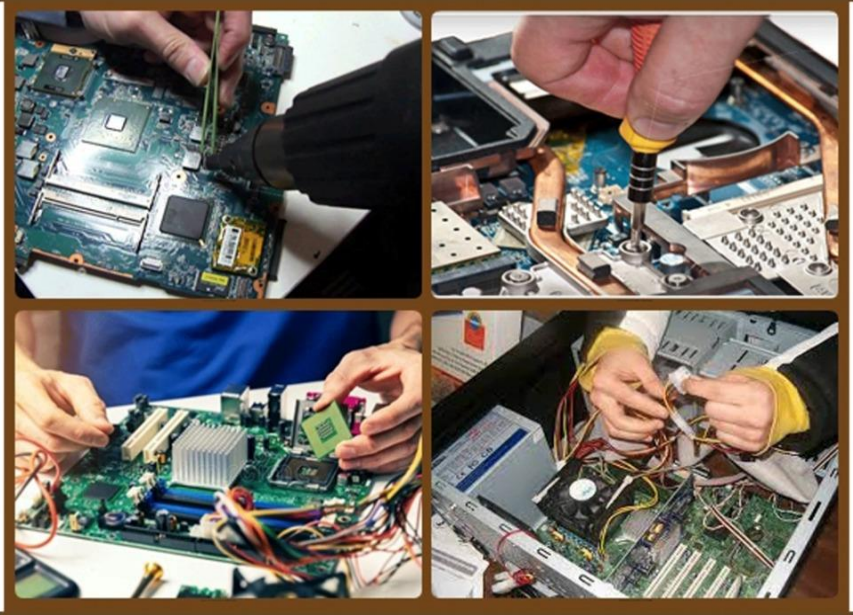
DIPLOMA OF ASSOCIATE ENGINEER
3RD YEAR
COMPUTER INFORMATION TECHNOLOGY
APPROVED BY TEVTA PUNJAB

A TEXT BOOK OF

PC SYSTEM AND PERIPHERALS REPAIR

CIT-352



Developed By
Academics Wing
Technical Education & Vocational
Training Authority Punjab

PC SYSTEM AND PERIPHERAL REPAIR

CIT-352

FOR DAE 3rd Year

TECHNICAL EDUCATION &
VOCATIONAL TRAINING AUTHORITY PUNJAB

PREFACE

The text book has been written to cover the syllabus PC System and Peripheral Repair 3rd year D.A.E (CIT) according to the new scheme of studies. The book has been written in order to cater the needs of latest concepts and needs of the course i.e., PC System and Peripheral Repair and to be able to attempt D.A.E Examination of PBTE Lahore.

The aim of bringing out this book is to enable the students to have sound knowledge of the subject. Every aspect has been discussed to present the subject matter in the most concise, compact lucid & simple manner to help the subject without any difficulty. Frequent use of illustrative figures has been made for clarity. Short Questions and Self-tests have also been included at the end of each chapter which will serve as a quick learning tool for students.

The author would like to thank the reviewers whose valuable recommendations have made the book more readable and understandable. Constructive criticisms and suggestions for the improvements in future are welcome.

MANUAL DEVELOPMENT COMMITTEE

Engr. Shoaib Ahmad
Instructor CIT- Govt. College of Technology, Bahawalpur
(CONVENER)

Abdul Ghaffar Sharif
Instructor CIT- Govt. College of Technology, Bahawalpur.
(MEMBER)

Tahir javed
Instructor CIT- Govt. College of Technology, Taxila
(MEMBER)

CIT 352 – PC System and Peripherals Repair

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Contents

Chapter No. 1

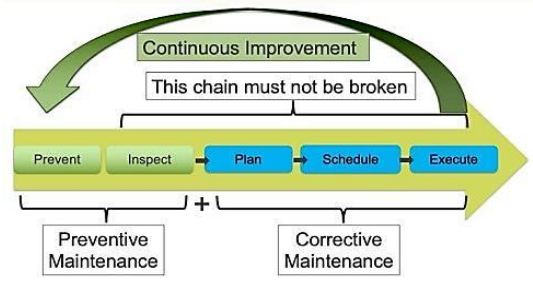
(Preventive Maintenance)

Objectives:

After completion of this chapter students will be able to:

1. Preventive and Practical Maintenance

Preventive maintenance is the regular and systematic inspection, cleaning, and replacement of worn parts, materials, and systems. Effective preventive maintenance reduces part, material, and system faults and keeps hardware and software in good working condition.



Preventive maintenance is the systematic maintenance and servicing of machines and facilities.

Preventative maintenance has the aim of increasing reliability, saving costs from major failure or down time, reducing the risk of failure and extending the life of machine or facilities.

Preventative maintenance includes test operations as per diagnosis, replacing worn out parts, measurements, tightening and adjustments.

1.1. Contributors to Failures

A system failure can occur because of a hardware failure or a severe software issue, causing the system to freeze, reboot, or stop functioning altogether. A system failure may or may not result in an error being displayed on the screen. The computer may shut off without warning and without any error message. If an error message is displayed, it often is displayed as a Blue Screen of Death error on Windows computers.

System failures may result from a hard drive with bad sectors, causing the operating system to not be able to read data from the hard drive. A failing motherboard can cause a system failure because the computer is not able to process requests or operate in general. A bad processor can and usually causes a system failure because the computer cannot operate if the processor is not working properly or at all. A bad RAM chip can also cause system failures because the operating system is not able to access data stored on the RAM chip.

System failures due to software issues can occur if the issue in the software, such as a bad line of code, is severe enough. The system failure and subsequent computer shut down occurs as an attempt to prevent damage to other software or the operating system.

Causes Hardware Failure

A hardware device can fail in the computer and cause it or only the device to stop working. Some of the common reasons why a hardware device or component could fail.

Over powered or under powered

Too much power or too little power can damage hardware. If the computer and hardware are not protected by a surge protector, it's at risk of getting too much power. If the hardware is not protected by a UPS (uninterruptible power supply), it's in danger of being under powered.

Movement

A desktop computer that is not made to be frequently moved can have expansion cards, memory, or cables in the computer loosened as it is being moved. Any card or cable not firmly connected can cause the computer not to work or fail. Even mobile devices designed to be moved can have components

in them become bad because of the device being dropped or abnormal movement.

Heat and temperature change

Too much heat either because of the environment or because a fan has failed can damage hardware components. Extreme environments where the temperature alternates between hot and cold can cause condensation. Moisture can damage a computer's electronics, or loosen components due to expansion and contraction over time.

Voltage Spike

This is a momentary change in the supply of electric power. It's important to remember that the size of the transient can range from just milliseconds to longer periods of time. Even a small power glitch can damage a computer and corrupt data. If the screen goes blank during a thunderstorm, it's likely that a voltage spike is responsible.

Failure to keep virus protection up to date

There are several malware protection packages available for computer rooms or data centers. Once installed, the subscription must be maintained. One telltale sign of a malware infected computer is slow data processing.

Environment

If a computer room has a dedicated cooling system, there may be an opportunity to closely control the heat. If the cooling is shared with other equipment or the space contains offices, we often face a more challenging task. People have comfort needs different to those of computers.

The effects of corrosion and magnetism to system performance

Atmospheric Corrosion

Environmental conditions – heat, cold, dust and excessive humidity all can damage and lessen the performance of a computer. External and internal temperature especially cause fluctuations of performance especially humidity – can directly affect the functioning and performance of computer.

Magnetism effects to system performance

Magnets have a bit of a bad reputation when it comes to computers. Magnets distort the flow of electrons through cables. Subwoofers (a loudspeaker component designed to reproduce very low bass frequencies).

use strong magnets that could erase magnetic storage media. Many people have placed computers near subwoofers with no ill effects, but most subwoofers aren't very powerful and don't include a strong enough magnet. Only large, powerful subwoofers are an issue.

Handle correctly Peripherals

A peripheral or peripheral device is an auxiliary device used to put information into and get information out of a computer. The term peripheral device refers to all hardware components that are attached to a computer and are controlled by the computer system, but they are not the core components of the computer, such as the CPU or power supply unit. In other words, peripherals can also be defined as devices that can be easily removed and plugged into a computer system.

Several categories of peripheral devices may be identified, based on their relationship with the computer:

- An input device sends data or instructions to the computer, such as a mouse, keyboard, graphics tablet, image scanner, barcode reader, game controller, light pen, light gun, microphone and webcam;
- An output device provides output data from the computer, such as a computer monitor, projector, printer, headphones and computer speaker;
- An input/output device performs both input and output functions, such as a computer data storage device (including a disk drive, solid-state drive, USB flash drive, memory card and tape drive), modem, network adapter and multi-function printer.

Handling of peripherals

Always check for recent firmware updates.

Firmware is the software program used by the device's components to communicate with the network and perform the various tasks required to accomplish its primary function. Manufacturers are continually offering firmware updates for peripherals that can enhance the performance of any device.

- Go to the manufacturer's website and find the firmware downloads page.
- Provide the required information when prompted. In most cases, you will need to enter the name and model number of the device, as well as the operating system installed on your computer, in order to locate the correct firmware update.
- Follow the instructions for downloading and installing the firmware update. Once downloaded, the installation wizard will guide you through the process of installing the firmware update.

Clean peripheral devices as needed.

Dirt, dust and debris can impact the performance of peripherals.

Power down the device and disconnect it from the computer prior to cleaning. Neglecting to do so could cause damage to peripheral devices.

Use a can of compressed air to blow off dust particles and other debris from the exterior of the device.

Use a damp paper towel to wipe away any dust particles that remain after using the compressed air. Use a cotton swab lightly dipped in rubbing alcohol to remove grime and dirt from inside cracks, seams and other hard to reach places. Use a microfiber cloth to clean LCD displays, camera lenses and device control panels. Do not use multi-purpose cleaners, which can cause serious damage to control panels, lenses and other types of displays on peripheral devices.

Update the device firmware every 6 months.

Manufacturers are continually offering firmware updates for computer peripherals that can significantly enhance the performance of any peripheral device.

Clean peripheral devices as needed.

Dirt, dust and debris can impact the performance of peripheral devices.

Power down the device and disconnect it from the computer prior to cleaning.

Follow the recommended maintenance schedule as directed by the manufacturer.

This information can typically be found in the operating manual included with documentation that came with the device at the time of purchase.

Describe Virus and Prescribe Measures to Prevent Virus Attacks

Virus

A computer virus is a type of malicious software, or malware that spreads between computers and causes damage to data and software. Computer viruses aim to disrupt systems, cause major operational issues, and result in data loss and leakage. A key thing to know about computer viruses is that they are designed to spread across programs and systems. Computer viruses typically attach to an executable host file, which results in their viral codes executing when a file is opened. The code then spreads from the document or software it is attached to via networks, drives, file-sharing programs, or infected email attachments.

Common Signs of Computer Viruses

A computer virus will more than likely have an adverse effect on the device it resides on and may be discoverable through common signs of performance loss, including:

Speed of System

A computer system running slower than usual is one of the most common signs that the device has a virus. This includes the system itself running slowly, as well as applications and internet speed suffering. If a computer does not have powerful applications or programs installed and is running slowly, then it may be a sign it is infected with a virus.

Pop-up Windows

Unwanted pop-up windows appearing on a computer or in a web browser are a telltale sign of a computer virus. Unwanted pop-ups are a sign of malware, viruses, or spyware affecting a device.

Programs Self-executing

If computer programs unexpectedly close by themselves, then it is highly likely that the software has been infected with some form of virus or

malware. Another indicator of a virus is when applications fail to load when selected from the Start menu or their desktop icon.

Accounts Being Logged Out

Some viruses are designed to affect specific applications, which will either cause them to crash or force the user to automatically log out of the service.

Crashing of the Device

System crashes and the computer itself unexpectedly closing down are common indicators of a virus. Computer viruses cause computers to act in a variety of strange ways, which may include opening files by themselves, displaying unusual error messages, or clicking keys at random.

Computer Viruses Attack and Spread

In the early days of computers, viruses were spread between devices using floppy disks. Nowadays, viruses can still be spread via hard disks and Universal Serial Bus (USB) devices, but they are more likely to be passed between devices through the internet.

Computer viruses can be spread via email, with some even capable of hijacking email software to spread themselves. Others may attach to legitimate software, within software packs, or infect code, and other viruses can be downloaded from compromised application stores and infected code repositories. A key feature of any computer virus is it requires a victim to execute its code or payload, which means the host application should be running.

Types of Computer Viruses

There are several types of computer viruses that can infect devices. This section will cover computer virus protections and how to get rid of computer viruses.

- Resident Virus
- Multipartite Virus
- Direct Action
- Browser Hijacker
- Overwrite Virus
- Web Scripting Virus
- File Infector
- Network Virus
- Boot Sector Virus

Computer Viruses Examples

There are common examples of what computer and internet users believe to be viruses, but are technically incorrect.

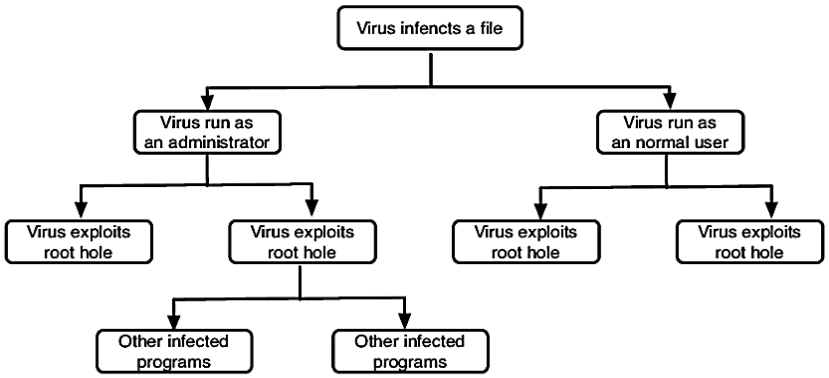
Trojan Virus

Worm Virus

Ransomware Virus

Rootkit Virus

Software Bug Virus



1.2.

Scheduled Maintenance and Error/Fault Record

To check or to efficient PC peripheral devices, memory devices (RAM, ROM, And Hard disk etc.), virus, input/output devices, essential operating system software and basic Input/output cards and repair or troubleshoot them after a specific time or after specific time intervals on regular base, is called Schedule maintenance of PC system.

Schedule maintenance for a computer involves taking regular steps that make your computer faster, more secure and less cluttered. If your computer seems slow, displays an error message about low disk space or takes a long time to boot up, doing routine maintenance can fix the issue and help your computer last longer. While some routine computer maintenance tasks prevent future problems like viruses or data loss, others free up space and even fix software bugs. Whether you have a PC or Mac, you can install updates, check for viruses, maintain your hard drive, backup files and perform other simple tasks to keep your computer in good shape.

Operating System and Software Updates

Installing operating system updates and keeping all your programs updated are important PC maintenance tasks that improve your computer's security and stability. Both Windows and Mac systems have the option to automatically download and install operating system updates, but you can manually check for updates at any time. Web browsers, productivity software, media players and other applications also need regular updates to fix bugs, improve performance and add new features. These programs might download

updates automatically and prompt you to install them, or you may need to check the software's help menu or website to determine if an update is available.

Virus Protection

Your computer also benefits from having antivirus software, such as Windows Defender or Malware bytes, that can perform real-time scans on files you download and open. This PC maintenance task helps protect you from malicious files that can slow your computer, destroy important system files or lead to theft of passwords and other personal information. When your antivirus program detects a threat, it will alert you to delete the file or move it to a self-contained location where it can't cause harm to your computer. For the strongest protection, set your antivirus software to download automatic updates to protect you from the latest viruses.

Hard Drive Maintenance

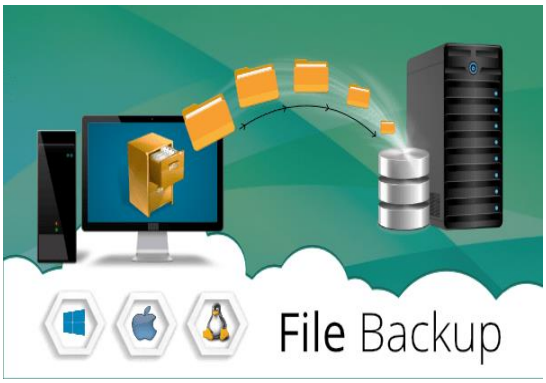
As you use your computer, temporary internet files, downloaded files and cache files build up and leave you with less hard-drive space. Running utilities such as the built-in Disk Cleanup for Windows and third-party programs like C Cleaner for Mac can locate and clear these files for you. Since visiting many websites collects files that can make your web browser sluggish, it also helps to check your browser's preferences or settings to find its option to clear the cache or temporary internet files.

In addition to removing junk files, occasionally checking your hard drive for unused programs and files you no longer use and removing them can restore space. If you're a Windows user, you can also try the built-in defragmentation utility, which reorganizes the data on your drive so your computer can boot up and access files faster.

File Backups

Creating regular file backups prevents data loss and can even provide a copy of your entire system in case of a hard-drive crash or destructive virus. Backup and Restore for Windows and Time Machine for Mac are native backup and restore utilities that can create a full system image, back up selected files and let you set a frequency and time for future backups. You can use an external hard drive, flash drive or DVDs to save your backups and then use the utility to easily restore individual files or return your computer to a previous state. If you prefer storing important files online, you can use One Drive, Drop

box or another cloud storage service to have more flexible access to your data on any device that can access the service's website.



1.3. Engineer's Tool bag and Use of Testing/Measuring Instruments

A toolkit should contain all the tools necessary to complete hardware repairs. As you gain experience, you learn which tools to have available for different types of jobs. Hardware tools are grouped into four categories:

1- ESD tools
2- Hand tools
3- Cleaning tools
4- Diagnostic tools

Electrostatic Discharge (ESD) Tools

The antistatic wrist strap and the antistatic mat. The antistatic wrist strap protects computer equipment when grounded to a computer chassis. The antistatic mat protects computer equipment by preventing static electricity from accumulating on the hardware or on the technician.

- Screwdrivers.
- Wrenches.
- Calipers.
- Scales.
- Bit holders.
- Tweezers.
- Waste bins.
- Brushes.

Hand Tools

Most tools used in the computer assembly process are small *hand tools*. They are available individually or as part of a computer repair toolkit. Toolkits range widely in size, quality, and price. Some common hand tools and their uses are:

Flat-head screwdriver	Used to tighten or loosen slotted screws.
Phillips-head screwdriver	Used to tighten or loosen cross-headed screws.
Torx screwdriver	Used to tighten or loosen screws that have a star-like depression on the top, a feature that is mainly found on laptops.
Hex driver	Used to tighten or loosen nuts in the same way that a screwdriver tightens or loosens screws (sometimes called a nut driver).
Needle-nose pliers	Used to hold small parts.
Wire cutters	Used to strip and cut wires.
Tweezers	Used to manipulate small parts
Part retriever	Used to retrieve parts from locations that are too small for your hand to fit.
Flashlight	Used to light up areas that you cannot see well
Wire stripper	A wire stripper is used to remove the insulation from wire so that it can be twisted to other wires or crimped to connectors to make a cable.
Crimper:	Used to attach connectors to wires
Punch-down tool	Used to terminate wire into termination blocks. Some cable connectors must be connected to cables using a punch down tool.

Cleaning Tools

Having the appropriate *cleaning tools* is essential when maintaining and repairing computers. Using the appropriate cleaning tools helps ensure that computer components are not damaged during cleaning. Cleaning tools include the following:

Soft cloth	Used to clean different computer components without scratching or leaving debris
Compressed air	Used to blow away dust and debris from different computer parts without touching the components
Cable ties	Used to bundle cables neatly inside and outside of a computer
Parts organizer	Used to hold screws, jumpers, fasteners, and other small parts and prevents them from getting mixed together

Diagnostic Tools

Diagnostic tools are used to test and diagnose equipment. Diagnostic tools include the following:

A digital multimeter is a device that can take many types of measurements. It tests the integrity of circuits and the quality of electricity in computer components. A digital multimeter displays the information on an LCD or LED.

Disk Management Tools

Software tools help diagnose computer and network problems and determine which computer device is not functioning correctly. A technician must be able to use a range of software tools to diagnose problems, maintain hardware, and protect the data stored on a computer.

You must be able to identify which software to use in different situations. Disk management tools help detect and correct disk errors, prepare a disk for data storage, and remove unwanted files.

The following are some disk management tools:

FDISK:

A command-line tool that creates and deletes partitions on a hard drive. The FDISK tool is not available in Windows XP, Vista, or 7. It has been replaced with the Disk Management tool.

Disk Management Tool:

Initializes disks, creates partitions, and formats partitions.

Format:

Prepares a hard drive to store information.

Scandisk or CHKDSK:

Checks the integrity of files and folders on a hard drive by scanning the file system. These tools might also check the disk surface for physical errors.

Defrag:

Optimizes space on a hard drive to allow faster access to programs and data.

Disk Cleanup:

Clears space on a hard drive by searching for files that can be safely deleted.

System File Checker (SFC):

A command-line tool that scans the operating system critical files and replaces files that are corrupted.

Use correctly testing and measuring instruments

Testing and maintaining tools and equipment

Everyone likely to be affected by electrical work must be kept safe with tools, testing equipment and personal protective equipment inspected and tested regularly.

A person conducting a business or undertaking (PCBU) who carries out electrical work must ensure the electrical safety of all persons and property likely to be affected by the electrical work.

A PCBU must have procedures in place to ensure that tools, testing equipment and personal protective equipment are regularly inspected and tested.

This requirement ensures that workers carrying out the work are electrically safe and that the work, when completed, is electrically safe.

Visual inspection

All tools, testing equipment and PPE should be visually inspected before each use for signs of damage.

PCBUs should have 'pre-start' visual inspection procedures in place to ensure that equipment such as, tools, PPE, rubber mats and LV rescue kits are in good working order before use.

Testing equipment should be checked for damage to insulated leads and probes and needs to be confirmed as working before use.

Testing of equipment

Testing equipment should be tested regularly to ensure it provides the level of protection required. Testing intervals will depend on several factors including:

- the frequency of use
- the environment in which it is being
- Manufacturer's advice.

For example, a multimeter used in a workshop environment may be subject to less damage that a multimeter carried in the back of a work van.

In absence of manufacturer's advice PCBUs should refer to a competent person with the knowledge and skills required for testing the particular type of equipment.

Items that have been misused or damaged should not be used until they have been re-retested and confirmed as functioning correctly.

Test equipment used for measurements such as earth continuity and insulation resistance should be regularly tested to confirm they are working correctly.

Some equipment such as multimeters may be able to be tested in-house, by using a calibrated resistor test block. Other equipment such as fault loop impedance testers or RCD testers may require specialist testing.

Make error or fault records

Purpose of Fault Recording

Fault records are one of the most important pieces of evidence that event analysts can have during system event investigations. They can provide the reasons for premature equipment failure, supply waveforms and status of equipment behavior during an event, and give necessary information to perform post-fault event analysis. Proper use and interpretation of event records can lead to corrective action for a given system problem resulting in improved performance and reliability of any generation, transmission, and distribution system.

BUG

In software testing, a bug is the informal name of defects, which means that software or application is not working as per the requirement. When we have some coding error, it leads a program to its breakdown, which is known as **a bug**. The **test engineers** use the terminology **Bug**.

Defect

When the application is not working as per the requirement is knows as **defects**. It is specified as the aberration from the **actual and expected result** of the application or software.

In other words, we can say that the bug announced by the **programmer** and inside the code is called a **Defect.**

Error

The Problem in code leads to errors, which means that a mistake can occur due to the developer's coding error as the developer misunderstood the requirement or the requirement was not defined correctly.
The **developers** use the term **error**.

Fault

The fault may occur in software because it has not added the code for fault tolerance, making an application act up.

A fault may happen in a program because of the following reasons:

- Lack of resources
- An invalid step
- Inappropriate data definition

Failure Many defects lead to the **software's failure**, which means that a loss specifies a fatal issue in software/ application or in its module, which makes the system unresponsive or broken.

In other words, we can say that if an end-user detects an issue in the product, then that particular issue is called a **failure**.

Possibilities are there one defect that might lead to one failure or several failures.

For example, in a bank application if the **Amount Transfer** module is not working for end-users when the end-user tries to **transfer money**, submit button is not working. Hence, this is a **failure**.

The flow of the above terminologies are shown in the following image:

Describe fault-finding flowchart

A graphical representation of a computer program in relation to its sequence of functions (as distinct from the data it processes)

1.4. Maintenance through Replacement

1. **Hardware upgrades:** When certain computer components become outdated or insufficient for the desired performance, they can be replaced with newer and more powerful ones. For example, replacing an older graphics card with a more advanced model or upgrading the amount of RAM to enhance system performance.
2. **Failed components:** If a critical hardware component, such as a hard drive or power supply, fails, it may be more practical and time-efficient to replace the faulty component entirely rather than attempting to repair it. This reduces downtime and ensures the system is up and running quickly.
3. **End-of-life components**: Over time, some computer components may reach their end-of-life or become obsolete. Instead of investing time and resources in repairing outdated components, it is often more cost-effective to replace them with newer models that offer better performance, compatibility, and reliability.
4. **Peripheral devices:** Maintenance through replacement is also applicable to peripheral devices such as printers, scanners, keyboards, and mice. If

these devices malfunction or experience issues, it is often easier and more efficient to replace them rather than attempting repairs.

It's worth noting that not all computer components are easily replaceable. Some specialized or integrated components, such as processors or motherboards, may require more complex procedures or technical expertise to replace. In such cases, repair or seeking professional assistance may be more appropriate.

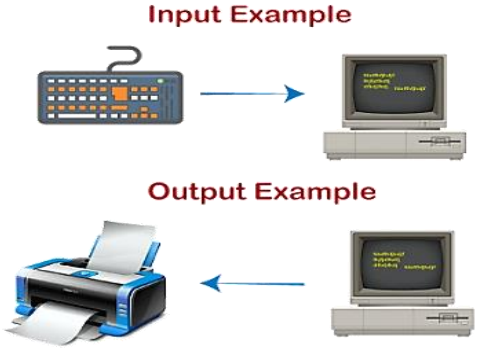
Before opting for maintenance through replacement, it is essential to consider factors such as cost, compatibility, availability of replacement parts, and the impact on system performance. Additionally, it's always recommended to back up important data before replacing any components to avoid data loss during the process.

Regular maintenance, including software updates, virus scanning, and disk cleanup, can help extend the lifespan of computer systems. However, when hardware components become faulty or outdated, maintenance through replacement can be an effective strategy to ensure optimal performance and efficiency.

1.5. Introduction of Input / Output Devices

An (I/O) device is a hardware device that has the ability to accept inputted, outputted or other processed data. It also can acquire respective media data as input sent to a computer or send computer data to storage media as storage output.

Input device helps the computer to receive instructions from users. The output device helps the computer to produce or display the information to the users. There are various input devices available like Microphone, Joystick, Keyboard, Pointing device, Image Scanner.



Input devices

An input device can receive instructions from users or forward information to another device, but it is not able to accept data from another system.

After receiving input, it translates these data into the electrical signals in binary code, which cannot be understandable by humans, and only a digital computer can understand it. There are many examples of input devices, which are discussed below:

- **Keyboard and Mouse:** These are the input devices that are used by the users to give input to the computer. They send the received input (Data) from users to the system. As these are input devices, they cannot receive or display output (information) from the computer.
- **Microphone: Another** input device is a microphone that accepts sound generated by an input source and allows users to send audio into their computers. In the microphone, the accepted signal may be converted into a digital signal or can be amplified as an analog signal.
- **Webcam:** A webcam is a video camera that connects to a computer and faces the user, which is used to capture pictures, make a video by a computer system. It takes images as input from where it is pointed and used for calling and taking selfies. However, most modern webcams have a microphone, which offers users a better sound quality while making videos. Webcams are attached to the monitor of a desktop computer and also built into laptops.

Output devices

Output devices are the section of a computer device that receives data from another device and produces output with the information. Although it cannot send data to another device, it has the ability to forward data from a computer to another computer system. It functions to take data from input devices and translate the digitized signals into a form that can be understandable by users. There are various examples of output devices; some are discussed below:

- **Monitor:** A monitor is a piece of computer hardware that accepts data from a computer (output) and displays it on the system screen through the computer's video card. Monitors have the ability to display information at a much higher resolution. Additionally, these are much like televisions and also known as video screen, display, video display terminal, or video display unit.
- **Speakers:** The most common output devices, speakers accept sound data from a computer and play the sounds for users to hear. Although speakers can be used with any type of sound system, some speakers are manufactured only for computers. It is a device that cannot receive sound generated by users as well as refer that sound to another device. The main objective of the speakers is to produce sound or audio output for the listener.
- **Projector:** A projector is an output device that accepts data from a computer (output) and projects that data or information as a picture onto a wall or screen or any large surface. It does not have the ability to receive data from a user and also not capable of sending that data to another device. When you are showing video or images to a large group of people, a projector is more beneficial to use instead of a monitor because it displays data on a large surface that can be visible to a large number of people clearly.

Input/output devices

An input/output device has the ability to accept data from users or another device (input), as well as forward data to another device (output). Some examples of input/output devices are discussed below:

- **CD-RW drive and DVD-RW drive:** These drives functions for accepting data from a computer as an input to copy onto a writable CD or DVD. And, this data contained on a CD or DVD is sent by the drive to the computer.
- **USB flash drive:** It is also referred to as a keychain drive, data stick, USB flash drive, thumb drive, memory unit, pen drive. It is a portable storage device that saves or accepts data from a computer (input). It connects to a

computer via a USB port and forwards data to a computer or another device (output).

Difference between Input and Output devices.

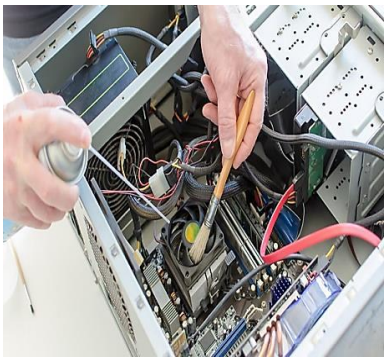
The below table contains major key points.

Input device	Output device
The input device receives data from users.	An output device displays data on the screen for users.
It works for translating user-friendly instructions into a machine friendly.	It works for translating the machine's instructions to user intelligible.
An input device can be commanded by the user.	Processor commands output device.
It accepts data from the user as an input and forwards it to the processor for further processing.	The data, which is processed by the processor, is sent to the output device for sending it back to the user; it means that the output device takes the processed data from the processor.
Its design is more complex.	As compared to input devices, its design is less complex.
Input device helps the computer to receive instructions from users.	The output device helps the computer to produce or display the information to the users.
There are various input devices available like Microphone, Joystick, Keyboard, Pointing device, Image Scanner, Graphics tablet, and more.	There are several output devices available such as Speakers, Printers, Plotters, Projector, Monitor and more.

1.6. Second Level of Maintenance

Second-level maintenance refers to professional maintenance tasks such as: replacements, repairs, fine-tuning. In general, these interventions require

expertise and in-depth knowledge of the machines, first of all their safety systems and the operating principles.




1.7. Hardware Diagnostic Routines and Diagnostic Software

Diagnosing computer problems requires a troubleshooting skill, logical thinking and an understanding of the equipment.

Diagnostic routines.

A typical diagnostic routine might attempt to isolate the cause of the error to a particular hardware or software subsystem, or simply record the values of the major data objects at the time that the error occurred.

Before working inside the case, we should:

1. Power off your computer, turn off the PSU, and unplug it.
2. Wear an antistatic wrist strap.
3. Ground yourself by first touching the PSU.
4. Be careful not to damage motherboard components with sharp, hard tools.
5. Don't use force to remove components and check the manual for how to remove them.
6. Don't do anything you are not comfortable with.

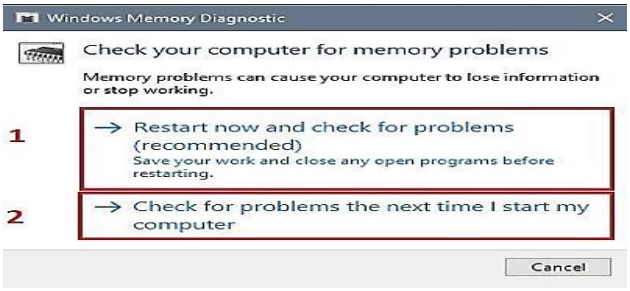
Use Diagnostic Software

Diagnostic software is used to identify problems on a computer or piece of equipment. These programs test the onboard systems for issues and help to alert users of potential problems or breakdowns. Over the years, these

programs have gone from very basic to complex and highly specialized. With this increase in technology, the skill required to use the software has actually decreased to the point where most people can use this software with little or no training. Programs that provide diagnostic information are common everywhere. Something as simple as the oil light on a car dashboard is a type of diagnostic software. These hard-coded diagnostic tools usually monitor one specific part of a larger piece of equipment and typically are always operating. While these types of diagnostic programs are the most common, they are usually the least versatile. When people think of true diagnostic software, they usually think of the types used on computers. These programs monitor the computer for problems involving every aspect of the machine, from hardware to software—far more complex and versatile than the change oil light.

1. Press the **Windows key** on your keyboard and the letter **R** at the same time to open the **Run** window. Type **mdsched.exe** and press **OK**.

2. **Windows Memory Diagnostic** will open with two options for scanning. The first option is **Restart now and check for problems** if you want to run the scan immediately. The second option is **Check for problems the next time I start my computer** if you want to run the scan later after a restart.



3. When the computer restarts, the Memory Diagnostic will automatically start. When the diagnostic completes the system will restart again.

Describe the limitation of diagnostic software

Diagnostic Tests	Target	Advantages	Limitation
Polymerase Chain Reaction (PCR)	Nucleic acid of virus	• Rapid and sensitive • Quantification of RNA molecule (10^4 to 10^{10} per reaction)	Require special equipment (Huang et al.2012)
DNA-based fluorescence nanobarcodes methodology	Nucleic acid of virus	• Multiplexed approach for detection. • Detection limit is 620 attomole.	Require skilled personnel.
ELISA (antigen detection)	Viral antigen	• Rapid and sensitive. • 30 ng/well of recombinant NP antigen could be detected (Niikura, et al.2001)	Sometimes provide false results.
Immunohistochemistry	Viral antigen	• It's a qualitative imaging method.	Time required.
Fluorescence assay	Viral antigen	• Rapid technique. • Qualitative analysis.	Interpretation of results requires skilled personnel.
ELISA (antibody based)	Virus specific antibodies	• Sensitive and specific technique. • Can detect upto 20 ng of EBOV Zaire GP protein.	Time required. Primary disease diagnosis is not possible.
Indirect Immunofluorescence assay	Virus specific antibodies.	• Easy to perform • Qualitative imaging method	Non-specific technique. Interpretation of results is difficult
Immuno-blot assay	Virus specific antibodies	• Specific technique. • Easy to perform	Interpretation of results is difficult sometimes.
Biosensors	Virus detection	• Based on antibody based specific detection. • Rapid and sensitive • Limit of detection is 0.005 PFU/ml	Based on antibody detection results, so cannot be used for primary disease diagnosis. As antibodies are generated in patient body on 7^{th} day and remains up to 3 months.
Electron Microscopy	Viral particles detection	• Immunostaining method used. Morphology can be seen. • Qualitative analysis.	Insensitive technique. Needs special equipment.
Immuno-chromatographic strip	Glycoprotein antigen	• Sensitive method. • Limit of detection 1 ng/ml of GP antigen.	It is not tested for ZEBOV.
Next generation sequencing	Viral genetic material	• Sequence large amount of genetic material. • Remarkable depth of covering sequence of genetic material	Do not identify sequence of interest and sequence all the host genetic material present.
LAMP assay	Virus	• Limit of detection was 10^{-3} FFU.	Unable to detect virus in oral samples.
Immunofluorescence assay	NP antigen	• Sensitive for the serum samples infected with REBOV and ZEBOV.	Detect antibodies to EBOV so cannot be used for initial screening of EVD

Multiple Choice Questions

1. To prevent the loss of data during power failures, use a(n)_____?

a. Encryption program c. Firewall

b. Surge protector d. UPS

2. The modification of the software to match changes in the ever changing environment, falls under which category of software maintenance?

a. Corrective b. Adaptive c. Perfective d. Preventive

3. Which of the following would be a logical first step in troubleshoot a pc.

a. Check the computer CMOS

b. Define the circumstances of the problem

c. Call the vendor

d. Define what applications are being used

4. Which would you do first when troubleshooting a faulty monitor?

a. Check its connections to the computer and power source
b. Use a meter to check the CRT and internal circuitry for continuity
c. Power down the monitor, then turn it on again to see if that corrects the problem
d. Power down the computer, then turn it on again to see if that corrects the problem

5. You have a PC with no video* Which of the following is LEAST likely to be causing the problem?

a. defective RAM (bank zero) c. crashed hard drive
b. defective microprocessor d. loose video card

6. When connecting a ribbon cable to a connector, how do you know which direction to plug it in?

a. The red line in the cable goes to the highest pin number
b. The colored line in the cable goes to pin #1
c. It does not matter
d. The blue or red line in the cable goes away from the power connector

7. What is the first step in diagnosing a completely dead computer at the client site that was working the day before?

a. Test the power supply
b. replace the CMOS battery
c. check the AC outlet
d. reseat the hard drive controller cable

8. A workstation has just been installed on an Ethernet LAN, but cannot communicate with the network. What should you check first?

a. reinstall the network protocols
b. reinstall the network interface card driver
c. verify the ip configuration on the workstation
d. verify the link status on the computer's network card

9. One of the major components of a PC is the Central Processing Unit (CPU) which can be best described as:

a. The device that sends the monitor signals telling it what to display
b. The area that regulates all of the system power usage
c. The area where all of the processing takes place
d. The area where ail the of the Basic input/output routines are stored

10. IDE cables have how many pins?

a. 25 b. 50 c. 100 d. 40

1	2	3	4	5	6	7	8	9	10
d	b	b	a	c	b	c	d	c	d

Short Questions

1. what are the preventive maintenance
2. List the contributors to failures of system
3. Handle correctly peripherals
4. Schedule maintenance
5. List tools used for system maintenance
6. Use correctly testing and measuring instruments
7. Perform system maintenance by replacement
8. Describe second level maintenance
9. Describe hardware diagnostic routines
10. Use diagnostic software

Long Questions

1. Describe the effects of corrosion and magnetism to system performance
2. Describe Virus and prescribe measures to prevent virus attacks
3. Make error or fault records
4. Describe fault-finding flowchart
5. Describe the limitation of diagnostic software

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Soper, David L. Prowse and Scott Mueller.
- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
- PRINCE GEORGE'S COMMUNITY COLLEGE
- Computer Hardware Technicians CH111, 5 CD-ROM set by NCSA Academy USA
- Computer Hardware Technicians

Chapter No. 2

(Troubleshooting and Repair of a Motherboard)

Objectives:

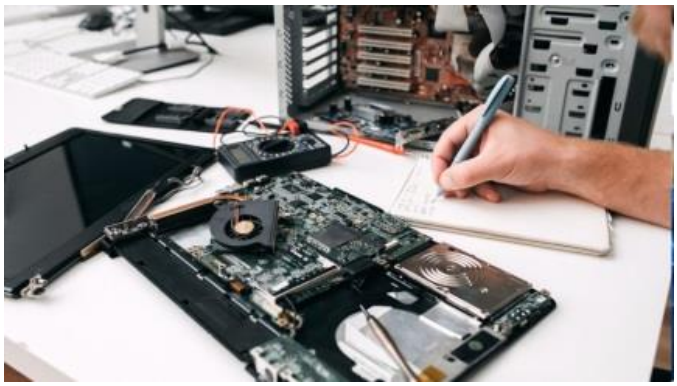
After completion of this chapter students will be able to:

2. Troubleshooting and Repair of Motherboard

2.1. Introduction to Motherboard
2.2. Motherboard and CPU Architectures
2.3. CPU Socket Types
2.4. Expansion Bus and alternatives
2.5. Motherboard Connectors and BIOS / CMOS
2.6. Commonly Occurring Faults and Important Signals for Fault Tracing
2.7. Diagnostic Tests
2.8. Preventive Measures

Troubleshooting

Troubleshooting is a systematic process used to locate the cause of a fault in a computer system and correct the relevant hardware and software issues. Approaching problem solving using a logical and methodical approach is essential to successful resolution. Although experience is very useful to problem solving, following a troubleshooting model will enhance effectiveness and speed.



Troubleshooters initially look for common, known causes. For example, when a laptop won't boot up, an obvious first step is to check

whether the power cable is working. Once common issues are ruled out, troubleshooters must run through a checklist of components to identify where the failure is happening.

2.1. Introduction to Motherboard

A motherboard is the main printed circuit board (PCB) in a computer. The motherboard is a computer's central communications backbone connectivity point, through which all components and external peripherals connect. Motherboards can be found in virtually all computers, especially desktop and laptop PCs.

Describe Motherboard

A **motherboard** (also called **mainboard, main circuit board MB, Mboard, backplane board, base board, system board, logic board** (only in Apple computers) or **mobo**) is the main printed circuit board (PCB) in general-purpose computers and other expandable systems. It holds and allows communication between many of the crucial electronic components of a system, such as the central processing unit (CPU) and memory, and provides connectors for other peripherals. Unlike a backplane, a motherboard usually contains significant sub-systems, such as the central processor, the chipset's input/output and memory controllers, interface connectors, and other components integrated for general use.

Motherboard means specifically a **PCB** with expansion capabilities. As the name suggests, this board is often referred to as the "mother" of all components attached to it, which often include peripherals, interface cards, and daughterboards: sound cards, video cards, network cards, host bus adapters, TV tuner cards, IEEE 1394 cards; and a variety of other custom components.

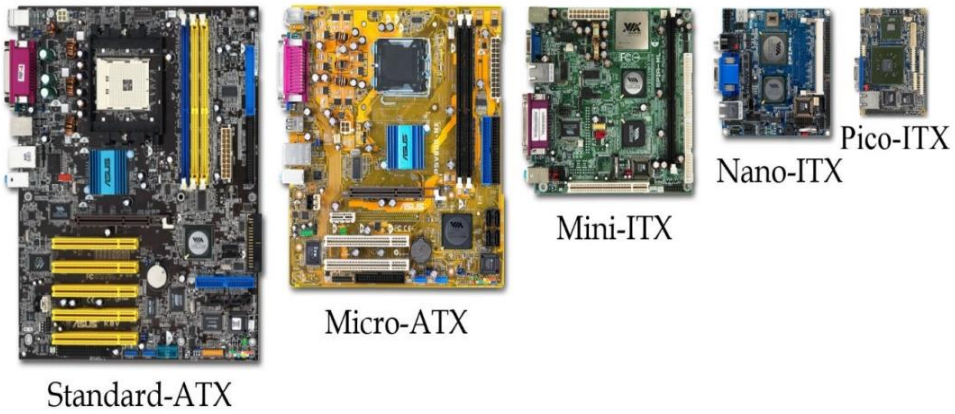
Dell Precision T3600 System Motherboard

This model follows the Baby AT (form factor), used in many desktop PCs.

Different types of Motherboards:

AT Motherboard. These motherboards have bigger physical dimensions of hundreds of millimeters and hence they are not the right fit for the mini desktop category of computers. ...

- ATX Motherboard.
- LPX Motherboard.
-
- Pico BTX motherboard.
- Mini ITX motherboard.



Describe system board and planar board

System Board

The system board is also called the motherboard, main-board, planar board, or logic board.

Prior to the advent of the microprocessor, a computer was usually built in a card-cage case or mainframe with components connecting to it by a back plane. It usually was consisting of a set of slots themselves connected with wires. The Central Processing Unit, memory and peripherals were housed on individual printed circuit boards which plugged into the back plate.

In the late 1980s, motherboards began to include single ICs (also called Super I/O chips) capable of supporting a set of low-speed peripherals: keyboard, mouse, floppy disk drive, serial ports, and parallel ports. By the late 1990s, many personal computer motherboards supported a full range of audio, video, storage, and networking functions without the need for any expansion cards at all.

The early pioneers of motherboard manufacturing were Micronics, Mylex, AMI, DTK, Hauppauge, Orchid Technology, Elite group, DFI, and a number of Taiwan-based manufacturers. The most popular computers such as the Apple II and IBM PC published schematic diagrams and other documentation which permitted rapid reverse-engineering and third-party replacement motherboards.

A motherboard provides the electrical connections by which the other components of the system communicate. Unlike a back plane, it connects the central processing unit and hosts other subsystems and devices.

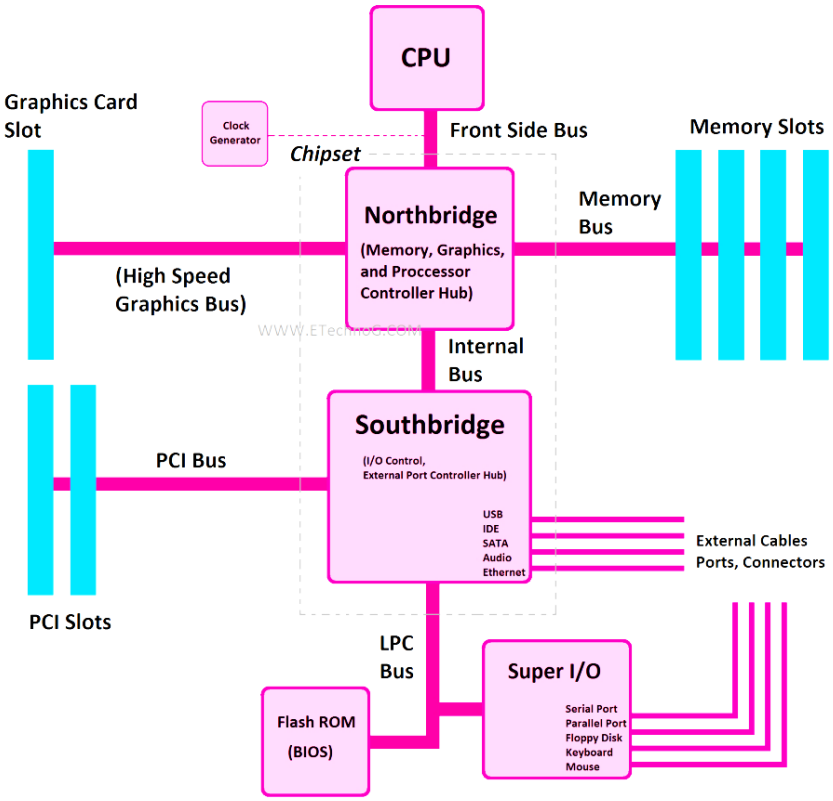
Usually the microprocessor, main memory, and other essential components are connected to the motherboard. Other components such as external storage, controllers for video display and sound, and peripheral devices may be attached to the motherboard as plug-in cards or via cables, in more modern computers it’s increasingly common to integrate some of these peripherals into the motherboard.

An important component of a motherboard is the microprocessor's supporting chip set. This chip set determines the features and capabilities of the motherboard.

Modern motherboards include, at a minimum sockets (slots), the CPU, slots for the system's main memory, a chip set which forms an interface between the CPU's front-side bus, main memory, and peripheral buses, non-volatile memory chips containing the system's firmware or BIOS, a clock generator to synchronize the various components, slots for expansion cards, power connectors, logic and connectors to support commonly used input devices, and occasionally video interface hardware

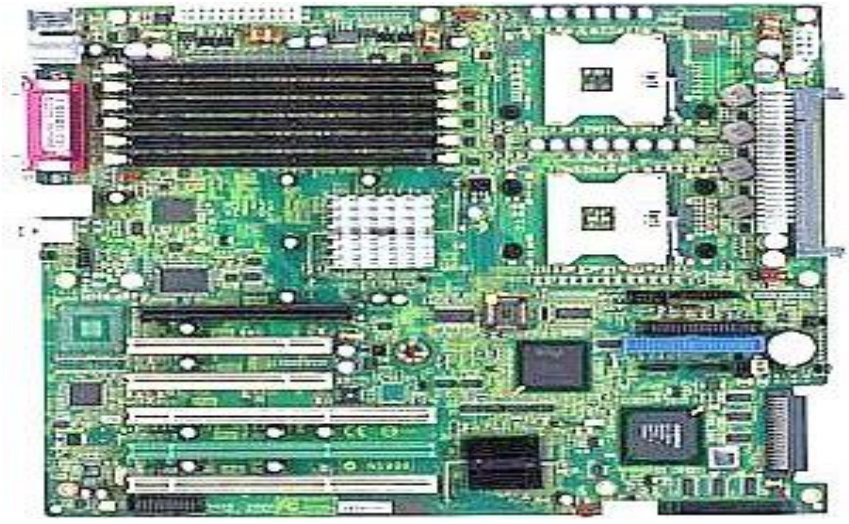
Modern motherboards nearly always include heat sinks and mounting points for fans to dissipate excess heat.

Identify Motherboard Components and functional block using block diagram



Computer Motherboard Block Diagram

Main Important Parts of Components of the Motherboard are.



1. CPU

CPU stands for Central Processing Unit. It is the heart of the motherboard or the whole computer. It performs the arithmetic operations such as addition, subtraction, division, multiplication, and logical operations such as rotate, moves, and many others. The CPU does not communicate directly with the real world. There are so many peripheral and supporting devices connected to the input and output of the CPU.

2. Clock Generator

It is basically a pulse signal generation circuit. It generates a pulse signal and provides to all the important devices of the motherboard such as processor, RAM, and other devices. It makes synchronization between all the devices for communication, data transferring, etc. The speed of the clock generation is measured by Hertz (Hz), Megahertz (MHz), or Giga Hertz (GHz).

3. Bus

Bus or Bus bar is a pathway for data or signal transmission between different components of the motherboard. It is built with so many electrical conductors or conducting paths.

4. Chipset

It is built with different ICs, devices that manage the data transmission between the processor and different components of the motherboard. Generally, the north bridge and south bridge chipset together is called the chipset.

5. Northbridge and South Bridge

The North Bridge and south bridge are the main two components of the chipset. The northbridge controls the memory units such as RAM, Processor, and the Accelerated Graphics Port (AGP). It is the controlling hub for the memory unit.

On the other hand, the south bridge controls all the Input/Output control such as USB, IDE, SATA, Ethernet, Audio Codec, and other ports.

6. Slots

Slots are the arrangement for placing or interfacing different devices such as audio cards, RAM graphics cards, network cards, modems, etc. Here, in the computer motherboard, you will see different types of slots such as

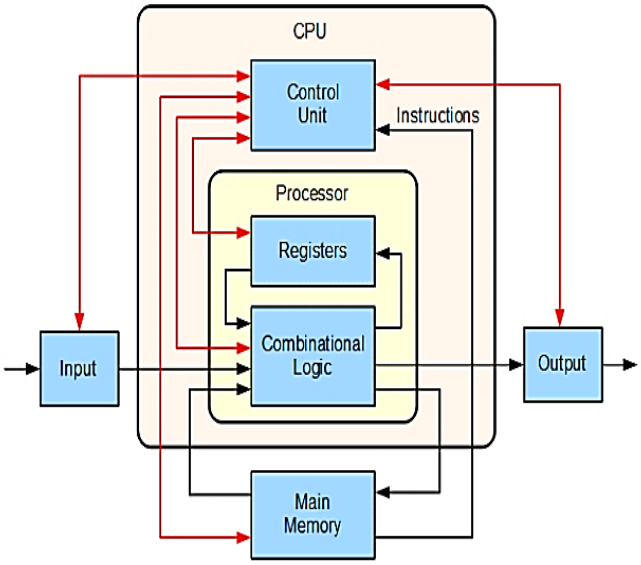
PCI(Peripheral Component Interconnect) Slots, Graphic Card Slot, Memory Card Slots, etc. These slots help to connect and disconnect devices very easily.

7. RAM and ROM

RAM stands for Random Access Memory and ROM Stands for Read-Only Memory. RAM is a memory that is used during the program execution by the CPU. It is a temporary memory. CPU stores data temporarily in this RAM. On the other hand, ROM is a permanent memory. Once the data is stored in the ROM, it cannot be deleted. ROM is used to store the main program instructions, BIOS software, etc.

2.2. Motherboard and CPU Architectures

The CPU can be further divided into three main parts: the arithmetic logic unit (ALU), the control unit (CU), and what are known as registers.



To make up the architecture, instruction set architecture is needed because it has a set of instructions that the processor understands. It has two instruction set one is RISC (reduced instruction set computer) and the second is CISC (complex instruction set computer)

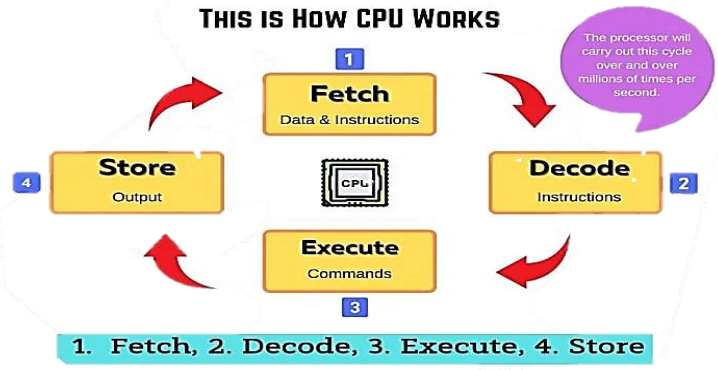
Enumerate types and characteristics of CPU

The acronym CPU is referred to as the Central Processing Unit. CPU is one of the most important parts of any digital computer or any other programmable device. Different types of central processing unit (CPU) is responsible for the efficiency and working of the device.

The CPU is the central memory of the computer or any device that allows all the tasks like gaming, editing, Internet surfing, messaging, etc., to be carried out efficiently. The processor is placed in the center of the motherboard around the VRM section.

In technical terms, the Central Processing Unit (CPU) is a vital component being the brain of a computer device that handles all the instructions and arithmetic or logical calculations.

And then signals are sent to the other units of the computer to carry out all series of processes related to the management of computer memory. During this process, heat generates whish's why small CPU fans need to install to dissipate it.



In short, the central processing unit is responsible for inputting and storing the programs and data that the machine will require at the time of executing a job as an output for the user.

The **Central Processing Unit** houses the internal units like RAM and ROM memories, hard drives, and power supply units.

These offers ports in which you can connect various input and output and storage devices such as monitors, pen drives, microphones, headphones,

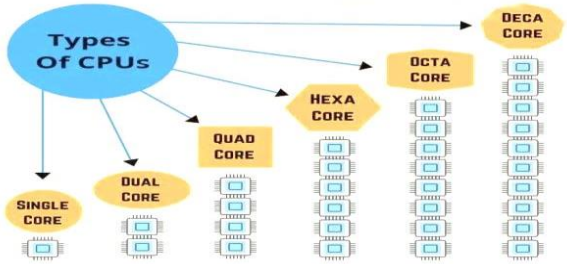
keyboards, mouse, digital graphics tablets, printers, and cameras via PC Cabinet.

Types of Central processing Unit / Types of Processors

There **are 6 types of central processing units Single Core Cpu, Dual Core Cpu, Quad Core Cpu, Hexa Core Cpu, Octa Core Cpu, and Deca Core Cpu.** These are the 6 types of central processing units that are being used in various devices like desktops, laptops, and mobile phones.

These types of CPUs decide the speed, Efficiency, Multithreading, cache, clock frequency, effective functioning of the computer, and mobile devices.

The performance at which software programs operate depends on how powerful the CPU is. The main manufacturers are Intel, and AMD in computers and Qualcomm (Snap Dragon), Media Tec, Samsung (Exons), and Apple Bionic are in mobile devices, each of them has its own type of Central Processing Unit.



CPU (Processor)				Speed and Cache Level
1. Single Core CPU	1	core processor in the Year **1971.**	4004	740 KHz and 640 bytes of RAM.
2. Dual Core CPU	2	Intel released their first Dual-core processor in the Year **2005.**	Pentium D	2.80 GHz and 2 MB of Cache.
3. Quad Core CPU	4	AMD released their first Quad-core processor in the Year **2009**.	Athlon II X4	3 GHz and 2 MB of Cache.
4. Hexa Core CPU	6	Intel released their first Hexa-core processor in the Year **2010**.	Intel core i7-980X	3.60 GHz and 12 MB of Cache.
5. Octa Core CPU	8	Intel released their first Octa-core processor in the Year **2014**.	Intel Core i7-5960X	3.50 GHz and 20 MB of Cache.
6. Deca Core CPU	10	Intel released their first Deca-core processor in the Year **2017**.	Xeon Silver 4114T	3 GHz and 13.75 MB of Cache.

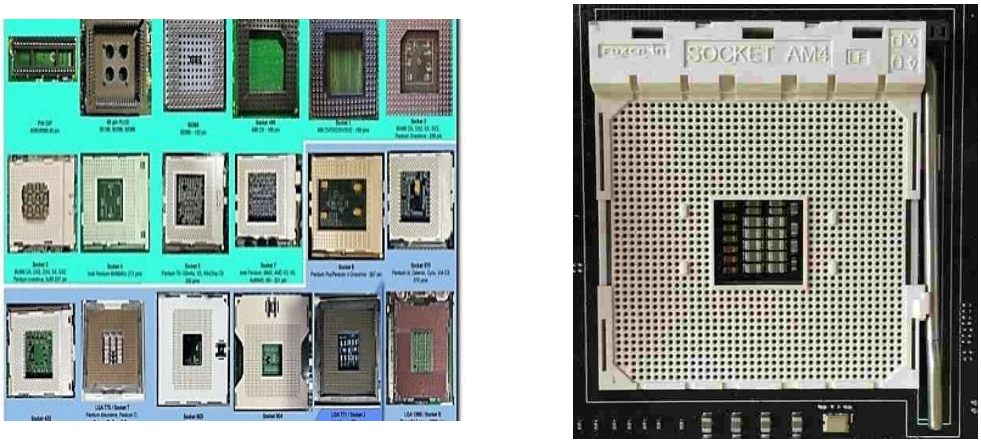
2.3. CPU Socket Types

Common types of CPU sockets include the Pin Grid Array (PGA) and the Land Grid Array (LGA). The difference between the two is that PGA places the pins on the processor and the holes in the socket, whereas LGA has a socket with pins that you place the processor on.

Depending on the physical arrangement of the socket components, there are mainly four types of computer processor sockets:

LGA Sockets. PGA Sockets. ZIF sockets.

BGA Sockets. Intel vs AMD CPU Sockets.



Processor Sockets – Intel and AMD Socket Types

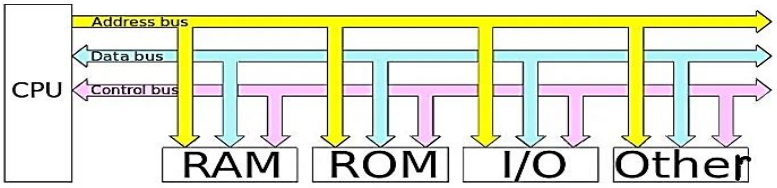
The ATX motherboard processor sockets used by AMD and Intel CPUs

2.4. Expansion Bus and alternatives

An input/output pathway from the CPU to peripheral devices. An expansion bus typically comprises a series of slots on the motherboard into which cards are inserted. PCI and PCI Express are common expansion buses in computers. See PCI, PCI Express, expansion card and PC data buses. See also bus extender.

Differentiate types of bus and slots

A bus is a common pathway through which information flows from one computer component to another. This pathway is used for communication purposes and it is established between two or more computer components. We are going to check different computer bus architectures that are found in computers.



The Address Bus

The address bus is used by the CPU to send the address of the memory location or the input/output port that is to be accessed at the instant. It is a unidirectional bus i.e. the address can be transferred in one direction only and that is form CPU to the required port or location. Whether it is a read operation or writes operation the CPU calculates the address of the required data and sends it on the data bus for the execution of the required operation. The maximum number of memory locations that can be accessed in a system is determined by the number of lines of an address bus. An address bus of n lines can be addressed at the most 2n locations directly. Thus a 16-bit address bus can allow access 2 16 bits or 64 K Byte of memory.

The Data Bus

A data bus is used to carry the data and instructions from the CPU to memory and peripheral devices and vice versa. Thus it is a bidirectional bus. It is one of most important parts of the connections to the CPU because every program instruction and every bite of data must travel across the bus at some point. The size of the data bus is measured in bits. The data bus size has much influence on the computer architecture because the important parameters of it like word size, the quantum of data etc. are determined and manipulated by the size of the data bus.

Generally, a microprocessor is called n-bit processors. Thus as the CPU became more advanced, the data bus grew in size. A 64-bit data bus can transfer 8 bytes in every bus cycle and thus its speed is much faster as compared to the 8-bit processor that can transfer one byte in every bus cycle.

The Control Bus

A control bus contains various individual lines carrying synchronizing signals that are used to control. Various peripheral devices connected to the CPU. The common signals that are transferred to the control bus from CPU to

devices and vice versa are memory read, memory writes, I/O read, I/O write etc.

Bus Terminologies

Computers have two major types of buses:

1. System bus:- This is the bus that connects the CPU to the main memory on the motherboard. The system bus is also called the front-side bus, memory bus, local bus, or host bus.
2. A number of I/O Buses, (I/O is an acronym for input/output), connecting various peripheral devices to the CPU. These devices connect to the system bus via a 'bridge' implemented in the processors' chipset. Other names for the I/O bus include "expansion bus", "external bus" or "host bus".

Expansion Bus Types

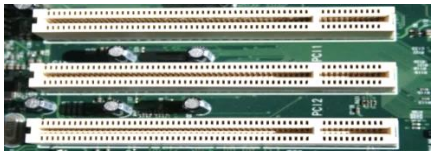
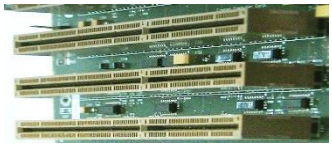
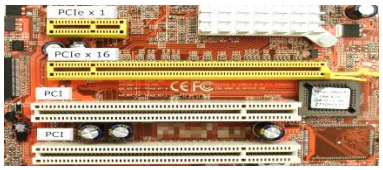
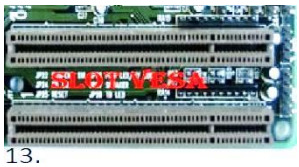
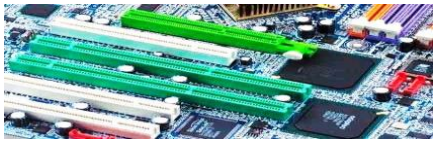
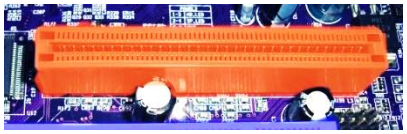
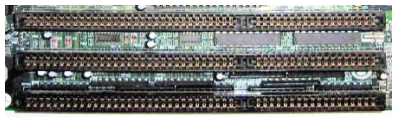
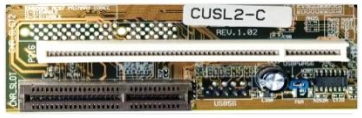
1. **ISA** - Industry Standard Architecture
2. **EISA** - Extended Industry Standard Architecture
3. **MCA** - Micro Channel Architecture
4. **VESA** - Video Electronics Standards Association
5. **PCI** - Peripheral Component Interconnect
6. PCI Express (PCI-X)
7. **PCMCIA** - Personal Computer Memory Card Industry Association
8. **AGP** - Accelerated Graphics Port
9. **SCSI** - Small Computer Systems Interface

Expansion slot

Alternatively known as a bus slot or expansion port, an expansion slot is a connection or port inside a computer on the motherboard or riser card. It provides an installation point for a hardware expansion card to be connected. For example, if you wanted to install a new video card in the computer, you'd purchase a video expansion card and install that card into the compatible expansion slot.

Different Types of Slots on Motherboard

1. PCI Slots
2. PCIe Slots
3. PCI-X Slots
4. AGP Slots
5. ISA Slots
6. EISA Slots
7. VESA Slots
8. RAM Slots
9. AMR Slots
10. CNR Slots

PCI Slots 	EISA Slots 
PCIe Slots 	VESA Slots  13.
PCI-X Slots 	RAM Slots 
AGP Slots 	AMR Slots 
ISA Slots 	CNR Slots 

Describe Daughter Boards

A daughterboard is type of circuit board that plugs in or is attached to the motherboard or similar expansion card to extend its features and services. A daughterboard complements the existing functionality of a motherboard or an expansion card.

A daughterboard is also known as daughter card, piggyback board, riser card or mezzanine board.

Explanation Daughterboard

A daughterboard is connected directly to the motherboard. Unlike expansion cards, which connect with the motherboard using bus and other serial interfaces, daughter boards are usually directly embedded through soldering. Like a motherboard, a daughterboard has sockets, pins, plugs and connectors to be attached to other boards. Typically, daughter boards are released as a post-launch update to a motherboard or expansion card. For example, a MIDI daughterboard is used to add on the functionality of the sound card.

A motherboard with daughterboard

2.5. Motherboard Connectors and BIOS / CMOS

Complementary metal-oxide-semiconductor (CMOS) is a small amount of memory on a computer motherboard that stores the Basic Input/ Output System (BIOS) settings. The BIOS is the software stored on the memory chip on the motherboard.

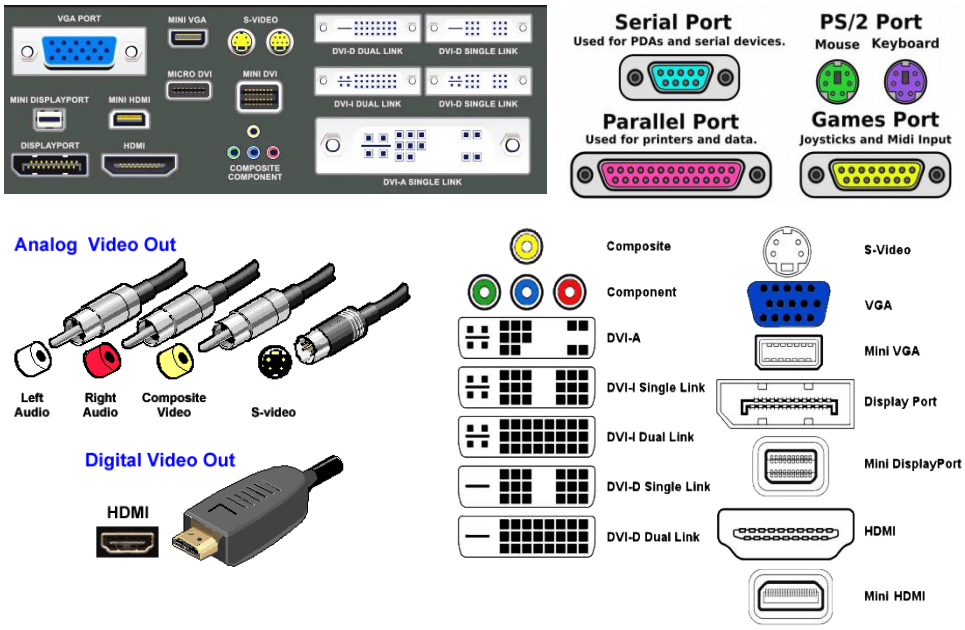
The BIOS is the program that starts a computer up, and the CMOS is where the BIOS stores the date, time, and system configuration details it needs to start the computer. The BIOS is a small program that controls the computer from the time it powers on until the time the operating system takes over.

Identify Common Video, I / O types

Video inputs and outputs are physical connectors of a device. These can be for example RF connectors (antenna/cable), CVBS a.k.a. Composite Video, S-Video or RGB connectors. Video and VBI capture devices have inputs. Video and VBI output devices have outputs, at least one each.

HDMI, Display Port, and USB-C™ are the most common types of monitor ports and cables, and you'll find them on the majority of modern displays. However,

there are legacy options available as well, such as VGA and DVI that you may need to connect to older devices.



2.6. Commonly Occurring Faults and Important Signals for Fault Tracing

List of Commonly Occurring Motherboard Faults

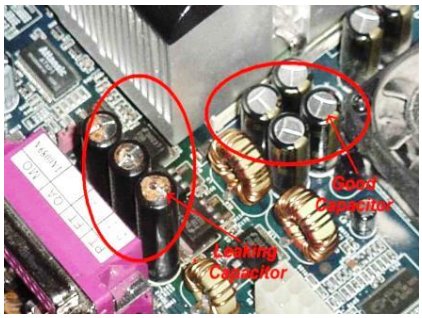
Common symptoms of motherboard issues are similar to CPU problems: The system does not display anything; an error code appears; one or more beeps occur; the system locks; the system reboots; a Windows BSOD (blue screen of death) appears; or one or more of the ports, expansion slots, or memory modules fails.

Your computer's motherboard is a critical component that plays a major part in what other components you can and can't install. Motherboards have a reputation for being finicky to troubleshoot, however, which keeps some PC enthusiasts fearful of ever touching it, let alone attempting to replace one. On rare occasions, you might even have motherboard issues with a new PC — these include random reboots, refusing to boot up, and continual crashes citing fatal exceptions, illegal operations, and general protection fault error messages.

Common Faults

- Not enough power
- Improperly installed components
- A short circuit
- No case power button connection
- UEFI/BIOS hardware incompatibility

Reasons Your Computers Motherboard Fail Might



- Electrical spikes and surge
- Dust ,pet hair and debris
- Citrate smoke
- Heating issues
- Impact or spill
- Manufacturer design defects
- Normal aging and wear

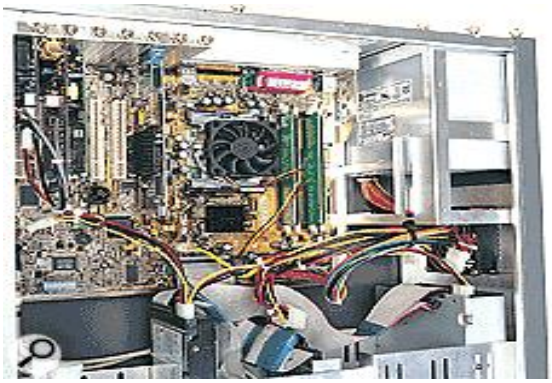
Identify Important Signals for Fault Tracing

Fault diagnosis methods are broadly classified into three main categories: model-based, hardware-based and history-based.

Fault detection is the process of discovering the presence of a fault in any equipment before it manifests itself in the form of a breakdown. It is the most important stage of FDD as all of the downstream processes depend on its accuracy.

There are three main types of faults: transient, intermittent, and permanent. A transient fault is a fault that happens once, and then doesn't ever happen again. For example, a fault in the network might result in a request that is being sent from one node to another to time out or fail.

Faults come from many different sources: software, hardware, design, implementation, operations, and the environment of the system. Here are some typical examples: Software fault: A programming mistake, such as placing a less-than sign where there should be a less-than-or-equal sign.



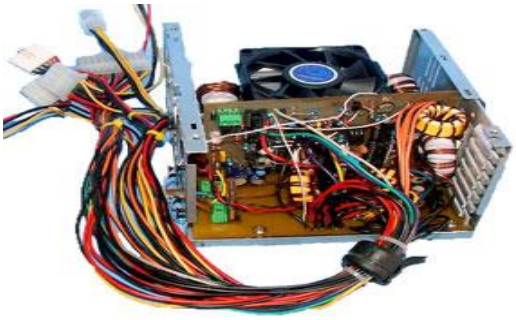
Intermittent Hardware Problems

An intermittent fault, often called simply an "intermittent", (or anecdotally "interfiling") is a malfunction of a device or system that occurs at intervals, usually irregular, in a device or system that functions normally at other times.

Intermittent problems cannot be made to appear again easily. Some examples of intermittent problems are: A reference code appears on the control panel (the system attention light is on) but disappears when you power off, then power on the system.

Power Supplies

The five common power supply problems include voltage and current issues at the input and output, reversed polarity, temperature issues, and missing external components.



Static Precautions

- Step 1: make sure you're grounded. Before you start, leave the connector plugged in so it stays grounded. ...
- Step 2: use an antistatic wrist strap. A different solution is to use a antistatic wrist strap. ...
- Step 3: avoid static surface and static-sensitive clothes.

BIOS Beep Codes

The computer post (power-on self-test) checks a computer's internal hardware for compatibility and connection before starting the remainder of the boot process. If the computer passes the POST, the computer may give a single beep (some computers may beep twice) as it starts and continues to boot. However, if the computer fails the POST, the computer may generate a beep code telling the user the source of the problem.

The most common causes of POST failures are problems with the following components.

- BIOS ROM
- CPU (processor)
- Motherboard
- RAM (memory)
- Video card

If your computer has an irregular POST or a beep code not mentioned below, follow the POST troubleshooting steps to determine the failing hardware component.

Cable Issues

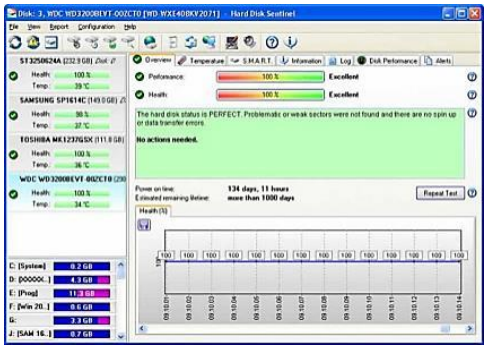
One common installation mistake to look out for is running data cables parallel to electrical wiring. The magnetic field generated in electric wiring can interrupt the signals in data cables, crippling network performance. Proper cabling is key to a reliable, efficient network.

Soundcard Problems

Most sound card problems are a result of improper, defective, or misconnected cables, incorrect drivers, or resource conflicts.

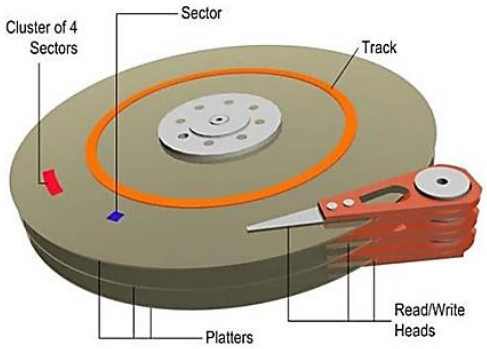
Hard Drive Health

Physical hard drive health is the easiest and quickest way to see if your device is damaged. More detailed checks can be performed in your operating system (Windows, or macOS). Testing your hard drive like this might reveal some problems, but not all hope is lost with other words, if the value of the "Off line uncorrectable sectors" is high, the health value of the disk cannot be larger than 30 %.



Bad Sectors

A bad sector in computing is a disk sector on a disk storage unit that is permanently damaged. Upon taking damage, all information stored on that sector is lost. When a bad sector is found and marked, the operating system like Windows or Linux will skip it in the future



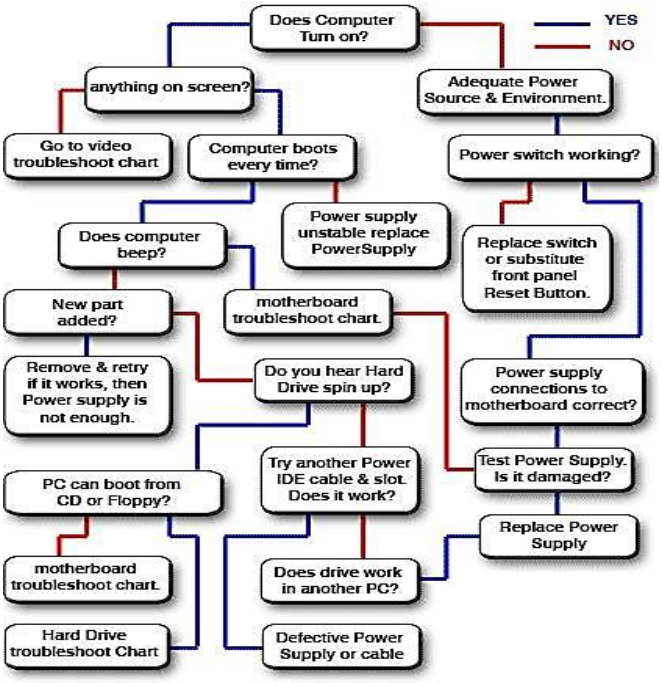
2.7. Diagnostic Tests

On every laptop or desktop computer, there is an option to run diagnostics before it boots up to its operating system. This is known as pre-boot diagnostics, boot diagnostics, or Apple Diagnostics for Mac users. It is a base-level test for its hardware, to find out possible faults and failures.

Isolate the area of fault probability

Computer Power on boot flowchart

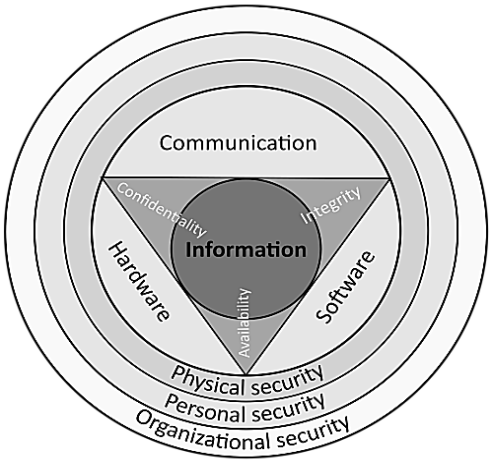
A **fault finding flow** chart provides an excellent way to model and share the process logic needed to help identify the root cause and most suitable resolution. Decision tree logic flowcharts provide a natural way to explore the troubleshooting investigation.



2.8. Preventive Measures

Describe diagnostic tests and perform fault preventive measures

Diagnosing computer problems requires a great deal of patience and an eye for detail, coupled with troubleshooting skills, logical thinking and an understanding of the equipment that you can use to assist you in fixing the problem at hand. Though technical knowledge is also desirable, however this can be acquired with experience, as well as extensive research.



There are many different devices that can be used to test the functionality of various PC components, ranging from multipurpose devices such as Multi meters and Oscilloscopes to specific tools such as Network Protocol Analyzers. Usually, the more specific the task of the tool, the less likely it is to be of use, and the more expensive it is.

A good knowledge of what tools are available and how they are used can mean the difference between putting yourself in a life-threatening situation, or wasting thousands of dollars and performing the role of a computer technician safely and efficiently.

Many modern devices use digital means to provide a continuous or “analogue” readout, as compared to an “on – off” or “digital” meter, so these terms are somewhat blurred in today’s language.

When discussing an Analogue Meter, we are referring to a continuous read out or display, and a Digital Meter has a stepped display limited to certain increments.

Software Diagnosis

Faults with hardware devices are actually very rare, unless the part is old and nearing the end of its designed functional life span, due to the stringent quality control measures from the manufacturer. Generally the root cause of hardware faults will be caused by a software issue, such as a corrupted or incorrect driver.

A good piece of advice for troubleshooting a PC is that it is essential to have a planned line of attack. I.e. understand what the fault is and areas within the machine potentially responsible for the fault. Once the fault type is understood, determine a procedure / process for testing each of the potential fault area individually. That way the troubleshooting process will be far more effective and resultantly you'll be more likely to pin point the actual root cause of the problem rather than unnecessarily, through trial and error, replacing the wrong hardware / software (or maybe both) in order to get to the root cause. This planning will not only save time and money but will greatly develop your troubleshooting skills. Going at it like a bull in a china shop will almost always make it worst.

There is lot of software for diagnosing various software related problems.

There are lots of websites on the internet which actually run a diagnostic check on your computer to see if there are any problems. Run a search on the internet to find out about websites currently offering this service.

These sort of tools run complete tests for cache memory, extended memory and expanded memory, hard drive diagnostics, multimedia testing, motherboard diagnostics including CPU, NPU, RTC, CMOS and DMA controllers, port diagnostics and modem diagnostics

Using these sort of tools might be very useful when doing routine pc maintenance because lot of major problems can be detected right when they start, saving money and data.

As well as the above 3rd Party web based software debugging tools, the Windows Operating system provides built in software diagnostic tools for checking all components of the PC.

Computer Diagnostic Equipment

There are various computer diagnostic equipment widely available nowadays, and they come to the rescue while troubleshooting computer problems and attempting to fix them. The most useful ones are:

Temperature monitor

A temperature monitor is a piece of diagnostic equipment used to provide information on the computer's inner temperature. An above average temperature or overheating can be an indication that something is malfunctioning inside the computer, most probably from the cooling equipment, such as internal fans, or probably a bigger CPU heat sink. A temperature sensor generally consists of an application installed on the computer which uses information obtained from various sensors installed inside the computer.

Registry cleaner, Virus scanner and spyware detector

A virus scanner, or anti-virus, is a piece of software used to prevent, detect and delete viruses, worms and Trojan horses from computers. A spyware detector is a piece of software used to detect and remove adware and malware from the computer. A registry cleaner removes unwanted or redundant data from the computer's registry.

Virus scanners and spyware detectors are some of the most important tools available for troubleshooting and diagnosis of computer problems. It is important to keep the computer free from viruses and spyware in order to keep the performance as close as possible to the optimal performance, and these will detect, block or delete most of the viruses and malicious actions against the machine. Therefore, it is important to ensure they are constantly updated, in order to have the latest virus definition.

USB port tester

Universal Serial Bus (USB) ports are increasingly being included with computers. Recent computers contain much more USB ports than a few years back. When a device is plugged into a USB port stops functioning, such as a keyboard or a mouse for example, one would normally suspect that the keyboard or the mouse are at fault, rather than the USB port itself. Effectively, there is an equal chance that the USB port is faulty, and this is the USB port tester comes in handy. This piece of equipment is used to diagnose the state of a USB port, and helps identifying faulty ports.

Power supply tester

A power supply tester assists in testing power supplies without using a multimeter. If a computer is experiencing troubles booting up for example,

you can use a power supply tester in order to test the power supply of that computer. However, it is important to know that power supply issues are not only limited to PCs not starting up, because a failing power supply can cause a range of problems such as unexpected and random computer lockups, computer reboots, and some error messages. To make the power supply testers even more user-friendly and easy to use, many models come equipped with an LCD screen which displays the results of the tests to notify you of the state of the power supply. For example, the LCD would display a "power good" signal to indicate that there are no issues with the current power supply. You should also be able to see how much voltage is passing through each connector of the power supply.

A power supply provides a more efficient and a safer method of testing power supplies, since it allows the person to stay more removed from electricity compared to using a multi meter. A multi meter test is a manual test, which means that it is prone to human errors; however a power supply tester is not manual which means that its results are more accurate and thus more conclusive.

While testing power supplies, it is very important that you take great care because you will be working with a high voltage power supply while it's plugged in to the power. You need to exercise common sense, and follow directions exactly in order to reduce the risk of damaging your computer or even electrocuting yourself.

CPU meter

A CPU meter reports on the performance and usage of the Central Processing Unit (CPU) for up to 8 cores, and displays the total amount of random access memory (RAM) available, as well as the amount of free and used RAM in the computer.

As shown above, some of the most important computer diagnostic equipment's consist of simple software installed on the computer which can provide an indication of a potential problem, and can also assist in fixing the problem either by removing the cause of the problem, such as detecting viruses and malware and removing them, or by identifying ways to reduce the risks of a problem, such as keeping an eye on the internal cooling system of a computer once the temperature monitor indicates that the computer is overheating. This would restore the system's optimal performance, and thus

speed up the computer. Most of the software discussed above is available in free demo versions which can be downloaded off the internet, as this would allow the user to test the software before buying it, however a license should be purchased before getting results. For example, a demo version of an anti-virus would scan your computer searching for viruses, worms and Trojan horses, and would display a list of the vulnerabilities of your system at the end of the scan. However, it will require a product key and activation before it actually starts to remove the malware from your computer.

Care should always be taken while installing or downloading software which is not popular, as these can be harmful to the computer. It is a good idea to consult an IT professional before installing any software that looks suspicious.

Hard Disk Tester

If you have previously experienced a failed hard disk in your computer, you would know that this is potentially the worst thing that can happen to your computer. Even worse, a hard disk failure usually happens without giving any apparent warning signs. When a hard disk fails, you will not only have to replace the hard disk itself, but also worry about restoring any data, photos, videos, etc. which were previously saved on it which is not always an easy task. Because the hard disk would not give you an indication that it is about to reach its end of life, you need to be able to run tests on your computer every now and then in order to get an idea about the current condition of your hard disk and be able to decide whether you need to purchase a replacement disk.

Perform card substitution method for repairs and replacement of motherboard

Motherboard failure is often manifested as system startup failure, no display on the screen, and sometimes it can start and sometimes it can't start, etc., difficult to intuitively judge. When inspecting and repairing the motherboard's failure, the maintenance principle of "one look, two listen, three smell, four "touches is generally adopted. It is to observe the failure phenomenon, listen to the alarm, smell a peculiar smell, and touch whether some parts are hot. Here are a few common motherboard repair methods. Each method has its own advantages and limitations. Generally, several methods are used in combination.

Substitution method

When you are unsure which component is caused by some failure phenomenon, you can replace the suspected component to eliminate the failure. You can take the suspected components to a good computer to try, and you can also connect the good components to a malfunctioning computer to try. For example, if an error is reported during self-checking or the capacity is incorrect, this method can determine the fault's real culprit.

Detection method

Use the motherboard bios self-check system, and use the test card to troubleshoot the motherboard.

Heating and Cooling System.

The heating and cooling methods are also highly targeted, mainly for motherboard failures caused by the poor thermal stability of a component in the motherboard. If the motherboard maintenance personnel suspect that the cause of the temperature increase of a certain component is suspicious, you can use the touch method at this time. When the temperature change can be clearly felt with the hand, you can use the cooling method to cool the related components forcefully. After cooling down the corresponding parts, turn on the computer. If the degree of computer failure decreases or even disappears, it can be judged that the component causes the motherboard failure, and the maintenance personnel only need to replace it. Generally speaking, heating and cooling require the motherboard repair personnel to have rich work experience to troubleshoot and ensure the quality and efficiency of maintenance.

Repair motherboard diagnostic and replacement system.

Motherboard diagnosis mainly uses the basic input and output system in the motherboard to automatically complete the computer motherboard failure's self-checking procedure. It can also display the results of automatic failure detection in the form of codes. Motherboard fault maintenance personnel use the motherboard diagnostic card for fault detection, which can effectively simplify the maintenance steps and save a lot of maintenance time. However, because the faults are presented in the form of codes, the maintenance personnel must have high professional quality and accurately judge the motherboard—the cause and location of the failure. The replacement method is relatively simple, but it may take a long time to determine the fault. That is, use normal components to replace the components in the computer motherboard. If the computer motherboard can operate normally after replacing a component, it means that the motherboard is malfunctioning. In this position, targeted maintenance can be carried out. But in fact, the replacement method needs to be established based on the motherboard diagnostic card. The replacement method's technical content is reduced, and it is more dependent on the motherboard maintenance personnel's experience. Therefore, many professional maintenance personnel will not use this method but combine it with the motherboard diagnostic card to quickly and accurately determine the computer motherboard's failure issue.

Multiple Choice Questions

PCB Stand for_____

a) Print current board
b) Printed Circuit Board
c) Power Circuit Board
d) None of these

2. In a desktop computer, the board containing micro-processor, RAM and other components is called _____board.

a) Graphic
b) Mother
c) White
d) None of these

3. The backbone of computer is called

a) Mouse
b) SMPS
c) Monitor
d) Motherboard

4. The main circuit board in the system unit is also called the

a) Bus board
b) Daughterboard

c) Motherboard
d) Chipboard

5. Boards that are used to connect additional devices to the mother board is called

a) Expansion card
c) Baby card
b) Port card
d) Bus card

6. Which would you have to upgrade to install an EIDE drive.

a) RAM BIOS
c) Controller Board
b) A 286 CPU
d) ISA Motherboard

7. The DC voltage on most circuit board is

a) – 12 volts
c) + 5 volts
b) 0 volts
d) + 12 volts

8. Where does the motherboard store the keyboard controller sport program

a) DRAM
c) RAM
b) Hard drive
d) ROM Chip

9. Which chip acts as a clock to keep the current date and time?

a) CMOSE
c) RAM
b) DVRAM
d) ROM

10. WRAM is used on a

a) Modem
c) Motherboard
b) Video card
d) ata connector

1	2	3	4	5	6	7	8	9	10
b	b	d	c	a	c	c	d	a	b

Short Questions

1. What is a motherboard in a computer?
2. Describe motherboard
3. Describe system board and planar board
4. Identify motherboard components
5. What are the types of RAM?
6. Enumerate types and characteristics of CPU
7. What are the 4 types of processors?
8. How many types of CPU parts are there?
9. List Differentiate types of bus and slots
10. Describe daughter boards

Long Questions

1. List of commonly occurring motherboard faults
2. Describe diagnostic tests and perform fault preventive measures
3. Perform card substitution method for repairs and replacement of motherboard

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Soper, David L. Prowse and Scott Mueller.
- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
- PRINCE GEORGE'S COMMUNITY COLLEGE
- Computer Hardware Technicians CH111, 5 CD-ROM set by NCSA Academy USA
- Computer Hardware Technicians

Chapter No. 3

(Troubleshooting and Repair of a Power Supply)

Objectives

After completion of this chapter students will be able to:

3. Troubleshooting and Repair of Power Supply

3.1. Operating Principle of a Power Supply

3.2. Power Supply Connectors

3.3. Power Supply Safety

3.4. Troubleshooting Procedures and Commonly Occurring Faults

3.5. Repair Techniques and Replacing a Power Supply

Troubleshooting

Troubleshooting is a systematic process used to locate the cause of a fault in a computer system and correct the relevant hardware and software issues. Approaching problem solving using a logical and methodical approach is essential to successful resolution. Although experience is very useful to problem solving, following a troubleshooting model will enhance effectiveness and speed.

Troubleshooting Process Steps

The troubleshooting process steps are as follows:

Step 1. Identify the problem.

Step 2. Establish a theory of probable cause.

Step 3. Test the theory to determine the cause.

Step 4. Establish a plan of action to resolve the problem and implement the solution.

Step 5. Verify full system functionality and, if applicable, implement preventive measures

Step 6. Document findings, actions, and outcomes.

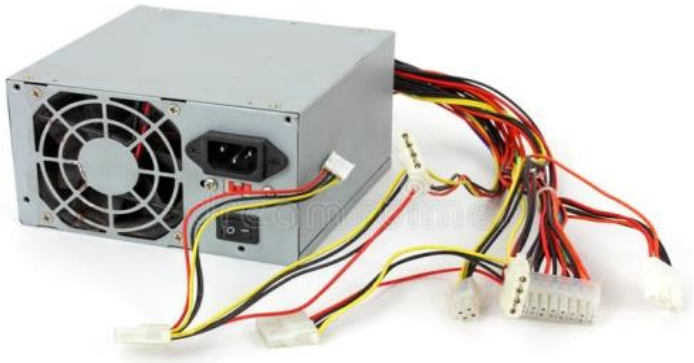
Power supply

A computer power supply is an electronic device that converts AC power from a wall outlet into DC power that is used to power the components of a computer.

The main components of a computer power supply include a transformer, rectifier, filter capacitors, voltage regulator, and output connectors.

A power supply unit (PSU) converts mains AC to low-voltage regulated DC power for the internal components of a computer. Modern personal computers universally use switched-mode power supplies. Some power supplies have a manual switch for selecting input voltage, while others automatically adapt to the mains voltage.

Most modern desktop personal computer power supplies conform to the ATX specification, which includes form factor and voltage tolerances. While an ATX power supply is connected to the mains supply, it always provides a 5-volt standby (5VSB) power so that the standby functions on the computer and certain peripherals are powered. ATX power supplies are turned on and off by a signal from the motherboard. They also provide a signal to the motherboard to indicate when the DC voltages are in spec, so that the computer is able to safely power up and boot.



Describe Regulation of Power Supply

Power supply regulation is the ability of a power supply to maintain an output voltage within a specified tolerance as referenced to changing conditions of input voltage and/or load.

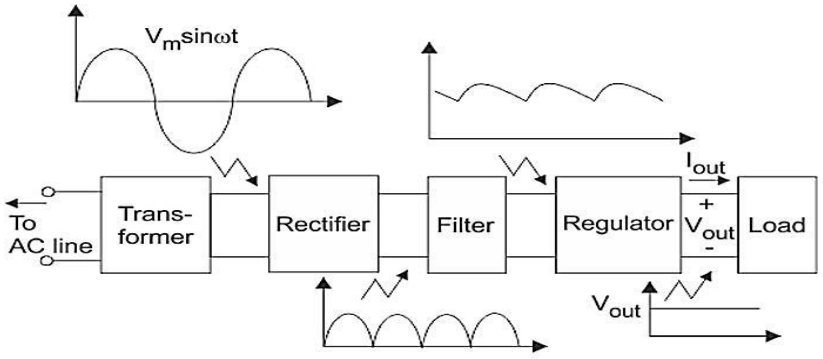
Most electronic equipment is powered from DC voltage derived from the unregulated AC mains voltage. A rectifier circuit converts the AC to DC which is then conditioned to meet the circuit or load requirements.

The rectified voltage follows the AC input and will vary as the mains vary. The variations may affect the circuit performance and is undesirable in sensitive equipment such as computers, sensor and precision circuits. In addition, components and circuits will only operate or perform efficiently when the power supply is within a certain limit. Anything beyond the design limit will either destroy the components and equipment or be insufficient to power the equipment such that it will not turn on or simply malfunction.

The mains supply voltage is usually supposed to remain within certain limits and most equipment are designed o accommodates these. However, these variations, sometimes beyond limits, may cause problems in the sensitive equipment since they will cause variations in the output voltage of the power supply.

Controlling the voltage variations are beyond the control of the equipment manufacturer and the consumer. For this reason, the best the designers can do is to ensure that the power supply output voltage remains fairly constant over a wide range of input voltages.

A power supply with regulation provides an output that remains constant irrespective of variations in the input mains voltage. A typical power supply unit consists of several blocks depending on the design and stability required. A simple linear supply will have a transformer, rectifier, filter and a regulator. A switched mode supply contains the four building blocks and additional blocks such as the inverters and feedback stages.



Components of typical linear power supply

Figure 1: Basic diagram block diagram of a linear power supply with regulation

In a regulated power supply, the input to the regulating device is usually higher than expected output. This allows the circuit to work with a wide range of input voltages while giving out a constant output. The regulating device is usually in series with the output. And since the input is always higher than expected output, the device or circuit works in a way that a certain amount of voltage is dropped across the regulating circuit.

Even with a low input AC voltage, the regulating circuit must receive a higher voltage; however, in this case, a small amount of voltage is dropped. If the input AC is very high, the regulating circuit drops a higher voltage. In switched power supplies, the regulation is achieved by varying the switching of the series transistor.

There are different forms of regulating circuits, the type varies with the power supply design and required level of stability. Typical regulating components include Zener diodes, series transistors or switching devices, and fixed and reliable integrated circuit regulators.

There are also some situations where consumers use automatic voltage regulators to condition the AC input voltage so that it remains within a specified limit. Some of these have bulky transformers and may not be practical in some cases due to cost, convenience and other factors.

3.1 Operating Principle of a Power Supply

A power supply takes the AC from the wall outlet, converts it to unregulated DC, and reduces the voltage using an input power transformer, typically stepping it down to the voltage required by the load. For safety reasons, the transformer also separates the output power supply from the mains input.

How Does a Switching Power Supply Work?

Figure 1 illustrates the general transformation from alternating current (AC) to direct current (DC) in a switching power supply.

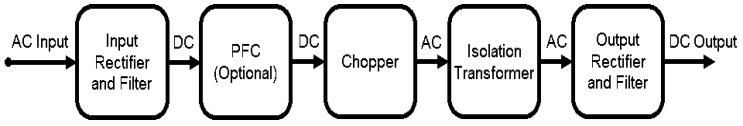


Figure 1: Isolated Switched-Mode AC/DC Power Supply

Input Rectification

Rectification is the process of converting AC voltage to DC voltage. Input signal rectification is the first step in switched-mode AC/DC power supplies.

It is commonly thought that DC voltage is a straight, unwavering line of constant voltage, like the type that comes out of a battery. However, what defines direct current (DC) is the unidirectional flow of electric charge. This means that the voltage flows in the same direction but is not necessarily constant.

A sine wave is alternating current's (AC) most typical waveform, and is positive for the first half-cycle but negative for the rest of the cycle. If the negative half-cycle is reversed or eliminated, then the current ceases to alternate, and becomes a direct current. This can be achieved by a process called rectification.

Rectification can be achieved by using a passive half-bridge rectifier to eliminate the negative half of the sine wave using a diode (see Figure 2). The diode allows current to flow through it during the positive half of the wave, but blocks the current when it flows in the opposite direction.

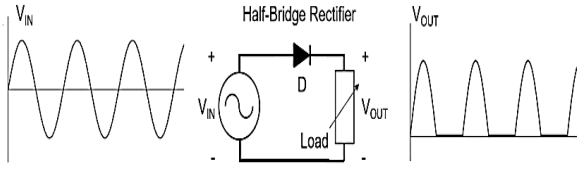


Figure 2: Half-Bridge Rectifier

After rectification, the resulting sine wave will have low mean power and will not be able to power devices efficiently. A much more efficient method would be to change the negative half-wave's polarity and make it positive. This method is called full-wave rectification, and it only requires four diodes in a bridge configuration **(see Figure 3)**. This arrangement maintains a stable current flow direction, regardless of the input voltage polarity.

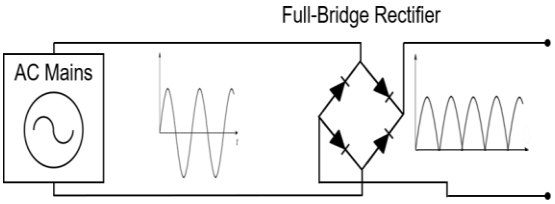


Figure 3: Full-Bridge Rectifier

A fully rectified wave has a higher mean output voltage than the one produced by the half-bridge rectifier, but it is still very far from being the constant DC waveform needed for powering electronic devices. Although this is a DC wave, using it to power a device would be inefficient due to the shape of the voltage wave, which changes value very quickly and very often. This periodic change in DC voltage is called a ripple — reducing or eliminating ripple is crucial to an efficient power supply.

The simplest and most commonly used method for ripple reduction is the use of a large capacitor at the rectifier output, called a reservoir capacitor or smoothing filter **(see Figure 4)**.

The capacitor stores voltage during the wave's peak, then supplies the load with current until its voltage is smaller than the now-rising rectified voltage wave. The resulting waveform is much closer to the desired shape, and can be considered a DC voltage with no AC component. This final voltage waveform can now be used to power DC devices.

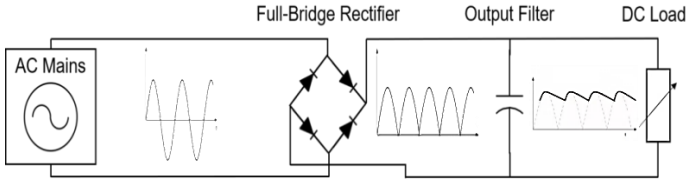


Figure 4: Full-Bridge Rectifier with Smoothing Filter

Passive rectification uses semiconductor diodes as uncontrolled switches, and is the simplest method to rectify an AC wave, but it is not the most efficient. Diodes are relatively efficient switches; they can switch on and off quickly with minimal power loss. The only problem with semiconductor diodes is that they have a forward bias voltage drop of 0.5V to 1V, which reduces efficiency.

Active rectification replaces diodes with controlled switches, such as MOSFETs or BJT transistors **(see Figure 5)**. The advantages of this are two-fold: First, transistor-based rectifiers eliminate the fixed 0.5V to 1V voltage drop associated with semiconductor diodes, because their resistances can be made arbitrarily small, and consequently have a small voltage drop. Second, transistors are controlled switches, which means the switching frequency can be controlled and therefore optimized.

The downside is that active rectifiers require more complicated control circuits to achieve their purpose, which requires additional components and consequently makes them more expensive.

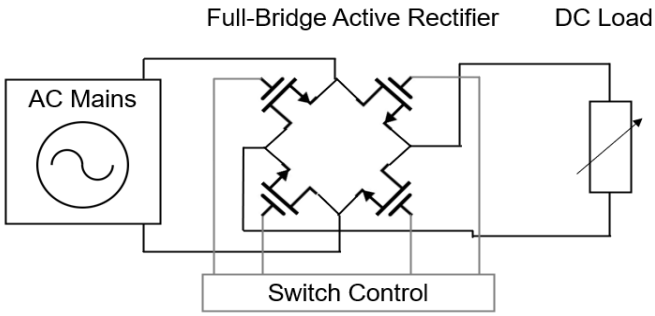


Figure 5: Full-Bridge Active Rectifier

Power Factor Correction (PFC)

The second stage in a switching power supply design is power factor correction (PFC).

PFC circuits have little to do with the actual conversion of AC power to DC power, but are a critical component of most commercial power supplies.

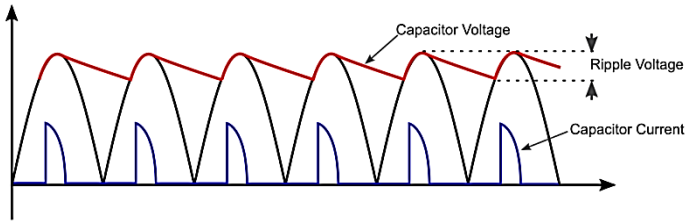


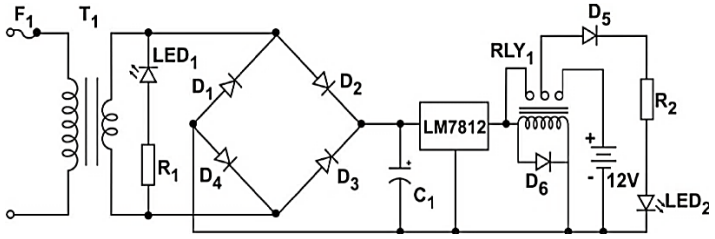
Figure 6: Voltage and Current Waveforms at the Rectifier Output

If you observe the current waveform of the rectifier's reservoir capacitor **(see Figure 6)**, you'll see that the charging current flows through the capacitor during a very short time span, specifically from the point where the voltage at

the input of the capacitor is greater than the capacitor's charge to the rectified signal's peak. This generates a series of short current spikes in the capacitor, thus creating a significant problem not just for the power supply, but for the entire power grid due to the large quantity of harmonics that these current spikes inject into the grid. Harmonics can generate distortion that may affect other power supplies and devices connected to the grid.
In a switching power supply design, the goal of the power factor correction circuit is to minimize these harmonics by filtering them out. To do so, there are two options: active and passive power factor correction.

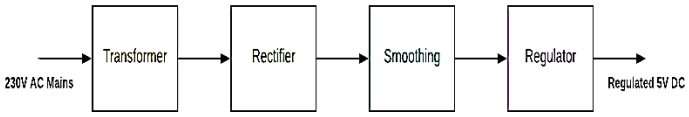
- Passive PFC circuits are composed of passive low-pass filters, which attempt to eliminate higher-frequency harmonics. However, power supplies, especially in high-power applications, cannot comply with international regulations on harmonic noise using only passive PFC. Instead, they must apply active power correction.
- Active PFC changes the current waveform's shape, and makes it follow the voltage. The harmonics are moved to much higher frequencies, making them easier to filter out. The most widely used circuit for these cases is a boost converter, also called a step-up converter.

Interpret block diagram or schematics of power supply



As shown in the figure above, a small step down transformer is used to reduce the voltage level to the devices needs... The output of the transformer is a pulsating sinusoidal AC voltage, which is converted to pulsating DC with the help of a rectifier. This output is given to a filter circuit which reduces the AC ripples, and passes the DC components. But here are certain disadvantages in using an unregulated power supply.

Figure given below shows the complete circuit of a regulated power supply with a transistor series regulator as a regulating device. Each part of the circuit is explained in detail.



Transformer

A step down transformer is used to step down the voltage from the input AC to the required voltage of the electronic device. This output voltage of the transformer is customized by changing the turns ratio of the transformer according the electronic device specs. The input of the transformer being 230 Volts AC mains, the output is provided to a full bridge rectifier circuit.

Full Wave Rectifier Circuit

The FWR consists of 4 diodes which rectify the output AC voltage or current from the transistor to its equivalent DC quantity. As the name implies the FWR rectifies both half's of the AC input. The rectified DC output is given as input to the filter circuit.

Filter Circuit

The filter circuit is used to convert the high rippled DC output of the FWR to ripple free DC content. A ∏ filter is used to make the waveforms ripple free.

Describe Switch Mode and Transformer-Based Unit of Power Supply

1. Switch Mode Power Supply

A switch mode power supply is a power converter that utilises switching devices such as MOSFETs that continuously turn on and off at high frequency; and energy storage devices such as the capacitors and inductors to supply power during the non-conduction state of the switching device.

The supplies have higher efficiencies of up to 90%, are small in size and widely used in computers and other sensitive electronic equipment.

The basic switch mode power supplies (SMPS) are categorized based on supply input and output voltage.

The main four groups are:

1. AC to DC – Off-line DC power supply
2. DC to DC – Converter
3. DC to AC – Inverter
4. AC to AC – Cycloconverter of frequency changer

Advantages of SMPS

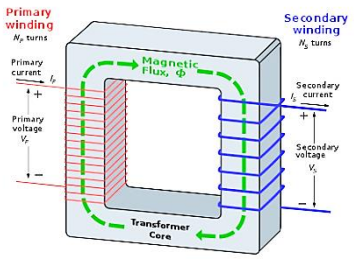
- The SMPS designs are more compact and use smaller transformers. The ability to shrink the supplies is an advantage and an essential requirement for most of the electronic devices with limited space
- High efficiency 68% to 90%
- Flexible technology
- The transformer-isolated supplies have stable outputs independent of the input supply voltage
- High power density

Disadvantages of switch mode power supply

- Extra external components which also requires more space
- Generation EMI and electrical noise
- Complex design
- Costly due to extra components

2. Transformer power supply

The purpose of using a transformer in power supply is to make electrical power accessible as it travels from a power utility to an office, home, worksite or other location. Energy is lost when it travels along transmission wires from a power plant to a customer. Utilities use a very high voltage to lose less energy In a traditional transformer-based UPS, the power flows via the rectifier, inverter and transformer to the output, with the transformer used to step up the AC voltage levels, protect the UPS from load disruptions and provide galvanic isolation.



Commonly used transformer type, depending upon voltage they are classified as:

Step-up Transformer: They are used between the power generator and the power grid. ...

Step down Transformer: These transformers are used to convert high voltage primary supply to low voltage secondary output.

Explain block diagram of a switching power supply.

A number of different design types are used. Where the input is the AC mains (line) supply the AC is rectified and smoothed by a reservoir capacitor before being processed by what is in effect a DC to DC converter, to produce a regulated DC output at the required level. Hence a SMPS can be used as an AC to DC converter, for use in many mains powered circuits, or DC to DC, either stepping the DC voltage up or down as required, in battery powered systems.

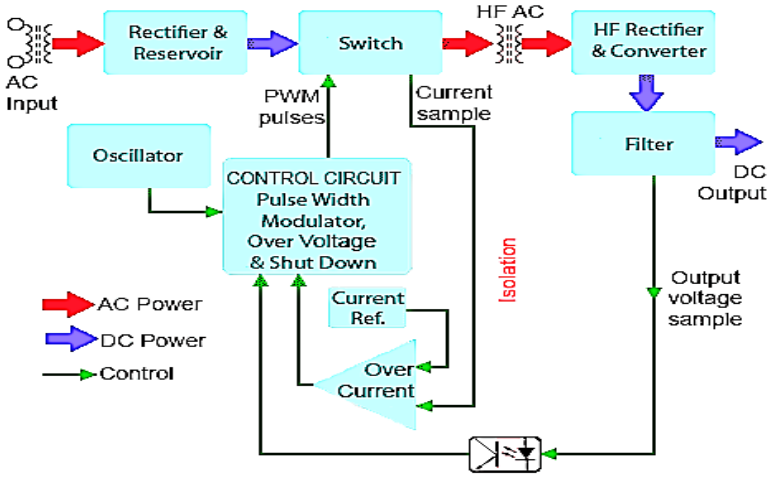


Fig. 1 Typical SMPS Block Diagram

Fig.1 shows a block diagram example of a typical SMPS with an AC Mains (line) input and a regulated DC output. The output rectification and filter are isolated from the High Frequency switching section by a high frequency transformer, and voltage control feedback is via an opto isolator. The control circuit block is typical of specialist ICs containing the high frequency oscillator, pulse width modulation, voltage and current control and output shut down sections.

Whatever the purpose of a SMPS, a common feature (after conversion of AC to DC if required) is the use of a high frequency square wave to drive an electronic power switching circuit. This circuit is used to convert the DC

supply into high frequency, high current AC, which by various means, depending on the design of the circuit, is reconverted into a regulated DC output. The reason for this double conversion process is that, by changing the DC or mains frequency AC to a high frequency AC, the components, such as transformers, inductors and capacitors, needed for conversion back to a regulated DC supply, can be much smaller and cheaper than those needed to do the same job at mains (line) frequency.

The high frequency AC produced during the conversion process is a square wave, which provides a means of controlling the output voltage by means of pulse width modulation. This allows the regulation of the output to be much more efficient than is possible in linear regulated supplies.

The combination of a square wave oscillator and switch used in switched mode supplies can also be used to convert DC to AC. In this way the switched mode technique also be used as an 'inverter' to create an AC supply at mains potential from DC supplies such as batteries, solar panels etc.

3.2. Power Supply Connectors

A power supply is an electrical device that offers electric power to an electrical load such as laptop computer, server, or other electronic devices. The main function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load.

Determine different output voltages of power supply

P1

A 20-pin power supply connector is an older type of connector that was used on older motherboards, while a 24-pin power supply connector is a newer type of connector that is used on newer motherboards. The additional 4 pins on the 24-pin connector provide additional power to the motherboard.

ATX12V (or P4)

A 4-pin power connector that goes to the motherboard in addition to a 20-pin P1 to supply power to the processor.

Molex

A 4-pin peripheral power connector that supplies power to IDE disk drives and CD-ROM/DVD drives.

Berg (or Mini-Molex)

A 4-pin power connector that supplies power to the floppy disk drive (it can also be used as an auxiliary connector for AGP video cards).

Serial ATA

This is a 15-pin power connector mainly used for SATA hard drives.

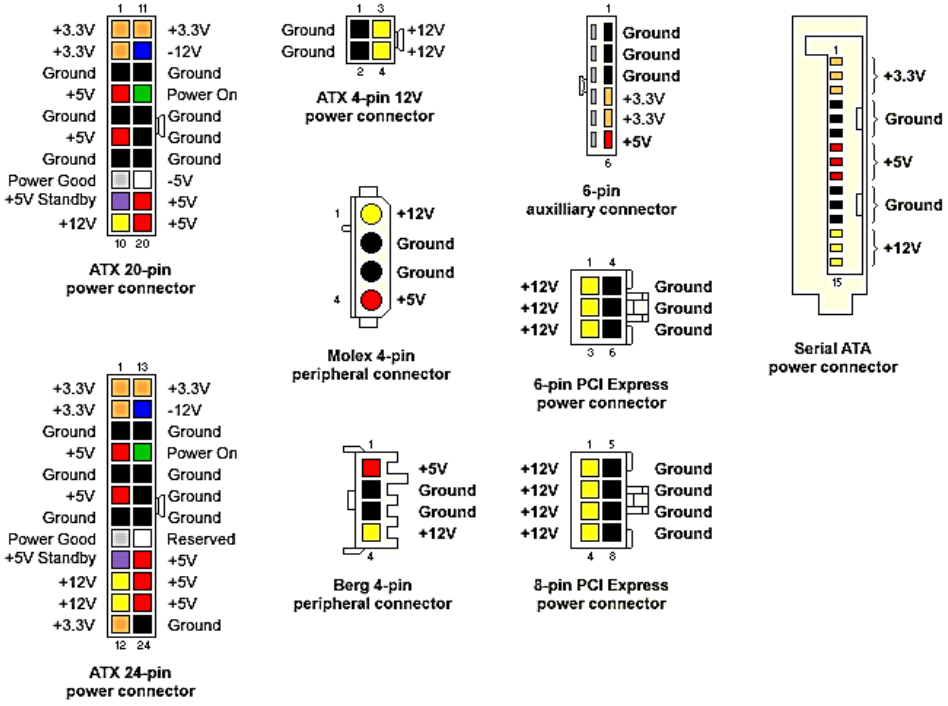
PCI Express

A 6-pin or (more recently) 8-pin power connector used for PCI Express graphics cards. Some 8-pin connections allow for either a 6-pin or an 8-pin card to be

connected by using two separate connectors on the same cable (one with 6 pins and another with 2 pins).

Standard Output Voltages

The positive output voltages produced by a power supply unit are +3.3V, +5V and +12V. Negative voltages of -5V and -12V are also provided, together with a +5V standby voltage. Different voltages (sometimes referred to as rails) are used to power different components, and a summary of which voltages and (and currents) are used for what purpose is given below. For those unfamiliar with the concept of negative voltages in dc circuits, this simply means that the potential difference is measured from ground to the signal rather than the other way round (ground is commonly used as a reference point for measuring voltage). The current requirements of the various system components are significant, because power is the product of voltage and current. The total power requirements of the system thus depend on the voltage and current requirements of its individual components.



Summary of PSU Voltages

Voltage	Purpose
-12V	Used on some older types of serial port amplifier circuits. Generally unused on newer systems. Current is usually limited to 1A.
-5V	Used on some early personal computers for floppy disk controllers and some ISA add-on cards. Generally unused on newer systems. Current is usually limited to 1A.
0V	The zero volt ground (also called *common* or *earth*) and reference point for other system voltages.
+3.3V	Used to supply power for the processor, some types of memory, some AGP video cards, and other digital circuits (most of these components required a +5V supply in older systems).
+5V	Still used to supply the motherboard and some of the components on the motherboard. Note that there is also a 5V standby voltage present when the system is powered down which can be grounded (e.g. by the user pressing the power switch on the front of the case) to restore power to the system.
+12V	Primarily used for devices such as disk drives and cooling fans which have motors of one sort or another. These devices have their own power connectors that come directly from the power supply unit.

3.3. Power Supply Safety

Do not touch the terminals while power is being supplied. Minor burns may occasionally occur. Do not touch the Product while power is being supplied or immediately after power is turned OFF. Fire may occasionally occur.

Computer power supplies can be dangerous if touched, as they can carry an electrical current. However, they are not typically considered to be a high-risk

electrical appliance. To avoid any potential danger, it is advised not to touch the power supply while it is plugged in.

It is critical to carefully follow the following safety precautions.

- Always connect a ground wire. ...
- Do not touch high voltage areas. ...
- Cover high voltage areas. ...
- Share an awareness of danger. ...
- Perform operations with your right hand. ...
- Turn off the power before touching equipment. ...
- Pay attention to electric charge in cables.

Test good signal power supply

The ATX specification defines the Power-Good signal as a +5-volt (V) signal generated in the power supply when it has passed its internal self-tests and the outputs have stabilized. This normally takes between 0.1 and 0.5 seconds after the power supply is switched on. The signal is then sent to the motherboard, where it is received by the processor timer chip that controls the reset line to the processor.

The ATX specification requires that the power-good signal ("PWR_OK") go high no sooner than 100 ms *after* the power rails have stabilized, and remain high for 16 ms after loss of AC power, and fall (to less than 0.4 V) at least 1 ms *before* the power rails fall out of specification (to 95% of their nominal value).

Cheaper and/or lower quality power supplies do not follow the ATX specification of a separate monitoring circuit; they instead wire the power good output to one of the 5 V lines. This means the processor will never reset given bad power unless the 5 V line drops low enough to turn off the trigger, which could be too low for proper operation.

Perform Troubleshooting Procedures of Power Supply

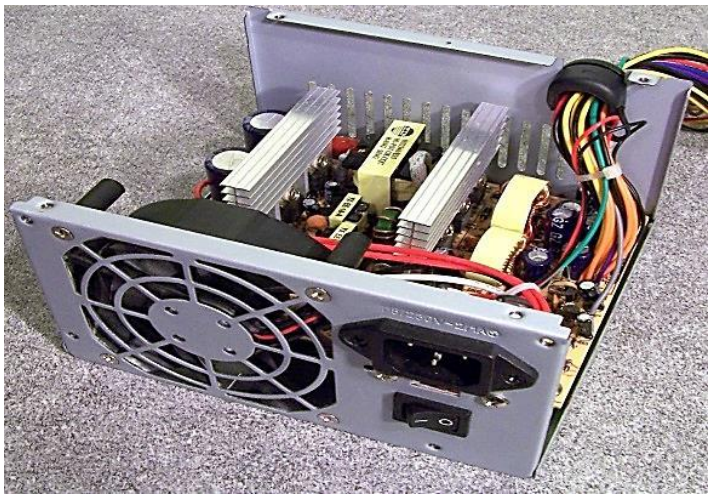
Troubleshooting Power-Supply Problems

Typical symptoms associated with power-supply failures include the following: No indicator lights are visible, with no disk drive action and no display on the screen. Nothing works, and the system is dead.

The On/Off indicator lights are visible, but there is no disk drive action and no display on the monitor screen. The system fan might or might not run.
The system produces a continuous beep tone.

CAUTION

Before changing any board or connection, always turn the system off first. In an ATX-style system, you should also disconnect the power cable from the power supply. This is necessary because even with the power switch off, some levels of voltages are still applied to the system board in these units.



Localize the fault into a narrow region of the circuit

Basic Fault-Finding

Here are some simple fault-finding techniques,

- Check that all components are in the correct position and orientation.
- Check that there are no short circuits
- Carry out some basic electrical tests to ensure power is reaching all parts of the circuit.
- Check all components are functioning correctly. Has overheating during soldering damaged any components?
- Remove and test suspect components using appropriate test equipment
- Make a thorough check of circuit voltages/currents/signals using appropriate test equipment.

3.4. Troubleshooting Procedures and Commonly Occurring Faults

Identify Commonly Occurring Faults of Power Supply

Signs of Power Supply Failure

- If you're experiencing any of these issues, you may have a failing or completely failed power supply:
- Power-on Fails (system fails to start or lock ups)
- Spontaneous Rebooting
- Intermittent lock ups during applications
- Hard drive and fan fail to spin up simultaneously (+12 failure)
- Overheating of power supply due to fan failure
- Small brownouts that cause the system to fail and restart
- Electric shocks when the case is touched
- System completely dead and no LED lit on motherboard
- Smoke from the PSU or other components
- Local circuit breakers popping when the computer is powered on

Explain Causes of Faults in Power Supply Itself

A failing PSU is one of the reasons why the computer won't turn on. Here, I will explain in detail the most common signs of a power supply failure that will occur if the power supply unit going bad or fails as well as the reasons behind it and how you can extend the life of the power supply unit.

The power supply unit installed in a desktop PC has a capacity of 300W or less, 300 to 600W, and 600W or more. The larger the number, the higher the price, but it can supply more power.

If this power supply unit fails, it will not be able to supply appropriate power to each part, causing various problems. In addition, being power problems, it could damage other components or directly cause the equipment not to turn on.

Signs of Power Supply Failure

1. Computer turns on for some time then it suddenly turns off.
2. Random black & blue screen crashes
3. Random Computer Crashes and Restarts.
4. Display Issues
5. Freezing
6. Smoke/Burning Smell
7. Strange noises from the PC case
8. Presence Of Frequent Electric Shocks When You Touch The Metallic Parts Of The Computer.
9. The power supply fan spins, but there is no power to other devices
10. PC won't start, but the case fans spin.
11. Overheating of PSU

Use essential tools and test equipment

Proper Use of Tools

Using tools properly helps prevent accidents and damage to equipment and people. This section describes and covers the proper use of a variety of hardware, software, and organizational tools specific to working with computers and peripherals.

Hardware Tools

For every job there is the right tool. Make sure that you are familiar with the correct use of each tool and that the correct tool is used for the current task. Skilled use of tools and software makes the job less difficult and ensures that tasks are performed properly and safely.

- ESD tools
- Hand tools
- Cleaning tools
- Diagnostic tools

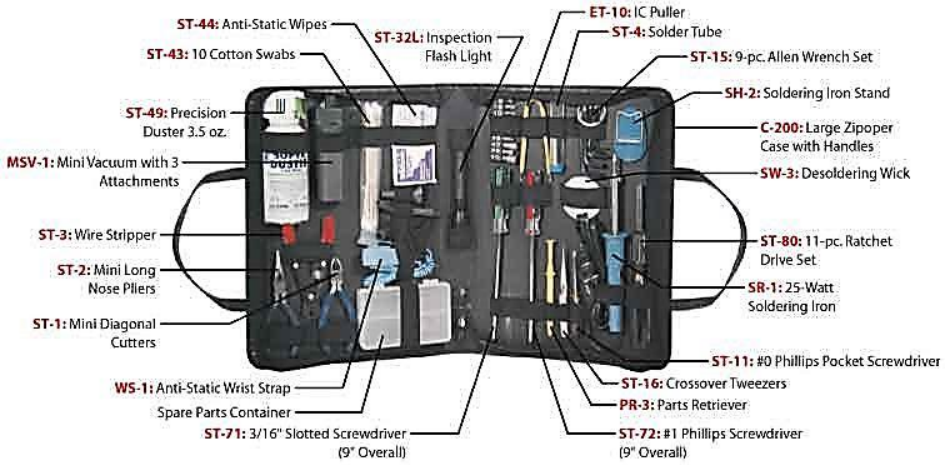


Figure shows some common tools used in computer repair

ESD Tools

There are two ESD tools: the antistatic wrist strap and the antistatic mat. The antistatic wrist strap protects computer equipment when grounded to a computer chassis. The antistatic mat protects computer equipment by preventing static electricity from accumulating on the hardware or on the technician.

Hand Tools

Most tools used in the computer assembly process are small hand tools. They are available individually or as part of a computer repair toolkit. Toolkits range widely in size, quality, and price. Some common hand tools and their uses are:

- ***Flat-head screwdriver*:** Used to tighten or loosen slotted screws.
- ***Phillips-head screwdriver*:** Used to tighten or loosen cross-headed screws.
- ***Torx screwdriver*:** Used to tighten or loosen screws that have a star-like depression on the top, a feature that is mainly found on laptops.
- ***Hex driver*:** Used to tighten or loosen nuts in the same way that a screwdriver tightens or loosens screws (sometimes called a nut driver).
- **Needle-nose pliers:** Used to hold small parts.
- **Wire cutters:** Used to strip and cut wires.
- **Tweezers:** Used to manipulate small parts.
- ***Part retriever*:** Used to retrieve parts from locations that are too small for your hand to fit.
- **Flashlight:** Used to light up areas that you cannot see well.

- ***Wire stripper*:** A wire stripper is used to remove the insulation from wire so that it can be twisted to other wires or crimped to connectors to make a cable.
- ***Crimper*:** Used to attach connectors to wires.
- ***Punch-down tool*:** Used to terminate wire into termination blocks. Some cable connectors must be connected to cables using a punch down tool.

Cleaning Tools

Having the appropriate *cleaning tools* is essential when maintaining and repairing computers. Using the appropriate cleaning tools helps ensure that computer components are not damaged during cleaning. Cleaning tools include the following:

- **Soft cloth:** Used to clean different computer components without scratching or leaving debris
- **Compressed air:** Used to blow away dust and debris from different computer parts without touching the components
- **Cable ties:** Used to bundle cables neatly inside and outside of a computer
- **Parts organizer:** Used to hold screws, jumpers, fasteners, and other small parts and prevents them from getting mixed together

Diagnostic Tools

Diagnostic tools are used to test and diagnose equipment. Diagnostic tools include the following:

- A *digital multimeter*, as shown in Figure is a device that can take many types of measurements. It tests the integrity of circuits and the quality of electricity in computer components. A digital multimeter displays the information on an LCD or LED.

Fig *Multimeter*

- A *loopback adapter*, also called a loopback plug, tests the basic functionality of computer ports. The adapter is specific to the port that you want to test.
- The *toner probe*, as shown in Figure is a two-part tool. The toner part is connected to a cable at one end using specific adapters, such as an RJ-45, coaxial, or metal clips. The toner generates a tone that travels the length of the cable. The probe part traces the cable. When the probe is in near proximity to the cable to which the toner is attached, the tone can be heard through a speaker in the probe.

Figure *Toner Probe*

Although an *external hard drive enclosure* is not a diagnostic tool, it is often used when diagnosing and repairing computers. The customer hard drive is placed into the external enclosure for inspection, diagnosis, and repair using a known-working computer. Backups can also be recorded to a drive in an external enclosure to prevent data corruption during a computer repair.

Software Tools

Like hardware tools, there are a variety of software tools that can be used to help technicians pinpoint and troubleshoot problems. Many of these tools are free and several come with the Windows operating system.

Disk Management Tools

Software tools help diagnose computer and network problems and determine which computer device is not functioning correctly. A technician

must be able to use a range of software tools to diagnose problems, maintain hardware, and protect the data stored on a computer.
You must be able to identify which software to use in different situations. *Disk management tools* help detect and correct disk errors, prepare a disk for data storage, and remove unwanted files.

The following are some disk management tools:

- **FDISK:** A command-line tool that creates and deletes partitions on a hard drive. The FDISK tool is not available in Windows XP, Vista, or 7. It has been replaced with the Disk Management tool.
- ***Disk Management Tool*:** Initializes disks, creates partitions, and formats partitions.
- ***Format*:** Prepares a hard drive to store information.
- ***ScanDisk or CHKDSK*:** Checks the integrity of files and folders on a hard drive by scanning the file system. These tools might also check the disk surface for physical errors.
- ***Defrag*:** Optimizes space on a hard drive to allow faster access to programs and data.
- ***Disk Cleanup*:** Clears space on a hard drive by searching for files that can be safely deleted.
- ***System File Checker (SFC)*:** A command-line tool that scans the operating system critical files and replaces files that are corrupted.

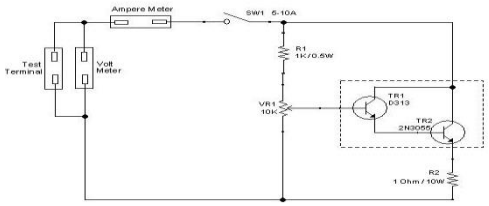
Use the Windows 7 boot disk for troubleshooting and repairing corrupted files. The Windows 7 boot disk repairs Windows system files, restores damaged or lost files, and reinstalls the operating system.
Third-party software tools are also available to assist in troubleshooting problems.

Explain Concept of a Dummy Load for Testing a Power Supply in No Load Condition

Dummy Load

A **dummy load** is a device used to simulate an electrical **load**, usually for testing purposes. **Load** banks are connected to electrical **power supplies** to simulate the **supply's** intended electrical **load** for testing purposes.

To test real capacity of a power supply, we need a load with variable current consumption. If we have high power variable resistor such as tapped wire-wound resistor, we can directly connect this resistor and make some measurement. Unfortunately, this kind of high-power resistor is expensive and not so flexible getting wide adjustment range. Here is a simple solution using power transistor. This kind of dummy load is widely used in testing power supply. A Darlington pair is used to provide high impedance input since we want to use a low wattage potentiometer to vary the loading. Here is the schematic diagram of the circuit.



Current and Power Rating

If you short circuit a battery you develop a large current. Large lead acid cells can create short circuit currents in excess of 500 amps. This is because the shorting wires have very little resistance. If you connect a resistor into the circuit the current will rise to a point that is dependent upon the value of the resistor (see the table on the next page to see how much current a resistor draws). Then, providing that the resistor has a big enough power rating, the resistor will happily burn off the heat created by the current. Electric fires use the same principle. The bars of the electric fire have a resistance that means one kilo Watt of heat will be produced by the fire at mains voltage (and only at mains voltage). You can calculate the maximum current drawn by a load resistor using Ohms law: Current (A) = Voltage (V) ÷ Resistance (R) However, this is the easy part. The most important issue in the design of the dummy load is that the power output should not exceed the power rating of the load resistor. You can calculate the maximum power that a resistor will dissipate using the power equation: Power (W) = Current 2 (A) x Resistance (R) Conversely, if you know the power rating of a load resistor you can calculate the current that it can handle by rearranging the above equation: Current (A) = √[Power (W) ÷ Resistance (R)] The calculated power rating for a resistor usually represents the level that will cause problematic overheating. Therefore the resistor used should have a capacity about 1.25 to 1.5 times more than the

calculated figure. Likewise the main current path in the circuit (discussed later) must use wire that has a capacity of 1.25 to 1.5 times the maximum calculated current.

Current Control

As noted above, if you have a fixed resistor then connecting it to a battery or power supply will create a fixed level of current or power load. Whilst useful for checking circuits at a single load, it's not very useful for checking how the power supply works at different power levels. Therefore we need to be able to vary the power drawn by the load without the hassle of continually disconnecting and reconnecting different values of resistor. The dummy load uses a field effect transistor, or FET, to switch the circuit on and off. By varying the period that the FET switches on or off, using a system called pulse width modulation (see the box on the next page), we can vary the amount of time that the FET is on and how much load the resistor will draw. FET transistors are able to switch very large currents using a very small control voltage. That means we can avoid using very expensive power components, such as high power variable resistors or rheostats. Instead the dummy load control circuit uses a single low power variable resistor and a single integrated circuit to change the switching period, or duty cycle, of the FET and hence how much current the load will draw.

3.5. Repair Techniques and Replacing a Power Supply

Describe various repairing techniques

Power supply problems can happen in **the primary or secondary section**. Even if there are some problems in the furthest part of any equipment circuit such as a **shorted ic or transistor in a Monitor color circuit board**, the power supply may not work or just blink.

There are many methods of troubleshooting a power supply

Whenever a power supply sent for repair whether it is a Monitor switching power supply or computer Atx power supply test the power supply first before open up the casing. Power supply problems can be categorize into no power, low output power, power supply cut-off after sometimes or once switch on, power blink and higher output voltage.

Whatever the problems are use a standard procedure method to test it.

-Check The On/Off Switch, fuse and discharge the large filter capacitor-if the fuse burnt into dark color then expect heavy short circuit in the power supply section. It could be a shorted bridge rectifier, a shorted power transistor or even a shorted power ic. Don't under estimate that a shorted primary winding in the switch mode power transformer can occurred. If the fuse is just a slight torn, may be the fuse spoilt by itself because fuse have lifespan too. Most of the time, replacing only the fuse will solve the no power supply symptoms.

-Make Sure All Secondary Diodes Are Working.

You can either remove one of the diodes lead to accurately check it or you can use a fly back tester.

-**Check Horizontal Output Transistor**, b+ fet and flyback transformer if you repair a Monitor. Anytime, if either one of these components have failure, it will affect the power supply functions. Testing fet and flyback transformer can be read by clicking on the blue link.

-Check All Electrolytic Capacitors with ESR tester in the primary and secondary section- if there are some electrolytic capacitor failure in the power supply section (either primary or secondary area) the power supply will blink, produced low output power or totally no power at all!

-Test the primary winding of switch mode power transformer with fly back tester. Check also the fly back primary winding, b+ coil winding and horizontal yoke coil if you repair monitor. One of these coils shorted can cause power to shut down, blink, and no power.

Power supply problems If you have confirmed that the secondary side of power supply components is working then what you need to do is to de-solder all the components in the primary side and test all the components in it. This is where your real troubleshooting skill is needed. Understanding and know how to test basic electronic components is very important otherwise you will be facing difficulty in finding the fault.

Primary side of power supply normally has about less than 30 components and it will take you less than 20 minutes to test all of them. Many times there are more than one component found to be faulty and by replacing only that particular component won't solve the problem. Once you have completed the entire components test and already replace the necessary parts, you have to power up the power supply by using a 100 watt bulb connected across the fuse holder.

If the bulb lights very bright and won't go off even after couples of minutes then there are still problems in the power supply. If the bulb goes dim or went off, you know that the shorts had been taken care and you now can switch on the power supply confidently and won't blow the fuse again.

Perform Soldering/de-Soldering, Chip/Component Replacement

Soldering" is defined as the process of joining two pieces of metals using a filler metal, known as solder, having a low melting point below the melting point of the work piece.

Solder Surface Mount Chips

The method to solder a surface mount chip is very similar to the method for soldering a resistor.

1. Start by applying flux on all the pads on the circuit board.
2. Apply some solder to one of the chip's corner pads.
3. Place and align the chip using tweezers.
4. Hold the chip in place while touching the corner pad with the tip of the soldering iron so that the solder melts the pin and the pad together.
5. Check the alignment of the chip. If it is not in its place, use your soldering iron to loosen the pin chip and align the chip properly.

De Soldering:

The reverse process of soldering is DE soldering. It is a process of removal of solder and components mounted on circuit boards. The soldered joint is removed by the process of DE soldering

Component Removal

1. Apply a small amount of liquid flux to both ends of the component.
2. Place the tip directly over the top of the component. The extra solder on the tip will melt both solder joints. When the solder has melted slide the component out and up.
3. Once the component is removed from the circuit board it can be removed from the tip by the shocking sponge or with a dull blunt instrument applying downward pressure on the component.
4. use 0.5mm wire to remove smd IC's

5. Clean the area.

Instructions for Soldering:

Tools and Supplies

- x1 soldering iron (digital or analog)
- PCB(Printed Circuit Board) with available pads
- SMD (Surface Mount Device) component that matches the available pad
- Solder (recommend water soluble, rosin core acceptable)
- DE soldering braid
- Flux w/ applicator
- Tweezers
- Rubbing alcohol (rosin core solder) OR
- Water (for water soluble solder)
- Anti-static cloth

Step 1: Preparing the PCB

1. Check to be sure the pad size of the PCB lines up with the pins on the SMD
2. Clean the PCB of any dust or debris.
3. Turn the soldering iron on now, and set the temperature between 600-700 degrees.
   Warning: When heated to these temperatures, you will be burned if you touch the tip of the soldering iron.

Step 2: Use Tweezers to Position the Component

Align the pins of the component with the pads on the circuit board. Since most surface mount components have the same amount of pins on both sides, it is important to find "pin 1" every time you place a new component.

Step 3: Tack Down One Corner

1. Keep one hand still, holding the component in place with the tweezers.
2. By now, the soldering iron should be hot. Get a small to medium sized dot of solder on the tip.
3. Pick any corner pin on the component
4. Touch and hold the soldering iron to the pad that will be associated with that pin.
5. If you have done this correctly, the solder should have transferred from the pad on the circuit board to the component pin, it does not matter if you have connected excess pins, this will be fixed later.

Step 4: Flux

There are 2 purposes for flux in soldering: to prevent beading of the solder, and help the solder flow from the soldering iron to the circuit board. Flux will be used on this board to limit the amount of bridged connections made, and generally make the job easier.

1. This substance is messy, so be sure to use an applicator. (Tooth pick, brush, etc.) In this case, I have used a metal tip.
2. Get a large amount of flux on the applicator.
3. Spread the flux over the pins on the opposite side of the component that was tacked down in the previous step.

Step 5: Solder

1. Pick up the soldering iron in one hand, and the solder in the other, as per the picture below.
2. Use the soldering iron to heat up the pad, not the pin on the component.
3. While the pin is hot, position the solder between the pad and the pin. The heat will melt the solder, and the flux will cause it to flow where it needs to.
4. Repeat this as many times as necessary.

Step 6: Heat Up DE soldering Wick to Fix Tack

It is fairly common that while preforming the previous step, a solder bridge will develop. A solder bridge might look something like the picture below.

These steps will also work for removing the component from the board.

1. Take the de-soldering wick and place it over the solder you want to remove.
2. With the soldering iron, lightly press on the wick, to ensure the heats transferred through to the solder.

Step 7: Clean With Rubbing Alcohol

If water soluble solder was used, replace rubbing alcohol with water.

Take the anti-static cloth and pour a small amount of rubbing alcohol onto it.

Gently clean around the newly soldered component, and where any excess flux exists. This will give a more professional look.

Perform replacement of power supply

ESD Precautions

When performing this service action, observe the following electrostatic discharge (ESD) precautions:

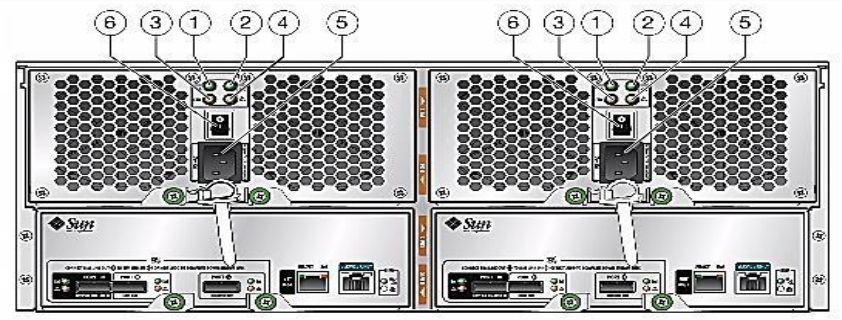
- Remove all plastic, vinyl, and foam material from the work area.

- Wear an antistatic wrist strap at all times when handling any component.
- Before handling any component, discharge any static electricity by touching a grounded surface.
- Do not remove a component from its antistatic protective bag until you are ready to install it.
- After removing a component from the chassis, immediately place it on an antistatic surface or in antistatic packaging.
- Handle any card that is part of a component only by its edges and avoid touching the components or circuitry.
- Do not slide a component over any surface.
- Limit body movement (which builds up static electricity) during the removal and replacement of a component.

Power Supply Components

Each chassis contains two hot-swappable, redundant power supplies. If one power supply is turned off or malfunctions, the other power supply maintains electrical power. Each power supply contains two internal fans that provide cooling for the system.

FIGURE 1 Power Supply LEDs and Components



1- AC power LED
2- DC power LED
3- Fan fault LED
4- Power supply fault LED
5- Universal power connector

Procedure

To replace a failed power supply, you must complete the following steps

1. Remove the failed power supply. See
2. Install the replacement power supply.
3. Verify the installation.

Caution - Potential loss of data access. Never remove a power supply unless the power fault LED or fan fault LED is amber (FIGURE 1).

Caution - Electrical shock hazard. The power supplies in this equipment can produce high energy hazards. Only trained personnel with authorized access to this equipment should remove and replace modules in the system.

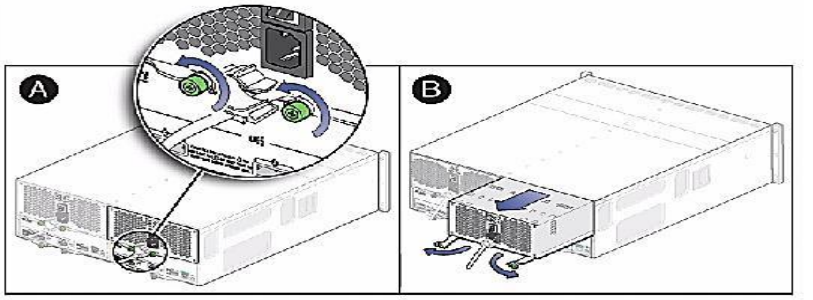
To Remove a Failed Power Supply

1. From the back of the cabinet, locate the failed power supply.
2. Ensure that the power supply on/off switch is in the "O" (off) position.
3. Remove the power cord tie strap from the power cord.
4. Unplug the power cord from its power supply connector.
5. Remove the power supply from the system (FIGURE 2):
6. Loosen the two captive screws on the power supply ejection levers.

Note - You might need a Phillips No. 2 screwdriver to loosen the screws.

Caution - Be careful to not damage the circuit board connector extending from the back of the power supply.

Removing a Power Supply



To Install a New Power Supply

Caution - Follow all ESD precautions and use care when handling either the new or failed power supply.

1. Unpack the new power supply.

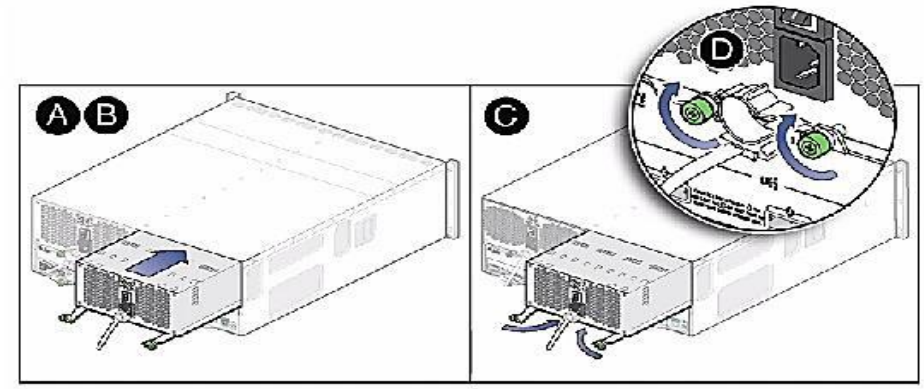
Caution - Be careful to not damage the circuit board connector extending from the back of the power supply.

2. Place the failed power supply in the packing materials so that you can return it to Oracle for proper disposal.
3. Insert the new power supply into the chassis by completing the following steps (FIGURE 3):

a. Swing both ejection levers to the fully open position.

b. Align the power supply with the open slot and slide it into the chassis until it engages with the chassis connectors and the ejection levers begin to swing closed.
c. Simultaneously push both ejection levers toward the middle of the power supply to seat it in the chassis.
d. Tighten the two ejection lever captive screws to secure the power supplies.

Installing a Power Supply



4. Ensure that the power supply on/off switch is in the “O” (off) position.
5. Plug the power cord into the new power supply and attach the power cord tie strap to the power cord.

To Verify the Installation

1. Place the power supply on/off switch to the “I” (on) position.
2. Verify that the AC and DC power LEDs are lit steady green and that the power supply fault LED is off.

Multiple Choice Questions

1. Regulated power supplies are used in _____
a. Mobile chargers
b. Measurement devices
c. Computers
d. All of the above
2. The voltage regulator output impedance is _____
a. Very small
b. High
c. Very high
d. None of the above
3. The Zener current is maximum when the load current is _____
a. Zero
b. Infinity
c. One
d. None of the above

4. The Zener diode made of _____

a. Silver
c. Copper
b. Silicon
d. None of the above

5. The regulated DC power supply also called _____

a. Linear power supply
c. Both a and b
b. Non-linear power supply
d. None of the above

6. Rectification can be done by using _____

a. Transformers
c. Bridge rectifiers
b. Conductors
d. None of the above

7. The output of the rectification is _____

a. Unidirectional
c. Multidirectional
b. Bidirectional
d. None of the above

8. The circuits are _____ in switch-mode power supply

a. Simple
c. Moderate
b. Complex
d. None of the above

9. In switch-mode power supply the regulation of voltage is done by controlling _____

a. Duty cycle
c. Both a and b
b. Voltage range
d. None of the above

10. The noise and interference in switch-mode power supply is _____

a. Very less
c. More
b. Less
d. None of the above

11. The source of supply is _____ in DC power supplies

a. Full wave rectifier
c. Delay
b. Battery
d. All of the above

12. A Zener diode utilises …… characteristic for voltage regulation

a. Forward
c. Both forward and reverse
b. Reverse
d. None of the above

13. Another name for Zener diode is …… diode

a. Breakdown
c. Power
b. Voltage
d. Current

14. Which of the following can be a source of supply in dc power supplies?

a. Battery
c. Full wave rectifier
b. Dry cell
d. All of the mentioned

15. Which of the following might not be needed in a power supply?

a. The transformer.
b. The filter.

c. The rectifier.
d. All of the above are generally needed.

16. In. a supply designed to provide high power at low voltage, the best rectifier design would probably be:

a. Half-wave.
c. Bridge.
b. Full-wave, center-tap.
d. Voltage multiplier.

17. The part of a power supply immediately preceding the regulator is:

a. The transformer.
c. The filter.
b. The rectifier.
d. The ac input.

18. Transient suppression minimizes the chance of:

a. Diode failure.
c. Filter capacitor failure.
b. Transformer failure.
d. Poor voltage regulation.

19. If a half-wave rectifier is used with 117-V rms ac (house mains), the average dc output voltage is about:

a. 52.7 V.
c. 117 V.
b. 105 V.
d. 328 V.

20. The output of a rectifier is:

a. 60-Hz ac.
c. Pulsating dc.
b. Smooth dc.
d. 120-Hz ac.

1	2	3	4	5	6	7	8	9	10
d	a	a	b	a	c	a	b	a	c
11	12	13	14	15	16	17	18	19	20
a	b	a	d	d	b	c	a	a	c

Short Questions

1. What is a computer power supply?
2. What are the main components of a computer power supply?
3. What is the difference between a 20-pin and a 24-pin power supply connector?
4. Describe regulation of power supply.
5. Draw block diagram or schematics of power supply
6. Describe battery type power supply
7. Determine different output voltages of power supply
8. Test good signal power supply
9. Identify commonly occurring faults of power supply

10. List essential tools and test equipment

Long Questions

1. Explain operating principle of power supply
2. Describe switch mode and transformer-based unit of power supply
3. Explain block diagram of a switching power supply.
4. Explain how a power good signal is produced
5. Explain troubleshooting procedures of power supply
6. Explain causes of faults in power supply itself
7. Describe various repairing techniques

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Soper, David L. Prowse and Scott Mueller.
- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
- PRINCE GEORGE'S COMMUNITY COLLEGE
- Computer Hardware Technicians CH111, 5 CD-ROM set by NCSA Academy USA
- Computer Hardware Technicians

Chapter No.4

(Troubleshooting Memories and Storage Devices)

Objectives

After completion of this chapter students will be able to:

4. Troubleshooting Memories and Storage Devices

4.1. Overview of RAM Module Types

4.2. DDR Speeds
4.3. Installation of RAM
4.4. Troubleshooting Routines
4.5. Storage Technology and Types (PATA / SATA / SSD etc)
4.6. Backup Storage and RAID Levels

Memories and Storage Devices

Computer memories and storage devices are essential components in any computer system. They provide the means to store and access data and instructions necessary for the computer to operate.

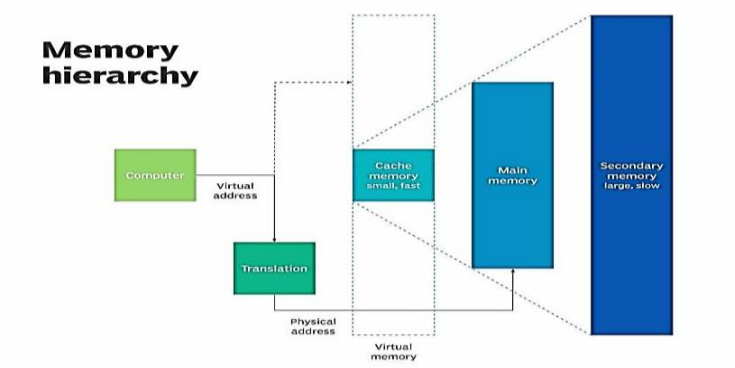
RAM, or Random Access Memory, is a type of volatile memory that temporarily stores data and instructions while the computer is running. The CPU, or Central Processing Unit, accesses the RAM to execute instructions and store data. The more RAM a computer has, the more programs and applications it can run simultaneously.

ROM, or Read-Only Memory, is a type of non-volatile memory that stores firmware or BIOS code, which is necessary for the computer to boot up and operate at a basic level.

Storage devices include hard disk drives (HDDs), solid-state drives (SSDs), flash memory, and optical drives. HDDs store data on spinning disks, while SSDs use flash memory to store data. Flash memory is also used in USB drives, memory cards, and other portable storage devices. Optical drives, such as CD/DVD drives, use laser technology to read and write data to discs.

When choosing a storage device, factors to consider include storage capacity, read and write speeds, and reliability. It is also important to consider the interface used to connect the storage device to the computer, such as SATA or NVMe for internal drives, and USB or Thunderbolt for external drives.

Proper maintenance of memories and storage devices can help prolong their lifespan and prevent data loss. This includes regular backups, proper handling and storage, and running diagnostic tools to check for errors or defects.



4.1. Overview of RAM Module Types

RAM (Random Access Memory) is a type of computer memory that allows data to be accessed randomly without accessing the previous data in a sequence. RAM modules come in various types, each with different characteristics and specifications. Here is an overview of the most common RAM module types:

SDRAM (Synchronous Dynamic Random Access Memory): This is the most common type of RAM used in computers today. It is synchronous because it operates in sync with the computer's clock speed. SDRAM modules have pins arranged in a single row and require a specific type of slot on the motherboard to function.

DDR SDRAM (Double Data Rate Synchronous Dynamic RAM): DDR SDRAM doubles the data transfer rate of SDRAM by transferring data twice per clock cycle. DDR SDRAM comes in different generations, including DDR, DDR2, DDR3, and DDR4, each with increasing speeds and bandwidths.

RDRAM (Rambus Dynamic RAM): RDRAM was a type of RAM that used a unique memory architecture that allowed for high bandwidth and fast access times. It was popular in the early 2000s but has since been replaced by other RAM types.

DDR2 FB-DIMM (Fully Buffered Dual Inline Memory Module): This type of RAM uses a buffer chip to increase its data transfer rate and reduce power consumption. FB-DIMMs have a higher capacity than traditional DDR2 modules and are commonly used in servers.

DDR3L SDRAM (Low Voltage Double Data Rate Synchronous Dynamic RAM): This is a low-voltage version of DDR3 that consumes less power and generates less heat. It is commonly used in laptops and other mobile devices.

DDR4 SDRAM (Double Data Rate Fourth Generation Synchronous Dynamic RAM): DDR4 is the most recent generation of DDR SDRAM and offers higher speed, bandwidth, and capacity than its predecessors. It is commonly used in high-performance computers and servers.

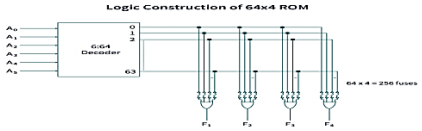
Describe RAM and ROM

RAM (Random Access Memory) and ROM (Read-Only Memory) are two types of computer memory with different characteristics.

RAM is a type of volatile memory that allows a computer to temporarily store data and program instructions that are actively being used by the CPU (Central Processing Unit) for processing. RAM is random access, meaning that any location in RAM can be accessed directly without having to access the data that comes before it. RAM is designed to be fast, so that the CPU can quickly read and write data to it. However, RAM is also volatile, meaning that its contents are lost when the computer is turned off or loses power.

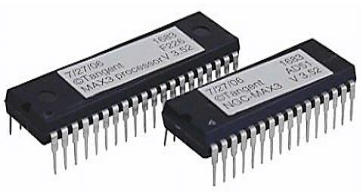
ROM, on the other hand, is a type of non-volatile memory that is used to store program instructions that are needed to start up the computer or other electronic devices. ROM is read-only, meaning that its contents cannot be changed once they are programmed onto the chip. ROM is used to store the BIOS (Basic Input/ Output System), which is the firmware that initializes the hardware and loads the operating system when the computer is turned on. Other types of ROM include PROM (Programmable Read-Only Memory) and EPROM (Erasable Programmable Read-Only Memory), which can be programmed and erased respectively.

In summary, RAM is used for temporary storage of data and program instructions that are actively being used by the CPU, while ROM is used for permanent storage of program instructions that are needed to start up the computer or other electronic devices.



RAM

RON



Enumerate Different Types of Memories

Computer memory is a generic term for all of the different types of data storage technology that a computer may use, including RAM, ROM, and flash memory.

Some types of computer memory are designed to be very fast, meaning that the central processing unit (CPU) can access data stored there very quickly. Other types are designed to be very low cost, so that large amounts of data can be stored there economically.

Another way that computer memory can vary is that some types are *non-volatile*, which means they can store data on a long term basis even when there is no power. And some types are *volatile*, which are often faster, but which lose all the data stored on them as soon as the power is switched off.

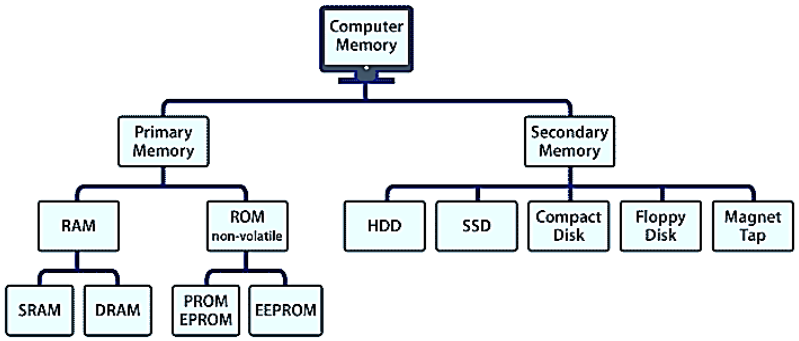
A computer system is built using a combination of these types of computer memory, and the exact configuration can be optimized to produce the maximum data processing speed or the minimum cost, or some compromise between the two.

Types of Computer Memory

Although many types of memory in a computer exist, the most basic distinction is between primary memory, often called system memory, and secondary memory, which is more commonly called storage.

The key difference between primary and secondary memory is speed of access.

- **Primary memory** includes ROM and RAM, and is located close to the CPU on the computer motherboard, enabling the CPU to read data from primary memory very quickly indeed. It is used to store data that the CPU needs imminently so that it does not have to wait for it to be delivered.
- **Secondary memory** by contrast, is usually physically located within a separate storage device, such as a hard disk drive or solid state drive (SSD), which is connected to the computer system either directly or over a network. The cost per gigabyte of secondary memory is much lower, but the read and write speeds are significantly slower.



Primary Memory Types:

RAM and ROM

There are two key types of primary memory:

1. RAM, or random access memory
2. ROM, or read-only memory

1) RAM Computer Memory

The acronym RAM stems from the fact that data stored in random access memory can be accessed – as the name suggests – in any random order. Or, put another way, any random bit of data can be accessed just as quickly as any other bit.

The most important things to understand about RAM are that RAM memory is very fast, it can be written to as well as read, it is volatile (so all data stored in RAM memory is lost when it loses power) and, finally, it is very expensive compared to all types of secondary memory in terms of cost per gigabyte. It is because of the relative high cost of RAM compared to secondary memory types that most computer systems use both primary and secondary memory.

Data that is required for imminent processing is moved to RAM where it can be accessed and modified very quickly, so that the CPU is not kept waiting. When the data is no longer required it is shunted out to slower but cheaper secondary memory, and the RAM space that has been freed up is filled with the next chunk of data that is about to be used.

Types of RAM

- **DRAM**: DRAM stands for Dynamic RAM, and it is the most common type of RAM used in computers. The oldest type is known as single data rate (SDR) DRAM, but newer computers use faster dual data rate (DDR) DRAM. DDR comes in several versions including DDR2 , DDR3, and DDR4, which offer

better performance and are more energy efficient than DDR. However different versions are incompatible, so it is not possible to mix DDR2 with DDR3 DRAM in a computer system. DRAM consists of a transistor and a capacitor in each cell.

- **SRAM**: SRAM stands for Static RAM, and it is a particular type of RAM which is faster than DRAM, but more expensive and bulker, having six transistors in each cell. For those reasons SRAM is generally only used as a data cache within a CPU itself or as RAM in very high-end server systems. A small SRAM cache of the most imminently-needed data can result in significant speed improvements in a system

The key differences between DRAM and SRAM is that SRAM is faster than DRAM – perhaps two to three times faster – but more expensive and bulkier. SRAM is usually available in megabytes, while DRAM is purchased in gigabytes. DRAM uses more energy than SRAM because it constantly needs to be refreshed to maintain data integrity, while SRAM – though volatile – does not need constant refreshing when it is powered up.

2) ROM Computer Memory

ROM stands for read-only memory, and the name stems from the fact that while data can be read from this type of computer memory, data cannot normally be written to it. It is a very fast type of computer memory which is usually installed close to the CPU on the motherboard.

ROM is a type of non-volatile memory, which means that the data stored in ROM persists in the memory even when it receives no power – for example when the computer is turned off. In that sense it is similar to secondary memory, which is used for long term storage.

When a computer is turned on, the CPU can begin reading information stored in ROM without the need for drivers or other complex software to help it communicate. The ROM usually contains “bootstrap code” which is the basic set of instructions a computer needs to carry out to become aware of the operating system stored in secondary memory, and to load parts of the operating system into primary memory so that it can start up and become ready to use.

ROM is also used in simpler electronic devices to store firmware which runs as soon as the device is switched on.

Types of ROM

ROM is available in several different types, including PROM, EPROM, and EEPROM.

- **PROM** PROM stands for Programmable Read-Only Memory, and it is different from true ROM in that while a ROM is programmed (i.e. has data written to it) during the manufacturing process, a PROM is manufactured in an empty state and then programmed later using a PROM programmer or burner.
- **EPROM** EPROM stands for Erasable Programmable Read-Only Memory, and as the name suggests, data stored in an EPROM can be erased and the EPROM reprogrammed. Erasing an EPROM involves removing it from the computer and exposing it to ultraviolet light before re-burning it.
- **EEPROM** EEPROM stands for Electrically Erasable Programmable Read-Only Memory, and the distinction between EPROM and EEPROM is that the latter can be erased and written to by the computer system it is installed in. In that sense EEPROM is not strictly read-only. However in many cases the write process is slow, so it is normally only done to update program code such as firmware or BIOS code on an occasional basis

Confusingly, NAND flash memory (such as that found in USB memory sticks and solid state disk drives) is a type of EEPROM, but NAND flash is considered to be secondary memory.

Secondary Memory Types

Secondary memory comprises many different storage media which can be directly attached to a computer system. These include:

- Hard Disk Drives
- Solid State Drives (ssds)
- Optical (cd or dvd) drives
- Tape drives

Secondary memory also includes:

- Storage arrays including 3D NAND flash arrays connected over a storage area network (SAN)
- Storage devices which may be connected over a conventional network (known as network attached storage, or NAS)

Arguably cloud storage can also be called secondary memory.

Differences between RAM and ROM

ROM:

- Non-volatile
- Fast to read
- Usually used in small quantities
- Cannot be written to quickly
- Used to store boot instructions or firmware
- Relatively expensive per megabyte stored compared to RAM

RAM:

- Volatile
- Fast to read and write
- Used as system memory to store data (including program code) that the CPU needs to process imminently
- Relatively cheap per megabyte stored compared to ROM, but relatively expensive compared to secondary memory

Describe each type of memory

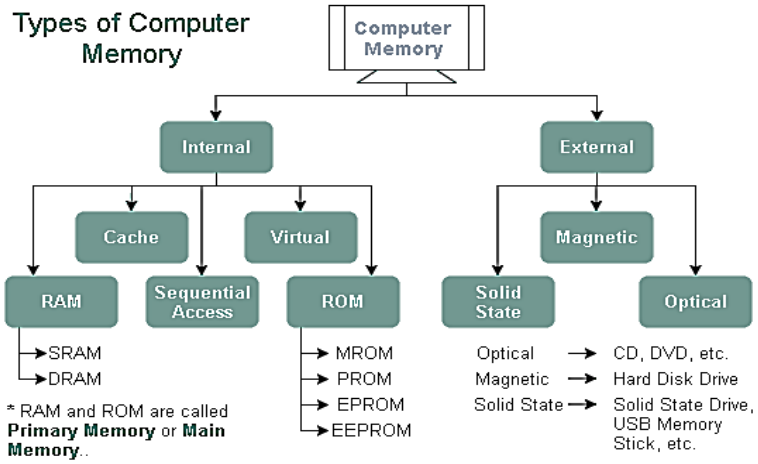
Memory is an essential part of the computer system because a computer cannot process any task without it. Memory is used to store data and instructions for performing specific tasks on the computer system. The computer memory is typically a storage space that is capable of storing and fetching data. Memory is a set of several memory cells known as the building blocks of memory. Each memory cell has a unique index number or identification number known as the unique address of that specific memory cell. The CPU is responsible for selecting memory cells to read or write data. The performance of the computer system depends on the memory and CPU. CPU cannot store programs or a large set of data permanently. They are only capable of storing basic instructions required to operate the computer. Therefore, it is mandatory to have the memory to run a computer system properly.

Types of Computer Memory

There are basically two types of computer memory:

• Internal Memory

• External Memory



Internal Memory

Internal memory usually refers to the chips or modules that are directly connected to the motherboard.

The following are the available internal memories used in the computer system:

❖ RAM

RAM is an acronym of 'Random Access Memory'. It constitutes the internal memory of the CPU (Central Processing Unit) for storing the given instructions and immediate results. It is also known as read-write memory. RAM is a primary volatile memory as the data is lost when we turn off (Switch off or Shut down) the computer or there is a power failure. RAM is small in size and comparatively faster than most of the available computer memories. But, it is not as fast as registers.

RAM can be further divided into the following two subcategories:

SRAM

SRAM stands for 'Static Random Access Memory'. It stores the data in a static form which means that the data remains in the memory as long as the computer system is on. SRAM is faster and more expensive than DRAM. It uses a matrix of six transistors and no capacitors. As the transistors do not need the power to prevent leakage, hence, there is no requirement to refresh SRAM again and again.

DRAM

DRAM stands for 'Dynamic Random Access Memory'. DRAM is widely used in computer systems. Previously, there was a single data rate (SDR) DRAM in

computers. At present, computers are using a dual data rate (DDR) DRAM. DDR is also available in different versions such as DDR2, DDR3, and DDR4, which are more energy-efficient and are providing better performance. DRAM is cheap, small and uses less power than other RAMs. DRAM is made up of a transistor and a capacitor in each
cell. Because of a capacitor, it has a leakage problem. Therefore, DRAM requires constant refreshing.

- **ROM**

ROM is an acronym of 'Read Only Memory'. As the name suggests, the data cannot normally be written to it. However,
the data can be read from this type of memory. ROM is a primary-non-volatile memory which means that it is capable of retaining the data in the memory even if there is no power supply.
ROM is a very fast type of computer memory that stores instructions required to start the computer as soon as it is connected to the power source. When a computer is connected to the power, the CPU starts reading the instructions stored in ROM. It does not require support from drivers or any other complex software to load the necessary parts of the operating system in the primary memory.
After that, the computer system boots up and becomes ready to be used. The entire operation is referred to as 'bootstrap' and the instructions that ROM contains are called 'bootstrap code'.

ROM can be further divided into the following subcategories:

MROM

MROM stands for 'Masked Read Only Memory'. MROM is a type of memory whose contents are pre-programmed with specific functional data by the integrated circuit manufacturer.

PROM

PROM stands for 'Programmable Read- Only Memory'. As the name suggests, these types of memory are programmable, which means that they can be coded or programmed by the user. PROM is manufactured as a blank memory. The user purchases a blank PROM and enters the set of programs or codes using a PROM programmer. The data or instructions cannot be changed or erased once they are written.

EPROM

EPROM stands for 'Erasable Programmable Read- Only Memory'. It is an upgraded version of PROM. Unlike PROM, EPROM allows users to erase the stored data as well as rewrite the data. The data stored in EPROM can be erased by passing ultraviolet light for a particular length of time using an EPROM eraser.

EEPROM

EEPROM stands for 'Electrically Erasable Programmable Read- Only Memory'. As the name suggests, this type of memory is programmed and erased electrically. Both programming and erasing of data takes around 4 to 10 milliseconds. EEPROM can be erased and reprogrammed for around ten thousand times. EEPROM can be erased 1 byte at a time, rather than erasing the entire memory at once. Therefore, the entire process is flexible but slow.

Note: RAM and ROM are known as the Primary Memory or Main Memory.

Cache Memory

Cache memory is a very high speed semiconductor memory that is used to store instances of programs and data frequently accessed by the CPU. It provides faster data storage and access to the CPU. Therefore, when the CPU requests the data and programs, they are quickly transferred from cache memory, so the CPU can access them instantly. CPU does not require accessing the primary memory or the hard disk to fetch the data. Cache memory generally lies in between CPU and the primary memory (RAM) and it acts as a buffer between CPU and RAM. Cache memory is costlier than the primary memory; However, it saves time and increases efficiency.

Virtual Memory

Virtual memory is an area of a secondary memory (e.g., hard disk drive or solid-state drive) that is configured to act as if it were a part of the computer's RAM. The main benefit of using this method is that the programs can be larger than physical memory. For example, when a user runs an application on a computer system, the data is stored in the primary memory (RAM). As the primary memory is fast, the CPU quickly accesses the data and start the application quickly. When a user runs a heavy application or when many applications are run at once, the system's primary memory may become full. In such cases,

The data stored in the primary memory which is not being used is temporarily transferred to the virtual memory. It frees up space in the primary memory which is further used by the system to provide smooth performance.

Virtual memory serves following two purposes:

• It allows us to add more physical memory by using a disk.

• It allows us to add memory protection as each virtual address is translated to a physical address.

Sequential Access Memory

Sequential Access Memory (also called SAM) is a class of data storage devices that read their data sequentially. In other words, the system must search the storage devices from the initial memory location or memory address until it finds the required data. It is also known as Serial Access Memory. This is in contrast to random access memory (RAM), where data can be accessed in any order. Drum memory is an example of sequential access memory.

External Memory

External memory is usually a kind of memory that is attached to the computer system separately. External memory is also known as 'Secondary Memory' or 'Auxiliary Memory'. These are used to store the data permanently. CPU does not directly access these types of memory. The data is first transferred to the primary memory and then the CPU can access it. This is because the secondary memory is not as fast as primary memory.

The following are the available external memories used in the computer system:

Magnetic Storage Devices

Magnetic storage devices are coated with magnetic material. The data is encoded on the magnetic material in the form of electric current. Magnetic devices use magnetic fields to magnetize tiny individual sections of a metal spinning disk. Each tiny magnetized section represents a binary ONE (1) and each demagnetized section represents a binary ZERO (0). These tiny sections can contain terabytes (TB) of data. These devices are cheap, fast in performance, high in capacity, and durable. Hard disk drive, magnetic tape, and floppy disks are widely used magnetic storage devices.

Solid State Storage Devices

Solid-state storage devices are made up of silicon microchips. These are non-volatile storage

Devices, which use integrated circuit assemblies as memory to continuously store any information. It can hold the data even after the computer is switched off. These are used as external secondary storage. The main advantage of

solid-state devices is that it has no moving parts. Due to this, they are portable, produce less heat and last longer. Solid-state storage devices are comparatively faster than the traditional hard disk drives, as the data is stored electrically in silicon chips known as cells. The binary data is kept within the cells by holding an electrical current in a transistor with an On/Off mode. RAM uses the same technique; However, it does not retain the data after the power is disconnected. Unlike RAM, solid-state devices have the ability to store the data even after the power is disconnected. This is possible through the use of a technology known as flash memory.

Solid-state drives (SSD) and USB (Universal Serial Bus) memory sticks or USB flash drive are examples of solid storage devices. Most modern devices are using solid-state storage devices to deliver better and consistent performance.

Optical Storage Devices

The data stored in optical storage devices can be read/write with the help of the laser beam. These devices contain spinning disc made from metal and plastic. The surface of a spinning disc is scanned by a laser beam. The surface is divided into tracks, and each track contains several flat areas and hollows. The flat areas are called 'lands' whereas the hollows are called 'pits'. Optical storage devices can store a large amount of data. Optical storage devices include CD-ROM (Compact Disc, read- only- memory), DVD-ROM (Digital versatile disc, read- only- memory), WORM (Write once, read- only- memory), etc.

4.2. DDR Speeds

DDR (Double Data Rate) is a type of synchronous dynamic random-access memory (SDRAM) that can transfer data twice per clock cycle. The speed of DDR memory is usually expressed in terms of its frequency or clock rate, measured in MHz (megahertz) or GHz (gigahertz).

The following are the common DDR speeds:

1. DDR-266 (PC-2100): This type of DDR memory has a clock rate of 133 MHz and a data transfer rate of 2.1 GB/s.
2. DDR-333 (PC-2700): This type of DDR memory has a clock rate of 166 MHz and a data transfer rate of 2.7 GB/s.
3. DDR-400 (PC-3200): This type of DDR memory has a clock rate of 200 MHz and a data transfer rate of 3.2 GB/s.
4. DDR2-533 (PC2-4200): This type of DDR memory has a clock rate of 266 MHz and a data transfer rate of 4.2 GB/s.
5. DDR2-667 (PC2-5300): This type of DDR memory has a clock rate of 333 MHz and a data transfer rate of 5.3 GB/s.
6. DDR2-800 (PC2-6400): This type of DDR memory has a clock rate of 400 MHz and a data transfer rate of 6.4 GB/s.
7. DDR3-1066 (PC3-8500): This type of DDR memory has a clock rate of 533 MHz and a data transfer rate of 8.5 GB/s.
8. DDR3-1333 (PC3-10600): This type of DDR memory has a clock rate of 667 MHz and a data transfer rate of 10.6 GB/s.
9. DDR3-1600 (PC3-12800): This type of DDR memory has a clock rate of 800 MHz and a data transfer rate of 12.8 GB/s.
10. DDR4-2133 (PC4-17000): This type of DDR memory has a clock rate of 1066 MHz and a data transfer rate of 17 GB/s.
11. DDR4-2400 (PC4-19200): This type of DDR memory has a clock rate of 1200 MHz and a data transfer rate of 19.2 GB/s.
12. DDR4-2666 (PC4-21300): This type of DDR memory has a clock rate of 1333 MHz and a data transfer rate of 21.3 GB/s.

Note that the actual speed and performance of DDR memory can also depend on other factors, such as the number of memory channels, the amount of installed memory, and the overall system configuration.

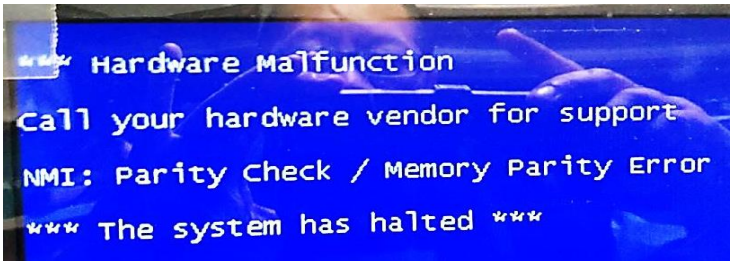
Describe Parity Error in Memory

Parity error in memory refers to a type of error that occurs when the data stored in a memory module becomes corrupted due to a single bit error. Parity is a mechanism used in memory to detect and correct such errors.

In a memory module with parity, an extra bit is added to each byte of data stored in memory, which is known as the parity bit. The parity bit is calculated in such a way that it is either set to 0 or 1, based on the number of 1s in the data byte. When the memory reads the data from the module, it checks the parity bit to ensure that the data has not been corrupted.

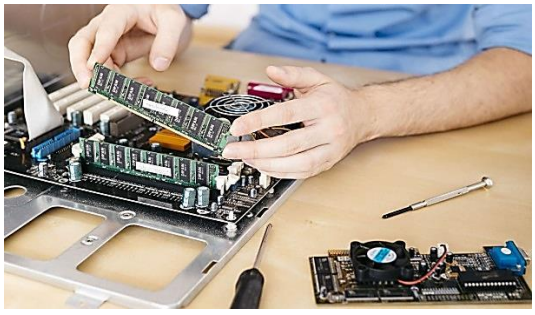
If a single bit error occurs in the data byte, the parity bit will not match the expected value, indicating that an error has occurred. This is known as a parity error. The memory controller will then generate a signal indicating the presence of an error, and the system may take appropriate action, such as retrying the operation or triggering an error message.

It is important to note that while parity checking can detect single bit errors, it cannot correct them. To correct errors, the memory must use error-correcting code (ECC) memory, which adds more bits to each data byte and can correct single bit errors and detect multi-bit errors.



4.3. Installation of RAM

The installation process for RAM (Random Access Memory) varies depending on the type of computer you have. However, the following steps will generally apply to most desktop computers:



1. Before purchasing a new RAM, check your computer's user manual or manufacturer's website to find out the type of RAM your computer supports, as well as the maximum amount of RAM your system can handle.
2. Turn off your computer and unplug it from the wall.
3. Open the computer case by removing the screws or releasing any latches or levers. This process varies depending on the computer model, so refer to your computer's user manual if you're not sure how to do it.
4. Locate the RAM slots on the motherboard. They should be long, rectangular slots near the CPU (Central Processing Unit).
5. Remove any existing RAM modules from the slots. You can do this by pushing down on the clips at either end of the module until it pops up, then pulling it out.
6. Align the notch on the new RAM module with the slot on the motherboard, then gently push down on the module until it clicks into place. Make sure that the clips on either end of the slot click back into place to secure the RAM.
7. Repeat the process for any additional RAM modules you need to install.
8. Close the computer case and secure it with screws or latches.
9. Plug in your computer and turn it on.
10. Check that the new RAM is recognized by your computer by going to your operating system's system information or task manager. If the RAM is not recognized or there are any issues, refer to your computer's user manual or seek technical support.

4.4. Troubleshooting Routines

Perform Troubleshooting Routines of Memory

Common Memory Problems

When you have a problem with memory, the cause is usually one of three things:

Improper Configuration:

You have the wrong part for your computer or did not follow the configuration rules.

Improper Installation:

The memory may not be seated correctly, a socket is bad, or the socket may need cleaning.

Defective Hardware:

The fact that many computer problems manifest themselves as memory problems makes troubleshooting difficult. For example, a problem with the motherboard or software may produce a memory error message.
This chapter is designed to help you figure out if you have a memory problem, and if so, what kind of problem it is, so you can get to a solution as quickly as possible.

BASIC TROUBLESHOOTING

Sure, here are some common troubleshooting routines for memory:

1. Restart your computer: This might sound obvious, but it's often the first thing you should try. Sometimes a simple restart can fix issues with memory.
2. Run a memory diagnostic tool: Windows has a built-in memory diagnostic tool that can help diagnose memory problems. To access it, open the start menu and search for "Windows Memory Diagnostic." Follow the prompts to run the tool and see if it detects any errors.
3. Reseat the memory: Sometimes memory can become loose and cause problems. Turn off your computer, unplug it from the wall, and open up the case. Find the memory modules and make sure they're securely seated in their slots. If they're not, carefully remove them and reinsert them.
4. Try different memory modules: If you have more than one memory module, try removing one and see if the problem goes away. If it doesn't, try the other module. This can help you determine if one of the modules is faulty.
5. Check for compatibility issues: Make sure the memory you're using is compatible with your computer's motherboard. Check the manufacturer's website for compatibility information.
6. Update your BIOS: Sometimes updating your computer's BIOS can help resolve memory issues. Check the manufacturer's website for BIOS updates and follow their instructions to update it.
7. Check for overheating: Overheating can cause memory problems. Make sure your computer's fans are working properly and that there's proper airflow around the memory modules.

These are some common troubleshooting routines for memory. If none of these steps help, you may need to replace your memory modules or seek assistance from a professional.

Replace Memory Chip

The type of RAM you need depends on the make and model of your computer and whether it's a desktop or a laptop. In addition, the computer's motherboard has strict requirements for which generation of RAM it will accept. So, be sure to look up the specifications for your machine. You also need to know which slots on the motherboard and in which combinations you can install the RAM modules.

Replace the RAM

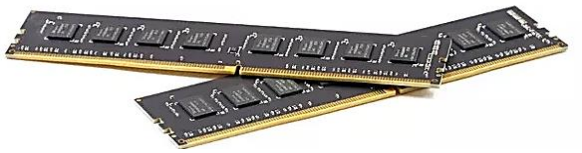
Open the computer and add those to empty slots intended for RAM chips or you remove the old chips and replace them with new chips.

The specific steps necessary to replace the memory in your computer depends on whether you are replacing the RAM in a desktop or laptop computer.

1. Shut your computer down.
   Don't just put the computer to sleep, make sure it actually shuts down.
2. Turn the computer off, if it has a physical power switch.
3. Unplug your computer from power.
4. If possible, unplug all of the components, wires, and cables from your computer so that you can move the computer to a clean, sturdy work surface.
5. Open the computer case. Most tower and mid-tower cases have side panels held in place by screws or latches, but some cases require you to remove additional screws or activate a latch to slide the entire cowling off as a single part.
   Note: Some cases are more complicated than others. If you aren't able to figure out how to open your case, contact the manufacturer for assistance.
6. With the case open, examine the motherboard to locate the existing RAM. You will install your new RAM alongside the existing modules.
   Note:If all of your RAM slots are full, you will have to remove existing modules and replace them with larger ones, e.g., replace 2GB RAM modules with 4GB RAM modules.
7. Before handling your new RAM modules, ground yourself with an anti-static wrist strap.

Note: If you don't have an anti-static strap, you can also ground yourself by touching a metal lamp or anything else that's capable of acting as a ground for any static that's built up in your body or clothes.

8. Examine your new RAM modules, paying special attention to the side with the visible gold contacts. That's the edge that you will need to seat into the sockets on the motherboard.
   Note: The edge with the contacts will typically be keyed with a notch that matches a socket's notch. This setup makes it so that you can't install the RAM backward, and it also shows you which way to install it.
9. If the RAM sockets on your motherboard have latches on the ends, gently pull them back to allow your modules' insertion.
   Note: You can see the upright retention clips in the currently occupied RAM sockets and the retention clips that have been pried back in the free sockets in this photo. Your motherboard may look slightly different, but most desktop computers use this basic configuration.
10. Line up the notch on your new RAM module with the notch in the socket, and carefully set the module in place. If latches are present, they will automatically close as you push the module in.
    Note: If you're installing RAM in a laptop, you will typically set the RAM in place at an angle and then gently push it down so that the module snaps into place flat against the motherboard instead of perpendicular. Look at the existing RAM modules to see how your new modules should be oriented.
11. Apply even force to the edge of the RAM module to gently click it into place. Be careful not to bend it back and forth, and don't force it. If it doesn't go in easily, pull it out and make sure you've lined up the notches correctly.
    Note: You may need to gently vacuum or blow dust out of the sockets if there is a lot of dust present inside your computer.
12. Verify that the RAM modules are seated properly, and close the computer back up. While you're doing that, make sure you didn't accidentally unplug anything while installing the RAM.
13. Hook your computer back up, turn it on, and verify that it can read the new memory.



Describe the Operational Principles of Floppy and Hard Disk Drives

Floppy Disk Drive (FDD)

A Floppy Disk Drive (FDD) is a type of magnetic storage device that was commonly used in personal computers (PCs) and other computing devices from the 1970s to the early 2000s. It uses floppy disks, which are thin, flexible plastic disks coated with a magnetic material that stores data in the form of magnetized spots on the disk surface.

The FDD consists of a drive unit, which is a hardware component installed in a computer or external enclosure, and a floppy disk, which is inserted into the drive. The drive unit contains a motor and read/write heads that interact with the floppy disk to read and write data. The floppy disk typically has a storage capacity ranging from 360 kilobytes (KB) to 1.44 megabytes (MB), although earlier versions of floppy disks had lower capacities.

Floppy disks were used for various purposes, such as storing and transferring data, installing software, and creating backups. However, due to their limited storage capacity, slow data transfer rates, and vulnerability to data loss due to magnetic interference or physical damage, floppy disks have largely been phased out and replaced by other storage technologies such as USB flash drives, CD/DVD drives, and cloud storage.

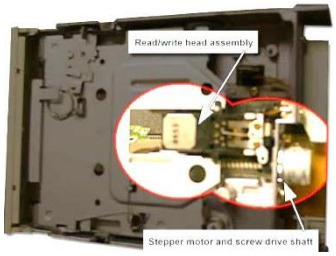
It's worth noting that floppy disk drives are now considered outdated technology and are not commonly found in modern computers. However, they hold historical significance as a pioneering form of magnetic storage that was widely used in the early days of personal computing.

The operational principles of a Floppy Disk Drive (FDD) involve several key components and processes that work together to read and write data on a floppy disk. Here's a high-level overview:

1. Motor: The FDD contains a motor that spins the floppy disk at a high speed when it's inserted into the drive. The rotational speed is typically around

300-360 revolutions per minute (RPM), although it may vary depending on the specific drive.

2. Read/Write Heads: The FDD has read/write heads that are positioned above and below the floppy disk. These heads are responsible for reading and writing data to and from the magnetic surface of the disk. The heads are mounted on an actuator arm that can move them across the surface of the disk.



3. Data Encoding: Data on a floppy disk is stored as magnetic spots on the disk surface. These spots represent binary data, where a magnetized spot is read as a "1" and a UN magnetized spot is read as a "0". The read/write heads use magnetic sensors to detect these spots and convert them into electrical signals.
4. Data Read: To read data from a floppy disk, the FDD positions the read/write heads over the desired track on the disk surface. The heads then emit magnetic pulses that interact with the magnetic spots on the disk, inducing electrical signals in the sensors. These signals are then amplified and processed to retrieve the stored data.
5. Data Write: To write data to a floppy disk, the FDD first positions the read/write heads over the desired track. The drive then applies electrical currents to the heads, which in turn generate magnetic fields that magnetize or demagnetize the spots on the disk surface, encoding the data onto the disk.
6. Data Interpolation: Floppy disks use a technique called Frequency Modulation (FM) or Modified Frequency Modulation (MFM) to store data. These encoding methods involve varying the frequency of the magnetic pulses to represent different data bits. The FDD's electronics interpret

these frequency changes to decode the data during reading and encoding during writing.

7. Disk Formats: Floppy disks come in different formats, such as 5.25-inch and 3.5-inch, which have varying capacities and track densities. The FDD must be compatible with the specific disk format in order to read and write data properly.

8. Controller: The FDD is typically connected to a controller, which is a hardware component that interfaces with the computer's motherboard and manages the data transfer between the computer and the floppy disk drive.

Overall, the operational principles of a floppy disk drive involve spinning the disk, positioning the read/write heads, encoding and decoding data using magnetic pulses, and interfacing with a controller to read from and write to the floppy disk.

Terminology

- Floppy disk - Also called diskette. The common size is 3.5 inches.
- Floppy disk drive - The electromechanical device that reads and writes floppy disks.
- Track - Concentric ring of data on a side of a disk.
- Sector - A subset of a track, similar to wedge or a slice of pie.

Hard Disk Drive (HDD)

A Hard Disk Drive (HDD) is a type of data storage device that uses magnetic storage to store and retrieve digital data. It consists of one or more rotating disks or platters coated with magnetic material, and read/write heads that move across the surface of the disks to access and modify the data.

HDDs are widely used in computers, servers, gaming consoles, and other electronic devices for storing data such as operating systems, applications, documents, multimedia files, and more. They are typically connected to a computer system via interfaces such as SATA (Serial Advanced

Technology Attachment), SAS (Serial Attached SCSI), or IDE (Integrated Drive Electronics).

HDDs offer several advantages, including relatively high storage capacity, relatively low cost per unit of storage, and long-term data retention even when powered off. However, they also have some limitations, such as being susceptible to mechanical failures due to the moving parts, slower data access speeds compared to solid-state drives (SSDs), and higher power consumption.

HDDs have evolved over the years with advancements in technology, such as increasing storage capacities, faster data transfer rates, improved reliability, and enhanced error correction techniques. They continue to be a popular choice for many storage needs, especially for applications that require large storage capacities at a lower cost per gigabyte compared to SSDs.

Capacity and Performance

The capacity and performance of Hard Disk Drives (HDDs) have improved significantly over the years with advancements in technology. Let's take a closer look at capacity and performance aspects of HDDs:

Capacity:

HDDs are available in a wide range of capacities, from small capacities of a few hundred gigabytes (GB) to large capacities of multiple terabytes (TB) or even petabytes (PB). As of 2021, consumer-grade HDDs commonly offer capacities ranging from 1 TB to 18 TB, while enterprise-grade HDDs can go up to 20 TB or higher. The capacity of an HDD is determined by the number of platters it has and the data density on each platter, with higher density allowing for more data to be stored on the same physical surface area.

Performance:

HDD performance is usually measured in terms of data transfer rate, latency, and seek time.

Data Transfer Rate: The data transfer rate of an HDD refers to how quickly data can be read from or written to the disk. It is typically measured in megabytes per second (MB/s) or gigabytes per second (GB/s). The data transfer rate of an HDD is influenced by factors such as the rotational speed of the disks (measured in revolutions per minute or RPM), the areal density (amount of data that can be stored on a given area of the disk), and the interface used (e.g., SATA, SAS, IDE).

Latency: Latency is the time it takes for the disk to rotate to the correct position so that the read/write heads can access the data on the desired track. It is typically measured in milliseconds (ms) and is dependent on the rotational speed of the disks. Lower latency means faster access to data.

Seek Time: Seek time is the time it takes for the read/write heads to physically move to the correct track on the disk. It is also typically measured in milliseconds (ms) and is influenced by factors such as the design of the HDD and the position of the data on the disk. Lower seek time indicates faster access to data.

It's worth noting that HDD performance can vary depending on the specific model, manufacturer, and other factors, and that HDDs generally have slower performance compared to Solid State Drives (SSDs) due to their mechanical nature. However, HDDs are still widely used due to their lower cost per unit of storage and high storage capacities, making them suitable for many applications where performance requirements are not as critical, such as bulk data storage, backups, and archival purposes.

Inside: Electronics Board

The best way to understand how a hard disk works is to take a look inside. (Note that **OPENING A HARD DISK RUINS IT**, so this is not something to try at home unless you have a defunct drive.

Here is a typical hard-disk drive:

It is a sealed aluminum box with controller electronics attached to one side. The electronics control the read/write mechanism and the motor that spins the platters. The electronics also assemble the magnetic domains on the drive into bytes (reading) and turn bytes into magnetic domains (writing). The electronics are all contained on a small board that detaches from the rest of the drive:

Inside: Beneath the Board

Underneath the board are the connections for the motor that spins the platters, as well as a highly-filtered vent hole that lets internal and external air pressures equalize:

Removing the cover from the drive reveals an extremely simple but very precise interior:

In this picture you can see:

- The **platters** - These typically spin at 3,600 or 7,200 rpm when the drive is operating. These platters are manufactured to amazing tolerances and are mirror-smooth (as you can see in this interesting self-portrait of the author... no easy way to avoid that!).
- The **arm** - This holds the read/write heads and is controlled by the mechanism in the upper-left corner. The arm is able to move the heads from the hub to the edge of the drive. The arm and its movement mechanism are extremely light and fast. The arm on a typical hard-disk drive can move from hub to edge and back up to 50 times per second

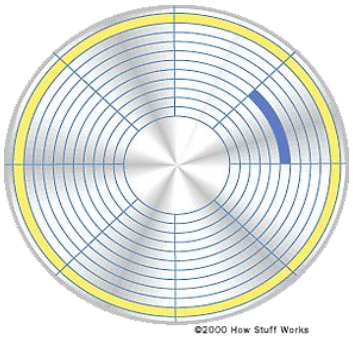
Inside: Platters and Heads

In order to increase the amount of information the drive can store, most hard disks have **multiple platters**. This drive has three platters and six read/write heads:

The mechanism that moves the arms on a hard disk has to be incredibly fast and precise. It can be constructed using a high-speed linear motor.

Many drives use a "**voice coil**" approach -- the same technique used to move the cone of a speaker on your stereo is used to move the arm.

Storing the Data



Data is stored on the surface of a platter in **sectors** and **tracks**. Tracks are concentric circles, and sectors are pie-shaped wedges on a track, like this:
A typical track is shown in yellow; a typical sector is shown in blue. A sector contains a fixed number of bytes -- for example, 256 or 512. Either at the drive or the operating system level, sectors are often grouped together into **clusters**.
The process of **low-level formatting** a drive establishes the tracks and sectors on the platter. The starting and ending points of each sector are written onto the platter. This process prepares the drive to hold blocks of bytes. **High-level formatting** then writes the file-storage structures, like the file-allocation table, into the sectors. This process prepares the drive to hold files.

Identify parts of floppy and hard disk drives

The main parts of a typical floppy disk drive (FDD) and hard disk drive (HDD):

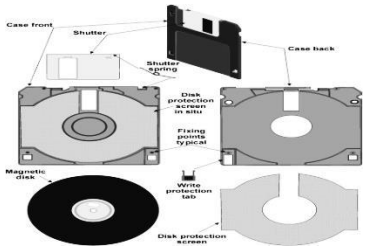
Floppy Disk Drive (FDD):

1. Diskette: A flexible magnetic disk that stores data.
2. Drive motor: Spins the diskette at a specified speed for reading or writing data.
3. Read/write head: Reads data from or writes data to the diskette.
4. Stepper motor: Moves the read/write head across the diskette to access different tracks.
5. Head actuator: Positions the read/write head over the desired track on the diskette.
6. Spindle: Holds the diskette in place as it spins.
7. Ribbon cable: Connects the FDD to the motherboard of the computer.
8. Power connector: Supplies power to the FDD.

Hard Disk Drive (HDD):

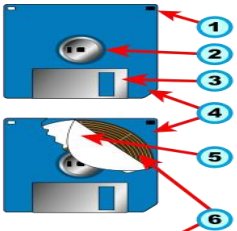
1. Platters: Circular disks coated with a magnetic material that store data.
2. Read/write head: Reads data from or writes data to the platters.
3. Actuator arm: Holds the read/write head and positions it over the desired location on the platters.
4. Actuator motor: Moves the actuator arm to access different tracks on the platters.
5. Spindle motor: Spins the platters at a high speed.
6. Head stack assembly: Consists of the actuator arm and read/write head, and moves as a single unit.
7. SATA (Serial ATA) or IDE (Integrated Drive Electronics) connector: Connects the HDD to the motherboard of the computer.
8. Power connector: Supplies power to the HDD.

Please note that the exact components and their names may vary slightly depending on the specific model and type of floppy disk drive or hard disk drive.



The basic internal components of a 3½-inch floppy disk:

1. Write-protect tab



2. Hub
3. Shutter
4. Plastic housing
5. Paper ring
6. Magnetic disk
7. Disk sector.

Floppy Disk Drive Part

Write-protect tab

If you hold the disk so that the edge that goes into the drive is at the bottom, this should be in the top left corner. If the movable part of the sliding tab is up, so that there's a hole in that corner of the disk, the disk is write-protected. If the movable part of the tab is down, the disk is write-enabled.

Hub

Hub The metal center of the magnetic disk. The holes in the hub are like the hole in the middle of a record-they fit over spindles inside the computer and hold the disk in place while it spins. · Paper rings The magnetic disk is sandwiched between two white paper rings.

Shutter

The shutter protects the disk surface from dirt and fingerprints. The shutter slide out of the way when the disk is inserted into the drive so that the read/write heads can reach the disk.

Plastic housing

A floppy disk or floppy diskette (casually referred to as a floppy, or a diskette) is an obsolete type of disk storage composed of a thin and flexible disk of a magnetic storage medium in a square or nearly square plastic enclosure lined with a fabric that removes dust particles from the spinning disk.

Paper ring

Paper rings The magnetic disk is sandwiched between two white paper rings. The two rings are glued down to the plastic housing, and stay still while the disk spins. They clean the disk, removing microscopic bits of dust. Write-protect tab This little plastic rectangle is in the upper right corner of most disk

Magnetic disk

A floppy disk is a magnetic storage medium for computer systems. It came in several different sizes, including the 8-inch and the 3.5-inch, and is composed

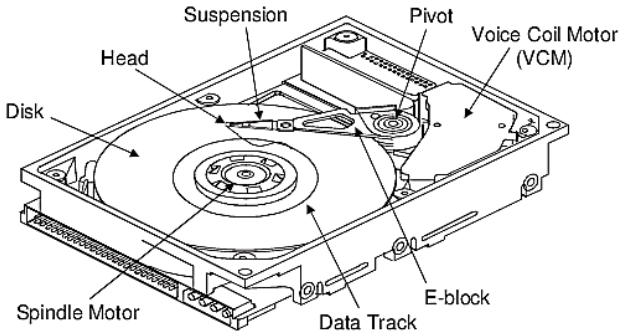
of a thin and flexible magnetic disk sealed in a square plastic carrier. The different types of floppy disks required a different floppy disk drive.

Disk sector

Disk storage, a sector is a subdivision of a track on a magnetic disk or optical disc. Each sector stores a fixed amount of user-accessible data, traditionally 512 bytes for floppy disk drives.

Parts Hard Disk Drives

The hard drive, which typically provides storage for data and applications within a computer, has four key components inside its casing -- the platter (for storing data), the spindle (for spinning the platters), the read/write arm (for reading and writing data) and the actuator (for controlling the actions of the read/write arm). Only the most technically proficient IT professionals should attempt to work on the components inside a hard drive.



Platters

The platters are the circular discs inside the hard drive where the 1s and 0s that make up your files are stored. Platters are made out of aluminum, glass or ceramic and have a magnetic surface in order to permanently store data. On larger hard drives, several platters are used to increase the overall capacity of the drive. Data is stored on the the platters in tracks, sectors and cylinders to keep it organized and easier to find.

The Spindle

The spindle keeps the platters in position and rotates them as required. The revolutions-per-minute rating determines how fast data can be written to and read from the hard drive. A typical internal desktop drive runs at 7,200 RPM, though faster and slower speeds are available. The spindle keeps the platters

at a fixed distance apart from each other to enable the read/write arm to gain access. (ref 1+3)

The Read/Write Arm

The read/write arm controls the movement of the read/write heads, which do the actual reading and writing on the disk platters by converting the magnetic surface into an electric current. The arm makes sure the heads are in the right position based on the data that needs to be accessed or written; it's also known as the head arm or actuator arm. There is typically one read/write head for every platter side, which floats 3 to 20 millionths of an inch above the platter surface.

Actuator

The actuator or head actuator is a small motor that takes instructions from the drive's circuit board to control the movement of the read/write arm and supervise the transfer of data to and from the platters. It's responsible for ensuring the read/write heads are in exactly the right place at all times.

Other Components

As well as the casing on the outside of the hard disk that holds all of the components together, the front-end circuit board controls input and output signals in tandem with the ports at the end of the drive. No matter what the type of drive, it has one port for a power supply and one port for transferring data and instructions to and from the rest of the system.

4.5. Storage Technology and Types (PATA / SATA / SSD etc)

Storage technology has evolved over the years, and various types of storage technologies are available in the market today. Some of the common storage technologies include:

1. Parallel Advanced Technology Attachment (PATA): PATA, also known as IDE (Integrated Drive Electronics), is an older storage technology that uses a parallel interface to connect storage devices, such as hard disk drives (HDDs) and optical drives, to a motherboard or controller. PATA drives have a wide data cable with 40 or 80 pins, and they have lower data transfer rates compared to newer technologies like SATA.

2. Serial Advanced Technology Attachment (SATA): SATA is a newer storage technology that has largely replaced PATA in modern computers. SATA uses a serial interface to connect storage devices, such as HDDs and SSDs, to a motherboard or controller. SATA drives have a smaller data cable with 7 pins, and they offer higher data transfer rates compared to PATA, resulting in faster data access and improved system performance.
3. Solid State Drive (SSD): SSDs are a type of storage technology that use NAND-based flash memory to store data. Unlike traditional HDDs, which use spinning disks and magnetic heads to read and write data, SSDs have no moving parts, making them faster, more reliable, and more energy-efficient. SSDs are known for their high-speed data access, low latency, and durability, making them popular in modern computing devices such as laptops, desktops, and servers.
4. Non-Volatile Memory Express (NVMe): NVMe is a high-performance storage interface designed specifically for SSDs. NVMe drives use a PCIe (Peripheral Component Interconnect Express) interface, which provides faster data transfer rates compared to SATA, making NVMe drives even faster than traditional SATA SSDs. NVMe drives are commonly used in high-end gaming PCs, workstations, and data center servers.
5. Redundant Array of Independent Disks (RAID): RAID is a storage technology that uses multiple hard drives to improve data redundancy, performance, or both. RAID arrays can be configured in different levels, such as RAID 0, RAID 1, RAID 5, RAID 10, and more, each with its own advantages and trade-offs in terms of data protection, performance, and capacity.
6. Network-Attached Storage (NAS): NAS is a type of storage technology that provides a dedicated storage solution for networks. NAS devices are standalone storage devices connected to a network, allowing multiple users and devices to access and store data centrally. NAS devices typically have their own operating system and can provide various advanced storage features such as data sharing, backup, and remote access.

These are some of the common storage technologies and types available in the market today. The choice of storage technology depends on factors such as performance requirements, capacity needs, budget, and intended use case,

and it's important to select the appropriate storage technology that best fits your specific needs.

Describe the IDE and SCSI setup of drives

IDE (Integrated Drive Electronics) and SCSI (Small Computer System Interface) are two types of interfaces used for connecting hard drives and other storage devices to computers. Here's a brief overview of IDE and SCSI SETUPS FOR DRIVES:

IDE Setup:

IDE is a common interface used for connecting hard disk drives (HDDs) and optical disk drives (ODDs) to a computer's motherboard. IDE cables typically have two or three connectors, with each connector supporting one drive. The two types of IDE connectors are:

IDE Parallel ATA (PATA): Also known as ATA or IDE, PATA is the older and slower IDE interface. It supports up to two drives per IDE channel (Primary and Secondary), with each drive having a master or slave designation. The master drive is typically connected to the end connector of the IDE cable, while the slave drive is connected to the middle connector.

IDE Serial ATA (SATA): SATA is the newer and faster IDE interface, which has largely replaced PATA in modern computers. SATA uses smaller and more efficient cables, with each cable supporting one drive only. SATA drives do not require master or slave designations, as each drive connects directly to a SATA port on the motherboard.

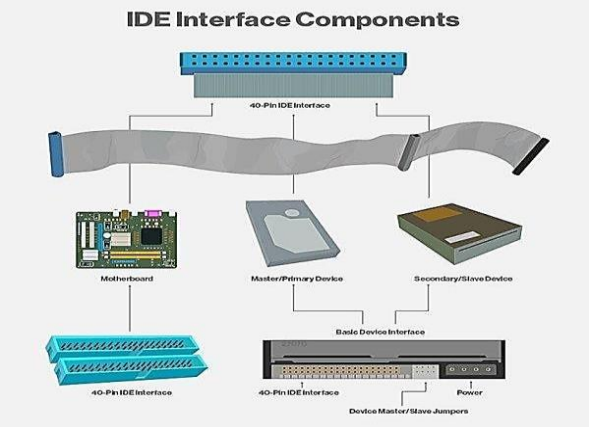
SCSI Setup:

SCSI is a more advanced and versatile interface used in high-performance storage systems, such as servers and workstations. SCSI supports multiple devices (up to 15 or more) on a single SCSI bus, which can be daisy-chained or connected in a more complex configuration. SCSI devices include hard drives, tape drives, CD/DVD drives, and other storage peripherals.

SCSI devices are assigned unique SCSI IDs, ranging from 0 to 15, and are typically configured using jumpers or software settings. Each SCSI device must have a unique ID to avoid conflicts on the SCSI bus. The device with the lowest ID is usually designated as the SCSI controller or host adapter, which connects to the computer's SCSI interface. SCSI devices can be hot-swappable, meaning they can be added or removed while the system is powered on.

SCSI also supports different SCSI protocols, such as SCSI-1, SCSI-2, SCSI-3, Ultra SCSI, Wide SCSI, and others, which define the data transfer rates and other features of the interface.

In summary, IDE and SCSI are two different types of interfaces used for connecting drives to computers. IDE uses parallel cables and supports up to two drives per channel, while SCSI uses a daisy-chained or more complex configuration and supports multiple devices on a single bus. IDE is common in consumer-grade computers, while SCSI is used in high-performance storage systems.



Main Differences Between SCSI and IDE

1. SCSI stands for Small Computer System Interface, and IDE stands for Integrated Drive Electronics.
2. SCSI hard drives offer a faster data transfer rate, resulting in improved performance and outcomes. The IDE, on the other hand, transfers data at a slower rate.
3. SCSI configuration is more complex for most users, whereas IDE configuration is simpler as compare to SCSI.
4. Unlike IDE, SCSI requires the usage of an interface expansion card virtually all of the time (unless the motherboard already has it). The usage of extra system resources is necessitated by the inclusion of more hardware. While, because today's motherboards all include an ATA/IDE interface, no more resources are needed until additional drives are needed.
5. SCSI is more expensive as compared to IDE, whereas IDE is less expensive than SCSI.

Install and setup floppy and hard disk drives

Install A Floppy Disk Drive

Remove existing floppy drive.

If you are installing a floppy disk drive to replace a faulty one, begin by disconnecting all cables from the current floppy drive and then remove it from the system.

Insert the floppy drive cable into the floppy drive connector. Make sure the pin 1 on the cable connects to the pin 1 on the floppy drive connector. As you already know by now that pin 1 is the red or pink strip on the edge of the floppy drive cable. Most floppy drive cables are designed so that it will only go in on way, so you cannot connect it incorrectly.

Push the floppy drive power cable to the power connector. This will only go in on way. Finally connect the other end of the floppy drive cable to floppy drive connector on your motherboard. Make sure pin 1 on the cable connects to pin 1 on the connector.

If you are using a diskette for the first time or if you want to format your diskette, perform the following steps.

1. Insert the floppy disk.
2. Select Check For Floppy from the File Menu. Note - ...
3. Choose Format Floppy from the File menu. Make sure the floppy window is active. ...
4. Click Format Disk.

Install A Hard Drive

Set the Jumpers

If installing an IDE hard drive, the jumpers must be properly set on the drive itself.

On the back of the hard drive should be small pins with a small plastic piece, known as a jumper block shunt.

Attach Cable and Power Connector

Once the hard is attached and secured to the computer case, connect the appropriate cable to the hard drive, as well as the power connector. If installing a SATA hard drive, use a SATA cable. If installing an IDE hard drive, use an IDE cable.

SATA cable

connecting the SATA cable to the hard drive, connect the other end of the cable to the motherboard's SATA connector.

IDE cable

connecting the **IDE** cable to the hard drive the IDE/EIDE cable (gray flat ribbon cable) has a blue or red line or dotted line on one side of the cable.

Power cable

Once the SATA or IDE cable has been connected to the hard drive, connect the power cable to the hard drive. Look at the power connection on the hard drive and then line up the power cable to connect it properly**.**

BIOS or CMOS Setup

Once the hard drive has been installed, place the case back onto the computer and connect the keyboard, monitor, and power to the computer.

Once connected, turn on the computer and as the computer is booting, access the BIOS or CMOS setup.

Verify the hard drive is being recognized or that each hard drive is setup as Auto**.**

Describe Operational Principles of tape, Compact, Bernoulli and Zip drives

Magnetic Tape Recorder Working Principle:

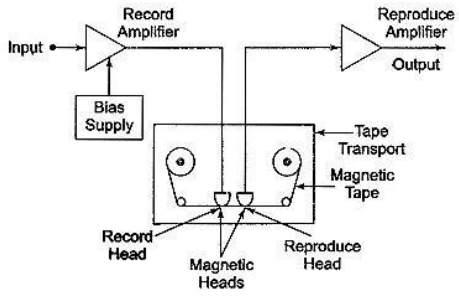
A magnetic tape recorder, also known as a reel-to-reel tape recorder, is a device that records and plays back audio or other analog signals on magnetic tape. The working principle of a magnetic tape recorder involves several key components and processes, including:

1. Magnetic Tape: The magnetic tape is a thin, plastic strip coated with a magnetic material, typically iron oxide or chromium dioxide. This tape is

wound onto two reels, the supply reel and the take-up reel, and threaded through the tape transport system of the recorder.

2. Recording Head: The recording head is an electromagnet that generates a magnetic field, which interacts with the magnetic coating on the tape. When an audio signal is fed into the recorder, the recording head converts the electrical signal into a magnetic pattern on the tape by aligning the magnetic particles along the tape's length according to the strength and polarity of the electrical signal.
3. Playback Head: The playback head is also an electromagnet that reads the magnetic patterns on the tape during playback. As the tape passes over the playback head, the magnetic patterns induce electrical currents in the head, which are then amplified to reproduce the original audio signal.
4. Erase Head: The erase head is another electromagnet that erases the magnetic patterns on the tape before recording a new signal. It generates a strong magnetic field that demagnetizes the tape, preparing it for fresh recording.
5. Tape Transport System: The tape transport system consists of motors, capstans, pinch rollers, and other mechanical components that control the movement of the tape through the recorder. The supply reel feeds the tape past the recording head, playback head, and erase head, and the take-up reel winds the tape back onto itself after passing through the heads.
6. Amplifiers and Electronics: The magnetic tape recorder also includes amplifiers and electronics that process and amplify the electrical signals generated by the recording head and read by the playback head. These signals are then sent to a speaker or other audio output device for listening.

The working principle of a magnetic tape recorder involves the recording head converting electrical signals into magnetic patterns on the tape, which are then read by the playback head during playback to reproduce the original audio signal. The tape transport system ensures smooth and accurate movement of the tape through the recorder, and the erase head prepares the tape for new recordings by erasing existing magnetic patterns. Amplifiers and electronics are used to process and amplify the signals for playback or recording.



Operational Principles of Compact Disk

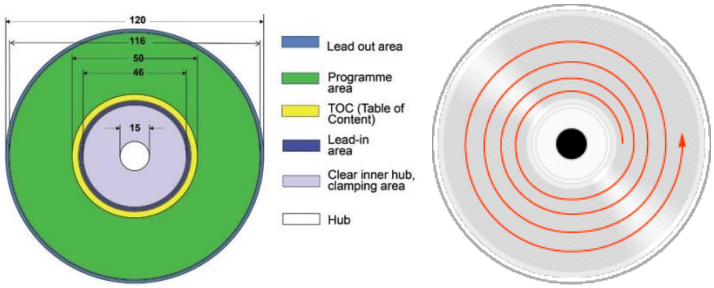
Compact Discs (CDs) are a digital optical disc format used for storing and playing back audio, video, and other digital data. CDs follow a set of operational principles that govern their functionality, which can be summarized as follows:

1. Optical Storage: CDs use optical storage technology, which involves encoding data as microscopic pits and lands on the reflective surface of the disc. These pits and lands are read by a laser beam, which reflects off the surface of the disc and is detected by a photoelectric sensor. The presence or absence of pits and lands represents the binary code used to store digital data.
2. Laser Reading: CDs use a low-power laser beam to read data from the disc. The laser beam is emitted from a laser diode and focused onto the disc's surface through a lens system. The laser beam scans the disc in a spiral track, starting from the innermost track and moving towards the outer edge. The reflected laser light is then converted into electrical signals by a photoelectric sensor.
3. Reflective Surface: CDs have a reflective layer made of aluminum or silver, which is applied to the disc's underside. This reflective layer reflects the laser beam back to the photoelectric sensor. The presence of a pit on the disc's surface causes the laser beam to scatter, resulting in less reflected light, while the presence of a land results in more reflected light. These changes in reflected light are detected by the photoelectric sensor and interpreted as digital data.
4. Data Encoding: CDs use a method called "Eight-to-Fourteen Modulation" (EFM) to encode data. EFM converts each 8-bit block of data into a 14-bit code, which includes additional bits for error correction and synchronization. This encoding scheme allows for efficient storage and

retrieval of digital data while providing robust error correction capabilities to ensure accurate data retrieval.

5. Track and Sector Structure: CDs have a spiral track that is divided into sectors, similar to the tracks and sectors on a traditional vinyl record. Each sector contains a fixed amount of data, typically 2048 bytes, along with additional space for error correction and other control information. The spiral track allows for continuous data storage on the disc, with the data organized in a logical format that can be easily accessed by the CD player.
6. Digital-to-Analog Conversion: CDs store data in a digital format, but audio data must be converted to analog for playback through speakers or headphones. CD players include a Digital-to-Analog Converter (DAC) that converts the digital audio data into analog signals that can be amplified and played back through audio output jacks.
7. Error Correction: CDs incorporate error correction techniques to ensure accurate data retrieval. Reed-Solomon error correction codes are used to detect and correct errors that may occur during reading due to scratches, dust, or other imperfections on the disc's surface. This allows for reliable playback even in the presence of minor disc damage.

These operational principles collectively allow CDs to store and retrieve digital data with high fidelity, making them a popular and widely used medium for audio and other digital content storage and playback.



Operational Principles Bernoulli Drive

The Bernoulli drive is a type of disk drive that was developed by Iomega Corporation in the 1980s and 1990s. It was a popular storage solution for personal computers during that time. The operational principles of a Bernoulli drive are as follows:

1. Disk Rotation: Like other disk drives, the Bernoulli drive has a rotating disk that stores data. The disk is made of a flexible material and is spun at a high

speed by a motor. The rotational speed typically ranges from 3,600 to 4,800 revolutions per minute (RPM).

2. Read/Write Head: The Bernoulli drive uses a read/write head that floats above the spinning disk using the Bernoulli effect, which is the principle of fluid dynamics that describes the behavior of a fluid flowing through a narrow space. As the disk spins, the air pressure beneath the read/write head decreases, causing the head to "fly" above the disk. This allows the head to read from or write data onto the disk without physically touching it, reducing wear and tear.
3. Cartridge Design: The Bernoulli drive uses a cartridge-based design, where the disk is enclosed in a protective cartridge that can be inserted into the drive. The cartridge contains a small opening that aligns with the read/write head, allowing it to access the disk. The cartridge also provides additional protection against dust and debris, helping to maintain the integrity of the data stored on the disk.
4. Data Encoding: The Bernoulli drive uses a method called Frequency Modulation (FM) to encode data on the disk. In this method, data is represented by variations in the frequency of the signal recorded on the disk. The read/write head uses magnetic fields to write data onto the disk and read data from it, interpreting the frequency variations to retrieve the stored information.
5. Controller Electronics: The Bernoulli drive is connected to a controller, which is responsible for controlling the movement of the read/write head, managing data transfer between the drive and the computer, and performing error correction to ensure data integrity.
6. File System: The Bernoulli drive uses a file system to organize and manage data on the disk. Common file systems used in Bernoulli drives include FAT (File Allocation Table) and HPFS (High Performance File System).
7. Motor Control: The Bernoulli drive uses a motor to spin the disk at the required rotational speed. The motor is controlled by the drive's electronics, which adjust the motor speed based on the drive's operational requirements.
8. Seek Time: The seek time of a Bernoulli drive refers to the time it takes for the read/write head to move from one track to another on the spinning disk. Seek time is an important performance metric for disk drives, and

Bernoulli drives typically have seek times in the range of 15 to 30 milliseconds.

Overall, the Bernoulli drive operates by utilizing the Bernoulli Effect to create a cushion of air that allows the read/write head to "fly" above the spinning disk, enabling data to be read from or written to the disk without physical contact. This cartridge-based design, combined with FM data encoding and controller electronics, allows for reliable data storage and retrieval in a compact and portable form factor.

Operational Principles Zip drives

Zip drives were a popular type of removable disk storage solution that was introduced by Iomega in the 1990s. They were known for their higher storage capacity compared to floppy disks, faster data transfer rates, and durability. Here are some operational principles of Zip drives:

1. Magnetic storage: Zip drives used magnetic storage technology to read and write data. The disks had a magnetic coating that stored data in the form of magnetic patterns.
2. Capacitive sensing: Zip drives used a capacitive sensing mechanism to detect the position of the read/write head. The head floated above the disk surface, and changes in capacitance caused by the magnetic patterns on the disk were used to determine the position of the head relative to the disk.
3. Spindle motor: Zip drives had a spindle motor that rotated the disk at a high speed, typically 2400 RPM for Zip 100 drives and 5400 RPM for Zip 250 drives. The rotation of the disk allowed the read/write head to access different sectors of the disk to read or write data.
4. Read/write head: Zip drives had a read/write head that was positioned very close to the disk surface to read and write data. The head used

electromagnetic principles to generate and detect magnetic fields on the disk surface.

5. Stepper motor: Zip drives used a stepper motor to move the read/write head across the disk surface. The stepper motor controlled the position of the head and allowed it to access different tracks on the disk to read or write data.
6. File system: Zip drives used a file system to organize and manage data on the disk. Common file systems used with Zip drives included FAT16, FAT32, and HFS (for Macintosh). The file system determined how data was stored, organized, and retrieved on the Zip disk.
7. Interfacing: Zip drives used different types of interfaces to connect to computers, such as parallel port, SCSI, USB, and IDE. The interface allowed the Zip drive to communicate with the computer and transfer data back and forth.
8. Formatting: Zip drives required formatting before they could be used to store data. Formatting prepared the disk for data storage and created the necessary file system structures. Zip drives were typically pre-formatted by the manufacturer, but they could also be formatted by the user using formatting software.
9. Disk capacity: Zip drives were available in different capacities, with Zip 100 drives having a capacity of 100 MB and Zip 250 drives having a capacity of 250 MB. The capacity of the disk determined the amount of data that could be stored on the disk.

These are some of the operational principles of Zip drives, which were widely used for data storage in the past but have become less common with the advent of more advanced storage technologies such as USB flash drives, external hard drives, and cloud storage.

Install and setup tape, compact, Bernoulli and Zip drives

1- Tape Drive:

Tape drives are used for data backup and storage purposes. Here's how you can install and set up a tape drive:

a. Hardware installation:

- Physically install the tape drive into an available drive bay in your computer or server, following the manufacturer's instructions.
- Connect the tape drive to the appropriate interface (such as SCSI, SATA, or SAS) using the appropriate cables.
- Power on the computer or server.

b. Software setup:

- Install the device driver for the tape drive, which is usually provided by the manufacturer or available from their website.
- Install backup software that is compatible with your tape drive, such as Bacula, Amanda, or Symantec Backup Exec.
- Configure the backup software to recognize and use the tape drive for backup or storage purposes.

2. Compact Drive:

Compact drives are a type of removable storage device similar to floppy drives but with higher capacity. Here's how you can install and set up a compact drive:

a. Hardware installation:

- Physically install the compact drive into an available drive bay in your computer, following the manufacturer's instructions.
- Connect the compact drive to the appropriate interface (such as IDE or SATA) using the appropriate cables.
- Power on the computer.

b. Software setup:

- Some compact drives may require device drivers to be installed, which are usually provided by the manufacturer or available from their website. Install the device drivers if required.

- Once the device drivers are installed (if necessary), the compact drive should be recognized by the operating system as a removable storage device.
- You can now use the compact drive to read from or write to compact discs (CDs) or digital versatile discs (DVDs).

3. Bernoulli Drive:

Bernoulli drives are a type of removable storage device that use large-capacity cartridges for data storage. Here's how you can install and set up a Bernoulli drive:

a. Hardware installation:

- Physically install the Bernoulli drive into an available drive bay in your computer, following the manufacturer's instructions.
- Connect the Bernoulli drive to the appropriate interface (such as SCSI or parallel) using the appropriate cables.
- Power on the computer.

b. Software setup:

- Some Bernoulli drives may require device drivers to be installed, which are usually provided by the manufacturer or available from their website. Install the device drivers if required.
- Once the device drivers are installed (if necessary), the Bernoulli drive should be recognized by the operating system as a removable storage device.
- You can now use the Bernoulli drive to read from or write to Bernoulli cartridges for data storage.

4. Zip Drive:

Zip drives are a type of removable storage device that use Zip disks for data storage. Here's how you can install and set up a Zip drive:

a. Hardware installation:

- Physically install the Zip drive into an available drive bay in your computer, following the manufacturer's instructions.
- Connect the Zip drive to the appropriate interface (such as IDE, USB, or SCSI) using the appropriate cables.
- Power on the computer.

b. Software setup:

- Some Zip drives may require device drivers to be installed, which are usually provided by the manufacturer or available from their website. Install the device drivers if required.
- Once the device drivers are installed (if necessary), the Zip drive should be recognized by the operating system as a removable storage device.
- You can now use the Zip drive to read from or write to Zip disks for data storage.

Note: The specific steps for installation and setup may vary depending on the make and model of your tape, compact, Bernoulli,

4.6. Backup Storage and RAID Levels

Backup storage and RAID (Redundant Array of Independent Disks) levels are two important concepts in data storage and protection. Let's explore each of them in more detail:

1. Backup Storage: Backup storage refers to the practice of creating and storing copies of important data in a separate location from the primary data storage, in order to protect against data loss due to various reasons such as hardware failures, software failures, data corruption, accidental deletion, natural disasters, or malicious activities. Backup storage is crucial for ensuring data availability, integrity, and recoverability in case of any data loss events.

There are various methods for backup storage, including:

- Full back up: A complete copy of all the data is created and stored in a separate location.
- Incremental backup: Only the changes made to the data since the last backup are stored, which reduces the storage space and time required for backups.
- Differential backup: Only the changes made to the data since the last full backup are stored, which provides a balance between storage space and restore time.
- Offsite backup: Backups are stored in a different physical location from the primary data storage, which protects against site-specific disasters.

- Cloud backup: Backups are stored in a remote cloud-based storage service, which provides scalable and accessible backup storage.

2. RAID Levels: RAID is a technology that combines multiple physical hard disk drives (HDDs) or solid-state drives (SSDs) into a single logical unit to improve data storage performance, reliability, and redundancy. RAID levels refer to different configurations or techniques used to organize the data across multiple drives in a RAID array. There are several RAID levels, including:

- RAID 0 (Striping): Data is striped across multiple drives without any redundancy, providing improved performance through parallelism, but without any fault tolerance.
- RAID 1 (Mirroring): Data is mirrored across multiple drives, providing redundancy and improved data protection, as the same data is stored on multiple drives.
- RAID 5 (Striping with Parity): Data is striped across multiple drives with distributed parity, providing improved performance and fault tolerance, with one drive able to fail without losing data.
- RAID 6 (Striping with Dual Parity): Data is striped across multiple drives with dual distributed parity, providing improved fault tolerance compared to RAID 5, as two drives can fail without losing data.
- RAID 10 (Striping and Mirroring): Data is striped across multiple mirrored sets of drives, providing a combination of improved performance and redundancy.
- RAID 50 (Striping and Parity): Data is striped across multiple RAID 5 arrays, providing improved performance and fault tolerance compared to RAID 5.
- RAID 60 (Striping and Dual Parity): Data is striped across multiple RAID 6 arrays, providing improved fault tolerance compared to RAID 6.

These are some of the common RAID levels, each with its own advantages and trade-offs in terms of performance, redundancy, and cost. The choice of RAID level depends on the specific requirements of the data storage system, including performance, reliability, and budget considerations. It's important to carefully evaluate and plan for backup storage and RAID levels to ensure data protection and availability in your storage environment.

Peripheral

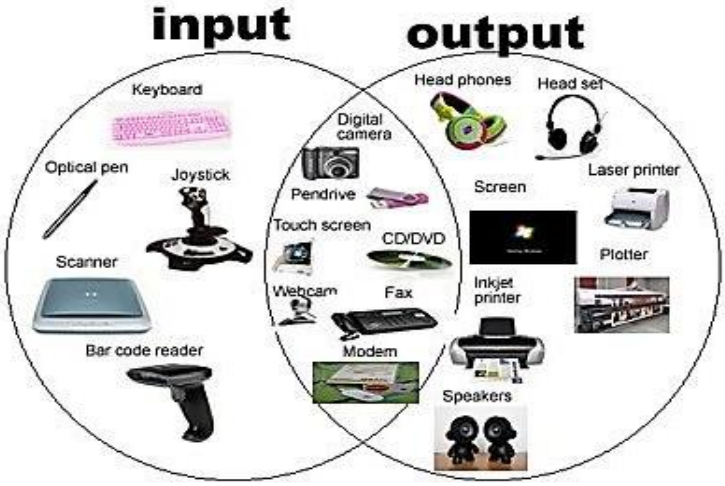
A computer peripheral is an external device that connects to a computer or other computing device to enhance its functionality or provide additional input or output capabilities. Computer peripherals are used for tasks such as inputting data, outputting information, storing data, communicating with other devices or networks, and more. Some common examples of computer peripherals include:

1. Keyboard: A device used to input text and commands into a computer. Keyboards come in various forms, including traditional desktop keyboards, laptop keyboards, and gaming keyboards.
2. Mouse: A pointing device used to control the cursor on a computer screen. Mice can come in different styles, such as optical or laser mice, trackballs, and touchpads.
3. Printer: A device that produces hard copies of digital documents on paper. Printers can be inkjet, laser, or dot matrix printers, and may offer color or black and white printing options.
4. Monitor: A display screen that shows visual output from a computer. Monitors can come in various sizes, resolutions, and types, such as LED, LCD, or OLED monitors.
5. Scanner: A device used to convert physical documents or images into digital format. Scanners can be flatbed, sheet-fed, or handheld, and are commonly used for document scanning, photo scanning, or barcode scanning.
6. External Storage: Devices used to store data externally, such as external hard drives, solid-state drives (SSDs), USB flash drives, and memory cards. These devices provide additional storage space for files, documents, photos, videos, and other digital content.
7. Speakers: Devices used to output audio from a computer or other multimedia devices. Speakers can come in different sizes, configurations, and types, such as stereo speakers, surround sound speakers, or Bluetooth speakers.
8. Webcam: A camera that captures video and images for video conferencing, live streaming, or other multimedia purposes. Webcams can be built-in on laptops or monitors, or external devices that connect via USB.
9. Headset: A combination of headphones and a microphone used for audio input and output during communication or multimedia activities. Headsets

are commonly used for gaming, voice calls, video conferencing, or listening to audio content.

10. Network devices: Peripherals used for networking, such as routers, switches, and modems, which enable communication between computers and other devices in a network, including the internet.

These are just a few examples of the many types of computer peripherals available in the market. Computer peripherals play a crucial role in enhancing the functionality and versatility of computers and other computing devices, allowing users to interact with their devices in various ways and perform a wide range of tasks.



Describe Peripherals Configuration

Configuring computer peripherals involves setting up and adjusting various external devices that connect to a computer. Here are some common computer peripherals and the steps to configure them:

1. Monitor:
   - Connect the monitor to the computer using the appropriate cables (e.g., HDMI, Display Port, VGA, etc.).
   - Power on the monitor and adjust the settings, such as brightness, contrast, and resolution, using the on-screen display (OSD) buttons on the monitor or the graphics card settings on the computer.
2. Keyboard and Mouse:
   - Connect the keyboard and mouse to the computer using USB or wireless receivers.

- Ensure that the keyboard and mouse are powered on and working properly.
- Install any required drivers or software for additional features or customization options.

3. Printer:
   - Connect the printer to the computer using USB, Ethernet, or Wi-Fi, depending on the printer's connectivity options.
   - Install the printer drivers and software on the computer from the printer's manufacturer website or the provided installation disc.
   - Set up printer preferences, such as paper size, print quality, and default printer settings, through the printer software or the computer's control panel.
4. Speakers or Headphones:
   - Connect the speakers or headphones to the computer's audio output port, typically labeled as "Audio out," "Line out," or "Headphone jack."
   - Adjust the volume levels on the speakers or headphones and the computer to a comfortable level.
   - Install any necessary audio drivers or software for enhanced audio settings or customization options.
5. External Storage Devices (e.g., external hard drives, USB flash drives):
   - Connect the storage device to an available USB or other appropriate port on the computer.
   - Wait for the computer to detect the storage device, and install any necessary drivers or software if prompted.
   - Access the storage device through the file explorer or other file management software to transfer, save, or retrieve files as needed.
6. Webcam:
   - Connect the webcam to an available USB port on the computer.
   - Install any drivers or software required for the webcam from the manufacturer's website or the provided installation disc.
   - Configure webcam settings, such as resolution, frame rate, and audio settings, through the webcam software or the computer's control panel.
7. Other peripherals, such as scanners, game controllers, and graphics tablets, may have specific configuration steps depending on their features

and connectivity options. It's recommended to refer to the manufacturer's instructions or documentation for detailed setup instructions.

Describe CONFIG.SYS file and its significance

The CONFIG.SYS file is a system configuration file used in DOS (Disk Operating System) and Windows operating systems. It is a plain text file that contains settings and commands that are loaded during the boot process to configure the system's hardware and software settings. The CONFIG.SYS file is typically located in the root directory of the system drive (e.g., C:\CONFIG.SYS).

The CONFIG.SYS file is loaded by the DOS or Windows operating system during the boot process and its contents are processed line by line. Each line in the CONFIG.SYS file typically contains a device driver or a system configuration command, which instructs the operating system on how to manage various hardware resources and settings. Some common commands used in CONFIG.SYS file include DEVICE, BUFFERS, FILES, and SHELL, among others.

The significance of the CONFIG.SYS file lies in its ability to configure various aspects of the system's hardware and software settings during the boot process. It allows users to customize system parameters, such as device drivers, memory management, file system settings, and more. By modifying the CONFIG.SYS file, users can control the behavior of the system and optimize its performance based on their specific requirements. However, improper configuration of the CONFIG.SYS file can result in system instability or failure to boot, so caution should be exercised when making changes to this file.

Explain Configuring Techniques

Configuring techniques refer to the methods or approaches used to set up, customize, or adjust various settings or parameters in software, hardware, or systems to achieve desired functionality, performance, or behavior. Configuring techniques are commonly used in various domains, including information technology, software development, networking, and system administration.

Here are some common configuring techniques:

1. User Interface (UI) Configuration: This involves customizing the appearance, layout, and behavior of the user interface of a software application or system. It may include options such as changing color

schemes, font sizes, and button placements to suit user preferences or accessibility requirements.

2. System Configuration: This involves setting up and adjusting settings of an operating system, server, or other system components to optimize performance, security, or other system behaviors. This may include configuring settings related to memory management, file system permissions, network configurations, and system services.
3. Application Configuration: This involves customizing settings and parameters within a software application to modify its behavior or functionality. For example, configuring a word processor to auto-save documents every few minutes or adjusting the settings of a video editing software to optimize rendering performance.
4. Network Configuration: This involves setting up and adjusting settings related to network devices, such as routers, switches, and firewalls, to establish and manage network connections, routing, and security. Network configuration may include setting IP addresses, subnet masks, DNS settings, and VPN configurations.
5. Database Configuration: This involves setting up and adjusting settings within a database management system (DBMS) to optimize performance, manage storage, and configure security. This may include configuring settings related to caching, indexing, backup and recovery, and user access permissions.
6. Hardware Configuration: This involves setting up and adjusting settings of hardware devices, such as computers, servers, and networking equipment, to ensure proper functionality and performance. Hardware configuration may include settings related to BIOS, firmware, drivers, and hardware parameters, such as clock speeds and fan speeds.
7. Security Configuration: This involves configuring settings related to security measures, such as firewalls, antivirus software, encryption, and access controls, to protect systems, networks, and data from unauthorized access, breaches, or other security threats.

Configuring techniques are essential in tailoring systems and software to meet specific requirements and optimize their performance, security, and usability. They typically require technical expertise and knowledge of the system or software being configured, and may involve making changes through graphical

user interfaces (GUIs), command-line interfaces (CLIs), configuration files, or other methods, depending on the system or software being configured.

Configure A Device In Device Manager

To configure a device in Device Manager, follow these steps.

1. Sign in to your computer as an administrator or as a member of the Administrators group.
2. Select Start, point to Administrative Tools, and then select Computer Management.
3. Under System Tools in the console tree, select Device Manager.
   The devices that are installed on your computer are listed in the right pane.
4. Double-click the type of device that you want to configure--for example, Ports (COM & LPT).
5. Right-click the device that you want to configure, and then select Properties.
6. Select the Resources tab.
7. Click to clear the Use automatic settings check box.
8. In the Settings based on box, select the hardware configuration that you want to modify--for example, Basic configuration 0000.
9. Under Resource type in the Resource settings box, select the type of resource that you want to modify--for example, Interrupt Request.
10. Select Change Setting.
11. In the Edit Resource dialog box, type the value that you want for the resource, and then select OK.
12. Repeat steps 8 through 11 to configure the resource settings that you want for the device.
13. Quit Device Manager.

View Resource Settings In Device Manager

To view a list of resources and the devices that are using them by type or by connection, follow these steps:

1. Select **Start**, point to **Administrative Tools**, and then select **Computer Management**.
2. Under **System Tools** in the console tree, select **Device Manager**.
   The devices that are installed on your computer are listed in the right pane.
   The default view lists devices by type.

3. Use one of the following methods:
   - To view a list of resources by type, select **Resources by type** on the **View** menu.
   - To view a list of resources by connection type, select **Resources by connection** on the **View** menu.

Search For Device Conflicts

A device conflict occurs when the same resources are given to two or more devices. Use Device Manager to search for device conflicts. To do so, follow these steps:

1. Select **Start**, point to **Administrative Tools**, and then select **Computer Management**.
2. Under **System Tools** in the console tree, select **Device Manager**.
   The devices that are installed on your computer are listed in the right pane.
3. Double-click the type of device that you want to test--for example, **Sound, video and game controllers**.
4. Right-click the device that you want to test for conflicts, and then select **Properties**.
5. Select the **Resources** tab.

Any conflicts that exist for the device are listed under **Conflicting device list**.

Describe auto-configuration and Plug and Play devices

Auto-configuration and Plug and Play (PnP) are two related concepts in the field of computer hardware and software that aim to simplify the process of adding new devices to a computer system and making them functional without manual configuration.

Auto-configuration refers to the ability of a computer system or an operating system to automatically detect and configure newly connected hardware devices, such as printers, scanners, or USB drives, without the need for manual intervention. This can include automatically installing device drivers, setting up appropriate settings, and making the device ready for use without requiring the user to manually configure settings or install drivers.

Plug and Play, on the other hand, is a set of industry standards that facilitate auto-configuration of devices in a computer system. It allows devices to be connected or "plugged in" to a computer system while it is powered on, and the system automatically detects and configures the device without requiring the user to perform complex configuration tasks. This greatly

simplifies the process of adding new devices to a computer system, as the devices can be easily connected and used without needing to manually configure settings or install drivers.

When a Plug and Play device is connected to a computer system, the device sends information about its capabilities and requirements to the operating system, which then automatically configures the device and makes it ready for use. This can include installing appropriate device drivers, setting up I/O addresses, IRQs (interrupt request lines), and other hardware resources, as well as configuring software settings. The goal of Plug and Play is to make the process of adding new devices to a computer system seamless and user-friendly, without requiring technical expertise or manual configuration.

Multiple Choice Questions

1. Which of the following is considered a volatile memory?
   a) ROM c) HDD
   b) RAM d) SSD
2. Which of the following storage devices uses magnetism to store data?
   a) SSD c) USB flash drive
   b) HDD d) CD/DVD
3. What is the capacity of a standard dual-layer DVD?
   a) 4.7 GB c) 700 MB
   b) 8.5 GB d) 1 TB
4. Which of the following is a type of non-volatile memory commonly used in USB flash drives?
   a) SDRAM c) DDR4
   b) EEPROM d) DDR5
5. Which of the following storage devices is typically the fastest in terms of data transfer speed?
   a) HDD c) DVD
   b) SSD d) USB flash drive
6. Which of the following is an example of cloud storage?
   a) USB flash drive c) SSD
   b) HDD d) Google Drive
7. Which of the following is an example of optical storage?
   a) SSD b) USB flash drive

c) HDD d) CD/DVD

8. Which of the following is an example of a magnetic storage device?
   a) USB flash drive c) Hard disk drive (HDD)
   b) DVD d) Blu-ray disc
9. Which property of magnets is utilized in magnetic storage devices?
   a) Attraction c) Magnetization
   b) Repulsion d) Conductivity
10. Which of the following is a characteristic of magnetic storage devices?
    a) Non-volatile c) Slow access time
    b) Volatile d) Limited storage capacity
11. Which type of magnetic storage device is commonly used for data backup and archiving?
    a) Magnetic tape c) Solid-state drive (SSD)
    b) Floppy disk d) Optical disc
12. Which of the following magnetic storage devices has the highest storage capacity?
    a) Floppy disk c) Magnetic tape
    b) Hard disk drive (HDD) d) Optical disc
13. Which type of magnetic storage device is most commonly used in portable devices like smartphones and tablets?
    a) Hard disk drive (HDD) c) Solid-state drive (SSD)
    b) Floppy disk d) Optical disc
14. Which of the following is a disadvantage of magnetic storage devices?
    a) High durability c) Susceptibility to magnetic fields
    b) High speed d) Low storage capacity
15. Which type of magnetic storage device is no longer in common use due to its limited storage capacity?
    a) Floppy disk c) Magnetic tape
    b) Hard disk drive (HDD) d) Optical disc

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
b	b	b	b	b	d	d	c	c	a	d	b	c	c	a

Short Questions

1. Describe RAM and ROM
2. Enumerate different types of memories

3. Describe parity error in memory
4. Replace memory chip
5. Identify parts of floppy and hard disk drives
6. Install and setup floppy and hard disk drives
7. Describe peripherals configuration
8. Explain configuring techniques

Long Questions

1. Describe each type of memory
2. Describe troubleshooting routines of memory
3. Describe the operational principles of floppy and hard disk drives
4. Describe the IDE and SCSI setup of drives
5. Describe operational principles of tape, compact, Bernoulli and Zip drives
6. Install and setup tape, compact, Bernoulli and Zip drives
7. Describe auto-configuration and Plug and Play devices
8. Describe CONFIG.SYS file and its significance

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Super, David L. Prowse and Scott Mueller.
- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
- PRINCE GEORGE'S COMMUNITY COLLEGE
- Computer Hardware Technicians CH111, 5 CD-ROM set by NCSA Academy USA
- Computer Hardware Technicians

Chapter No. 5

(Maintenance and Repair of Printers)

Objectives

After completion of this chapter students will be able to:

5. Maintenance and Repair of Printers

Printer

A printer is a device that produces a hard copy (physical copy) of digital documents or images that are stored in electronic format. It is an output device that converts electronic data into a printed form on paper, labels, or other materials.

Printers come in different types, including inkjet, laser, dot matrix, and thermal printers. Inkjet printers use liquid ink sprayed through tiny nozzles onto paper, while laser printers use toner that is melted onto the paper using heat. Dot matrix printers use tiny pins to strike an inked ribbon against the paper, and thermal printers use heat to transfer an image onto special heat-sensitive paper.

Printers can be connected to a computer or other devices using cables, Wi-Fi, or Bluetooth. They are commonly used in homes, offices, schools, and other settings for printing documents, photos, and other types of content. Some printers also have additional features, such as scanning, copying, and faxing capabilities.

Impact Printers vs. Non-Impact Printers

1. Printing Method: Impact printers use a mechanical mechanism to strike an ink ribbon onto the paper to create the desired characters. Non-impact printers use methods such as spraying ink droplets onto the paper or using heat to melt the ink onto the paper.
2. Noise: Impact printers make a loud noise due to the mechanical striking of the ink ribbon onto the paper. Non-impact printers are much quieter because they use non-mechanical methods to print.
3. Print Quality: Impact printers are known for producing high-quality, precise and durable prints, especially when printing forms or documents with multiple copies. Non-impact printers, on the other hand, can produce high-quality photo-realistic prints, but they are generally less durable than impact prints.
4. Maintenance: Impact printers require more maintenance and are more prone to breakdowns due to their mechanical components. Non-impact printers require less maintenance, and their components are generally more durable and long-lasting.
5. Cost: Impact printers are generally less expensive to purchase than non-impact printers, but they require more frequent replacement of ink ribbons and other consumables, which can increase the overall cost of ownership.

Overall, the choice between an impact and non-impact printer depends on your specific printing needs. If you require high-quality, durable prints and are willing to tolerate the noise and higher maintenance requirements, an impact printer may be the best option. If you need photo-realistic prints or require a quieter, low-maintenance printing solution, a non-impact printer is likely to be the better choice.

Difference between Impact and Non-Impact Printers

Parameters	Impact Printer	Non-Impact Printer
Definition	Impact printers create pictures and figures by hitting a device such as a wheel or a print hammer against an inked ribbon.	Non-impact printers create figures and pictures without any connection between the printing device and the paper.
Printing Execution or Mechanism	In impact printers, printing is executed by hammering a character dye or metal pin.	In non-impact printers, printing is executed by dropping ink on paper in any manner.
Speed Of Printers	Impact printers are low in terms of speed.	Non-impact printers are comparatively fast in speed. They can print several pages in one minute.
Noise Of Printers	They produce high-level noise as they have many moving parts.	They have a low level of noise.
Printing Process	Impact printers generally utilize hammers, pins, or wheels to hit against an inked ribbon to print on paper.	Non-impact printers use a spray of ink, laser, or heat and pressure to execute their printing operation.
Print Quality	The print quality of impact printers is lower.	The print quality of non-impact printers is higher.
Printing Ink	When print head strikes, then they prefer special inked ribbons to produce print on paper.	They prefer cartridges or toner for printing on paper.
Technology	They utilize traditional printing technologies.	They utilize contemporary printing technologies.
Value	They are pretty affordable.	They are quite expensive as compared to impact printers.
Paper Sheet Used	They prefer continuous paper sheets.	They prefer individual paper sheets.
Graphic Images	Except Dot matrix printers, no other impact printers can print graphics images.	Printing graphical illustrations are possible in non-impact printers.
Character Style	Except for the dot matrix, the character or figure style cannot be changed in the other impact printers.	It can print various types of figures from carrying the individual printer.

5.1 Ink Jet Printer

An inkjet printer is a type of printer that works by spraying tiny droplets of ink onto paper or other media in order to create text or images. Inkjet printers are commonly used for home and office printing tasks, as they are relatively affordable, easy to use, and produce high-quality output.

The inkjet printing process involves the use of a print head that contains a number of small nozzles. These nozzles spray ink onto the paper in tiny droplets, which combine to form the text or image being printed. The ink used in inkjet printers typically comes in small cartridges that can be easily replaced when they run out.

Inkjet printers are available in a range of models and sizes, from small desktop printers for personal use to large format printers for commercial printing applications. They are also available in both color and black and white options, and can print on a variety of media types, including paper, photo paper, labels, and more.

5.1.1. Jet Ink Printer: An Introduction

A inkjet printer, also known as a "jet ink printer," is a type of printer that uses small droplets of ink to create text or images on paper.

In an inkjet printer, ink is stored in cartridges and sprayed through tiny nozzles onto paper to create the desired printout. These printers are popular for their ability to produce high-quality color prints and their relatively low cost compared to other types of printers. They are commonly used in homes, offices, and small businesses.

There are two main types of inkjet printers: thermal and piezoelectric. Thermal inkjet printers use a heating element to create a bubble of ink, which then gets pushed through the nozzle and onto the paper. Piezoelectric inkjet printers use a small crystal to create pressure, which then forces the ink through the nozzle and onto the paper.

Overall, inkjet printers are versatile, easy to use, and produce high-quality prints. However, the cost of ink cartridges can add up over time, and they are generally slower than other types of printers.

Working: The basic principle of inkjet printer is the electrostatic phenomenon i.e. it uses electric charge in its operation. Ink from supply is forced put out of

a small nozzle and breaks up into extremely small droplets during their flight. These droplets pass through two electrical components

(i) a Charging Electrode" and (ii) Deflection plates

Identify working parts of jet ink printer

1. Power Supply
2. On /Off Switch
3. Main Tank
4. Pump
5. Decompression Valve
6. Piezo Element
7. Charging Electrode Plates
8. Charge Sensor
9. Deflection Electrode Plates
10. Gutter
11. Pump

5.1.2. User Level Preventive and Corrective Maintenance

Inkjet Printers are such a handy item to have around the home or office that is until they start to play up. The following tips will help you to keep your inkjet printer in tip top shape!

Inkjet Printers by nature are relatively trouble free however if abused they can become a real headache. Your printer needs to be used regularly and a few simple rules need to be followed.

- Try to use your printer at least two or three times a week. By doing so the print head will remain clear and there will be little chance of ink drying inside the print head resulting in poor print outs.
- Use a good quality ink. This can be either a genuine product or a good quality compatible ink. If you try using a cheap, low grade compatible then you are sure to encounter ongoing problems with the print head clogging.
- Never run your ink cartridges until they are dry. This eventually will lead to your print head dying or at the least air being introduced into the print head resulting in low grade print outs.
- Never remove an ink cartridge and rapidly shake it to check if it has ink inside. This is a common mistake which people make when their printer isn't printing correctly. By shaking an ink cartridge it simply aerates the ink and introduces air into the print head or the line which feeds the print head. This can be very difficult to remove.
- Never do more than 5 print head clean at the most. If your printer is not showing signs of improvement after this many cleans then you may need to resort to a print head cleaning kit.

- Avoid printing only in black and white. Although inkjet printers still use the colors when printing in black and white it is highly recommended to print a color page every so often to keep the ink flowing freely from the print head.
- Clean your printer out every so often with a vacuum or low pressure air gun. This may help prolong the life of the drive gear and the paper rollers. Also try cleaning the paper rollers every so often as this helps to prevent them becoming shiny and resulting in paper jam.
- It's a good practice in Canon printers to maybe once a year remove the print head from the printer and flush it under hot water. This simply removes any dried ink that may be floating around in the print head. (be very gentle with the actual print head surface as these are very easily damaged if treated harshly).
- Keep your printer away from windows where temperatures tend to fluctuate quite drastically. The more consistent the temperature is the better. This is the same for most electronic devices.
- Use a quality paper as some cheap, course papers may eventually damage your print head or even the paper rollers. Also cheaper papers can often cause paper jam (this seems to be more common in Brother Printers).

5.1.3. Disassembly and Assembly of Jet Ink Printer

As an AI language model, I don't have the physical capability to perform disassembly and assembly of a jet ink printer. However, I can provide you with general guidance on disassembly and assembly of a typical jet ink printer.

Before starting any disassembly, make sure to turn off and unplug the printer to avoid any electrical hazards. Also, keep in mind that disassembling a printer may void its warranty, so proceed at your own risk.

Remove the outer casing of the printer: This usually involves removing a few screws and prying open the casing.

Remove the ink cartridges: Most printers have a simple mechanism to remove the ink cartridges. Follow the instructions in the printer manual or on the printer display to remove the cartridges safely.

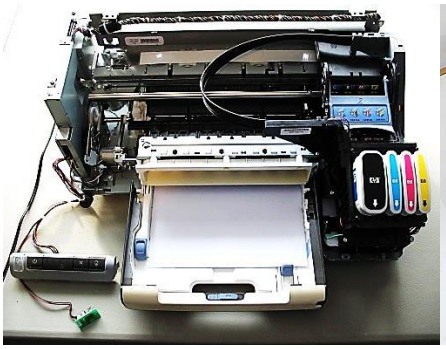
Remove the print head: The print head is the component that sprays the ink onto the paper. It is usually held in place with a latch or screws.

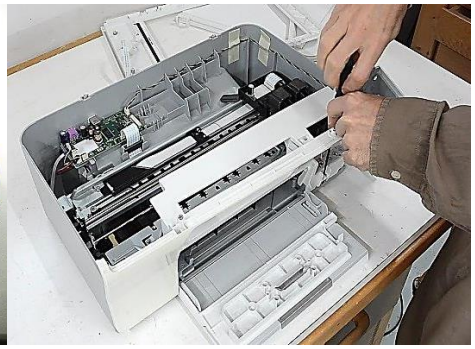
Remove other components: Depending on the printer model, you may need to remove other components such as the paper tray, control panel, or scanner.

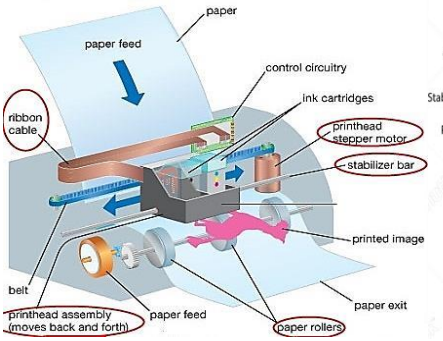
Reassemble the printer: To reassemble the printer, follow the steps in reverse order. Make sure to connect all the wires and cables correctly, and replace any screws or latches that were removed.

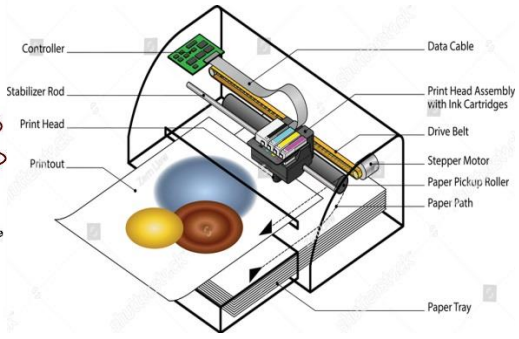
Test the printer: After reassembly, turn on the printer and run a test print to make sure everything is working correctly.

It's worth noting that disassembly and assembly of a jet ink printer can be a complex process, and it's easy to damage components if you don't have experience or the right tools. If you're not confident in your abilities to perform this task, it's best to seek professional help.









5.1.4. Common Faults and Repairing Jet Ink Printer

Some common faults that can occur in a jet ink printer include:

1. Clogged print heads: This can cause streaks, lines, or blank spots in the printed output. It can be caused by dried ink or dust buildup in the nozzles.
2. Paper jams: This occurs when the printer is unable to feed the paper through properly, which can be caused by paper misalignment or debris in the printer.

3. Ink smudging: This can occur when the ink is not drying properly, which can be caused by incorrect paper type or printer settings.
4. Error messages: These can appear on the printer's display panel and can be caused by a range of issues such as low ink levels, communication errors, or hardware malfunctions.

To repair these faults in a jet ink printer, here are some troubleshooting steps you can take:

Clean the print heads: Many printers have a built-in cleaning function that can be accessed through the printer software. If the print heads are still clogged, you can try soaking them in warm water or using a cleaning solution.

Check for paper jams: Open the printer cover and remove any paper that may be stuck inside. Make sure the paper is loaded correctly and the tray is properly aligned.

Adjust printer settings: If you are experiencing ink smudging, try adjusting the printer settings to a higher quality print mode or use a different paper type.

Replace ink cartridges: If the printer displays a low ink level message, replace the cartridges with new ones.

If these steps do not resolve the issue, you may need to contact the printer manufacturer or a professional technician for further assistance.

To help you get back up and running with as little downtime as possible, list of the following 10 common printer problems and how to fix them.

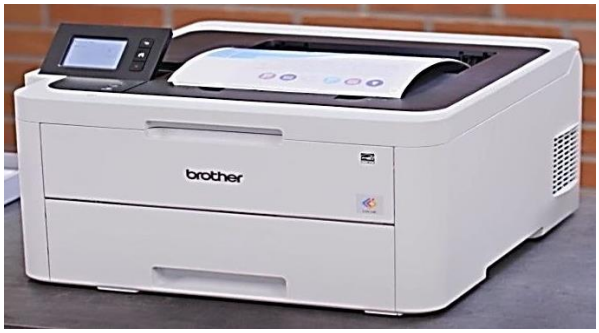
1. Printer is unresponsive
2. Printer won't print
3. Bad print quality
4. Uncertain about printer security
5. My printer won't scan
6. Too many paper jams
7. Prints too slowly
8. Printing is too expensive
9. I can't print from my mobile device
10. Wi-Fi printing takes too long

5.2. Laser Printer

A laser printer is a type of printer that uses a laser beam to produce high-quality printouts on paper. It works by using a laser to create an electrostatic image on a photosensitive drum, which then attracts toner particles. The toner is transferred to the paper and fused onto the paper using heat, creating the final printed output.

Laser printers are known for their fast printing speeds and high-quality output. They are often used in offices and businesses that require high-volume printing. Laser printers also tend to be more cost-effective over time than inkjet printers because they have a lower cost per page.

One drawback of laser printers is that they typically have a higher upfront cost than inkjet printers. They also tend to be larger and heavier than inkjet printers, which can make them less portable. Additionally, laser printers are not well-suited for printing photos or other types of color graphics, as they are typically designed to print black-and-white or gray scale documents.



5.2.1. Introduction of Laser Printing

Laser printing is a technology that uses a laser beam to produce high-quality text and images on paper. The first laser printer was developed by Gary Stark weather at Xerox in the 1970s, and it quickly became a popular alternative to traditional dot-matrix and daisy-wheel printers.

In laser printing, the laser beam is used to create a static charge on a rotating drum, which then attracts toner particles to form the desired image or text. The toner is then transferred onto the paper and fused using heat to create a permanent print.

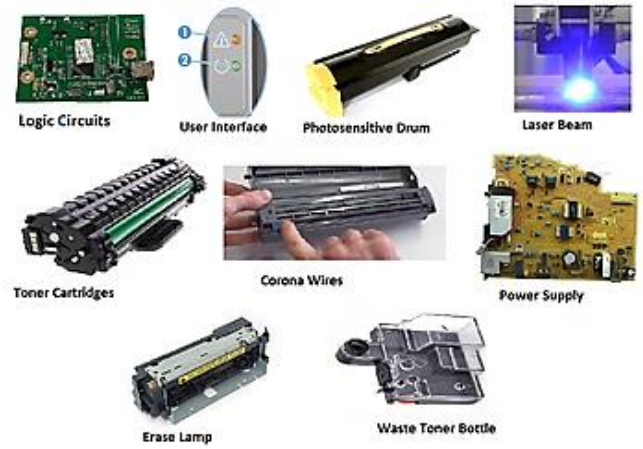
Laser printers offer many advantages over other printing technologies, including faster print speeds, higher print resolution, and lower operating costs. They have become the standard for printing in homes and offices around the world.

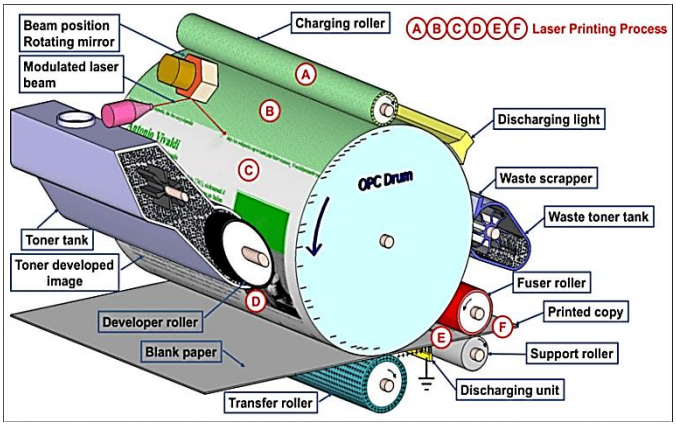
Today, laser printing continues to evolve, with advancements in technology leading to even faster and more efficient printers. In addition, laser printing is also being used in 3D printing applications, where lasers are used to melt and solidify layers of material to create complex objects.

Laser Printer Parts

Laser printers consist of several parts that work together to create high-quality prints. Here are some of the main parts of a laser printer:

1. Toner Cartridge: The toner cartridge holds the toner, which is a powder that is used to create the text and images on the page.
2. Drum Unit: The drum unit is a cylindrical part that is coated with a photoconductive material. It is charged with an electrostatic charge and attracts the toner particles to create the image on the page.
3. Fuser Assembly: The fuser assembly is responsible for melting the toner particles and fusing them to the paper to create a permanent image. It consists of a heated roller and a pressure roller.
4. Transfer Belt: The transfer belt is a rotating belt that transfers the toner particles from the drum unit to the paper.
5. Paper Tray: The paper tray is where the paper is stored before it is fed into the printer. Some printers have multiple paper trays to hold different types of paper.
6. Control Panel: The control panel is where the user can interact with the printer, change settings, and initiate print jobs.
7. Power Supply: The power supply provides the electrical power needed to operate the printer.
8. Laser Scanning Unit: The laser scanning unit is responsible for creating the electrostatic charge on the drum unit. It consists of a laser beam, a rotating mirror, and a lens.
9. Pickup Roller: The pickup roller is responsible for feeding the paper from the paper tray into the printer.
10. Exit Roller: The exit roller is responsible for moving the paper out of the printer after it has been printed.





Working

A laser printer is a type of printer that uses a laser beam to produce high-quality text and images on paper. The laser printing process involves several steps:

1. Cleaning: The printer's drum is cleaned with a special roller to ensure there is no residual toner from previous prints.
2. Charging: The drum is then given a negative electrical charge by a corona wire or a charging roller.
3. Exposing: The printer's laser beam then "draws" the image onto the drum, using a rotating mirror to direct the laser beam to the correct locations on the drum.
4. Developing: The drum is then coated with toner particles, which are attracted to the areas that have been negatively charged.
5. Transferring: The toner-coated image is transferred onto the paper using a transfer roller or belt.

6. Fusing: The toner particles are melted onto the paper by passing it through a pair of heated rollers, creating a permanent image.
7. Cleaning: Finally, any remaining toner particles are removed from the drum and other printer components to prepare the printer for the next print job.

5.2.2. Common Faults and Safety Measures

Common Faults of Laser Printers Include:

1. Paper jams: This is a common problem with printers where paper gets stuck inside the printer. This can be caused by improper loading of paper, or dust and debris buildup inside the printer.
2. Toner smudging: This is a problem where the toner gets smudged on the printed page. This can be caused by a malfunctioning toner cartridge or a dirty print head.
3. Print quality issues: This can be caused by a variety of factors, including low toner levels, a dirty print head, or a damaged drum unit.
4. Connectivity issues: This can be caused by problems with the printer's network connection or a malfunctioning USB cable.

Safety Measures for Laser Printers Include:

1. Use in a well-ventilated area: Laser printers emit fumes and particles during the printing process, which can be harmful if inhaled. Make sure to use the printer in a well-ventilated area.
2. Avoid direct contact with toner: Toner can be harmful if ingested or inhaled. Avoid direct contact with toner and make sure to wash your hands after handling it.

3. Regular cleaning: Regularly clean the printer to remove dust and debris buildup, which can cause paper jams and print quality issues.
4. Follow manufacturer guidelines: Follow the manufacturer's guidelines for installing and using the printer, and only use approved toner cartridges and replacement parts.

5.2.3. Preventive Maintenance and Corrective Maintenance

Preventive maintenance for laser printers involves taking proactive steps to prevent potential problems from occurring. This type of maintenance typically includes routine cleaning of the printer, replacing worn or damaged parts, and ensuring that the printer is operating at optimal levels. Here are some tips for performing preventive maintenance on a laser printer:

1. Clean the printer regularly: Dust and debris can accumulate inside the printer, which can affect its performance. Use a soft, lint-free cloth to wipe down the exterior of the printer, as well as the interior components.
2. Check the toner cartridge: Make sure that the toner cartridge is not low on toner or damaged in any way. Replace the cartridge if necessary.
3. Inspect the paper path: Check the paper path for any debris, such as torn paper or labels that may be obstructing the path of the paper.
4. Calibrate the printer: If the printer is producing poor quality prints or is misaligned, calibrate the printer to ensure that it is producing high-quality prints.

Corrective maintenance for laser printers involves addressing problems that have already occurred. This type of maintenance typically includes troubleshooting the printer to determine the cause of the problem, replacing faulty parts, and repairing any damage to the printer. Here are some tips for performing corrective maintenance on a laser printer:

1. Identify the problem: Determine what is causing the printer to malfunction, such as a paper jam, toner cartridge issue, or connectivity problem.
2. Troubleshoot the printer: Use the printer's troubleshooting guide or seek assistance from the manufacturer's customer support team to identify the source of the problem.

3. Replace faulty parts: If a part is damaged or worn, replace it with a new one. Common parts that may need replacement include the toner cartridge, fuser unit, and imaging drum.
4. Repair any damage: If the printer has sustained physical damage, such as a cracked housing or broken gears, repair the damage to restore the printer to working condition.

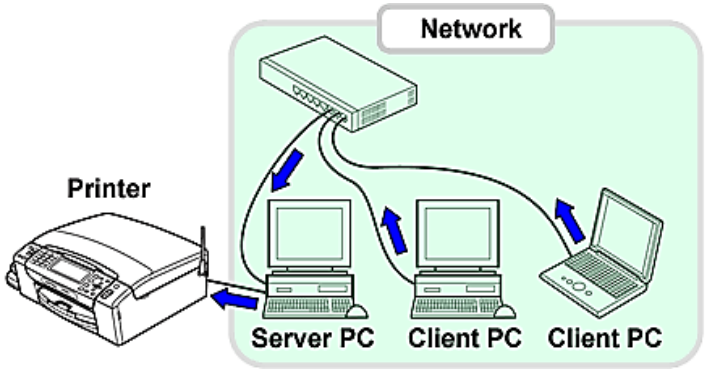
5.3. Network Printer

A network printer is a type of printer that is connected to a computer network and can be accessed by multiple users. Unlike a local printer, which is connected directly to a single computer, a network printer is connected to a network switch, router or hub and can be accessed by any computer or device on the network that has permission to use it.

Network printers can be either wired or wireless. Wired network printers use Ethernet cables to connect to the network, while wireless network printers use Wi-Fi or Bluetooth to connect to the network.

Network printers can be shared by multiple users, making them a convenient option for offices or other settings where multiple users need to print documents. They can also be managed centrally, which can simplify the administration of printers and reduce maintenance costs.

Some network printers also have additional features, such as the ability to scan, copy, or fax documents, and may include other advanced features like automatic document feeding and duplex printing.



Add a Network Printer Using Microsoft Windows

All modern versions of Windows include a feature called File and Printer Sharing for Microsoft Networks. This feature allows a printer connected to one PC to be shared with other PCs on a local network.

This method requires the printer to be actively connected to the PC and the computer to be turned on so that other devices can reach the printer through it.

To network a printer using this method:

1. Enable sharing on the computer. Go to **Control Panel** > **All Control Panel Items** > **Network and Sharing Center** > **Advanced sharing settings**. Then select **Turn on file and printer sharing**, then select **Save Changes**.
2. Close the window and choose the **Devices and Printers** or **Printers and Scanners** option on the Start menu.
3. Right-click the target computer, select **Printer properties,** go to the **Sharing** tab and then select the **Share this printer** check box.
4. Printers can be installed on a PC using Devices and Printers. Some printers come with software utilities (either on a CD-ROM or downloadable from the web) to simplify the installation process, but these are generally optional.

Line Printer

A line printer is a type of computer printer that prints one entire line of text at a time. It works by using a print head that contains a series of pins or hammers that strike an inked ribbon against the paper, creating a printed image. Line printers were commonly used in the past for printing large volumes of text documents, such as reports or invoices, but have largely been replaced by newer technologies such as laser printers and inkjet printers.

There are two main types of line printers: impact printers and non-impact printers. Impact line printers use physical force to create an image on paper, while non-impact line printers use heat or other technologies to create an image without physically striking the paper.

One of the advantages of line printers is their speed. They can print large volumes of text quickly, making them useful in applications where speed is important, such as in high-volume data processing environments. However, they can be noisy and may not produce the high-quality output that is expected from modern printing technologies.

Overall, while line printers have largely been superseded by newer printing technologies, they still have some niche applications where their speed and durability make them a useful option.

5.4 Plotter

A plotter is a computer output device that is used to draw or print vector graphics. Unlike printers, which are used to print raster graphics (images made up of small dots), plotters use pens or pencils to draw lines on paper. Plotters were commonly used in engineering, architecture, and design applications before the widespread adoption of computer printers.

There are two main types of plotters: drum plotters and flatbed plotters. Drum plotters use a rotating drum to move the paper while a pen or pencil draws on it. Flatbed plotters move the pen or pencil across a stationary sheet of paper.

Plotters are often used to create large-scale technical drawings, such as blueprints and engineering schematics. They are also used for creating maps, posters, and other large-format graphics. While plotters are less common today than they were in the past, they are still used in some specialized applications where high precision and accuracy are required.

5.4.1. Introduction of Plotter

A plotter is a computer output device that is used to create high-quality graphical outputs. Unlike a regular printer, which can only print in a limited number of colors and at relatively low resolutions, a plotter can produce high-resolution, full-color graphics on a variety of media, such as paper, film, or vinyl.

Plotter technology has been around since the 1950s and has evolved significantly over the years. The earliest plotters were pen plotters, which used a series of pens of different colors and thicknesses to draw images on paper. Later models used inkjet or electrostatic technology to create images.

Today, plotters are used in a wide range of applications, from architectural and engineering design to sign-making and textile printing. They are often used in conjunction with CAD (computer-aided design) software to produce highly detailed and accurate images, and are a critical tool for many professionals in a variety of industries.

5.4.2. Common Faults and Safety Measures

Plotters are devices used for printing large-format graphics and technical drawings. Here are some common faults and safety measures for plotters:

Common faults:

1. Paper jams: Paper jams can occur if the paper is not loaded properly or if the printer rollers are dirty or worn out.
2. Print quality issues: Plotters can experience issues such as faint or streaky print, misaligned images or text, or uneven ink distribution.
3. Mechanical failures: Plotters can suffer from mechanical failures such as broken belts, damaged gears, or worn out components.
4. Software issues: Plotters rely on software to control the printing process, and problems can occur if the software is not configured properly or if there are compatibility issues with the operating system.

Safety measures:

1. Read the user manual: Before using a plotter, make sure to read the user manual to understand its features, capabilities, and limitations.
2. Use the right materials: Plotters are designed to work with specific types of paper and ink, so make sure to use the recommended materials to avoid damage to the machine or poor print quality.

3. Keep the machine clean: Regular cleaning of the printer rollers, print heads, and other components can help prevent paper jams and print quality issues.
4. Follow proper handling procedures: When replacing ink cartridges or loading paper, follow the manufacturer's instructions to prevent damage to the plotter and ensure proper operation.
5. Proper ventilation: Some plotters emit fumes that can be harmful if inhaled, so make sure to use the plotter in a well-ventilated area or use a fume extractor if necessary.

5.4.3. Preventive Maintenance and Corrective Maintenance

Plotters are specialized printers commonly used for printing large-format drawings and designs, and they require regular maintenance to ensure their longevity and optimal performance. There are two types of maintenance that are typically performed on plotters: preventive maintenance and corrective maintenance.

Preventive maintenance is a routine set of procedures designed to prevent potential problems from occurring in the first place. This type of maintenance is important because it helps to ensure that the plotter is always running at peak efficiency and reduces the likelihood of breakdowns or malfunctions. Some examples of preventive maintenance procedures for plotters include:

1. Cleaning the plotter regularly to remove dust, debris, and other contaminants that can cause jams or damage the print head.
2. Replacing worn or damaged parts such as belts, rollers, and motors on a regular schedule to prevent them from failing.
3. Calibrating the plotter regularly to ensure that it is printing accurately and producing high-quality prints.
4. Keeping the plotter software up-to-date to ensure that it is compatible with the latest operating systems and drivers.

Corrective maintenance, on the other hand, is performed after a problem has occurred with the plotter. This type of maintenance is designed to identify and fix the problem as quickly as possible to minimize downtime and reduce the risk of further damage. Some examples of corrective maintenance procedures for plotters include:

1. Replacing a damaged print head or other parts that have failed.
2. Resolving paper jams or other printing issues that are preventing the plotter from producing prints.
3. Troubleshooting software or driver issues that are causing the plotter to malfunction.

Multiple Choice Questions

1. What type of ink is used in a Jet Ink Printer?
   a) Toner c) Solid ink
   b) Liquid ink d) None of the above
2. Which technology is used in Jet Ink Printers for creating images?
   a) Thermal inkjet technology c) Dot matrix technology
   b) Laser technology d) None of the above
3. Which of the following is a disadvantage of Jet Ink Printers?
   a) High printing speed c) Prone to smudging
   b) Low printing cost d) High durability of prints
4. Which of the following is not a factor affecting the print quality of a Jet Ink Printer?
   a) Print resolution c) Printer model
   b) Ink type d) Humidity
5. Which type of paper is recommended for use in Jet Ink Printers?
   a) Glossy paper c) Bond paper
   b) Matte paper d) Any type of paper can be used
6. What technology is used in Laser Printers for creating images?
   a) Inkjet technology c) Dot matrix technology
   b) Laser technology d) None of the above
7. Which of the following is a major advantage of Laser Printers over Inkjet Printers?
   a) Lower printing cost c) Better color accuracy
   b) Higher printing speed d) Smaller size
8. Which component of a Laser Printer uses heat to fuse toner onto paper?
   a) Drum c) Toner cartridge
   b) Fuser unit d) Laser unit
9. Which of the following is not a factor affecting the print quality of a Laser Printer?
   a) Print resolution b) Toner type

c) Printer model d) Humidity

10. Which type of paper is recommended for use in Laser Printers?
    a) Glossy paper c) Bond paper
    b) Matte paper d) Any type of paper can be used
11. Which type of connection is commonly used to connect a network printer to a local area network?
    a. USB c. FireWire
    b. Ethernet d. Parallel
12. Which of the following is a characteristic of a line printer?
    a) It prints one character at a time c) It prints one page at a time
    b) It prints one line at a time d) It prints in color
13. Which of the following is a type of line printer?
    a) Laser printer c) Dot-matrix printer
    b) Inkjet printer d) Thermal printer
14. Which of the following is an advantage of a line printer?
    a) It is fast c) It is quiet
    b) It produces high-quality prints d) It is inexpensive
15. Which of the following is a disadvantage of a line printer?
    a) It is bulky
    b) It is expensive
    c) It produces low-quality prints
    d) It requires frequent maintenance
16. Which of the following is NOT a type of plotter?
    a) Drum plotter c) Pen plotter
    b) Flatbed plotter d) Printer plotter
17. What is the main difference between a pen plotter and a flatbed plotter?
    a) Pen plotters use pens to draw while flatbed plotters use blades
    b) Pen plotters are more accurate than flatbed plotters
    c) Flatbed plotters use a flat surface to hold the drawing medium while pen plotters use a drum
    d) Flatbed plotters are faster than pen plotters
18. Which of the following plotters is most suitable for creating large scale engineering and architectural drawings?
    a) Drum plotter c) Pen plotter
    b) Flatbed plotter d) Laser plotter

19. What is the main advantage of using a laser plotter over other types of plotters?
    a) It is faster
    b) It produces higher quality prints
    c) It is less expensive
    d) It can print in color
20. Which of the following is NOT a common drawing medium used in plotters?
    a) Paper
    b) Vinyl
    c) Mylar
    d) Glass

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b	a	c	c	a	b	b	b	c	c
11	12	13	14	15	16	17	18	19	20
b	b	c	a	c	d	c	a	b	d

Short Questions

1. What is jet ink printer
2. Identify common faults occurring in jet ink printer
3. Disassemble and assemble jet ink printer
4. Explain preventive and corrective maintenance of jet ink printer
5. Identify the laser printer Parts
6. Describe the laser printer common faults manual.
7. Define corrective maintenance
8. Describe Installation steps for a line printer
9. Explain the significance of result of test.
10. Introduction of Laser Printing
11. Common Faults and Safety Measures
12. Preventive maintenance and Corrective Maintenance
13. Introduction of Plotter
14. Common Faults and Safety Measures
15. Preventive maintenance and Corrective Maintenance

Long Questions

1. Explain the operational principles of jet ink printer
2. Identify working parts of jet ink printer
3. Describe the function of each part of jet ink printer
4. Install a jet ink printer
5. Explain the operational principles of laser diode.

6. Describe the working of a photocopier for comparison with working of a laser printer.
7. Explain the danger against laser beam exposure of eyes and skin etc.
8. Explain the steps for preventive maintenance with the help of a user
9. Explain print mechanism of line printer to print a complete line at a time.
10. Explain every indicator especially the engineer's fault indicator of line printer control panel
11. Explain these with the help of the technical service manual, which accompanied the printer.

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Soper, David L. Prowse and Scott Mueller.
- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
- PRINCE GEORGE'S COMMUNITY COLLEGE
- Computer Hardware Technicians CH111, 5 CD-ROM set by NCSA Academy USA
- Computer Hardware Technicians

Chapter No. 6

(Maintenance and Repair of Scanners)

Objectives

After completion of this chapter students will be able to:

6. Maintenance and Repair of Scanners

6.1. Types of Scanners (Flatbed vs. Sheetfed)

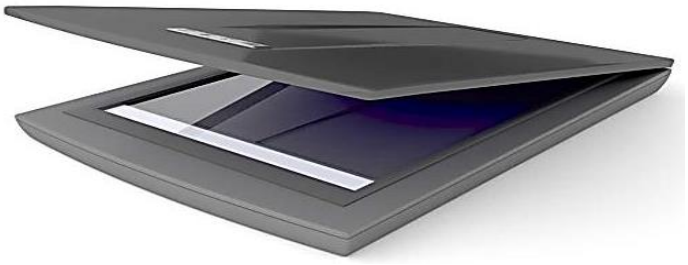
6.2. An Overview: Image Reading

6.3. Disassembly and Assembly of Scanner

6.4. Common Faults: Steps of Preventive and Corrective Maintenance

Scanner

A scanner is an electronic device used to convert physical documents, images, or objects into digital format. It works by capturing the details of the original item and creating a digital image that can be saved, edited, or shared. There are various types of scanners, including flatbed scanners, sheet-fed scanners, handheld scanners, and drum scanners. Flatbed scanners are the most common type and are often used to scan documents and photos.



6.1. Types of Scanners (Flatbed vs. Sheetfed)

There are three types of scanners available:

- **Drum Scanner**
- **Flatbed Scanner**
- **Hand Held Scanners**

Drum Scanner

A drum scanner is a type of scanner that uses a cylindrical drum to scan images. The image is mounted on the drum and rotates while a scanning head moves back and forth across the length of the drum, capturing the image in high resolution.

Drum scanners were originally developed for use in the printing industry, where high-quality scans are necessary for accurate reproduction of images. They are able to capture images at very high resolutions, up to 20,000 dots per inch (dpi), and can reproduce colors with great accuracy.

However, drum scanners are expensive and complex machines that require skilled operators to use them effectively. As a result, they have largely been replaced by flatbed scanners and other digital scanning technologies that are easier to use and more affordable for the average user.

Flatbed Scanner

A flatbed scanner is a type of scanner that is commonly used to create digital copies of physical documents or images. It works by using a flat glass surface where the document or image is placed face-down, and a scanning element moves across the surface to capture the image and create a digital file. Flatbed scanners are versatile and can handle a variety of document sizes and thicknesses, making them useful for both personal and professional applications. They are commonly found in offices, libraries, and homes, and can be connected to a computer via USB or other types of cables.

Hand Held Scanners

Handheld scanners are portable devices that can read and capture information from various sources such as barcodes, QR codes, and other types of codes. They are commonly used in retail, logistics, and manufacturing industries to quickly and accurately scan products, track inventory, and manage assets.

Handheld scanners can either be wired or wireless, with wireless scanners offering greater mobility and flexibility. Some handheld scanners also feature Bluetooth connectivity, allowing them to communicate with other devices such as smartphones and tablets.

There are several types of handheld scanners available in the market, including linear imagers, 2D imagers, and laser scanners. Linear imagers use an LED light source to capture information from a barcode or other type of code, while 2D imagers use a camera to capture and decode information from 2D codes such as QR codes. Laser scanners use a laser beam to scan and read barcodes.

Handheld scanners are typically easy to use and require minimal training, making them an ideal choice for businesses looking to improve their efficiency and accuracy. They can also be customized with different settings and configurations to suit the specific needs of different industries and applications.

6.2. An Overview: Image Reading

Image reading for a scanner refers to the process of converting physical documents or images into digital files that can be stored or transmitted electronically. Scanners are devices that are specifically designed for this purpose, and they can be found in many offices, businesses, and homes.

The process of image reading for a scanner typically involves the following steps:

Preparation: The physical document or image is prepared for scanning. This may involve removing any staples or paper clips, flattening the document, and cleaning the scanner glass.

Scanning: The document or image is placed in the scanner, and the scanning process is initiated. The scanner captures the image and converts it into a digital file.

Image Processing: The digital file is processed to improve the quality of the image. This may involve adjusting the brightness and contrast, removing any noise or artifacts, and straightening the image.

Saving the File: The digital file is saved to a computer or other storage device. The file can then be shared, edited, or printed as needed.

There are different types of scanners available, including flatbed scanners, sheet-fed scanners, and handheld scanners. Each type has its own advantages and disadvantages, and the choice of scanner will depend on the specific needs of the user.

Overall, image reading for a scanner is an essential process for converting physical documents and images into digital files, making them more accessible and easier to manage.

Image Reading Through Scanner

- A light source illuminates the paper, and light is reflected of the paper down the scanning mechanism.
- Blank or white spaces reflect more light than darker areas.
- A motor moves the scanning head underneath the page along its length.
- As the scan head moves down the page, it captures the reflected light bounced off the page.
- The light captured from the page is reflected through a series of mirrors.
- A lens assembly focuses the light beam from the mirrors onto a light sensitive array that converts the light into electrical signals.
- The electrical signals are converted into corresponding dots. In a color scanner, the light is passed through red, green and blue filters in order to extract color information.
- The converted dots are sent to the computer for storage.

6.3. Disassembly and Assembly of Scanner

As a language model, I do not have a physical body or hands to disassemble and assemble a scanner. However, I can provide you with some general information on how to disassemble and assemble a scanner.

Disassembling a scanner typically involves opening up the casing and removing the internal components. To do this, you will need to first unplug the scanner and remove any cords or cables that may be attached to it. Next, you will need to use a screwdriver to remove the screws that hold the casing in place. Once the casing is removed, you can access the internal components of the scanner.

To **assemble** a scanner, you will need to reverse the steps you took to disassemble it. This involves reattaching the internal components, putting the casing back in place, and screwing it back together. It's important to make sure that everything is properly aligned and securely attached to prevent any damage or malfunctioning.

However, it's important to note that disassembling a scanner can be a complicated process and should only be done by someone who has experience with electronics and understands the risks involved. If you are unsure about how to disassemble or assemble a scanner, it's best to seek the help of a professional technician.

6.4. Common Faults: Steps of Preventive and Corrective Maintenance

Common Faults Scanner

Scanner Operation Problems

- The Start button light does not come on.
- The scanner does not scan.
- Pressing the button does not start scanning.
- Pressing the buttons in a Mac OS X environment starts Classic mode.
- You cannot scan multiple images.
- You cannot scan from the Automatic Document Feeder.
- Paper jams in the Automatic Document Feeder.

Problems you may have while using the scanner often involve the operation of your software and computer. Operation problems usually occur because of:

- Incorrect setup of the interface

- Incorrect setup of your computer or software
- Incorrect operation of your software

Multiple Choice Questions

1. Which of the following is a type of scanner that uses a light source to scan the document?
   a. Flatbed scanner
   b. Drum scanner
   c. Handheld scanner
   d. Digital camera
2. Which of the following scanners uses a revolving cylinder to scan images?
   a. Flatbed scanner
   b. Drum scanner
   c. Handheld scanner
   d. Sheet-fed scanner
3. Which of the following scanners is designed to be portable and handheld?
   a. Flatbed scanner
   b. Drum scanner
   c. Handheld scanner
   d. Sheet-fed scanner
4. Which of the following scanners uses a feeder to scan a stack of documents?
   a. Flatbed scanner
   b. Drum scanner
   c. Handheld scanner
   d. Sheet-fed scanner
5. What is the first step you should take before disassembling a scanner?
   a) Remove the power cord
   b) Remove the scanner lid
   c) Remove the USB cable
   d) None of the above
6. What tool is commonly used to open the case of a scanner?
   a) Screwdriver
   b) Pliers
   c) Hammer
   d) Wrench
7. What precaution should you take when disassembling a scanner to avoid damaging the glass bed?
   a) Wear gloves
   b) Clean the glass bed with a cleaning solution
   c) Cover the glass bed with a protective material
   d) None of the above
8. Which part of the scanner should you avoid touching during the disassembly process?
   a) Glass bed
   b) Control panel

c) Scanner motor d) All of the above

9. What should you do with the screws and other parts you remove from the scanner during disassembly?
   a) Throw them away
   b) Keep them in a separate container
   c) Put them back in their original positions
   d) None of the above
10. What is the purpose of preventive maintenance for a scanner?
   a. To repair any issues that arise
   b. To minimize downtime and repair costs
   c. To increase the lifespan of the scanner
   d. To upgrade the scanner's software
11. Which of the following is an example of preventive maintenance for a scanner?
   a. Cleaning the scanner glass and rollers
   b. Replacing a broken scanner bulb
   c. Upgrading the scanner's software
   d. Repairing a paper jam
12. What is the purpose of corrective maintenance for a scanner?
   a. To minimize downtime and repair costs
   b. To upgrade the scanner's software
   c. To repair any issues that arises
   d. To increase the lifespan of the scanner
13. Which of the following is an example of corrective maintenance for a scanner?
   a. Cleaning the scanner glass and rollers
   b. Replacing a broken scanner bulb
   c. Upgrading the scanner's software
   d. Performing regular maintenance checks
14. What is the recommended frequency for preventive maintenance on a scanner?
   a. Once a year b. Once every six months

c. Once a month d. Once a week

15. Which of the following is a common fault in scanners?
    a. Software incompatibility
    b. Printer cartridge jams
    c. Scanner overheating
    d. Network connectivity issues
16. What is the cause of image quality issues in scanners?
    a. Paper jams
    b. Scanner bulb failure
    c. Dust on the scanner glass
    d. Network connectivity issues
17. What is a common symptom of a scanner bulb failure?
    a. The scanner produces blank pages
    b. The scanner produces distorted images
    c. The scanner produces low-quality images
    d. The scanner produces incorrect colors
18. Which of the following is a common cause of paper jams in scanners?
    a. Paper type incompatibility
    b. Dust on the scanner glass
    c. Scanner bulb failure
    d. Printer cartridge jams
19. Which of the following is a common symptom of network connectivity issues with a scanner?
    a. The scanner produces blank pages
    b. The scanner produces distorted images
    c. The scanner produces low-quality images
    d. The scanner cannot connect to the network
20. What is the maximum resolution typically available in flatbed scanners?
    a. 300 dpi c. 1200 dpi
    b. 600 dpi d. 2400 dpi

1	2	3	4	5	6	7	8	9	10
a	b	c	d	a	a	c	d	b	b

11	12	13	14	15	16	17	18	19	20
a	c	b	c	a	c	a	a	d	d

Short Questions

1. Explain image reading
2. List kinds of scanners
3. Install and operate scanner
4. Use a scanner.
5. Disassemble/Assemble a scanner
6. Describe common scanner faults
7. Describe preventive maintenance
8. Describe corrective maintenance

Long Questions

1. Explain the physical connection, the loading of software, setting up the configuration (theory only) etc.
2. Explain optical character recognition mechanism.

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Soper, David L. Prowse and Scott Mueller.
- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
- PRINCE GEORGE'S COMMUNITY COLLEGE
- Computer Hardware Technicians CH111, 5 CD-ROM set by NCSA Academy USA
- Computer Hardware Technicians

Chapter No. 7

(Maintenance and Repair of Display Devices)

Objectives

After completion of this chapter students will be able to:

7. Maintenance and Repair of Display Devices

7.1. Overview of Monitors
7.2. Overview of LCDs
7.3. Overview of Multimedia Projectors
7.4. Common Faults and troubleshooting
7.5. Diagnostics, Preventive and Repairs of Monitors

Display Devices

Computer display devices are devices used to display output from a computer. They are also known as computer monitors, screens, or displays. There are several types of computer display devices, including:

1. **Cathode Ray Tube (CRT) monitors:** These were the first type of computer monitors and are now outdated. CRT monitors use an electron beam to create images on a phosphorescent screen.
2. **Liquid Crystal Display (LCD) monitors:** These are the most common type of computer monitors used today. LCD monitors use liquid crystals to display images.
3. **Light Emitting Diode (LED) monitors:** These are similar to LCD monitors, but they use LED backlighting to display images.
4. **Organic Light Emitting Diode (OLED) monitors:** These are a newer type of monitor that uses organic compounds to emit light and create images.
5. **Plasma monitors:** These were once popular for larger displays, but are now mostly found in specialized applications. They use small cells filled with ionized gas to create images.
6. **Projectors:** These are not technically monitors, but they are used to display computer output on a large screen or wall. Projectors use a light source and lenses to project images onto a surface.

The type of display device used can have an impact on the image quality, energy efficiency, and cost of the computer system. When selecting a display device, it's important to consider factors such as screen size, resolution, refresh rate, and color accuracy.

7.1. Overview of Monitors

A computer monitor, also known as a display screen, is an electronic device that displays visual output from a computer. Monitors come in various sizes, resolutions, and types, and are an essential component of any computer system.

Here are some common types of computer monitors:

1. **LCD (Liquid Crystal Display) Monitors:** These are the most common type of monitor and use a liquid crystal display to create images.
2. **LED (Light Emitting Diode) Monitors:** These are similar to LCD monitors, but use LED backlighting to produce brighter and clearer images.
3. **OLED (Organic Light Emitting Diode) Monitors:** These monitors use a layer of organic material to emit light and produce vibrant colors.
4. **CRT (Cathode Ray Tube) Monitors:** These older monitors are bulky and heavy, and use a cathode ray tube to create images.
5. **Curved Monitors:** These monitors have a curved screen that provides a more immersive viewing experience.

Monitors also come in various sizes and resolutions, such as:

1. **1080p (1920 x 1080) resolution:** This is the most common resolution for computer monitors, and is suitable for most everyday tasks.
2. **1440p (2560 x 1440) resolution:** This resolution provides sharper and clearer images than 1080p, and is ideal for graphic design, video editing, and gaming.

3. **4K (3840 x 2160) resolution:** This resolution provides even sharper and clearer images than 1440p, and is ideal for professional video editing and high-end gaming.

Measurements of Performance

Display geometry:

- **Viewable image size** - is usually measured diagonally, but the actual widths and heights are more informative since they are not affected by the aspect ratio in the same way. For CRTs, the viewable size is typically 1 in (25 mm) smaller than the tube itself.
- **Aspect ratio** - is the ratio of the horizontal length to the vertical length. Monitors usually have the aspect ratio 4:3, 5:4, 16:10 or 16:9.
- **Radius of curvature** (for curved monitors) - is the radius that a circle would have if it had the same curvature as the display. This value is typically given in millimeters, but expressed with the letter "R" instead of a unit (for example, a display with "3800R curvature" has a 3800 mm radius of curvature.[11]
- **Display resolution** is the number of distinct pixels in each dimension that can be displayed. For a given display size, maximum resolution is limited by dot pitch or DPI.
- **Dot pitch or pixel pitch** represents the size of the primary elements of the display. In CRTs, dot pitch is defined as the distance between sub-pixels of the same color. In LCDs it is the distance between the centers of two adjacent pixels. Dot pitch is the reciprocal of pixel density.
- **Pixel density** is a measure of how densely packed the pixels on a display are. In LCDs, pixel density is the number of pixels in one linear unit along the display, typically measured in pixels per inch (px/in or ppi).

Color characteristics

- **Luminance** - measured in candelas per square meter (cd/m^2, also called a *nit*).
- **Contrast ratio** is the ratio of the luminosity of the brightest color (white) to that of the darkest color (black) that the monitor is capable of producing simultaneously. For example, a ratio of 20,000:1 means that the brightest shade (white) is 20,000 times brighter than its darkest shade (black). Dynamic contrast ratio is measured with the LCD backlight turned off.

- **Color depth** - measured in bits per primary color or bits for all colors. Those with 10 bpc (bits per channel) or more can display more shades of color (approximately 1 billion shades) than traditional 8 bpc monitors (approximately 16.8 million shades or colors), and can do so more precisely without having to resort to dithering.
- **Gamut** - measured as coordinates in the CIE 1931 color space. The names sRGB or Adobe RGB are shorthand notations.
- **Color accuracy** - measured in ΔE (delta-E); the lower the ΔE, the more accurate the color representation. A ΔE of below 1 is imperceptible to the human eye. A ΔE of 2–4 is considered good and requires a sensitive eye to spot the difference.
- **Viewing angle** is the maximum angle at which images on the monitor can be viewed, without excessive degradation to the image. It is measured in degrees horizontally and vertically.

Input speed characteristics:

- **Refresh rate** is (in CRTs) the number of times in a second that the display is illuminated (the number of times a second a raster scan is completed). In LCDs it is the number of times the image can be changed per second, expressed in hertz (Hz). Maximum refresh rate is limited by response time. Determines the maximum number of frames per second (FPS) a monitor is capable of showing.
- **Response time** is the time a pixel in a monitor takes to change between two shades. The particular shades depend on the test procedure, which differs between manufacturers. In general, lower numbers mean faster transitions and therefore fewer visible image artifacts such as ghosting. Grey to grey (GtG), measured in milliseconds (ms).
- **Input latency** is the time it takes for a monitor to display an image after receiving it, typically measured in milliseconds (ms).
- **Power consumption** is measured in watts.

7.2. Overview of LCDs

A computer LCD (Liquid Crystal Display) is a flat-panel display technology that uses a layer of liquid crystals sandwiched between two polarizing filters. When an electric current is applied to the liquid crystals, they align to allow or block light, creating the image displayed on the screen.

LCDs have largely replaced CRT (Cathode Ray Tube) displays in computers due to their lighter weight, smaller size, and energy efficiency. They are commonly used in computer monitors, laptops, and tablets.
LCDs offer several advantages over CRTs, including:

1. **Energy efficiency:** LCDs require less power to operate than CRTs, resulting in lower energy bills and reduced environmental impact.
2. **Space-saving design:** LCDs are much thinner and lighter than CRTs, making them ideal for space-limited environments.
3. **Reduced eye strain:** LCDs emit less radiation than CRTs, reducing eye strain and fatigue.
4. **Better image quality:** LCDs offer sharper, more vibrant images with better contrast and color accuracy than CRTs.

Some of the disadvantages of LCDs include limited viewing angles, slower response times, and the possibility of "dead pixels" or other defects in the display. However, these issues have largely been addressed in newer LCD models.
Overall, LCDs offer a reliable and cost-effective display technology for computers and other electronic devices.

Applications

LCDs are used in a wide range of applications, including LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in LCD projectors and portable consumer devices such as digital cameras, watches, digital clocks, calculators, and mobile telephones, including smartphones. LCD screens are also used on consumer electronics products such as DVD players, video game devices and clocks. LCD screens have replaced heavy, bulky cathode-ray tube (CRT) displays in nearly all applications. LCD screens are available in a wider range of screen sizes than CRT and plasma displays, with LCD screens available in sizes ranging from tiny digital watches to very large television receivers. LCDs are slowly being replaced by OLEDs, which can be easily made into different shapes, and have a lower response time, wider color gamut, virtually infinite color contrast and viewing angles, lower weight for a given display size and a slimmer profile (because OLEDs use a single glass or plastic panel whereas LCDs use two glass

panels; the thickness of the panels increases with size but the increase is more noticeable on LCDs) and potentially lower power consumption (as the display is only "on" where needed and there is no backlight). OLEDs, however, are more expensive for a given display size due to the very expensive electroluminescent materials or phosphors that they use. Also due to the use of phosphors, OLEDs suffer from screen burn-in and there is currently no way to recycle OLED displays, whereas LCD panels can be recycled, although the technology required to recycle LCDs is not yet widespread. Attempts to maintain the competitiveness of LCDs are quantum dot displays, marketed as SUHD, QLED or Triluminos, which are displays with blue LED backlighting and a Quantum-dot enhancement film (QDEF) that converts part of the blue light into red and green, offering similar performance to an OLED display at a lower price, but the quantum dot layer that gives these displays their characteristics cannot yet be recycled.

Specifications

- **Resolution** The resolution of an LCD is expressed by the number of columns and rows of pixels (e.g., 1024×768). Each pixel is usually composed 3 sub-pixels, a red, a green, and a blue one. This had been one of the few features of LCD performance that remained uniform among different designs. However, there are newer designs that share sub-pixels among pixels and add Quattron which attempt to efficiently increase the perceived resolution of a display without increasing the actual resolution, to mixed results.
- **Spatial performance:** For a computer monitor or some other display that is being viewed from a very close distance, resolution is often expressed in terms of dot pitch or pixels per inch, which is consistent with the printing industry. Display density varies per application, with televisions generally having a low density for long-distance viewing and portable devices having a high density for close-range detail. The Viewing Angle of an LCD may be important depending on the display and its usage, the limitations of certain display technologies mean the display only displays accurately at certain angles.
- **Temporal performance:** the temporal resolution of an LCD is how well it can display changing images, or the accuracy and the number of times per second the display draws the data it is being given. LCD pixels do not flash on/off between frames, so LCD monitors exhibit no refresh-induced flicker

no matter how low the refresh rate. But a lower refresh rate can mean visual artefacts like ghosting or smearing, especially with fast moving images. Individual pixel response time is also important, as all displays have some inherent latency in displaying an image which can be large enough to create visual artifacts if the displayed image changes rapidly.

- **Color performance**: There are multiple terms to describe different aspects of color performance of a display. Color gamut is the range of colors that can be displayed, and color depth, which is the fineness with which the color range is divided. Color gamut is a relatively straight forward feature, but it is rarely discussed in marketing materials except at the professional level. Having a color range that exceeds the content being shown on the screen has no benefits, so displays are only made to perform within or below the range of a certain specification.[165] There are additional aspects to LCD color and color management, such as white point and gamma correction, which describe what color white is and how the other colors are displayed relative to white.
- **Brightness and contrast ratio:** Contrast ratio is the ratio of the brightness of a full-on pixel to a full-off pixel. The LCD itself is only a light valve and does not generate light; the light comes from a backlight that is either fluorescent or a set of LEDs. Brightness is usually stated as the maximum light output of the LCD, which can vary greatly based on the transparency of the LCD and the brightness of the backlight. Brighter backlight allows stronger contrast and higher dynamic range (HDR displays are graded in peak luminance), but there is always a trade-off between brightness and power consumption.

Advantages

- Very compact, thin and light, especially in comparison with bulky, heavy CRT displays.
- Low power consumption. Depending on the set display brightness and content being displayed, the older CCFT backlit models typically use less than half of the power a CRT monitor of the same size viewing area would use, and the modern LED backlit models typically use 10–25% of the power a CRT monitor would use.
- Little heat emitted during operation, due to low power consumption.
- No geometric distortion.

- The possible ability to have little or no flicker depending on backlight technology.
- Usually no refresh-rate flicker, because the LCD pixels hold their state between refreshes (which are usually done at 200 Hz or faster, regardless of the input refresh rate).
- Sharp image with no bleeding or smearing when operated at native resolution.
- Emits almost no undesirable electromagnetic radiation (in the extremely low frequency range), unlike a CRT monitor.
- Can be made in almost any size or shape.
- No theoretical resolution limit. When multiple LCD panels are used together to create a single canvas, each additional panel increases the total resolution of the display, which is commonly called stacked resolution.
- Can be made in large sizes of over 80-inch (2 m) diagonal.
- Masking effect: the LCD grid can mask the effects of spatial and grayscale quantization, creating the illusion of higher image quality
- Unaffected by magnetic fields, including the Earth's, unlike most color CRTs.
- As an inherently digital device, the LCD can natively display digital data from a DVI or HDMI connection without requiring conversion to analog. Some LCD panels have native fiber optic inputs in addition to DVI and HDMI.
- Many LCD monitors are powered by a 12 V power supply, and if built into a computer can be powered by its 12 V power supply.
- Can be made with very narrow frame borders, allowing multiple LCD screens to be arrayed side by side to make up what looks like one big screen.

Disadvantages

- Limited viewing angle in some older or cheaper monitors, causing color, saturation, contrast and brightness to vary with user position, even within the intended viewing angle.
- Uneven backlighting in some monitors (more common in IPS-types and older TNs), causing brightness distortion, especially toward the edges ("backlight bleed").
- Black levels may not be as dark as required because individual liquid crystals cannot completely block all of the backlight from passing through.
- Display motion blur on moving objects caused by slow response times (>8 ms) and eye-tracking on a sample-and-hold display, unless a strobing

backlight is used. However, this strobing can cause eye strain, as is noted next:

- Only one native resolution. Displaying any other resolution either requires a video scalar, causing blurriness and jagged edges, or running the display at native resolution using 1:1 pixel mapping, causing the image either not to fill the screen (letterboxed display), or to run off the lower or right edges of the screen.
- Fixed bit depth (also called color depth). Many cheaper LCDs are only able to display 262144 (2^{18}) colors. 8-bit S-IPS panels can display 16 million (2^{24}) colors and have significantly better black level, but are expensive and have slower response time.
- Input lag, because the LCD's A/D converter waits for each frame to be completely been output before drawing it to the LCD panel. Many LCD monitors do post-processing before displaying the image in an attempt to compensate for poor color fidelity, which adds an additional lag. Further, a video scalar must be used when displaying non-native resolutions, which adds yet more time lag. Scaling and post processing are usually done in a single chip on modern monitors, but each function that chip performs adds some delay. Some displays have a video gaming mode which disables all or most processing to reduce perceivable input lag.
- Dead or stuck pixels may occur during manufacturing or after a period of use. A stuck pixel will glow with color even on an all-black screen, while a dead one will always remain black.
- Subject to burn-in effect, although the cause differs from CRT and the effect may not be permanent, a static image can cause burn-in in a matter of hours in badly designed displays.
- In a constant-on situation, thermalization may occur in case of bad thermal management, in which part of the screen has overheated and looks discolored compared to the rest of the screen.
- Loss of brightness and much slower response times in low temperature environments. In sub-zero environments, LCD screens may cease to function without the use of supplemental heating.

7.3. Overview of Multimedia Projectors

Multimedia projectors are devices that are used to display visual content on a large screen or wall. They are often used in business, education, and

entertainment settings, and are commonly used for presentations, lectures, and movie screenings.

Multimedia projectors work by using a light source, such as a lamp or LED, to project an image onto a screen or wall. The image is typically produced by a digital source, such as a laptop or DVD player, and is transmitted to the projector using cables or wireless connections.

There are several types of multimedia projectors, including LCD, DLP, and LCoS projectors. LCD projectors use liquid crystal display technology to produce images, while DLP projectors use digital light processing technology. LCoS projectors use liquid crystal on silicon technology to produce images.

When selecting a multimedia projector, it is important to consider factors such as the brightness, resolution, and contrast ratio of the device. Other important features may include the number and type of input ports, the size and weight of the device, and the lamp life and replacement cost.

Multimedia projectors can be used in a variety of settings, including classrooms, conference rooms, home theaters, and outdoor events. They are a versatile and effective tool for displaying visual content and can greatly enhance the overall viewing experience.

Different Projector Types

There are several types of multimedia projectors, including:

LCD Projectors: LCD (Liquid Crystal Display) projectors use a combination of red, green, and blue LCD panels to create an image. They are known for producing bright, vibrant images and are often used in classrooms, boardrooms, and home theaters.

DLP Projectors: DLP (Digital Light Processing) projectors use a small chip made up of millions of tiny mirrors to create an image. They are known for producing high-quality images with excellent contrast and are often used in home theaters, conference rooms, and large venues.

LCoS Projectors: LCoS (Liquid Crystal on Silicon) projectors use liquid crystals placed on a reflective silicon substrate to create an image. They are known for producing sharp, detailed images with excellent color accuracy and are often used in home theaters and professional settings.

LED Projectors: LED (Light Emitting Diode) projectors use LED lights as their light source, which are known for being energy-efficient and long-lasting. They are often used in portable projectors and for outdoor events.

Laser Projectors: Laser projectors use lasers as their light source, which can produce very bright and vivid images. They are often used in large venues, such as concert halls and stadiums.

REAL-TIME

- Camera obscura
- Concave mirror
- Opaque projector
- Overhead projector
- Document camera

STILL IMAGES

- Slide projector
- Magic lantern
- Magic mirror

MOVING IMAGES

- Movie projector
- Video projector
- Handheld projector
- Virtual retinal display

Advantages of Projector

1. Stable performance

The laser is a cold light source, the temperature of the machine will be greatly reduced, the burning degree of the display chip will be greatly reduced, and can maintain excellent color for a long time. The laser machine can switch on and off instantaneously without preheating and heat dissipation and the brightness can reach 100%.

2. High clarity under the same lumen, low attenuation of brightness in long-term use

The brightness of the laser projector decreases slowly during long-term use, and its service life can reach more than 20,000 hours.

3. The total cost is lower than that of an ordinary bulb machine.

After about 2000 hours of use, the brightness of the traditional bulb projector decreases rapidly, with an average of 1.5 years to replace the bulb once, plus

vulnerable accessories, maintenance, and other costs, the after-sales cost is relatively high. Laser projector does not need after-sale cost, low failure rate, improve the work effect.

Disadvantages of Laser Multimedia Projector:

1. **Lack of flexibility**
2. **The price is more expensive than ordinary projectors.**

The main reason why laser projectors are more expensive than ordinary projectors is the high brightness. Luminance is the biggest advantage of laser projection. The maximum brightness of LED projection can only reach about 1000 ANSI lumens, while the brightness of laser projection can reach 3000-6000 A ANSI lumens, or even higher.

Types of a Projector

On the basis of its display property, Projectors can be classified in three types. They are:

- Cathode Ray Tube (CRT)
- Liquid Crystal Display (LCD)
- Digital Light Processing (DLP)

Cathode Ray Tube (CRT)

A CRT projector is basically a video projecting device. It uses a tiny cathode ray tube which has high-brightness for image generation. A Lens is kept in front of the CRT face which focuses the image and enlarge it onto a big projection screen. A CRT projector focuses on the image or video by its lenses to project it on screen. These images are processed with help of three separate colored (red, green and blue) CRT tubes. CRT projectors are not portable as they are huge in size and heavy in weight. Their electricity consumption is also high because of three light guns. At initial stage, it may be difficult and tricky to set up a CRT projector, but the users say that a CRT projectors have a brilliant and outstanding picture quality. People say that these projectors are nevertheless than newer technologies and are compatible with new improvement.

Liquid Crystal Display (LCD)

The meaning of Liquid Crystal Display is approximately clear from its name. The word LCD resembles two states of matter, the liquid and the solid. A Liquid Crystal Display uses liquid crystal to project an image or object.

These types of display panel is generally used in computer, Laptops, TVs, portable video games and cell phones. Displays in LCD technology are much thinner as compared to CRT technology.

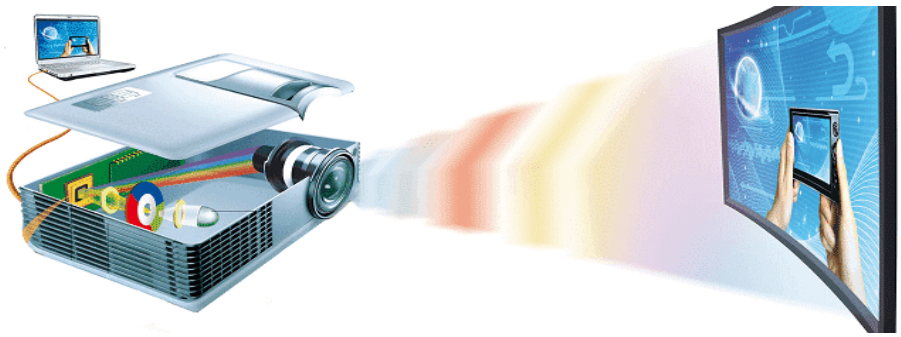
Digital Light Processing (DLP)

Digital Light Processing (DLP) is a video innovation made by Texas Instruments that is utilized for front and back projection units. DLP is used in both back and front projections. It is regular for back projection in TVs and also utilized in front projectors for units intended for organizations and classrooms. A DLP comes in two noteworthy structures i.e. 1 chip DLP and 3 chip DLP. Digital Light Processing makes utilization of micro mirrors called a Digital Micro mirror Device to reflect light and shading onto a screen. These micro mirrors are situated in a semiconductor chip and are little. Most of the DLP chips are manufactured by Texas Instruments.

Working

A projector is an optical gadget that projects a picture (or moving images) onto a surface, usually a projection screen. Most projectors create a photo through projecting a bright light via a small lens. However, some newer types of projectors can project the image directly, by using the usage of lasers. A digital

retinal display, or retinal projector, is a projector that projects a photograph at once on the retina as a substitute of using an external projection screen.



Applications of a Projector

In Classrooms

Projectors are used in schooling area for describing a topic. With the aid of a projector, videos or photograph become more enjoyable and children can easily learn by fun way. Further, we can easily zoom-in or zoom-out the image to clear the vision and to search minor points.

In Companies

Projectors are used in big MNC's and enterprises for meeting, presentation and conference purposes.

At Home

Projectors are even used as home theaters that permit you to see the movie or any serial on a massive display with a first-rate sound nice, which makes you feel like you are staring at live.

7.4. Common Faults and Troubleshooting

Multimedia projectors are popular devices for presentations and entertainment purposes. However, like any electronic device, they are prone to faults that can affect their performance. Here are some common faults and troubleshooting tips for multimedia projectors:

1. No power: If your projector doesn't power on, check the power cable and ensure that it is properly plugged into a working power outlet. Also, check the fuse on the power cable to ensure that it's not blown.
2. No image: If the projector powers on but doesn't display any image, check the input source and ensure that it is properly connected to the projector. Also, check the brightness and contrast settings on the projector to ensure they are adjusted correctly.

3. Image quality issues: If the image displayed by the projector is blurry or distorted, check the focus adjustment on the projector to ensure that it is properly set. Also, check the resolution and refresh rate of the input source to ensure that it's compatible with the projector's specifications.
4. Overheating: If the projector overheats and shuts down, check the air filter to ensure that it's not clogged with dust. Clean or replace the air filter if necessary. Also, ensure that the projector has proper ventilation and is not placed in an enclosed space.
5. Fan noise: If the projector's fan is making loud noises, check for any obstructions in the air vents and ensure that the projector is properly ventilated. If the problem persists, the fan may need to be replaced.
6. Remote control issues: If the remote control doesn't work, check the batteries to ensure they are properly installed and have sufficient charge. Also, ensure that the remote control is pointed directly at the projector and that there are no obstructions in the way.

7.5. Diagnostics, Preventive and Repairs of Monitors

Diagnostics:

When diagnosing monitor issues, it's essential to first determine whether the problem is related to the monitor itself or the computer it's connected to. Here are some steps you can take to diagnose monitor issues:

1. Check the cables: Ensure that the cables connecting the monitor to the computer are securely connected and not damaged.
2. Check power: Ensure the monitor is receiving power and turned on.
3. Test with another monitor: Connect another monitor to the computer to see if the problem persists.
4. Check settings: Verify that the monitor settings are correctly set up on the computer.
5. Check for driver issues: Ensure that the monitor drivers are up-to-date.

Preventive Measures:

Preventive measures can help keep monitors in good working condition and avoid potential issues. Here are some ways to prevent problems:

1. Avoid exposure to direct sunlight: Monitors should be positioned in a location away from direct sunlight or other heat sources.

2. Clean the screen: Regularly clean the monitor screen with a soft, dry cloth to remove dust and fingerprints.
3. Adjust brightness and contrast: Adjust the brightness and contrast settings to a comfortable level to avoid eye strain.
4. Avoid touching the screen: Avoid touching the screen with your fingers or any other objects as it can damage the screen.
5. Turn off when not in use: Turn off the monitor when it's not in use to save power and extend the lifespan of the monitor.

Multiple Choice Questions

What is the aspect ratio of a standard widescreen monitor?

A) 3:2
B) 4:3
C) 16:9
D) 5:4

Which type of monitor uses a cathode ray tube (CRT)?

A) LCD monitor
B) LED monitor
C) OLED monitor
D) CRT monitor

Which type of monitor provides the widest viewing angles?

A) TN
B) IPS
C) VA
D) OLED

What is the difference between a monitor's resolution and its refresh rate?

A) Resolution is the number of pixels on the screen, while refresh rate is the number of times per second the screen updates.
B) Resolution is the number of times per second the screen updates, while refresh rate is the number of pixels on the screen.
C) Resolution and refresh rate are the same thing.
D) None of the above.

Which of the following is NOT a type of monitor connection?

A) VGA
B) DVI
C) USB
D) HDMI

Which type of monitor backlighting is more energy-efficient and longer-lasting?

A) CCFL
B) LED
C) OLED
D) CRT

What is the maximum number of colors that can be displayed on a 24-bit monitor?

A) 16 million
B) 24 million
C) 32 million
D) 64 million

What is the maximum resolution of a Full HD (1080p) monitor?

A) 720p
B) 1080p
C) 1440p
D) 2160p

Which type of monitor is typically the most expensive?

A) TN
B) IPS
C) VA
D) OLED

What is the purpose of the VESA mount on the back of a monitor?

A) To connect the monitor to a computer
B) To adjust the monitor's brightness and contrast
C) To mount the monitor on a wall or stand
D) None of the above

What does LCD stand for?

A) Light Control Device
B) Liquid Crystal Display
C) Light Crystal Diode
D) Liquid Control Device

What is the main advantage of LCDs over CRTs?

A) Better color accuracy
B) Higher contrast ratio
C) Less power consumption
D) Faster refresh rates

Which of the following is not a type of LCD?

A) TN
B) IPS
C) OLED
D) LED

What is the full form of TFT?

A) Thin Film Transistor
B) Time for Test
C) True Fast Technology
D) The Fine Tuning

What is the main drawback of TN panels?

A) Limited viewing angles
C) Low contrast ratio
B) Poor color accuracy
D) High power consumption

Which of the following is not a common projection technology used in multimedia projectors?

A) DLP
C) OLED
B) LCD
D) LCoS

What is the aspect ratio commonly used in multimedia projectors?

A) 16:9
C) 2.35:1
B) 4:3
D) 1:1

Which of the following is not a common resolution for multimedia projectors?

A) 720p
C) 4K
B) 1080p
D) 8K

Which of the following is not a common connectivity option for multimedia projectors?

A) HDMI
C) USB
B) VGA
D) Thunderbolt

Which of the following is not a common feature of multimedia projectors?

A) Keystone correction
C) Lens shift
B) Zoom
D) Virtual reality capability

1	2	3	4	5	6	7	8	9	10
C	D	B	A	C	B	A	B	D	C
11	12	13	14	15	16	17	18	19	20
B	C	D	A	A	C	A	D	D	D

Short Questions

1. Define pixels, dot pitch, aspect ratio, power indicator, contrast, brightness, -/+ buttons, and other adjustment buttons
2. Differentiate color monitor diagram from monochrome monitor diagram.
3. Enumerate common faults of a monitor
4. Diagnose common monitor faults
5. Diagnose monitor interface card fault.

Long Questions

1. Describe horizontal position/size, vertical position/size, 15-Pin D-Subtype connector, non-glare screen, tinted screen, and tilt/swivel stand.

2. Describe video controller chip, video RAM, video image chip, digital to analog converter, port to monitor, signal assignment, factory preset timing signals
3. Describe display adapters: MDA, CGA, EGA, VGA, SVGA, XGA, 8514.
4. Classify various faults: Power Supply-based, deflection faults, horizontal hold, vertical hold, and alignment faults, supply line faults, interface-based faults.
5. Describe preventive measures for monitors.

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Soper, David L. Prowse and Scott Mueller.
- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
- PRINCE GEORGE'S COMMUNITY COLLEGE
- Computer Hardware Technicians CH111, 5 CD-ROM set by NCSA Academy USA
- Computer Hardware Technicians

Chapter No.8

(Maintenance and Repair of Keyboard)

Objectives
After completion of this chapter students will be able to:

8. Maintenance and Repair of Keyboard

8.1. Basic Working of Keyboard and Keyboard Installation
8.2. Disassembly/Assembly of a Keyboard

8.3. Interface Problems

8.4. Diagnostics, Preventive and Repair techniques

Keyboard

A computer keyboard is an input device that is used to enter characters and commands into a computer. It typically consists of a set of keys that are arranged in a specific layout, such as the QWERTY layout commonly used in English-speaking countries.

The keyboard is connected to the computer via a cable or wireless connection and sends signals to the computer when a key is pressed. These signals are then processed by the computer's software and converted into text or commands that can be understood and executed by the computer.

In addition to the standard keys for letters, numbers, and punctuation, modern computer keyboards often include additional keys for functions such as media control, volume adjustment, and launching specific applications. Some keyboards also feature programmable keys that can be customized to perform specific actions or commands.

Overall, the computer keyboard is a crucial input device for many computer users, enabling them to efficiently and accurately input text and commands into their devices.

Types

There are different types of keyboards. They can be based on the way the keys work; for example, laptops have keys that do not move a lot, because the keyboard has to be very thin in order to fit inside the laptop. On the other hand, video game players often like keyboards with keys that move a lot, so that they feel the key working. Gaming keyboards also need fast reaction times. In between these two types, an ergonomic keyboard is made to be easier for people to type for long periods of time, without hurting their hands or arms.

There are also different ways the keys on a keyboard are arranged, usually to deal with different regions and languages of the world. Most computer keyboards have the keys in six rows, but some laptops use only five or even four rows to save space. The most popular layout is called QWERTY, which is based on the first six letters on them. The QWERTY design was made so that the most common letters would not make the moving parts of a mechanical typewriter "jam", or stop working. Now, even though most people do not use typewriters anymore, the design stayed because people were used to it. Other layouts have been developed, for example the Dvorak keyboard, which puts the most common letters in the places that are easiest to reach.

Types of Keyboard Interface.

1. **PS/2 interface:** This is a common interface for connecting a keyboard to a computer. It uses a small, round connector and is typically colored purple.
2. **USB interface:** This is the most common interface for connecting a keyboard to a computer. It uses a rectangular connector and can be found on most modern computers.
3. **Bluetooth interface:** This is a wireless interface that allows a keyboard to connect to a computer or other device using Bluetooth technology.
4. **Serial interface:** This is an older interface that uses a serial port to connect a keyboard to a computer. It is not commonly used today.
5. **Infrared interface:** This is a wireless interface that uses infrared technology to connect a keyboard to a computer or other device.
6. **Wireless RF interface:** This is a wireless interface that uses radio frequency (RF) technology to connect a keyboard to a computer.

8.1. Basic Working of Keyboard and Keyboard Installation

Working

A keyboard is a hardware device that allows users to input text, numbers, and commands into a computer or other electronic device. Most keyboards use a QWERTY layout, which is named after the first six letters on the keyboard's top row.

The basic working of a keyboard involves pressing a key, which activates a switch beneath it. The switch sends an electrical signal to the computer, which then translates the signal into a character or command. Keyboards can be

connected to computers in several ways, including through USB, Bluetooth, or a PS/2 port.

To install a keyboard, simply plug it into the appropriate port on your computer. The operating system should automatically recognize the keyboard and install the necessary drivers. If your keyboard doesn't work after installation, you may need to check your device manager to ensure that the keyboard is properly recognized and installed. You can also check the settings in your operating system to make sure that the keyboard is configured correctly.

Overall, the installation and working of a keyboard is quite simple. With a basic understanding of how keyboards work, you can easily troubleshoot any issues and ensure that your keyboard is functioning properly.

8.2. Disassembly/Assembly of a Keyboard

- Disconnect the key board from PC
- First, turn the keyboard upside down and remove the screws from the side with screwdriver.
- After this, flip it back over and remove the keys from the top.
- Disassemble the outer case. This consists of removing three Allen screws from the underside of the keyboard. The keyboard assembly then lifts out of the base.
- Two ribbons are coming from the keyboard assembly and connected into the keyboard encoder circuit.
- To remove this ribbon, just pull on the tabs on both sides on the cable.
- Remove all screws holding the encoder board into place.
- Reverse the all step for assemble the keyboard.

8.3. Interface Problems

Keyboard Symptoms

Typical symptoms associated with keyboard failures include the following:

- No characters appear onscreen when entered from the keyboard.
- Some keys work, whereas others do not work.
- A Keyboard Error—Keyboard Test Failure error appears.
- A KB/Interface Error—Keyboard Test Failure error appears.
- An error code of *six short beeps* is produced during bootup (BIOS dependent).

- The wrong characters are displayed.
- An IBM-compatible 301 error code appears.
- An Unplugged Keyboard error appears.
- A key is stuck.

Basic Keyboard Checks

The keys of the keyboard can wear out over time. This might result in keys that don't make good contact (no character is produced when the key is pressed) or that remain in contact (stick) even when pressure is removed. The stuck key produces an error message when the system detects it; however, it has no way of detecting an open key.

An unplugged keyboard, or one with a bad signal cable, also produces a keyboard error message during startup. Ironically, this condition might produce a configuration error message that says "*Press F1 to continue*."
If the keyboard produces odd characters on the display, check the Windows keyboard settings in Device Manager. Device Manager is located under the System icon (found in Control Panel) in Windows 9x and Windows Me. In Windows 2000, the path is similar—Control Panel, System, Hardware tab. However, in both Windows 2000 and Windows XP, Device Manager is usually accessed through the Computer Management console. If the keyboard is not installed or is incorrect, install the correct keyboard type. Also, be certain that you have the correct language setting specified in the Keyboard Properties dialog box (found by double-clicking the Keyboard icon in Control Panel).

Keyboard Hardware Checks

If you suspect a keyboard hardware problem, isolate the keyboard as the definite source of the problem (a fairly easy task). Because the keyboard is external to the system unit, detachable, and inexpensive, simply exchange it with a known-good keyboard.

If the new keyboard works correctly, remove the back cover from the faulty keyboard and check for the presence of a fuse in the +5V DC supply and check it for continuity. Neither the older five-pin DIN nor the six-pin PS/2 mini-DIN keyboards can be hot-swapped. Disconnecting or plugging in a keyboard that has this type of fuse while power is on can cause the keyboard to fail. If the fuse is present, simply replace it with a fuse of the same type and rating.

If replacing the keyboard does not correct the problem, and no configuration or software reason is apparent, the next step is to troubleshoot

the keyboard receiver section of the system board. On most system boards, this ultimately involves replacing the system board.

8.4. Diagnostics, Preventive and Repair Techniques

Preventive

Keep Your Keyboard Clean

The following tips will ensure you enjoy a dirt-free keyboard for a longer period:

- Don't eat over your keyboard. This will help to keep food crumbs from getting trapped beneath the keys. The same goes for drinks. Even if you're using a straw, reduce the risk of spilling liquids on your keyboard by taking time off from your computer.
- Keep your laptop closed when it is not in use to minimize the collection of dust.
- Invest in a good keyboard protector or keyboard cover. This is a device that you place on top of a computer keyboard to reduce contact with the environment.
- After eating, wash your hands before using your keyboard to avoid getting food crumbs and oil stuck on them.
- Don't allow pets and children to play with your computer keyboard. Pet fur or hair is not keyboard-friendly, and neither are dirty little hands. Children may also contract diseases from contaminated keyboards, so it's always a good idea to teach them proper hand hygiene when dealing with such electronics.
- Buy a washable keyboard that you can soak in water and scrub using the included brush without worrying about damage.

Clean a Computer Keyboard

Cloth. Use a microfiber cloth to rub down computer components.

Paper towels. It helps to have paper towels to quickly blot spilled liquid. Most hardware can also be easily cleaned using paper towels.

Rubbing alcohol. Some of the dirt you'll need to clean will require a moist cloth. It's best to use rubbing alcohol, as other solvents are not recommended for use on the plastics used to make your computer.

Portable Vacuum. To suck out the dust and little particles of dirt, you will need a small vacuum. Don't use the standard vacuum cleaner, though, as it produces static electricity that may be harmful to computer components.

Cotton swabs. To clean between keys, you'll need to moisten cotton swabs with rubbing alcohol.

Can of compressed air. Compressed air will help you blow the dust off the surface of your keyboard.

Home dust mask. This will protect your respiratory system from the fine dust that you may dislodge from the keyboard.

Safety goggles. These will keep dust and other particles from getting into your eyes.

Anti-static gloves. These will prevent the dirt you're cleaning from the keyboard from sticking on your hands.

Repair techniques

Software Related Issues

Reboot your system: Rebooting the system can fix a thousand problems regarding the system and is also one of the easiest and much-recommended methods in order to fix the simplest issues regarding PCs. If due to the problem with the keyboard you are unable to reboot your system then just hold the power button for 10 to 15 minutes which will turn off the system then you can turn it back on.

1. **Reinstallation of the keyboard driver:** Due to the installation of third-party software into your system, the driver managing your keyboard in your system may run into some kind of a problem. In order to fix this issue, you need to go into the device manager in your system, if any of the devices in this section are flashing an exclamation mark next to it then it means that there is some problem. Although rebooting the system should solve this issue, if it doesn't then go to the laptops manufacturer page and install the latest drivers for the keyboard.
2. **Change the layout of the keyboard:** Sometimes there are issues regarding the key generated by the keyboard. you struggle pressing one button but with keyboard types something else. Such a situation can be very frustrating. in order to fix this issue in the start menu type 'language' to find Windows' Region & Language settings panel. Here you can click one you want to use.
3. **Virus Attack:** If none of the above-discussed solutions works then there are pretty good chances at your system is affected by a virus. In that case, running a malware scanner in your system can save the situation.

Hardware Related Issues

1. **Dust – the Danger:** All the above-discussed laptop keyboard repair methods were regarding software related issues but if in the case from the above instructions you were able to charge that your system is going through hardware related issues then the first thing you must take care is whether your system is clean or is subjected to entrapped dust. The first thing you must do in order to clean it is holding it upside down and give it a good shake. Sometimes food crops from your last snack get trapped in the keys of your keyboard. such a situation is much more dangerous for older laptops but still, you can give it a try even if you have a new system.
2. **Remove the battery of the system:** The battery which resides under the keyboard is removed and plugged in again may solve your situation. Otherwise, you can also try booting the system without the battery installed in it using only AC power.

Keyboard Troubleshooting

When you use a wired keyboard, you may experience one or more of the following problems:

- The keyboard is not detected.
- The keys on the keyboard do not work.
- Wrong characters are typed.

The keyboard is not functioning

Step 1: Verify the connection

If the keyboard is not functioning at all, make sure that it is connected correctly to the computer. Check all the keyboard's plugs to make sure that there are no loose connections. Connect the keyboard to your computer by using a different USB port.

If an adapter (PS/2 to USB or PS/2 to AT) is being used, verify that it is the adapter that was included with the keyboard or that the keyboard supports adapting to a different port. For example, the Internet Keyboard does not adapt to a USB port, and a PS/2 to USB adapter will not work. It does not include an adapter.

To connect or to disconnect the keyboard to a PS/2 port, follow these steps:

1. Shut down the computer.
2. Plug your device into the correct port. Make sure that the plug is pushed securely into the connector on the computer.

3. Restart the computer. Microsoft Windows detects the change, and then installs the drivers on the new port automatically.

If the issue continues to occur, try connecting the keyboard to a different computer. If the keyboard functions correctly on a different computer, the port to which the keyboard was connected on the original computer may be damaged. If this is the case, contact your computer manufacturer to inquire about how to repair or replace the damaged port.

If the keyboard does not function correctly on another computer, the keyboard may be defective. If this is the case, and the warranty on the keyboard is still valid, you can exchange the defective keyboard for a new keyboard. For information about how to contact Microsoft Supplemental Parts, see the “References” section.

Step 2: Download and install the latest keyboard software

To download the latest drivers for the keyboard

Step 3: Manually reinstall the drivers

The keys do not strike correctly

If the keys do not strike correctly, make sure that the keyboard is free of dust, dirt, and foreign matter.

Turn the keyboard upside down to allow for any foreign debris, such as hair, food particles, or dust, to fall out.

We recommend that you periodically use compressed air to blow dust out of the hard-to-clean crevices in the keyboard.

If you spill a drink or some other liquid on the keyboard, immediately turn the keyboard upside down to let the liquid drain out, and then remove as much liquid as possible. Wait until the keyboard is completely dry before you use it again.

Multiple Choice Questions

1. What is the function of the "Ctrl" key on a keyboard?
   a) It is used to access the computer's settings
   b) It is used to control the computer's volume
   c) It is used in combination with other keys to perform keyboard shortcuts
   d) It is used to turn on and off the computer
2. What is the purpose of the "Shift" key on a keyboard?

a) It is used to capitalize letters

b) It is used to access special characters

c) It is used to delete text

d) It is used to open a new window

3. What is the function of the "Tab" key on a keyboard?

a) It is used to switch between open windows

b) It is used to create a new paragraph

c) It is used to indent text

d) It is used to delete text

4. What is the purpose of the "Backspace" key on a keyboard?

a) It is used to go back to the previous webpage

b) It is used to delete the character to the right of the cursor

c) It is used to delete the character to the left of the cursor

d) It is used to close the current window

5. What is the function of the "Enter" key on a keyboard?

a) It is used to insert a new line or paragraph

b) It is used to submit a form or command

c) It is used to switch between open windows

d) It is used to turn off the computer

6. What is the purpose of the "Esc" key on a keyboard?

a) It is used to access the computer's settings

b) It is used to close the current window

c) It is used to cancel an action or operation

d) It is used to switch between open windows

7. What is the function of the "Alt" key on a keyboard?

a) It is used to access the computer's settings

b) It is used to control the computer's volume

c) It is used in combination with other keys to perform keyboard shortcuts

d) It is used to turn on and off the computer

8. What is the purpose of the "Delete" key on a keyboard?

a) It is used to delete the character to the left of the cursor

b) It is used to delete the character to the right of the cursor

c) It is used to close the current window

d) It is used to turn off the computer

9. Which of the following is NOT a common interface problem of computer keyboards?

a) Sticky keys c) Broken keys

b) Ghosting d) Overheating

10. What is the term used to describe a problem where multiple keys pressed simultaneously are not all registered by the computer?

a) Stuck keys c) Ghosting

b) Sticky keys d) None of the above

1	2	3	4	5	6	7	8	9	10
c	a	c	c	b	c	c	b	d	c

Short Questions

1. Describe basic working of a keyboard
2. Define concept of rows and columns to form a matrix of key positions.
3. Identify keyboard matrix, controller chip, 5-pin connector.
4. Clean dirty key contacts

Long Questions

1. Describe functions of signals between the CPU and keyboard
2. Assemble keyboard
3. Disassemble keyboard

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Soper, David L. Prowse and Scott Mueller.
- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
- PRINCE GEORGE'S COMMUNITY COLLEGE
- Computer Hardware Technicians CH111, 5 CD-ROM set by NCSA Academy USA

- Computer Hardware Technicians

Chapter No.9

(Maintenance and Repair of Mouse)

Objectives

After completion of this chapter students will be able to:

9. Maintenance and Repair of Mouse

9.1. Working of a Mouse and Installation

9.2. Disassembly and Assembly of a Mouse

9.3. Cleaning and Preventive Measures

Introduction

A computer mouse is a hand-held pointing device that detects two-dimensional motion relative to a surface. This motion is typically translated into the motion of a pointer on a display, which allows a smooth control of the graphical user interface of a computer.

The first public demonstration of a mouse controlling a computer system was in 1968. Mice originally used two separate wheels to track

movement across a surface: one in the X-dimension and one in the Y. Most modern mice use optical sensors that have no moving parts.

In addition to moving a cursor, computer mice have one or more buttons to allow operations such as the selection of a menu item on a display. Mice often also feature other elements, such as touch surfaces and scroll wheels, which enable additional control and dimensional input.

Type of Mouse

Mouse can be classified on various types depending upon their design and working. Like wired or wireless, mechanical or optical so and so on.

Wired Mouse

The pointer or cursor on a display screen is operated by a mouse. A mouse can roll over a flat surface, hard is a small object. The name derives from its shape, a bit like a mouse, the wire that you can imagine to be the tail of the mouse, and the fact that you will scurry along a floor. The display pointer moves in the same direction when you move the mouse.

Wireless Mouse

Instead of using the "usual" wires, the wireless mouse uses radio frequency to connect with the computer unit. This applies to the mouse that has no cord stitching. The equation consists of two parts: The mouse is the transmitter and gives wireless signals when shifting and clicking. The machine receives and behaves accordingly these wireless signals. As for 'Wireless Signals,' it is not universal. Some wireless mouse is standard Bluetooth, some have a wireless 2.4 GHz standard and some have their own wireless USB dongle.

Optical Mouse

An optical mouse is an advanced computer pointing device that uses a light-emitting diode (LED), an optical sensor, and digital signal processing (DSP) in place of the traditional mouse ball and electromechanical transducer. Movement is detected by sensing changes in reflected light, rather than by interpreting the motion of a rolling sphere.

Mechanical Mouse

In the old days, the mechanical mouse is what we used and one of the most popular mice in computer history. This is also called a ball mouse, as it uses a rubber ball to track motion – the ball rotates as you turn the mouse and sensors determine the direction in which you turn.

9.1. Working of a Mouse and Installation

A mouse typically controls the motion of a pointer in two dimensions in a graphical user interface (GUI). The mouse turns movements of the hand backward and forward, left and right into equivalent electronic signals that in turn are used to move the pointer.

The relative movements of the mouse on the surface are applied to the position of the pointer on the screen, which signals the point where actions of the user take place, so hand movements are replicated by the pointer. Clicking or pointing (stopping movement while the cursor is within the bounds of an area) can select files, programs or actions from a list of names, or (in graphical interfaces) through small images called "icons" and other elements. For example, a text file might be represented by a picture of a paper notebook and clicking while the cursor points at this icon might cause a text editing program to open the file in a window.

Working of Mouse

Point: Stop the motion of the pointer while it is inside the boundaries of what the user wants to interact with. This act of pointing is what the "pointer" and "pointing device" are named after. In web design lingo, pointing is referred to as "hovering." This usage spread to web programing and Android programming, and is now found in many contexts.

Click Left: Pressing and releasing a button.

- Single-click: clicking the main button.
- Double-click: clicking the button two times in quick succession counts as a different gesture than two separate single clicks.
- Triple-click: clicking the button three times in quick succession counts as a different gesture than three separate single clicks. Triple clicks are far less common in traditional navigation.

Click Right: clicking the secondary button. In modern applications, this frequently opens a context menu.

Drag: Pressing and holding a button, and moving the mouse before releasing the button. This is frequently used to move or copy files or other objects via drag and drop; other uses include selecting text and drawing in graphics applications.

Mouse button chording or chord clicking:

- With more than one button simultaneously.

- While simultaneously typing a letter on the keyboard.
- And rolling the mouse wheel simultaneously.
- While holding down a modifier key.

Moving the pointer a long distance: When a practical limit of mouse movement is reached, one lifts up the mouse, brings it to the opposite edge of the working area while it is held above the surface, and then lowers it back onto the working surface. This is often not necessary, because acceleration software detects fast movement, and moves the pointer significantly faster in proportion than for slow mouse motion.

Multi-Touch: This method is similar to a multi-touch touchpad on a laptop with support for tap input for multiple fingers, the most famous example being the Apple Magic Mouse.

Installation of Mouse

There are different ways to connect mouse with PC or Desktop computer. Following are few methods depending upon the mouse type.

- USB
- PS/2
- Serial Port
- Wireless/Bluetooth

Universal Serial Bus (USB)

Connect the USB cable coming from the mouse to one of the USB ports on the back or side of your computer. If you are using a USB port hub, connect the mouse cable to that. After the mouse is connected, the computer should automatically install the drivers and provide basic functionality.

PS/2 Port (Obsolete Technology)

Connect the cable coming from the mouse to the green-colored PS/2 port on the back of the computer. If your PS/2 ports are not color-coded, use the mouse port furthest from the left side of the computer chassis.

After the mouse is connected, the computer should automatically install the drivers and provide basic functionality. If you want to change how any special buttons work on your mouse, additional software may need to be

installed.

Computer PS/2 Ports

Serial Port (Obsolete Technology)

Connect the mouse to the serial port on the back of the computer. If you have more than one serial port on the computer, we recommend connecting the mouse to the first port. Once connected, depending on your computer setup, you may need to configure the mouse COM ports in the BIOS setup.

Bluetooth Mouse

A Bluetooth mouse connects to a computer wirelessly using a Bluetooth signal. The computer must have built-in Bluetooth or have a Bluetooth adapter connected to it.

To connect a Bluetooth mouse to your computer, follow the steps below.

1. Open the Bluetooth utility on your computer and make sure Bluetooth is enabled. The Bluetooth utility, if enabled, is in the notification area, with an icon that looks like the Bluetooth symbol.
2. Turn on the mouse if it has an On/Off switch. Check the Bluetooth utility to see if it detects the Bluetooth mouse.
3. When the Bluetooth utility finds the Bluetooth mouse, select the mouse in

the Bluetooth device list and click the Pair button.

4. If successful, the mouse connects to the computer.

9.2-Disassembly and Assembly of a Mouse

Following steps are followed to disassemble

Step 1: Turn the mouse over and determine if it's a track-ball type mouse or an optical mouse. Track-balls have the actual ball visible and a round cover surrounding it. Optical versions have a light rather than a ball, which illuminate with the mouse connected to the computer.

Step 2: Disconnect the mouse from the computer before you attempt to disassemble it. Unplug it, or for a wireless mouse, manually disable the wireless connection.

Step 3: Twist the cover over the track ball by placing your fingers or a finger and thumb on opposite sides of the round cover, and twist in the direction of the arrows if any are visible. If not, apply pressure one way and then the other to determine the correct direction to twist. This should not require much effort at all and may only take a quarter-turn to remove.

Step 4: Flip the mouse back right side up and let the ball fall into the palm of your hand. Put it in a safe place because it's easy for the ball to roll off the back of the desk and cause a bigger headache trying to retrieve it.

Step 5: Look for a screw on an optical mouse, holding the base on, normally towards the bottom of the mouse. If a screw isn't visible, remove the footpads on the mouse as some manufacturers hide them for aesthetic purposes.

Step 6: Use a small screwdriver to remove the screws and put them in a safe place, either in a small dish or on a strip of tape so you can find them after you disassemble the mouse.

Note: Reverse All Step to Assemble mouse.

9.3-Cleaning and Preventive Measures

Following steps are followed for cleaning mouse

Step 1: Disconnect the mouse cable from the back of the computer case.

Step 2: Lightly dampen a cleaning cloth with isopropyl alcohol and wipe down the outside of the computer mouse and mouse pad. If you are concerned about damaging the plastic, dilute the alcohol 50:50 with water or use a mild detergent solution instead.

Step 3: Remove the bottom cover of the mouse. To do this, turn it over and note the directional arrows that indicate the direction of rotation, or how to slide it off. Press with your fingers in the direction of the arrows and then turn the mouse right side up, letting the cover and mouse ball drop into your hand.
Step 4: Wipe the computer mouse ball with a lint-free cloth dampened with isopropyl alcohol. Put it aside.
Step 5: Dampen a swab with isopropyl alcohol and clean between, around and on top of the keys. Change swabs as they become dirty. You may need several swabs.
Step 6: Replace the mouse ball and cover.
Step 7: Wipe the mouse cord. Lightly dampen a cleaning cloth with mild soap solution and gently pull the cord through the cloth. Too tight a grip may damage it. Dry the cord with a dry cloth.
Step 8: Plug the mouse back into the computer.

Multiple Choice Questions

1- Optical Mouse uses_____ technology.

a. Fiber
b. Laser
c. Rj-45
d. Bal

2- Which is the fastest mouse from following _____

a. USB
b. PS/2
c. Serial
d. LAN

3- Wireless Mouse uses _____ technology
   a. RF
   b. 3G
   c. 4G
   d. Bluetooth
4- Selection is done using _____ click.
   a. Double
   b. Triple
   c. Single
   d. Right
5- First mouse controlling a computer system was in _____
   a. 1967
   b. 1968
   c. 1969
   d. 1970

1	2	3	4	5
B	a	d	c	b

Short Questions

1. Write a note of Mechanical Mouse.
2. What do you know about Optical Mouse?
3. Briefly explain Wired Mouse.
4. Briefly explain Wireless Mouse.
5. Write a note of USB Mouse.
6. Write a note of PS/2 Mouse.
7. Write a note on Serial Mouse.
8. Write a note of Bluetooth Mouse.

Long Questions

1. Explain the working of Mouse.
2. Write Steps to disassemble mouse.
3. Write steps to clean mouse.
4. Explain the types of mouse.
5. Explain different installation methods of mouse.

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Soper, David L. Prowse and Scott Mueller.

- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
- PRINCE GEORGE'S COMMUNITY COLLEGE
- Computer Hardware Technicians CH111, 5 CD-ROM set by NCSA Academy USA
- Computer Hardware Technicians

Chapter No.10

(Troubleshooting Basic I/O Interface Card and Surface Mount PCB)

Objectives

After completion of this chapter students will be able to:

10. Troubleshooting Basic I/O Interface Card and Surface Mount PCB

10.1. Theory of Basic Input and Output Ports
10.2. Construction of an I/O card
10.3. Fault Diagnosis and Repairs.
10.4. Use of Special Tools for Soldering
10.5. Troubleshooting an IC and SMD

I/O Cards

The term I/O means “input” and “output” and is the fundamental idea behind computers. Basically, for every input, there’s an output. You pull up a document on your computer and use the keyboard to print it. The keyboard is the input and the printer is the output. This is a simple explanation of I/O, but it’s a good start to help explain what I/O cards are and how they work.

I/O cards function as a bridge between a computer and an outside device – this can range from a monitor to a keyboard. The outside device transmits a signal to the I/O card which results in an action being performed. The part of the I/O card that faces out can accept a variety of different devices and cables. While some cable inputs might be as simple as a USB plug, industrial size I/O cards may be customized to accept specially designed plugs and devices.

10.1. Theory of Basic Input and Output Ports

The input/output units that is the devices that allow the introduction of data and the display of the results (keyboard, mouse, monitor, printers, etc.), are external to the motherboard, and are connected through appropriate connectors, called ports of connection or input/output (I/O).

Port

In computer hardware, a **port** serves as an interface between the computer and other computers or peripheral devices. In computer terms, a port generally refers to the part of a computing device available for connection to peripherals such as input and output devices. Computer ports have many uses, to connect a monitor, webcam, speakers, or other peripheral devices. On the physical layer, a computer port is a specialized outlet on a piece of equipment to which a plug or cable connects. Electronically, the several conductors where the port and cable contacts connect provide a method to transfer signals between devices.

Computer ports in common use cover a wide variety of shapes such as round (PS/2, etc.), rectangular (FireWire, etc.), square (Telephone plug), trapezoidal (D-Sub — the old printer port was a DB-25), etc. There is some standardization to physical properties and function. For instance, most computers have a keyboard port (currently a Universal Serial Bus USB-like outlet referred to as USB Port), into which the keyboard is connected.

Features of Computer Ports:

- We can connect external devices to the computer with the help of ports and cables.
- These are basically slots on motherboard where we connect external devices, or we can plug in external devices through cables.

- Mouse, keyboards, printers, speakers are some examples of external devices that connected to the computer through ports.

Types of Ports:

Serial Ports

A serial port is basically a serial communication interface through which information transforms one bit at a time. It is one of the oldest type of interfaces.

- These are basically used for external modems.
- These are basically available in two versions in market these are 9 pins, 25 pin models.
- Data travels at a speed of 115 kilo-bits per second.

Parallel Ports –

A parallel port is basically a parallel communication interface through which information transforms multiple bits at a time.

- These are basically used to connect peripherals such as scanners or printers.
- These are also known as printer ports.
- These are available in a 25 pin model.
- Data travels at a speed of 150 kilo bits per second.

PS/2 Ports –

These are basically 6 pin mini Din connector used to connect keyboard, mice to a PC compatible computers.

- These are basically used by old computers for connecting mouse or keyboard.
- These are called mouse ports.
- These ports are still favored in organization for security reason.
- These ports provides no restriction on key rollover.

Universal Serial Bus Port –

It is basically a standard cable connection interface between computer and external device. USB is an industrial standard for short-distance digital data communication.

- Basically it can connect all types of external devices to the computer such as mouse, keyboard, printers, speakers etc.
- These ports were introduced in 1997.
- Minimum 2 ports are there in every computer system.
- Data basically travels at a speed of 14mb/s which is much faster than serial port.
- The devices that uses USB port gets power from a USB port.

VGA Ports –

VGA connector stands for Video Graphic Array connector, these are basically 15 pin connector available in many video-cards, computer, projectors etc.

- It is used to connect monitor to computer's video card.
- It is 15 pin connector.
- These were introduced by IBM in 1987.
- VGA basically utilizes analog signal hence it can only be used to lower resolution or we can say VGA is only capable of lowering the resolution.

These are some of the common ports available in computer system. Except these there are many more ports available in computer. These are as follows:

Modem Port:

These are basically used to connect PC's modem to telephone networks.

Ethernet Port:

These are basically used to connect Ethernet cables to the computer. In this data may travel with a speed of 10mb/s to 100 mb/s based on the network bandwidth.

Game Port:

These ports are available in computer to connect joysticks which are now replaced by USB. Digital Video Interface or we can say DVI Port these are

basically used to connect flat panel LCD Monitor to the computer's high end video graphics.

Sockets:

Sockets are basically used to connect microphone or speakers to the sound card of the computer.

10.2. Construction of an I/O Card

Generally, I/O devices communicate with a computer through an interface called a bus. This interface has two main functions.

1. Interpreting. The bus addresses and performs "handshaking" between the devices using basic commands (like "READY" or "BUSY"). This handshaking allows the devices to communicate with each other successfully.

2. Converting. The interface's second function is to convert data from serial to parallel or vice versa when necessary. This conversion is what allows devices with different types of information to communicate.

Computers and most other digital systems operate in binary, so any input signal must be in binary by the time it arrives at the computer's processor. Therefore, any analog inputs go through a conversion to digital using an **analog-to-digital converter (ADC)** – though that is often part of the device/peripheral itself, as in the case of a scanner. The digital signal that results may also need conversion, as mentioned above, since digital data can be either serial or parallel. At this stage, the bus can typically facilitate conversion between types of digital data.

Conversely, an output bus will facilitate the conversion of the computer's data into whatever form is needed, whether it's audio, video, or something else. In some cases, such as with audio, digital information will convert back into analog. Users will need to employ a **digital-to-analog converter (DAC)** to allow the data to be used with real-world devices.

To Create an Input Card

Procedure

1. Select the **Input Cards** element under the map in the Outline view.
2. On the **Card** menu, click **New**.
   The Add Input Card dialog box is displayed.
3. Define the card by entering the appropriate information for each setting.
4. Click **OK**.

To Create an Output Card

Procedure

1. Select the **Output Cards** element under the map in the Outline view.
2. On the **Card** menu, click **New**.
   The Add Output Card dialog box is displayed.
3. Define the card by entering the appropriate information for each setting.
4. Click **OK**.

10.3. Fault Diagnosis and Repairs.

ICs fail due to several factors. The most frequent causes of IC failure can be categorised under manufacturing defects, physical damage to the packaging, harsh operating temperature conditions, and electrostatic discharge (ESD).

Failures Due to Manufacturing Defects

Impurities and contaminants within the bulk silicon, crystal defects, and design issues during IC fabrication contribute to stability issues in the final chip. Small clearances between the die and the substrate (i.e. die-attach failure) can lower the thermal conductivity of the die.

This problem can cause a die to overheat and crack under normal operation, leading to premature failure. Also, tiny cracks at the interface between the die and bond wire, due to excessive bonding pressure (i.e. wire-bond failure), can adversely impact the reliability of ICs.

Failures Due to Packaging-related Damage

Cracks and chips on the packaging of integrated circuits (due to high mechanical stress or process temperatures, etc.) can reduce IC reliability and cause failures during operation. Moisture and cleaning chemicals absorbed through cracks can also short internal components, leading to malfunction; and on top of this, IC packaging can be damaged during transit or due to improper handling.

Failures Due to Operating Conditions

High operating and ambient temperatures can cause thermal overstress in ICs. An essential metric for ICs is the junction temperature, after all: ideally, each IC’s junction temperature should not exceed 125 to 150°C to avoid excessive internal stress. Indeed, utilising ICs above their maximum-rated voltage and current can cause electrical overstress, which can lead to catastrophic failures.

Consider, for example, that cooling system (such as heat sink and cooling fan) failures in consumer electronics, such as laptops, can cause ICs to heat up at a critically fast rate.

Electrostatic Discharge

Static electricity generated during the fabrication, handling, and storage of ICs can damage the internal circuitry due to the turboelectric effect. ICs are more likely to fail when exposed to ESD. The resulting electric fields induced in the IC may break down oxide layers and junctions within the device and/or increase the current flow—once again causing overheating.

10.4. Use of Special Tools for Soldering

To perform such an intricate process effectively, you have to equip yourself with the right set of equipment.

Soldering is used in different industries like plumbing, electronic assembly, automotive repairs, and making jewelry. You cannot use the same set of tools for all soldering applications.

Depending on the materials, their chemical composition, and size, you need to choose the right set of tools.

Soldering Equipment

Below is a comprehensive list of the different soldering equipment available for your soldering needs,

1. Soldering Station

A soldering station is a complete kit that comes with all the essential tools for soldering. The common tools include soldering iron, hot air guns, and de-soldering tools. A soldering station is commonly used to solder sensitive electronic components as you can set the precise temperature of the soldering tip.

You have to plug the soldering station into a power outlet and set the temperature to the lowest. Step by step, you have to increase the temperature until the solder melts.

2. Soldering Iron

Soldering iron is the most basic soldering equipment that is shaped in the form of a pen. This is used by beginners for DIY soldering works such as soldering PCBs and other electronic components. First, heat the tip of the iron by powering the device. Once heated, place it on the solder and melt it.

3. Soldering Gun

Soldering guns are shaped like pistols and are operated using electricity. The soldering gun uses tin-based solder to solder copper wires or make other electrical connections. You have to connect it to a power outlet and press the trigger to heat the solder.

4. De soldering Station

A de soldering station uses either hot air or vacuum to melt and remove excess solder after the soldering process. The de soldering station uses a hose to direct air from an air pump. The hose has a nozzle and heating element at the end. The heating element heats the air which melts the solder. Once melted, you can remove the solder easily.

5. Soldering Pencil

Similar to soldering iron, the soldering pencil is used to solder small metallic elements and electrical components. You heat the solder using the heating element located at the end of the soldering pencil. Soldering pencil has a finer point that helps in detailed and microscopic soldering works.

6. Butane Soldering Iron

The butane soldering iron is a modified version of the conventional soldering iron that runs on butane. It heats up fast and can melt solder in less than 40 seconds. Besides, it is also cordless and has a wide range of temperatures. So, you can use this for a wide range of soldering purposes and for soldering different materials.

Best Soldering Tools

Besides the equipment, you also need certain tools to perform soldering. These tools are responsible for preparing the materials before soldering and cleaning the surface after the process.

Here is a complete list of tools that are involved in the soldering process,

1. Solder

Solder is the filler material that melts and joins the two materials. The rule of thumb is that it should have a lower melting point than the materials to be joined. Only then the solder will melt first and bond the materials. The solders come with and without lead. Based on the materials you are soldering, you have to choose the solder with a lower melting point.

2. Solder Flux

The solder flux is a chemical agent that is used to clean the surface of the metals that are to be joined. You can solder without applying flux. But, the joints might not be strong and can be broken easily. The flux removes the oxides formed on metal surfaces and prevents further oxidation. This strengthens the soldering joints.

You can apply the flux using your hands or a brush. But for mass soldering works, there are different techniques you can adopt for applying the flux.

3. Solder Flux Pen

A solder flux pen is used to apply flux on the metal surface before the soldering process. The main advantage of using a flux pen is that you can apply the flux only in areas where you are going to solder. This is especially useful while soldering PCBs. Using a flux pen is pretty easy.

First, you have to depress the tip of the pen to saturate its flux. Then press the tip against the areas where you will solder the electronic components to apply the solder.

4. Solder Seal Wire Connectors

A solder seal wire connector is shaped in the form of a small tube and is used to join wires. The connector has solder at both of its ends. When you heat the connector using a lighter or small heat gun, the solder melts and flows through the disjoined wires. Once the solder solidifies, it creates a joint between the wires.

5. Solder Tips

The tip of the soldering iron that heats and melts the solder is known as a solder tip. It is generally made of a copper core as copper is a good conductor of heat. It is coated with iron or nickel. The solder tips come in different shapes with each shape, more suited for a specific type of soldering.

6. Soldering Wick

Soldering wick is a type of de soldering tool that is made of intertwining copper wires together. When you place the tip of the soldering wick and heat it, the

wick will melt the solder and absorb it. Once a portion of the soldering wick is covered with solder, you will have to remove the part. Repeat the process until you remove all the solder.

7. Solder Paste

The solder paste is used in PCB assembly for soldering the electronic components. It is made of minute solder spheres held together by solder flux. To apply the solder paste, you have to use a stencil or other techniques. The solder paste is only applied to areas where you need to solder.

8. Solder Sucker

Also known as a de soldering pump, it is used to remove solder from PCBs. Some de soldering pumps come with a soldering iron. If not, you have to get an iron separately and heat the solder before using this pump to suck the solder.

The pump has a bulb at one end. You have to squeeze the pump and place the other end on the solder. Now when you release the bulb, it will suck the solder. Some models also come with a piston, instead of a bulb. Pushing and releasing the piston sucks the solder.

Best Soldering Accessories

Apart from the soldering tools, accessories also play an important part in ensuring that you perform the soldering effectively and safely.

Below is the complete list of accessories that you will need while performing soldering,

1. Soldering Preheaters

When you use hot air guns for soldering, you will face the issue of overheating the materials. The overheating will damage the materials. Besides, a sudden increase in temperature will lead to thermal shock. To avoid this, you have to use a preheater. The primary purpose of a preheater is to gradually raise the temperature of the materials.

2. Soldering Helping Hands

The soldering helping hands have hand-like clutches that can hold wires when you are soldering. This allows you to create precision joints. The number of hands differs from one model to another. Most models come with two hands while some can have four. You can also place the soldering iron on these hands.

3. Soldering Mat

A soldering mat is heat resistant and protects your floors, walls, cables, and other flammable materials when you are soldering. The soldering mats can resist heat up to 1250 degrees celsius. The soldering mat is generally used while soldering copper pipes in plumbing. But, you can use it for all soldering purposes as well.

4. Soldering Magnifying Glass

A soldering magnifying glass is used in microelectronic soldering works. Microelectronic soldering requires a high level of precision that is not possible with the naked eye. So, you have to use a magnifying glass to see the electronic parts clearly. The magnifying glasses will come with a stand so that you don't have to hold them. They have a magnification range of 2x to 10x depending on the model.

5. Smoke Absorber

The fumes released during soldering can be very toxic. Especially, if you are using lead-based solder, the soldering fumes can cause irreversible health damages. To protect yourself from inhaling toxic fumes, you can use a smoke absorber.

The smoke absorber comes with a fan and a filtration unit that sucks up the fumes and filters them. You can just place them on a table. Some bigger units are kept on the floor.

6. Solder Tape

The solder tapes are used to hold the binding metal parts together while soldering. It has a high heat resistance and prevents the heat from transferring

to other parts of the metal. The solder tapes come with widths ranging between 1/8 inches and 2 inches.

7. Tweezers Set

One rule of thumb in soldering is never to hold the solder materials using your hand. You should always use a pair of tweezers to hold the materials. If you are someone who solders materials of different sizes and thickness, then you should get a tweezer set. You cannot use the same pair of tweezers to hold materials of different sizes.

8. Soldering Iron Tip Cleaner (Brass Wool)

After the completion of soldering, you have to clean the tip of the soldering iron to remove the solder and carbon material. For this, you can use brass wool. It is a type of dry cleaner that is made of soft metal shavings and coated with flux. You have to thrust the iron tip into the brass wool a few times to clean it.

9. Solder Stand

A solder stand is used to safely keep the soldering tools when not in use. The most common stand you will come across is the soldering iron stand. It allows you to keep the hot soldering iron away from your work area after use. It also makes it easier for you to clean the soldering iron tips.

10. Soldering Tip Thinner

The soldering tip thinner is made of mild acid and is used to prevent the oxidation of the soldering iron tip when you are not using it. Besides, you can also use it to remove the residue after soldering. You have to insert the soldering iron tip into the thinner and then wipe it with a damp sponge or cloth. This will remove the residue and prevent oxidation of the tip.

11. Wire Cutters

If you are soldering electrical wires, then you definitely need to have a wire cutter in your arsenal.

They make short work of cutting the wires and stripping the ends. Besides, they don't cost a fortune.

10.5. Troubleshooting an IC and SMD

ICs are far from easy to troubleshoot, particularly when they're already mounted on a PCB. At least, using the following techniques, you can fairly easily determine if an IC is defective and needs to be replaced:

Perform a Visual Inspection

Again, physical damage to ICs can cause them to malfunction of course. Performing a visual inspection of the chip can identify problems such as cracks, chippings, and charring that may have been caused by high mechanical impact or overheating.

Check for Short-circuiting

One of the best ways to ascertain the condition of an IC is to carry out a short-circuit test. You can test for shorts using a digital multimeter in the following steps:

1. Set the multimeter to its continuity function
2. Bridge all the pins on one side of the IC and connect it to one of the multimeters test probes
3. Test each of the IC pins with the remaining multimeter test probe: if there's continuity in more than 50% of the pins, then the IC is likely shorted

Test the IC Temperature

To check if an IC overheats:

- Turn on the device (or supply power to the inputs of the IC for 10 to 15 seconds)
- Touch the surface of the IC with the tip of one finger to check its temperature
- Remember that ICs that become very hot after 10 to 15 seconds are likely defective.

Faults for SMD Troubleshooting

Solder Balls

Causes

1. Solder Paste smearing on underside of stencil.
2. What is squeegee pressure?
3. Is stencil underside cleaned with a solvent and is solvent still present after cleaning?
4. Is stencil proper aligned with PCB?

Solution

1. Check squeegee pressure
2. Check for proper gas kitting and alignment
3. Check if cleaning solvent is completely evaporated before printing

Oxidized Paste

Cause

1. Was paste shipped refrigerated?
2. Did paste spend a long time in a hot area?
3. Was old paste returned to jar?
4. Was jar put back into refrigeration after opening?
5. Is alloy sensitive to oxidation?
6. Squeegee pressure too high

7. Run fresh paste from a different lot under same conditions and see if solder bars go away.
8. Reduce squeegee pressure

Grapping Effect on Solder Joint

Causes: Excessive heat applied during preheat and soak causing flux to become exhausted before entering reflow stage.

Solution:

Reduce time and/or temperature during preheat and soak stage of profile.

Multiple Choice Questions

1. Which port is used to connect a mouse to a computer?
   a) VGA port c) USB port
   b) Ethernet port d) HDMI port
2. Which port is used to connect a printer to a computer?
   a) VGA port c) USB port
   b) Ethernet port d) HDMI port
3. Which port is used to connect a keyboard to a computer?
   a) VGA port c) USB port
   b) Ethernet port d) HDMI port
4. Which port is used to connect a microphone to a computer?
   a) VGA port c) USB port
   b) Ethernet port d) Audio port
5. Which port is used to connect a monitor to a computer?
   a) VGA port c) USB port
   b) Ethernet port d) HDMI port
6. Which port is used to connect a camera to a computer?
   a) VGA port c) USB port
   b) Ethernet port d) HDMI port
7. Which port is used to connect a mobile phone to a computer?
   a) VGA port c) USB port
   b) Ethernet port d) HDMI port

1	2	3	4	5	6	7
c	c	c	d	a	c	c

Short Questions

1. Write a short note on parallel port.
2. Write a short note on serial port.
3. Write a short note on PS/2 port.
4. Write a short note on USB port.
5. Write a short note on VGA port.
6. Write a short note on Modem port.
7. Write a short note on Ethernet port.
8. What do you know about Soldering Iron
9. Explain soldering station.
10. Define soldering paste.
11. Write a short note on Soldering Wick.
12. How soldering sucker work
13. Explain tweezer set.
14. How to check short circuiting of IC.
15. How to test IC temperature.

Long Questions

1. How to create I.O card?
2. What are the different ways to diagnose fault and repair?
3. Discuss in detail about the soldering equipment's.
4. What do you know about soldering tools? Explain.
5. Explain all the Soldering accessories you know.
6. Discuss in detail faults for SMD troubleshooting.

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Soper, David L. Prowse and Scott Mueller.
- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
- PRINCE GEORGE'S COMMUNITY COLLEGE

- Computer Hardware Technicians CH111, 5 CD-ROM set by NCSA Academy USA
- Computer Hardware Technicians

Chapter No.11

(Customized Systems)

Objectives

After completion of this chapter students will be able to:

11. Customized Systems

11.1. Introduction to Customized Systems
11.2. Thick Clients
11.3. Virtualization Workstation
11.4. Audio Video Editing Station
11.5. Gaming Systems
11.6. Types of Servers
11.7. Troubleshooting an IC and SMD

11.1. Introduction to Customized Systems

Customized Systems

A custom-built PC is a computer that's built and customized to meet specific consumer needs. People build computers for gaming, video and photo editing, animation, web browsing, and productivity needs. Different parts of the computer are prioritized based on the functions required by the builder. Individual components, like the graphics card, CPU, case, and motherboard. A specialized computer is a hardware device that's not as open as a general-purpose computer and more complex than a special-purpose computer. The specialized computer may have the capabilities of a general-purpose

computer but is designed to only do specific tasks. Good examples of specialized computers are today's gaming consoles. DIY and custom-built PCs **allow far more hardware configuration options than a pre-built PC**. Some custom gaming PC builders provide the option for a professional to customize the look of your build. While there is no “cheapest” option, cost-cutting strategies can save you money on pre-built, custom-built, and DIY PCs.

You may need to design, build, and install computers for a customer that can accomplish a specific task. All computers can run programs, store data, and use I/O devices. A standard thick client is a traditional desktop computer that meets the recommended requirements for Windows and runs desktop applications. In contrast, a specialized computer must support hardware and software that allows a user to perform tasks that a thick client cannot perform.

Powerful Processor

CAx software must make enormous amounts of calculations very quickly. You must meet the needs of the software when choosing a CPU.

High-end Video Card

Some CAx software is used to create 3D models. Realistic shading and texturing add to the complexity of the models, and a video card that can handle high resolutions and high detail is needed. Often, multiple monitors are desired or even required so that the user can work with code, 2D renderings, and 3D models all at the same time. Choose a video card that supports multiple monitors.

RAM

Because of the high amount of data processed by a CAx workstation, RAM is very important. The more RAM that is installed, the more data the processor can calculate before needing to read from slower storage, such as hard drives. Install as much memory as is supported by the motherboard and the operating system. The quantity and speed of the memory should exceed the minimums recommended by the CAx application

11.2. Thick Clients

A thick client (sometimes called a fat client) is a form of client-server architecture. Specifically, it is a networked computer system with most resources installed locally, rather than distributed over a network. Thick client

devices can be, for example, PCs, because they have their own hard drives, software applications and other local resources. Most, if not, all essential components are contained in a thick client.

Thick clients are almost unanimously preferred by network users because they are very customizable and the user has more control over what programs are installed and the specific system configuration. Workplaces will commonly provide thick clients to employees so they can work offline. With thick clients, there is no need to have continuous server communication.

Thick clients are connected to a server over a network connection but don't need to have a maintained connection. The temporary connection is needed to download programs, data and updates to the operating system. In addition, thick clients don't need to consume any server computing resources. Most resources will be available on the client, so it can function independently. Thick clients will excel in environments where the primary server has limited storage and computing capacity, or experiences high network speeds, as well as in work-from-home environments.

Similarly, a system that has some components and software installed but also uses resources distributed over a network is sometimes known as a rich client.

Benefits and drawbacks of thick clients

Thick clients have a number of benefits to them, for example:

- **Working offline**.
  One of the biggest benefits of thick clients is the ability it gives to work offline. Thick clients normally have the hardware and software requirements to work as needed, often without needing to be connected to a central server.
- **Server connection**.
  Thick clients can work offline because they don't need to maintain constant connections to central servers. Once an initial amount of information is gathered from a server, server connections are generally not needed.
- **Fewer server requirements.**
  The servers that thick clients connect to don't need to be as high-performing. Since the thick clients do a lot of the application processing, that can allow for cheaper servers.
- **Server capacity**.

The use of thick clients normally means more server capacity is available. With fewer requirements that a server has to provide to each individual client, the server can benefit more clients.

- **More flexibility**.
  Having a computer that works off of its own local resources -- operating system, user interface, storage -- means a large level of flexibility. They should be able to work from wherever, as long as they are able to have a momentary connection to a central server to download any needed data.
- **Existing infrastructure**.
  In the same line of thought, many organizations may already have fast enough local PCs to implement an infrastructure to run thick clients with relative ease.
- **Storage**.
  Files and applications can be stored on the thick client, meaning they can be accessed at any time.
- **Computer performance**.
  Any application that would be resource or bandwidth-intensive should be able to perform well since resources are being taken from the individual computers and not being allocated by a central server.

Thick clients are not free from their downsides, however, including:

- **Security**.
  The individual will now have to be more responsible for the security and protection of their computer, since data will be stored on the thick client.
- **Data storage**.
  Data storage can be a double-edged sword as data now needs to be backed up in order to ensure the data isn't gone forever if something goes wrong.
- **Investment into each client**.
  The hardware and software will have a higher up-front cost, and will then have a continual cost in maintenance and updates.
- **Maintenance**.
  May include updates for security or any hardware and software fixes across the connected clients.
- **Network traffic**.

There can be a lot of network traffic since each client needs to bring data through a network to work on locally.

- **New applications**.
  New applications that a client may need may also have to be uploaded on other workstations.

11.3. Virtualization Workstation

A **workstation** is a special computer designed for technical or scientific applications. Intended primarily to be used by a single user, they are commonly connected to a local area network and run multi-user operating systems. The term *workstation* has also been used loosely to refer to everything from a mainframe computer terminal to a PC connected to a network, but the most common form refers to the class of hardware offered by several current and defunct companies such as Sun Microsystems, Silicon Graphics, Apollo Computer, DEC, HP, NeXT and IBM which opened the door for the 3D graphics animation revolution of the late 1990s.

Workstations offer higher performance than mainstream personal computers, especially with respect to CPU and graphics, memory capacity, and multitasking capability. Workstations are optimized for the visualization and manipulation of different types of complex data such as 3D mechanical design, engineering simulations (e.g., computational fluid dynamics), animation, medical imaging, rendering of images, and mathematical plots. Typically, the form factor is that of a desktop computer, consists of a high resolution display, a keyboard and a mouse at a minimum, but also offers multiple displays, graphics tablets, 3D mice (devices for manipulating 3D objects and navigating scenes), etc. Workstations were the first segment of the computer market to present advanced accessories and collaboration tools.

The increasing capabilities of mainstream PCs since the late 1990s have blurred the lines between PCs and technical/scientific workstations. Typical workstations previously employed proprietary hardware which made them distinct from PCs; for instance IBM used RISC-based CPUs for its workstations and Intel x86 CPUs for its business/consumer PCs during the 1990s and 2000s. However, by the early 2000s this difference largely disappeared, as workstations now use highly commoditized hardware dominated by large PC vendors, such as Dell, Hewlett-Packard (later HP Inc. and Hewlett Packard

Enterprise) and Fujitsu, selling Microsoft Windows or Linux systems running on x86-64 processors.

Virtualization

Virtualization is the process of running a virtual instance of a computer system in a layer abstracted from the actual hardware. Most commonly, it refers to running multiple operating systems on a computer system simultaneously. To the applications running on top of the virtualized machine, it can appear as if they are on their own dedicated machine, where the operating system, libraries, and other programs are unique to the guest virtualized system and unconnected to the host operating system which sits below it.

There are many reasons why people utilize virtualization in computing. To desktop users, the most common use is to be able to run applications meant for a different operating system without having to switch computers or reboot into a different system. For administrators of servers, virtualization also offers the ability to run different operating systems, but perhaps, more importantly, it offers a way to segment a large system into many smaller parts, allowing the server to be used more efficiently by a number of different users or applications with different needs. It also allows for isolation, keeping programs running inside of a virtual machine safe from the processes taking place in another virtual machine on the same host.

Hypervisor

A hypervisor is a program for creating and running virtual machines. Hypervisors have traditionally been split into two classes: type one, or "bare metal" hypervisors that run guest virtual machines directly on a system's hardware, essentially behaving as an operating system. Type two, or "hosted" hypervisors behave more like traditional applications that can be started and stopped like a normal program. In modern systems, this split is less prevalent, particularly with systems like KVM. KVM, short for kernel-based virtual machine, is a part of the Linux kernel that can run virtual machines directly, although you can still use a system running KVM virtual machines as a normal computer itself.

Virtual Machine

A virtual machine is the emulated equivalent of a computer system that runs on top of another system. Virtual machines may have access to any number of

resources: computing power, through hardware-assisted but limited access to the host machine's CPU and memory; one or more physical or virtual disk devices for storage; a virtual or real network inferface; as well as any devices such as video cards, USB devices, or other hardware that are shared with the virtual machine. If the virtual machine is stored on a virtual disk, this is often referred to as a disk image. A disk image may contain the files for a virtual machine to boot, or, it can contain any other specific storage needs.

Virtualization of Workstation

Desktop virtualization is virtualizing a workstation load rather than a server. This allows the user to access the desktop remotely, typically using a thin client at the desk. Since the workstation is essentially running in a data center server, access to it can be both more secure and portable.

You may need to build a computer for a client that uses virtualization technologies. Simultaneously running two or more operating systems on one computer is called virtualization. Often, an operating system is installed, and virtualization software is used to install and manage additional installations of other operating systems. Different operating systems from multiple software companies may be used. There is another type of virtualization called Virtual Desktop Infrastructure (VDI). VDI allows users to log in to a server to access their own virtual computers. Input from the mouse and keyboard is sent to the server to manipulate the virtual computer. Output such as sound and video is sent back to the speakers and display of the computer accessing the virtual computer. Low-powered devices, known as thin clients, use a server that is much more powerful to perform difficult calculations. A thin client meets the minimum requirements for running windows and runs basic applications from the server. Laptops, smart phones, and tablets can also access the VDI to use virtual computers.

Working Of Virtualization

Software called hypervisors separate the physical resources from the virtual environments—the things that need those resources. Hypervisors can sit on top of an operating system (like on a laptop) or be installed directly onto hardware (like a server), which is how most enterprises virtualize. Hypervisors take your physical resources and divide them up so that virtual environments can use them.

Resources are partitioned as needed from the physical environment to the many virtual environments. Users interact with and run computations within the virtual environment (typically called a guest machine or virtual machine). The virtual machine functions as a single data file. And like any digital file, it can be moved from one computer to another, opened in either one, and be expected to work the same.

When the virtual environment is running and a user or program issues an instruction that requires additional resources from the physical environment, the hypervisor relays the request to the physical system and caches the changes—which all happens at close to native speed (particularly if the request is sent through an open source hypervisor based on KVM, the Kernel-based Virtual Machine).

11.4. Audio Video Editing Station

Audio and Video Editing

An audio and video editing workstation are used during many stages of development when creating audio and video material. An audio editing workstation is used to record music, create music CDs, and CD labels. A video editing workstation can be used to create television commercials, prime-time programming, and movies for the theater or home movies. Specialized hardware and software are combined to build a computer to perform audio and video editing. Audio software on an audio editing workstation, shown in the figure, is used to record audio, manipulate how the audio sounds through mixing and special effects, and finalize recordings for publication. Video software is used to cut, copy, combine, and change video clips. Special effects are also added to video using video software. Consider the following hardware when you need to run audio and video editing software:

Specialized audio card

When recording music to a computer in a studio, multiple inputs from microphones and many outputs to effects equipment may be needed. An audio card capable of handling all these inputs and outputs is needed. Research different audio card manufacturers and understand the needs of your customer to install an audio card that will meet all the needs of a modern recording or mastering studio.

Specialized video card

A video card that can handle high resolutions and multiple displays is necessary to combine and edit different video feeds and special effects in real time. You must understand the needs of the customer and research video cards to install a card that can handle the high amounts of information that comes from modern cameras and effects equipment.

Large, fast hard drive

Modern video cameras record in high resolution at fast frame rates. This translates into a high amount of data. Small hard drives will fill up very quickly, and slow hard drives will not be able to keep up with demands, even dropping frames at times. A large, fast hard drive is necessary to record high-end video without errors or missed frames. RAID levels such as 0 or 5, where striping is used, can help to increase storage speed.

Dual monitors

When working with audio and video, two, three, or even more monitors can be very helpful to keep track of everything that is going on with multiple tracks, scenes, equipment, and software. Find out how your customer likes to work to decide how many monitors is most beneficial. If multiple monitors are required, specialized video cards are necessary when building an audio or video workstation

11.5. Gaming Systems

A **gaming computer**, also known as a **gaming PC**, is a specialized personal computer designed for playing video games at very high standards. Gaming PCs typically differ from mainstream personal computers by using high-performance video cards and high core-count central processing units with raw performance. Gaming PCs are also used for other demanding tasks such as video editing. Many gamers and computer enthusiasts choose to overclock their CPU(s) and GPU(s) in order to gain extra performance. The added power draw needed to overclock either processing unit often requires additional cooling, using upgraded air cooling or water cooling.

Many people enjoy playing computer games. Each year, games become more advanced and require more powerful hardware, new hardware types, and additional resources to ensure a smooth and enjoyable gaming experience. You may be required to build a computer for a customer designed

specifically for playing games. This is some of the hardware required when building a gaming computer:

Powerful processor

Games require all the components in the computer to work together seamlessly. A powerful processor helps ensure that all the software and hardware data can be addressed in a timely fashion. Multiple core processors can help increase the responsiveness of hardware and software.

High-end video card

Modern games use high resolutions and intricate detail. A video card that has a fast, specialized GPU and high amounts of fast video memory is necessary to ensure that the images displayed on the monitor are high quality, clear, and smooth. Some gaming machines use multiple video cards to produce high frame rates or use multiple monitors.

High-end sound card

Video games use multiple channels of high-quality sound to immerse the player in games. A high-quality sound card increases the quality of sound above that of built-in sound on a computer. A dedicated sound card also helps improve overall performance by taking some of the demand off of the processor.

High-end cooling

High-end components often produce more heat than standard components. More robust cooling hardware is often needed to make sure that the computer stays cool under heavy loads while playing advanced games. Oversized fans, heat sinks, and water-cooling devices are often used to keep CPUs, GPUs, and RAM cool.

Large amounts of fast RAM

Computer games require large amounts of memory to function. Video data, sound data, and all the information needed to play the game are constantly being accessed. The more RAM that the computer has, the less often the computer needs to read from slower storage, such as hard drives or SSDs. Faster RAM helps the processor keep all the data in sync, because the data that it needs to calculate can be retrieved when it is needed.

Fast storage

7200 RPM and 10000 RPM drives can retrieve data at a much faster rate than 5400 RPM hard drives. SSD drives are more expensive, but they improve the performance of games dramatically. Gaming-specific hardware - Some games involve communicating with other players. A microphone is required to talk to them, and speakers or headphones are required to hear them. Find out what type of games your customer plays to determine if a microphone or headset is needed. Some games can be played in 3D. Special glasses and specific video cards may be required to use this feature. Also, some games might benefit from the use of more than one monitor. Flight simulators, for example, can be configured to display cockpit images across two, three, or even more monitors at the same time

11.6. Types of Servers

Server

In computing, a **server** is a piece of computer hardware or software (computer program) that provides functionality for other programs or devices, called "clients". This architecture is called the client–server model. Servers can provide various functionalities, often called "services", such as sharing data or resources among multiple clients, or performing computation for a client. A single server can serve multiple clients, and a single client can use multiple servers. A client process may run on the same device or may connect over a network to a server on a different device. Typical servers are database servers, file servers, mail servers, print servers, web servers, game servers, and application servers.

Client–server systems are usually most frequently implemented by (and often identified with) the request–response model: a client sends a request to the server, which performs some action and sends a response back to the client, typically with a result or acknowledgment. Designating a computer as "server-class hardware" implies that it is specialized for running servers on it. This often implies that it is more powerful and reliable than standard personal computers, but alternatively, large computing clusters may be composed of many relatively simple, replaceable server components.

1. Web Server

A web server powers the site you're looking at right now. This genre of server focuses on serving web content to clients.

Web servers simply take "GET" and "POST" requests from clients (among other verbs).

A **"GET"** request is when a client simply wants to retrieve information and doesn't have any information to submit to the server.

A **"POST"** request on the other hand is when a client *does* have information to share with the server and expects a response back. For example, filling up a form on a web server and clicking the submit button is a "POST" request from the client to the server.

Web servers are typically "headless" in nature. This is to preserve the memory on the server and ensure that there's enough to power the operating system and applications on the server.

"Headless" means that it doesn't run like a traditional home computer, but rather just serves content. The administrators of these servers can only connect to them through command line terminals.

Remember that these types of servers can run any type of application just like your home computer can. They can also run on any operating system, as long as they obey the general "rules" of the web. Modern web applications usually run on a series of layers, starting with server-side scripts and programs that process data (e.g., PHP, ASP.NET etc.), and ending with client-side scripting (e.g., JavaScript) that programs how the data should be displayed.

A web browser then renders the content accordingly to show the page as you're reading it now.

Some popular webservers include Microsoft IIS, Apache, Nginx etc.

Some Ports used for Webservers: Port 80 for HTTP (not encrypted) and Port 443 for HTTPs (encrypted).

2. Database Server

A database server typically operates in tandem with another type of server. This kind of server simply exists to store data in groups. There are countless methods of keeping data that operate on different theories. One of the more common types is known as "SQL" or "Structured Query Language". Database programmers can create databases on these servers using scripting in the language of the database. Web applications usually have their server-

side components connect to a Database server to grab data as users request it. A good practice is to have webservers and database servers on different machines. The reason that database servers should exist on their own is for security. If a hacker gains access to the main webserver but not the database server, they will be able easily to retrieve or modify the data stored in the database server.

Some popular Database servers include MySQL, MariaDB, Microsoft SQL, Oracle Database etc.

Some Ports used for Database Servers: Port 3306 (MySQL, MariaDB), Port 1433 (MS-SQL), Port 1521 (Oracle DB).

3. eMail Server

An email server typically runs on "SMTP" or "Simple Mail Transfer Protocol". There are other possible protocols that newer mail servers operate on, but SMTP remains the dominant protocol. An email server powers mail services. These servers in themselves simply take in emails from one client to another and forward the data to the other server. Data is simplified when sent through SMTP, so some information, like web formatting, is usually lost in email transactions. The modern approach to email servers typically pairs them with web servers. This allows for users to have a "web client" that graphically shows the data on a web page. Some newer web applications can even mimic a home computer email client without installing anything.

Some Ports used for eMail Servers: Port 25 (SMTP), Port 587 (Secure SMTP), Port 110 (POP3)

4. Web Proxy Server

A web proxy server can run on one of many protocols, but they all do one thing in common. They take in user requests, filter them, and then act on the user's behalf. The most popular type of web proxy server is designed to get around school and organizational web filters. Because web traffic is all through one IP address and website that isn't yet blocked, users can gain access to sites that are forbidden through these filters. The less popular type is an organizational proxy server. This has the same effect, but it's typically authorized by an organization. It takes users' web traffic, usually logs it for evaluation later, and sends it to the Internet. This puts users' traffic all together so that one computer cannot be differentiated publicly from another.This is done intentionally by an organization to prevent users from

being targeted and usually to be able to inspect, cache and analyze packets sent and received.

Some Ports used for Web Proxy Servers: Port 8080, 8888 etc

5. DNS Server

A DNS server, or "Domain Name Service" server, is used to translate domain names to their corresponding IP addresses. This server is what your browser references when you type in a domain name and press Enter. The idea is that users don't have to memorize IP addresses and organizations can have a fitting name. Typically, Internet Service Providers (ISPs) provide DNS servers to their users. However, there are many organizations that provide this lookup service for free, as well (such as the popular Google DNS server with IP 8.8.8.8).Some users who are more concerned about their privacy on the web often use these alternate DNS servers. DNS servers are also tapped when users create a new domain name. DNS servers operate on a hierarchical basis, so there are some more "authoritative" servers than others. The domain name is registered with one higher-up DNS server that other, lower-level DNS servers reference. Usually through a process taking anywhere from 24 to 48 hours, this registration propagates across the world.

Ports used for DNS Servers: Port 53 (both TCP and UDP).

6. FTP Server

FTP servers, or "File Transfer Protocol" servers, have a single purpose: to host a file exchange among users. These servers do not provide any type of encryption by default, so there are a number of secured versions of the protocol that are often used in its place (such as sFTP which is FTP over secure SSH protocol).This type of server allows users to upload files to it or download files after authenticating through an FTP client. Users can also browse the server's files and download individual files as they wish.

Some Ports used for FTP Servers: Ports 20,21 for FTP or Port 22 for sFTP.

7. File Server

A File Server is different from an FTP server. This type of server is more modern and is typically capable of "mapping" networked files onto drives. This means that users can use their home computer's file browser to look into folders. The main advantage of this form of server is that users can upload and download shared files. Permissions to files are controlled by the administrator. Usually

File Servers exist in corporate networks in a Windows Active Directory environment or in Linux environments.

8. DHCP Server

A DHCP Server uses the Dynamic Host Communication Protocol (DHCP) to configure the network settings of client computers.Instead of having to manually configure static IP address and other network settings to client computers in a large network, a DHCP server in the network configures dynamically these network settings to LAN computers.

Port used for DHCP Servers: Port UDP 67.

Different Server Platforms

There are mainly two types of servers found in networks: Physical Servers and Virtual Servers. Here's how they're alike and how they differ.

1. Physical Server

A Physical Server is what truly serves data in the end. Operating on metal and electricity, modern physical servers are often capable of serving far more than one user could ever want.

These are typically housed in data centers by hosting companies to serve a variety of clients. The only exception would be larger organizations who rely on these; in these cases, the organizations usually own the network of physical servers.

In the past, each server in a network (e.g Webserver, Database Server etc) was hosted on its own dedicated physical server. This concept is now being replaced with Virtualization technologies whereby each server can be a virtual machine inside a bigger physical machine.

2. Virtual Server

A virtual server is a partitioned part of a physical server. Most "servers" online are virtual servers. They often are given a dedicated amount of physical server resources to utilize (such as RAM, CPU, Storage space).

Users can rent virtual servers for a fraction of the cost of a physical server.

11.7. Troubleshooting an IC and SMD

ICs are far from easy to troubleshoot, particularly when they're already mounted on a PCB. At least, using the following techniques, you can fairly easily determine if an IC is defective and needs to be replaced:

Perform a Visual Inspection

Again, physical damage to ICs can cause them to malfunction of course. Performing a visual inspection of the chip can identify problems such as cracks, chippings, and charring that may have been caused by high mechanical impact or overheating.

Check for Short-circuiting

One of the best ways to ascertain the condition of an IC is to carry out a short-circuit test. You can test for shorts using a digital multimeter in the following steps:

1. Set the multimeter to its continuity function
2. Bridge all the pins on one side of the IC and connect it to one of the multimeters test probes
3. Test each of the IC pins with the remaining multimeter test probe: if there's continuity in more than 50% of the pins, then the IC is likely shorted

Test the IC Temperature

To check if an IC overheats:

- Turn on the device (or supply power to the inputs of the IC for 10 to 15 seconds)
- Touch the surface of the IC with the tip of one finger to check its temperature
- Remember that ICs that become very hot after 10 to 15 seconds are likely defective.

Faults for SMD Troubleshooting

Solder Balls

Causes

1. Solder Paste smearing on underside of stencil.
2. What is squeegee pressure?
3. Is stencil underside cleaned with a solvent and is solvent still present after cleaning?
4. Is stencil proper aligned with PCB?

Solution

1. Check squeegee pressure
2. Check for proper gas kitting and alignment
3. Check if cleaning solvent is completely evaporated before printing

Multiple Choice Questions

1- A _____ client is a low-cost network computer
   a. Thick b-Thin c-FTP d- Online
2- A _____machine is the emulated equivalent of a computer system.
   a. Virtual b. Physical c. Web d. Dynamic
3- A _____ server powers the website.
   a. FTP b. DHCP c. Web d- DNS
4- A _____ server typically exist to store data.
   a. File b. Database c. Web d- DNS
5- A _____ server typically runs on SMTP.
   a. Email b. Web c. Database d. DNS
6- A _____ server is used to translate domain names.
   a. DHCP b-Web c-DNS d- Proxy
7- The purpose of _____ servers is to host a file exchange.
   a. Web b. Proxy c. DHCP d. FTP
8- IP distribution is the responsibility of _____ Server.
   a. FTP b. DHCP c. Web d- DNS
9- _____ is the process of running a virtual instance of a computer system.
   a. Diagnosis b. Troubleshooting c. Tracing d- Virtualization

1	2	3	4	5	6	7	8	9
b	a	c	b	a	c	d	b	d

Short Questions

1. Write a short note on thick clients.
2. What are the benefits of thick clients?
3. Differentiate between thick and thin clients.
4. What is specialized audio card?
5. What is specialized video card?
6. What is high end audio card?
7. What is high end video card?
8. What is FTP server?
9. What is DNS server?
10. What is DHCP server?
11. What is Proxy server?
12. What is File server?

13. What is Database server?
14. What is Web server?

Long Questions

1. Explain in detail customized system?
2. What are thick clients? Explain in detail.
3. What is virtualization server and its benefits?
4. Explain different audio video stations.
5. Define server and explain different types of server.

References

- Comp TIA A+ 220-801 and 220-802 Authorized Cert Guide, Third Edition, Mark Edward
- Soper, David L. Prowse and Scott Mueller.
- Microprocessors And Interfacing 2E, DOUGLA V Hall by McGraw-Hill Education
- The Complete A+ Guide to PC Repair Fifth Edition Update (5th Edition), Cheryl Schmidt
- A Guidebook in PC Hardware, Maintenance And Repair Ent 284, William A. Lloyd by
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