIMM0" and "SIMM1". If you use "SIMM1" and "SIMM2", you will be accidentally installing half a bank of memory into each of the first two banks on the motherboard, and the system will not function.

2. Orient Module: Line up the module next to the socket. Modules are keyed to prevent incorrect insertion. The keying on the module itself is obvious, but you may have to look very carefully at the socket to see which way the notch goes, and the module itself may appear to be able to sit into the slot either way. Don't worry too much about this; if you put the module in the wrong way you'll realize it as soon as you try to tilt the module into place (it won't work).
3. Insert Module: Insert the module into the socket. The instructions depend on the type of module:

- SIMM: Hold the module at about a 60 degree angle to the motherboard and then insert it into the socket. You will probably have to rock the module back and forth slightly to get it to go in. Make sure that the module is seated all the way into the bottom of the module; if it won't go all the way in, you may have it

oriented backwards.

- DIMM: Firmly but gently push the module straight down into the socket. It will not go all the way to the very bottom at this stage, but make sure it is pushed in as far as it will go without requiring excessive force.

4. Lock Module Into Place: The module will still be loose in the socket at this point; it is not fully installed until you lock it into position:

- SIMM: Tilt the module up from the approximately 60 degree angle you used when inserting it, to a 90 degree angle (perpendicular to the motherboard). This may require a bit of pressure, but if the module will not tilt up at all, it is almost certainly inserted either backwards or not all the way into the bottom of the socket. Do not force the module. Pull it out and reinsert it if necessary; don't feel bad, this happens to me all the time. After you tilt the module into place, you should see (and may even hear) small metal or plastic clips snap into place around the module's circuit board, on either side. Sometimes the clips don't snap properly and you may need to jimmy them a bit to get them to tuck behind the SIMM; a small screwdriver may help here, but be careful with it.
- DIMM: There should be a plastic lever on either end of the socket. Grasp the lever and tilt it up. As you do this, the DIMM should be drawn down into the socket. Tilt up both levers and the module should be installed.

5. Double-Check Installation: It's sometimes hard to be sure those modules are inserted correctly. The module should be securely and firmly in its socket. It may wiggle a bit if you try to move it but it should not be loose. For SIMMs, there should be clips on either side of the module holding it into the socket. The contacts should be squarely inside the socket. If you have installed two identical modules, check their height from the surface of the motherboard; it should be the same for both modules.

6. Repeat If Necessary: Repeat steps 2 to 5 as necessary for each module being installed.

Experiment-16

Motherboard Physical Installation Procedure

This procedure describes how to install a motherboard into a system case. I have taken great pains to be excruciatingly detailed in this procedure, for one simple reason: physically installing the motherboard is probably the trickiest part of building a new system or performing a motherboard upgrade. It's not that the actual installation is all that difficult, it's just that it is a process that requires more experience; you might even say "finesse", than many other installation or configuration jobs. I have not found any other procedures on the 'net that really address this procedure at the level of detail that someone needs when they've never done this before. One reason why this is hard to do is that there are so many different combinations of motherboards and cases...

Procedure Overview

- Difficulty Level: 4 (High). As I state above, it can be tricky to get the motherboard installed properly. Be patient with this one. It's worth taking a few extra minutes to get this correct.
- Risk Factor: 3-4 (Moderate to High). It's pretty easy to not install the motherboard properly, which can result in spurious operation or even hardware damage.
- Hardware Required
  - Phillips head screwdriver.
  - Motherboard mounting hardware: brass and/or plastic standoffs, screws, and sometimes paper washers. These should come in a small bag with the system case.
  - Wire snips, knife or scissors.
  - Recommended: 3/16" hexagonal nut driver. This corresponds to the size used by the metal spacers that go between the motherboard and system case. Otherwise, you'll need a pair of needle-nose pliers or similar.
- Software Required: None.

Preparation /Warnings:

- The instructions in this procedure are derived primarily from my experiences installing AT form factor motherboards. ATX motherboard installation will require some improvisation; I will change the procedure when I have more experience with ATX.
- There is a very high degree of variability in motherboards and cases. It's not too likely that your hardware will match exactly what I describe in this procedure, and in particular, there seem to be no two system cases that are alike. So stay on your toes in following these directions.
- Be very careful when physically manipulating the board not to bang it or any of the components on it, into anything. Handle the board by the edges.
- If the system case has a removable motherboard panel (and most newer tower cases do) then remove it before beginning this procedure; it will make your life a lot easier. The steps below are geared toward either a direct case installation or installation to a removable panel.
- I would strongly recommend against installing the motherboard into the case if when you are finished, the board is not firmly supported in at least six places around the board, including at least one point in the center. If the board is not supported properly, the chance of damage later on is very real.
- When you are finished with the installation, check under the motherboard for loose screws or other hardware; you definitely do not want these left inside the case!

Procedure Steps:

1. Orient Case or Mounting Panel: Arrange the case (or removable motherboard mounting panel) so that the expansion card slots and keyboard and other connectors are farthest away from you. For the rest of this procedure, I refer to the edge of the motherboard where the connectors go as the "back" of the motherboard.
2. Find Motherboard Mounting Holes: Examine the motherboard and locate its mounting holes. These are usually found as follows:

- One row of three or four holes along the back of the board, where the expansion slots are.
- A second row of either two or three holes somewhere in the middle of the board. These may not all be in a straight line.
- A third row of usually two holes, but maybe three, along the front edge of the board.

3. Find System Case or Mounting Panel Holes: Examine the system case and see what types of mounting holes it uses. You will generally see the following:
   - Threaded screw holes: These are small screw holes that are intended to take screw-in metal standoffs. All cases have at least a couple of these; some have more than others.
   - Eyelet holes: These are large, oblong holes about an inch or so in length that take the sliding plastic standoffs. They are narrower at one end than the other. Some cases no longer use these at all.
4. Orient Motherboard and Match Motherboard Mounting Holes to Case Mounting Holes: Take the motherboard and physically locate it in space a few inches over the case (or removable case panel). Orient the motherboard so that it is approximately where it will be when installed. Any integrated connectors on the back of the motherboard should line up with the holes in the case designed for them, especially the keyboard connector. Then take note of the following:
   - Determine which motherboard mounting holes line up with threaded screw holes on the case or mounting panel. There must be at least two of these or you cannot properly secure the motherboard to the case. These will usually be found in the back of the case near the expansion slots (if nowhere else).
   - Determine which motherboard mounting holes line up with eyelet holes on the case or mounting panel. They should line up with the narrow end of the eyelet hole.
   - Determine which motherboard mounting holes line up with no holes at all on the case or mounting panel. This is quite common and nothing to be concerned about as long as most of the holes do line up. It is most common for the holes along the front of the motherboard to not line up with the

holes along the front of the case, because the size of motherboards varies from the nominal standard. The holes along the back and middle will almost always line up.

5. Install Standoffs: Attach the mounting hardware, following these specific instructions for each of the different case hole types mentioned in the step above:
   - For those motherboard holes that line up with screw holes in the case, screw a metal standoff into the case (or mounting panel). Use a 3/16" nut driver if you have one.
   - For the motherboard holes that line up with eyelet holes, insert a plastic slider standoff into the motherboard. Push the pointed end into the appropriate hole from the bottom, until it pushes through the top of the board.
   - For the motherboard holes that do not have a matching case hole, take one of the plastic slider standoffs mentioned just above. Using a pair of wire snips or a knife, cut off the small plastic disk at the end of the standoff opposite the pointed end. Then push the pointed end into the hole from the bottom as for the eyelet holes. Cutting off the disk at the end will allow this modified spacer to support the motherboard without having to insert into the case in the location where there is no matching hole (a little trick I discovered).
6. Slide Motherboard Into Place: Follow the appropriate directions depending, again, on the type of holes being used:
   - If there are eyelet holes in the case, then place the motherboard so that the round plastic parts at the end of the plastic standoffs are inserted into the wide part of the eyelet holes. Then slide the board so that the standoffs move toward the narrow part of the hole. When you have completed doing this, the other mounting holes should line up with the metal standoffs they are mated with. Double-check that the alignment is correct. Be careful when sliding the board not to rub the bottom of the board against anything, including any metal standoffs in the case.
   - If there are no eyelet holes, then you can just put the motherboard down

directly into the case. Double-check that all of the holes line up with the metal standoffs underneath them.

7. Determine If Washers Are Required: Examine the heads of the screws that you will use to secure the motherboard to the metal standoffs under the screw-in mounting holes. If the head of the screw is large enough that after tightening the screw the head might make contact with the circuitry on the motherboard, you must use a plastic or paper washer under the screw head to prevent accidentally shorting out the motherboard. Most motherboard manufacturers are smart enough today to leave a little extra space around the mounting holes.
8. Screw Motherboard Into Place: Using washers (if necessary), screw the motherboard into the metal standoffs underneath it. First insert all the screws and hand-tighten them, then tighten them all using a screwdriver (not too tight).
9. Replace Removable Panel: If your case uses a removable motherboard mounting panel, replace it into the case now. This basically just means undoing whatever you did to remove the panel in the first place; most cases either have a pull-down, spring-loaded "handle" that loosens the panel, or they use screws to secure it. Be careful to make sure that the bottom of the panel is in the right place where it fits into the bottom of the case; in most cases there are metal guides or tabs that the panel must align with in order to be reinserted properly. Also be careful not to damage the motherboard in this step by banging it (or anything inserted into it like the CPU or memory modules) against anything else in the case.
10. Test Motherboard Installation: An incorrectly-installed motherboard can be the bane of any homebuilt PC; strange and unpredictable behavior will result that can be very hard to diagnose. I would therefore take the time to check the following after installing the board:
    - **Level:** Check the board to ensure that it is flat in the case. All parts of the motherboard should be the same distance from the case.
    - **Contact:** Make sure that no part of the motherboard is touching anything that it should not be. Look under the board too, if possible.
    - **Fit:** Check to make sure that the board is not loose. You should not be able to move it around in the case.

- **Alignment:** Double-check that the motherboard is in the correct position. The expansion card slots should line up with the expansion slot holes in the case. The keyboard connector should line up as well.
- **Rigidity:** This one is important, and is not addressed sufficiently by enough homebuilders in my opinion. The motherboard must be adequately supported to ensure that it can take the biggest torture test that any motherboard goes through: insertion and removal of expansion cards. Test the installation of a video card, for example. Start trying to insert the card into a slot; if the motherboard starts bending more than a tiny amount, stop right away! This means that the board has not been properly supported and you will need to address this before proceeding. The motherboard should not flex under the pressure of inserting or removing the card.

Experiment-17

System Case Cover Removal Procedure

This procedure provides specific instructions on how to remove the cover from and thereby open a variety of different types of system cases. While it may seem like overkill to have a procedure for what seems on the surface to be a simple matter, in fact some cases can be surprisingly difficult to figure out if you're used to a different style.

Procedure Overview

- Difficulty Level: 1 (Very low).
- Risk Factor: 1 (Very low).
- Hardware Required: Phillips-head screwdriver for conventional models, none for most screwless or single-screw models.
- Software Required: None.

Preparation / Warnings

- If this case is on a retail or brand-name PC that is under warranty, be very sure that opening the case will not void your warranty. Some vendors now have this policy, and you may even see stickers on the case that say that if they are removed or broken the warranty is void (but some have the policy and not the stickers!)
- Case and system manufacturers are getting quite creative, so not every imaginable case design is covered here. If you read all of the different choices you are likely to find one that is close to what you have, however. If you run into anything radically different from what I have here, please write me and I'll add it.
- Be careful not to touch any of the internal components when removing the cover.

Procedure Steps:

1. Disconnect Cables: Make sure the PC itself is off. Detach all the cables from the back of the system case. Make a note of what went where so that you will know

how to reconnect them later on.

2. Remove Monitor and Other Devices From Top of Case: If you have a desktop case, you of course need to move the monitor so that you can open the case. Also remove any other devices from the top of the case. (This is also a good time to clean the case if it is dusty).
3. Remove Plastic Back Panel (If Necessary): Some cases, especially older full tower models, have a plastic panel about a half-inch thick that mounts onto the back of the case. You have to remove this panel to access the screws that actually hold the cover. It usually pulls right off the back of the case. Start with one corner and gently pull it loose and set it aside.
4. Loosen and Remove Cover: The instructions for removing the cover depend on what sort of case you have. Find the one that best describes your system:
   - Conventional Tower: This is the classic design that has been around for years and is still being sold. Locate the screws along the edge of the back of the case, and remove them using a screwdriver. There are usually three to six. Gently pull back on the U-shaped top cover about a half-inch.; you may have to rock it slightly. Lift the cover up off the frame of the case. Be careful, as these covers are large and unwieldy.
   - Conventional Desktop: The conventional desktop case has been around since the original IBM PC in 1982, and is still sometimes seen in new systems, although not as often with the latest machines. Locate the screws along the edge of the back of the case, and remove them with a screwdriver. There are usually five but may be fewer. Gently push the cover forward. Watch out for drive faceplates that may become caught on the cover as you try to slide it forward. On some cases, the front cover slides all the way off the front of the case. On others it will slide forward a couple of inches and stop, and then you lift it up off the case.
   - Front-Screw Desktop: An odd design found on some slimline and proprietary systems, this case has the screws that hold the cover on the front of the case, and in a very hard to find spot. (The first time I ran into one of these I was scratching my head for quite a while trying to figure it

out). Look at the front of the case near the bottom, where you may see small sliding plastic doors on both sides of the case. Lift these out of the way and they will reveal small screws. Loosen the screws, and the slide the cover forward off the case. There may be additional screws at the back of the case as well. Watch out for drive faceplates that may become caught on the cover as you slide it.

- Front-Screw Tower: I have seen some tower cases that have screws on the front of the case holding the top cover on. There may be a front panel that you have to remove to expose the screws and allow you to loosen and remove the cover.
- Single-Screw Tower / Desktop: This is a popular design amongst many brand-name PC manufacturers, although the fully screwless design is now replacing it. Locate the single screw at the top of the back of the case; this can usually be loosened with your fingers. Look at the bottom of the case to see if there are any clips holding the cover to the case, as there sometimes are. Loosen these. Push the cover forward about an inch and then lift it off the case frame. Some of these may lift straight up instead of sliding off from the front.
- Screwless Tower / Desktop: There are many different screwless designs; the one I describe here is popular in such cases as those made by Enlight Corporation. The trick with these puppies is that they often come apart in pieces. Usually you have to start by pulling the front panel off. From the bottom, grasp the plastic front panel and pull it loose, working your way to the top. You may need to use a screwdriver to loosen it (ironic, isn't it?) Then slide each of the side panels forward about a half-inch and lift up to remove them. Finally, lift the top of the case straight up to remove it.

5. Store Screws in Safe Place: Some people forget this step and are very sorry for it later on.

Experiment-18

Post-Assembly Initial Test Procedure

This procedure describes system tests that you should perform after setting up a system or completing a significant upgrade such as a motherboard upgrade. Using this procedure will help you to verify that you have completed your assembly successfully and that all the various components in your system are working properly.

Procedure Overview

- Difficulty Level: 2 (Low).
- Risk Factor: 2 (Low).
- Hardware Required: You may need a flashlight, screwdriver or needle-nose pliers if you need to make adjustments to any of the hardware, but otherwise, no hardware is required.
- Software Required: Bootable floppy disk.

Preparation / Warnings

- Make sure you ground yourself before touching any components. Also be extremely careful when working inside the case with the power on.
- Always power the system down safely before changing anything inside the box.
- Your system will probably vary from the one discussed here, so be sure to test whatever your system actually contains.
- I assume that the system has been powered up and is able to boot up from the floppy disk to a DOS prompt. If you are having problems getting the system to boot up, you need to resolve that first before commencing this procedure. Try looking at the Boot Process Troubleshooting section for help.
- If you have an AMI BIOS with a graphical BIOS setup program, then you already know whether or not your mouse is working. Otherwise, you will have to wait until you go to install Windows to test your mouse.

Procedure Steps:

1. Check LEDs: Check the power LED and the turbo LED (if connected). Both should be on. You should also see the hard disk LED come on during the boot

process, when the BIOS is doing its testing, but it may not. You may want to try reversing the leads of the hard disk LED if it does not light up, but you may also want to wait until you are sure the hard disk is in action.

2. Test Turbo Button (if applicable): If your system has an operational turbo button, press it and see if the turbo LED toggles. Note that in most systems this button does not actually do anything.
3. Check Hard Disk Drive: The hard disk should be spinning.
4. Check Fans: Make sure that the power supply fan, CPU fan, and any other fans in the system are all spinning and not obstructed.
5. Test CD-ROM Drive Mechanism: Press the eject button on the CD-ROM to test if the drive has power and the tray is working.
6. Check System Configuration (during next bootup): In the next step you will reset the system. While the system is rebooting, carefully check the system configuration screen that the BIOS displays. Make sure that all the storage devices, serial and parallel ports and other devices are listed. Check the listed total for the system memory and make sure that it is correct. Make sure the processor's listed speed is correct. Reset the system a second time if necessary (the screen may scroll past too fast).
7. Test Reset Button: Press the reset button and reboot the system.
8. Test Keylock: If your system has a keylock, test it by turning it to the locked position and rebooting. You should get an error message saying that they keyboard is locked. Unlock the case After the system has been running for at least 10 minutes, continue with these steps:
9. Turn System Off: Turn the power to the system off.
10. Ground Yourself: Touch the outside of the metal box of the power supply to ensure that you are grounded.
11. Check Temperature of Processor, Memory and Cache Chips: Carefully touch the metal of the heat sink near where it attaches to the processor, or the edge of the processor itself. It should be warm but not too hot to the touch. Repeat for the memory chips, and the cache chips on the motherboard or cache module.

12. Check Temperature of Hard Disk: The middle of the hard disk may be warm, but should definitely not be hot (in fact, it will normally be not much above room temperature).

Experiment-19

Hard Disk Partitioning and Formatting Procedure

This procedure describes how to set up a new, empty hard disk so that it is ready for an operating system to be installed on it. This process includes partitioning and formatting and results in a bootable hard disk. The procedure covers configuring the hard disk as a single large partition or splitting it into multiple, smaller partitions. The procedure provides specific instructions for using the FDISK program and is based on the Windows 95 OEM SR2 (Windows 95B) FDISK version with FAT32 support.

Warning: This procedure is intended to be used for setting up a new hard disk containing no information on it. Do not follow these steps if your hard disk has already been partitioned and formatted, or data loss will likely result.

Procedure Overview

- Difficulty Level: 2 (Low).
- Risk Factor: 1 (Very low). This assumes that the hard disk has no data on it.
- Hardware Required: None.
- Software Required: Boot disk containing the FDISK.EXE and FORMAT.COM programs.

Preparation / Warnings

- To be safe, always run FDISK from DOS only.
- Be extremely careful when using the FDISK program, as one incorrect keystroke can result in major data loss. In particular, in a system with multiple hard disk drives be careful to make sure you are working on the right physical disk or you may accidentally end up disturbing the contents of the wrong drive. Beware that DOS drive letters can change after creating or deleting partitions, and that with multiple hard disks the partitions may be lettered in an unexpected sequence
- Do not perform this procedure until the system is in good working order. Resolve any hardware conflicts or other issues before commencing.
- I assume that the system has been turned on and booted from the floppy disk.
- FDISK uses binary megabytes when displaying drive and partition sizes, not

decimal megabytes

- All commands in DOS or within FDISK require you to press {Enter} to select them; I'm not going to repeat it a zillion times within the procedure below.

Procedure Steps:

1. Check Version Number: At the DOS prompt, enter the following command: "ver". The system will respond with the version of DOS/Windows you have booted. Make sure that this matches whatever you want to install on the hard disk. For Windows 95 OEM SR2 the version number will be "4.00.1111".
2. Plan Partitions: Decide how you want to partition your hard disk. In particular, for large hard disks under Windows 95 OSR2, decide if you want to set up your hard disk with a single large FAT32 partition, or several smaller FAT16 partitions. (You can of course mix these). I provide instructions for doing either of these, but cannot tell you how to set up your system. You must decide based on what makes sense for you. For assistance in making this decision, and more general information on partitioning, cluster sizes and related issues, refer to this section. Most people today prefer to set up a new system using a single FAT32 partition.
3. Run FDISK.EXE: From the command prompt, enter the command "fdisk". If you have a disk large enough to warrant the use of FAT32, you will be asked if you want to enable "large disk support". Enter "Y" if you want to enable FAT32 or "N if you do not want to enable FAT32. If you do enable this, any partitions over 500 MB that you create will be FAT32. Note that if you do not enable FAT32, you will not be able to put your entire hard disk into one partition if it is greater than 2 GB in size.

If you decided to place your entire hard disk into a single partition, then follow this step:

4. Partition Hard Disk (Single Partition): Follow these steps to set up your hard disk:
    A. Select from the FDISK menu "1. Create DOS partition or Logical DOS Drive".

B. Select "1. Create Primary DOS Partition". FDISK will verify drive integrity. Then it will ask if you want to use the maximum available size of the disk for the primary partition and set it active. Enter "Y". The system will allocate the whole disk to the partition, and that's that.

C. Press {Esc} to exit FDISK.

If instead you want to set up your hard disk with multiple partitions (or if you don't have Windows 95 OEM SR2), follow this step. In order to make the process easier to follow, I am going to use an example below. In the example, a 3100 (binary) MB hard disk is being partitioned into four partitions of 1000 MB, 800 MB, 700 MB and 600 MB respectively:

5. Partition Hard Disk (Multiple Partitions): Follow these steps to set up your hard disk:

   A. Select from the FDISK menu "1. Create DOS partition or Logical DOS Drive".

   B. Select "1. Create Primary DOS Partition". FDISK will verify drive integrity. Then it will ask if you want to use the maximum available size of the disk for the primary partition and set it active. Enter "N". The system will show the size of the entire disk in MB.

   C. Enter the size of the primary partition. In our example, this would mean entering "1000". The system will tell you that it has created the primary partition, and will assign it the drive letter "C:".

   D. Press {Esc} to return to the FDISK menu.

   E. Select "2. Set active partition". Select partition 1. FDISK will report that it has set partition 1 active.

   F. Press {Esc} to return to the FDISK menu.

   G. Select from the FDISK menu "1. Create DOS partition or Logical DOS Drive".

   H. Select "2. Create Extended DOS Partition".

   I. When prompted, press {Enter} to select the entire remaining area of the disk for the extended DOS partition. FDISK will report that it has created

the extended DOS partition.

J. Press {Esc}. FDISK will automatically prompt you to create your first logical DOS volume within the extended DOS partition.

K. Enter the size of the first logical partition (the second partition overall). In our example you would enter "800". FDISK will create the partition, label it "D:", and then say "Logical DOS Drive created, drive letters changed or added". Don't touch anything, just wait, and FDISK will prompt you for the next volume.

L. Repeat the previous step for the remaining partitions (in our example there would be two more partitions to create, the 700 MB and 600 MB ones). When all of the partitions have been created, FDISK will report "All available space in the Extended DOS Partition is assigned to logical drives".

M. Press {Esc} to exit FDISK.

Continue with the procedure:

6. Reboot: Reboot the system using either the Reset button or the "three-fingered salute" ({Ctrl}+{Alt}+{Delete}). Make sure the floppy disk is in its drive, since you still need it. Note that you may get "Invalid media type reading drive C" errors while rebooting. This is normal at this stage.
7. Format Primary Partition: From the "A:" DOS prompt, issue the following command: "format c:/s". Do not forget the "/s", as this is what will make your C: drive bootable. You will get a "scary" warning message such as "WARNING, ALL DATA ON NON-REMOVABLE DISK DRIVE C: WILL BE LOST. Proceed with Format (Y/N)?". Since of course there is no data presently on drive C:, just enter "Y" and the system will format the hard disk. The program will show you its progress as it formats and at the end will prompt you for a volume label. Enter one if you wish.
8. Format Additional Partitions (if necessary): If you set up multiple partitions, format the additional partitions now. This is done in almost the same way as formatting the primary DOS partition, except that you leave off the "/s". So normally you would be entering "format d:", "format e:" and so on, until all the

partitions have been formatted. The prompts should be the same as in the preceding step.

Warning: If you have a second hard disk in the system and it has a primary DOS partition, that partition is probably assigned D: because DOS assigns letters to all primary partitions before any logical partitions. Be careful of what you format.

Remove Boot Floppy: Eject the boot floppy from the floppy disk.

9. Reboot: Reboot the system using either the Reset button or {Ctrl} + {Alt} + {Delete}. The system should boot up from the hard disk this time, and stop at the "C:" prompt. Note that if you get an error such as "NO ROM BASIC, SYSTEM HALTED" or "No boot device found" at this stage, this means you forgot to set the primary DOS partition "active". Reboot from the floppy, run FDISK again and use option 2 to set the primary partition active, then reboot. If you get an error like "No operating system", this means you probably forgot the "/s" parameter when formatting the C: drive. Put the floppy disk back in the drive and then return to step 5.

Experiment-20

Post-Assembly Inspection Procedure

This procedure describes some overall system checks that I recommend you perform after completing significant assembly procedures, such as a new PC build or a motherboard upgrade. While each subprocedure of a build concludes with a step recommending that you check what you just did, it is still worth a few minutes to double-check some of the more important aspects of the assembly, to reduce the chances of an unsuccessful initial turn-on of the system. I focus here primarily on the most common "gotchas" that I have run into in assembling systems.

Procedure Overview

- Difficulty Level: 1 (Very low).
- Risk Factor: 1 (Very low).
- Hardware Required: A small flashlight is helpful but not required.
- Software Required: None.

Preparation / Warnings: None, other than to be careful while checking for problems not to introduce any new ones.

Procedure Steps:

1. **Power Inspection:** Verify the following key items related to the system power:
    - If the system case has a dual voltage switch, make sure it is set to the correct voltage for your part of the world.
    - Make sure the power switch is off. You don't want the PC booting up as soon as you connect the power cord. Most power switches are toggles; you can tell if the power is on or off by pushing the switch in several times; it will feel in most cases as if you have to push the button in farther to make it toggle, when it is on before you press the button.
    - If you are working in an AT system, double-check that the two 6-wire power cables that go between the power supply and the motherboard have been inserted fully and correctly, and that the four black wires are together in the middle.

- If you are working in an ATX system, double-check that you have connected the power switch to the motherboard properly.
- Make sure all your drives have a power connector attached to them correctly.
- Make sure that the CPU fan and any additional case fans have their power connectors attached.

2. Cable Inspection: Check these cable connections to make sure they are correct. Check for "off by one" alignment errors, loose connections or cables that are overly taut. Make sure that you have lined up the red edge of the cable to pin 1 of each device:
   - Check the IDE cable(s) going to the hard disk drive and CD-ROM drive. Make sure you have lined up the red edge to pin 1 of each device.
   - Check the floppy cable going to the floppy disk drive(s).
   - Check the cables that attach the I/O port connectors and PS/2 mouse port connector to the motherboard (if appropriate).
   - Make sure the cables running to the case switches and LEDs are correct.
3. Motherboard Inspection: Double-check these configuration and installation aspects relevant to the motherboard:
   - Double-check the motherboard jumper settings. If you decide not to bother checking all of these, at least check the CPU voltage settings.
   - Make sure the memory is inserted into the correct socket(s) and is fully seated.
   - Make sure the processor is inserted correctly and is all the way into its socket.
   - Ensure that the heat sink is secured properly to the processor.
   - Wipe up any thermal compound that may have leaked out from around the CPU, if you used too much the way I always do. :^)
   - Make sure the video card is seated properly in its slot.
4. Physical Interference Inspection: Check the following physical issues:
   - Ensure that all the drives are properly physically secured in their bays.

- Make sure there are no loose wires in the case that may interfere with any moving objects inside the case; for the mostpart, this refers to the CPU fan.
- You are most likely going to be turning on the PC at first with the cover off. Make sure that nothing from outside the case can poke or fall into the case by accident.

Experiment-21

Identification Procedures

I have gathered into this section of the Procedure Guide a collection of procedures that involve identification of hardware or software areas of your PC. It is very often necessary to learn various pieces of information about your system, especially when you are troubleshooting a problem, or looking to perform an upgrade. The procedures on the left can help you determine what you need to know.

Video Card Identification Procedure

This procedure is used for identifying the manufacturer and chipset name and version of the video card, using the DOS "DEBUG" command. You'll need to do this typically when debugging problems or when you are looking for updated video drivers. An alternative option is to look carefully at the labelling on the video card and its components, but the advantage of this procedure is that it can be performed without the need to open up the system case.

Procedure Overview

- Difficulty Level: 1 (Very low).
- Risk Factor: 1 (Very low).
- Hardware Required: None.
- Software Required: Any version of MS-DOS or Windows 95.

Preparation / Warnings: Make sure you have all work saved in open applications on your system before starting.

Procedure Steps:

1. Get to an MS-DOS Prompt: If you are running a version of Windows, you need to either open an MS-DOS prompt or shut Windows down to MS-DOS mode.
2. Enter the "DEBUG" Program: From the DOS prompt, type "debug" and then {Enter}. The system will display a single dash ("-").
3. Display the Video Card BIOS Area: Type the following, exactly (and nothing else, or you risk doing something to your system that you really don't want to): "d c000:0010". This will display the contents of the beginning part of the video

BIOS ROM. The system will display a bunch of hexadecimal digits across most of the screen. On the left-hand side you will see text letters that correspond to these codes. For most video cards, you will see the name of the manufacturer and information about the video chipset type and version number.

4. Scroll Down If Necessary: On some systems you may need to scroll down further to find the information. Do this by typing just "d" and then {Enter}, one or more times. More information will display on the screen.
5. Exit "DEBUG": Press "q" and then {Enter} to quit the debug program.

Windows 95 Version Identification Procedure

You can use this procedure to identify which version of Windows 95 you are running on your system. This is normally information you will need when troubleshooting, selecting software or drivers, etc. I have provided two different ways to do this, one of which you can use as Windows 95 is booting, and the other while it is running.

Procedure Overview

- Difficulty Level: 1 (Very low).
- Risk Factor: 1 (Very low).
- Hardware Required: None.
- Software Required: None.

Preparation / Warnings

Control Panel Method (Run-Time) - Procedure Steps:

1. Open the Control Panel: From the Start Menu, select "Settings" and then "Control Panel".
2. Open System Properties: Double-click on the "System" icon in the Control Panel.
3. Look At the Version Number: In the upper right-hand part of the dialog box, you will see "System: Microsoft Windows 95". Directly below that will be the version number. If it says "4.00.950" then you have the original Windows 95. If it says "4.00.950a" then you have Windows 95a, with the first service pack

applied. If it says "4.00.950 B" then you have Windows 95b, also known as "OEM SR2" or "OSR2".

4. Exit System Properties: Select "Cancel" to exit the system properties screen.

Boot Screen Graphics Method (Boot-Time) - Procedure Steps:

1. Watch the Screen during the Bootup of Windows 95: You will want to be looking at the bottom of the Windows 95 "cloud" graphics screen that appears while Windows 95 is booting. You will see a bar at the bottom with different shades of blue that appear to be moving across the screen. If the bar is comprised of "blocks" of color about a half-inch wide moving from left to right, this is the original Windows 95. If you see "blocks" moving right to left, you have Windows 95a. If you see smooth, gradual shades of blue moving left to right, this is Windows 95b, a.k.a. "OEM SR2" or "OSR2".

File System Identification Procedure

This procedure is used to determine if a disk volume on your system is using the conventional FAT16 or the newer FAT32 file system on your Windows 95 OSR2 system. This is important when deciding what sort of utility software to purchase (since some of it is not compatible with FAT32), when considering setting up a multiple operating system configuration, or when troubleshooting. There are two different ways to do this simply, both of which are described here.

Procedure Overview

- Difficulty Level: 1 (Very low).
- Risk Factor: 1 (Very low).
- Hardware Required: None.
- Software Required: None.

Preparation / Warnings

1. If you are not running the OSR2 version of Windows 95, then you don't need to do this procedure, because all your partitions will be (should be) FAT16. If you aren't sure which version you are running, try this procedure.
2. Do not use this procedure on mapped network drives, CD-ROMs, etc.

3. If you use CHKDSK, do not run with the /F option.

Windows Explorer Method - Procedure Steps:

1. Open Windows Explorer: Open an instance of Windows Explorer if one is not open already.
2. Open Disk Volume Properties: In the left-hand window, find the icon corresponding to the disk volume you want to check (remember that a system can have both FAT16 and FAT32 partitions). Right-click on this icon and then select "Properties" from the bottom of the menu.
3. Examine the Volume Type: In the box that opens, near the top, you will see "Type:". To the right of it, you will see one of the following:
   - "Local Disk": This means that you are not running Windows 95 OSR2. The volume is FAT16.
   - "Local Disk (FAT)": You are running Windows 95 OSR2 and the volume is FAT16.
   - "Local Disk (FAT32)": You are running Windows 95 OSR2 and the volume is FAT32.
4. Exit Properties: Hit the "Cancel" button to exit the disk properties window.

CHKDSK (DOS) - Procedure Steps:

1. Get to an MS-DOS Prompt: Either open an MS-DOS prompt or shut Windows down to MS-DOS mode.
2. Run CHKDSK: At the DOS prompt, type "chkdsk N:", where "N" is the drive letter you want to examine, and then {Enter}. The system will scan the hard disk for information and produce output to the screen.

Examine Output: You will see several lines on the screen. If you see "4,096 bytes in each allocation unit" and a number greater than 65,526 for "total allocation units on disk", the volume is FAT32. Otherwise the volume is FAT. Note that some disk utilities can allow strange combinations of cluster size and volume size to be created, but under normal circumstances this is accurate.