



BASIC DESKTOP COMPUTER HARDWARE TROUBLESHOOTING

UNDERSTANDING COMMON PC COMPONENTS AND HOW TO
DIAGNOSE PROBLEMS

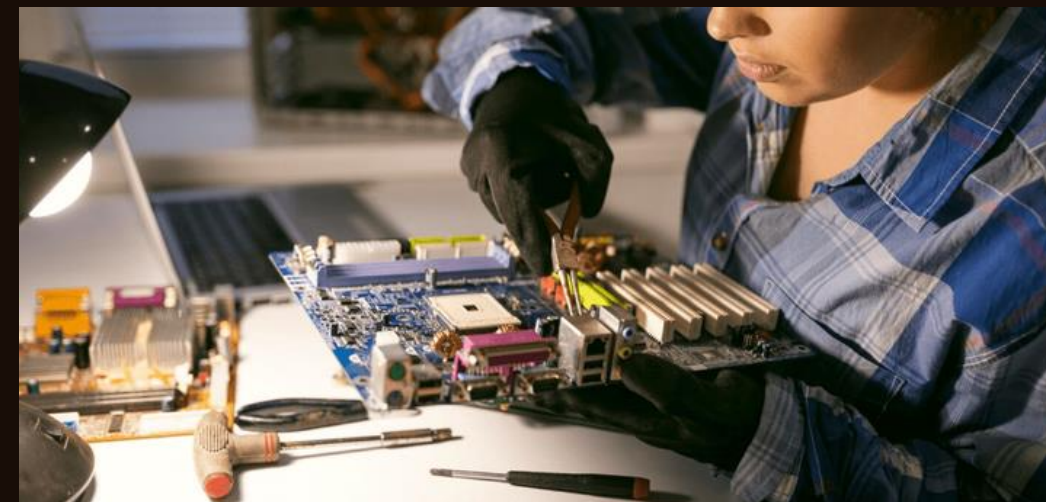
WHAT IS HARDWARE TROUBLESHOOTING?

DEFINITION:

The process of identifying, diagnosing, and fixing physical computer component issues

FOCUS:

- Desktop PC internal hardware
- Power, performance, and boot-related problems



WHY HARDWARE TROUBLESHOOTING IS IMPORTANT?

- Prevents unnecessary part replacement
 - Reduces downtime
- Helps identify the root cause of problems
- Essential skill for IT support and technicians



COMMON DESKTOP PC PROBLEMS

- PC does not power on
- No display or black screen
- Random restarts or shutdowns
- Slow system performance
- Overheating and loud fan noise

We apologize for the inconvenience, but Windows did not start successfully. A recent hardware or software change might have caused this.

If your computer stopped responding, restarted unexpectedly, or was automatically shut down to protect your files and folders, choose Last Known Good Configuration to revert to the most recent settings that worked.

If a previous startup attempt was interrupted due to a power failure or because the Power or Reset button was pressed, or if you aren't sure what caused the problem, choose Start Windows Normally.

Safe Mode
Safe Mode with Networking
Safe Mode with Command Prompt

Last Known Good Configuration (your most recent settings that worked)

Start Windows Normally

Use the up and down arrow keys to move the highlight to your choice.
Seconds until Windows starts: 11

MAIN HARDWARE COMPONENTS

- Power supply unit
- Motherboard and CPU
 - RAM and GPU
 - Storage devices
- BIOS and cooling devices

POWER SUPPLY UNIT

Description

- A Power Supply Unit (PSU) supplies power to a computer or electronic system.
- It converts electricity from the wall into a usable form for internal components.

Function

- Converts AC (Alternating Current) to DC (Direct Current)
 - Supplies required voltages (3.3V, 5V, 12V)
 - Distributes power to all components
- Protects hardware from electrical damage

POWER SUPPLY UNIT

Common Issues

- Computer does not turn on
- Random shutdowns or restarts
- Overheating or noisy fan
- Burning smell or unstable power

Importance

- Ensures stable system performance
- Prevents damage to components



POWER SUPPLY UNIT PINS


What Are PSU Pins?

- PSU pins are the metal contacts inside power connectors
- They carry electricity from the power supply to computer parts
- Each pin has a specific job (power, ground, or control signal)
- Pins are grouped into connectors (24-pin, CPU, GPU, SATA)
 - They ensure the right amount of power goes to each component



POWER SUPPLY UNIT PINS

Common PSU Pins & Their Functions

- 24-Pin Main Connector
 - Powers the motherboard
 - Supplies power to CPU, RAM, and system components
 - 4-Pin / 8-Pin CPU (EPS)
 - Supplies power to the processor (CPU)
 - 6-Pin PCIe
 - Provides power to mid-range graphics cards
 - Peripheral Component Interconnect Express 
- EPS = Entry-Level Power Supply (standard for Supplies dedicated power to the CPU)

It's the modern, high-speed version of the older PCI standard used to connect devices like graphics cards, SSDs, and network cards to the motherboard.



POWER SUPPLY UNIT PINS

8-Pin PCIe (6+2)

- Provides extra power to high-performance graphics cards

SATA Power Connector

- Powers SSDs, HDDs, and optical drives

4-Pin Molex

- Powers older devices, fans, or accessories

Floppy (Berg) Connector

- Powers legacy floppy drives (rarely used)





8-inch (200 mm), 5.25-inch (130 mm), and 3.5-inch (90 mm) floppy disks

POWER SUPPLY UNIT TROUBLESHOOTING

1. System Does Not Power On

- Check power cable and wall socket
 - Ensure PSU switch is ON
- Test with another power cable or outlet

2. Random Shutdowns or Restarts

- Check if PSU wattage is sufficient
 - Look for overheating issues
- Inspect for loose internal power cables

3. Noisy or Non-Working Fan

- Clean dust from PSU vents
- Check if fan is spinning properly
 - Replace PSU if fan is faulty

4. Burning Smell or Sparks

- Immediately turn off power
- Disconnect PSU from mains
- Replace PSU (do not attempt repair)

Key Tip

Never open a PSU — dangerous high voltage inside

VGA, DVI, HDMI & DISPLAYPORT

Description

VGA (Video Graphics Array)

- Analog video cable
- Older display standard

DVI (Digital Visual Interface)

- Digital (and sometimes analog) video
- Better quality than VGA, no audio

HDMI (High-Definition Multimedia Interface)

- Digital video and audio cable
- Common for monitors, TVs, laptops

DisplayPort (DP)

- Digital video and audio interface
- Supports high resolution and refresh rates

Function

- Transmit video signals from PC to monitor
- HDMI & DisplayPort also transmit audio

VGA, DVI, HDMI & DISPLAYPORT



VGA, DVI, HDMI & DISPLAYPORT

Display on PC – Common Issues

- No display / black screen
- Flickering or distorted image
- Incorrect screen resolution
 - No audio via HDMI / DisplayPort
- Monitor shows "No Signal"

PC Display Troubleshooting

- Ensure monitor is powered ON
- Adjust brightness and contrast
- Update or reinstall graphics drivers
 - Test with another monitor
- Check graphics card installation and power

VGA, DVI, HDMI & DISPLAYPORT

VGA, DVI, HDMI & DisplayPort Troubleshooting

- Check cable connections
- Select correct monitor input source
 - Try another cable or port
 - Restart PC and monitor
- Check for bent or damaged pins

[VGA/DVI]

Key Tip

DisplayPort or HDMI provides the best display quality

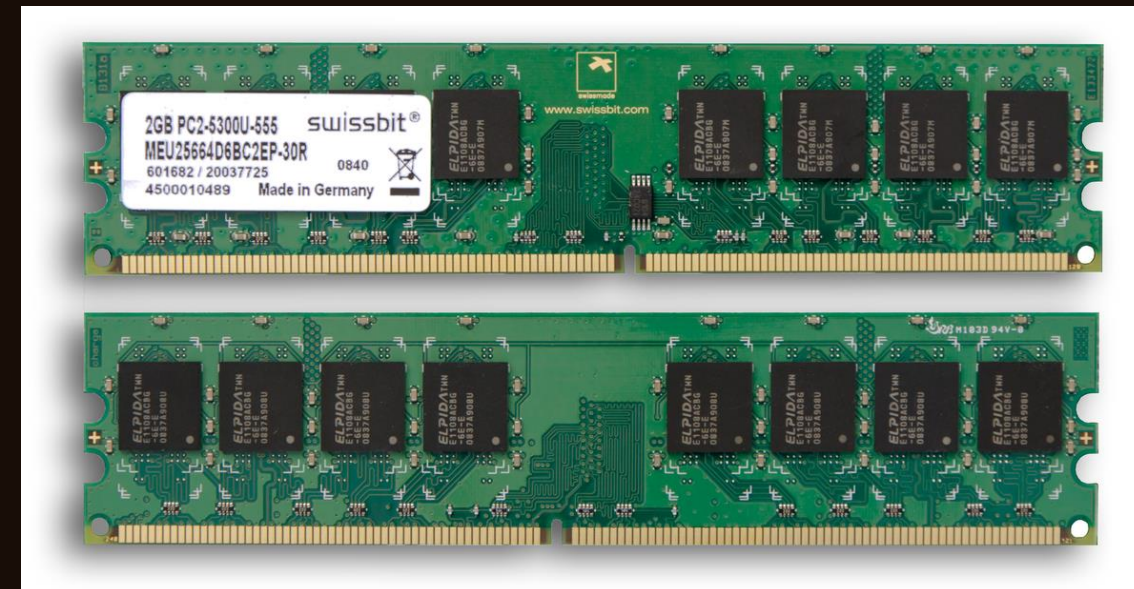
RAM (RANDOM ACCESS MEMORY)

Description

RAM is temporary memory used by the computer to store data that is currently in use.

Function

- Stores running programs and data
 - Allows fast access for the CPU
- Improves system speed and multitasking



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RAM [RANDOM ACCESS MEMORY]

RAM speed, measured in Megahertz [MHz], represents how fast Random Access Memory can transfer data to and from the CPU, directly impacting system responsiveness and application performance.

Very Simple Summary

Hertz [Hz] - How many times per second

Access time - How fast memory responds

Clock speed - The working pace / rhythm

Nanoseconds - Tiny units of time

Real-Life Analogy [Easy to Remember]

Imagine ordering food in a fast-food restaurant:

Clock speed: How fast the workers move

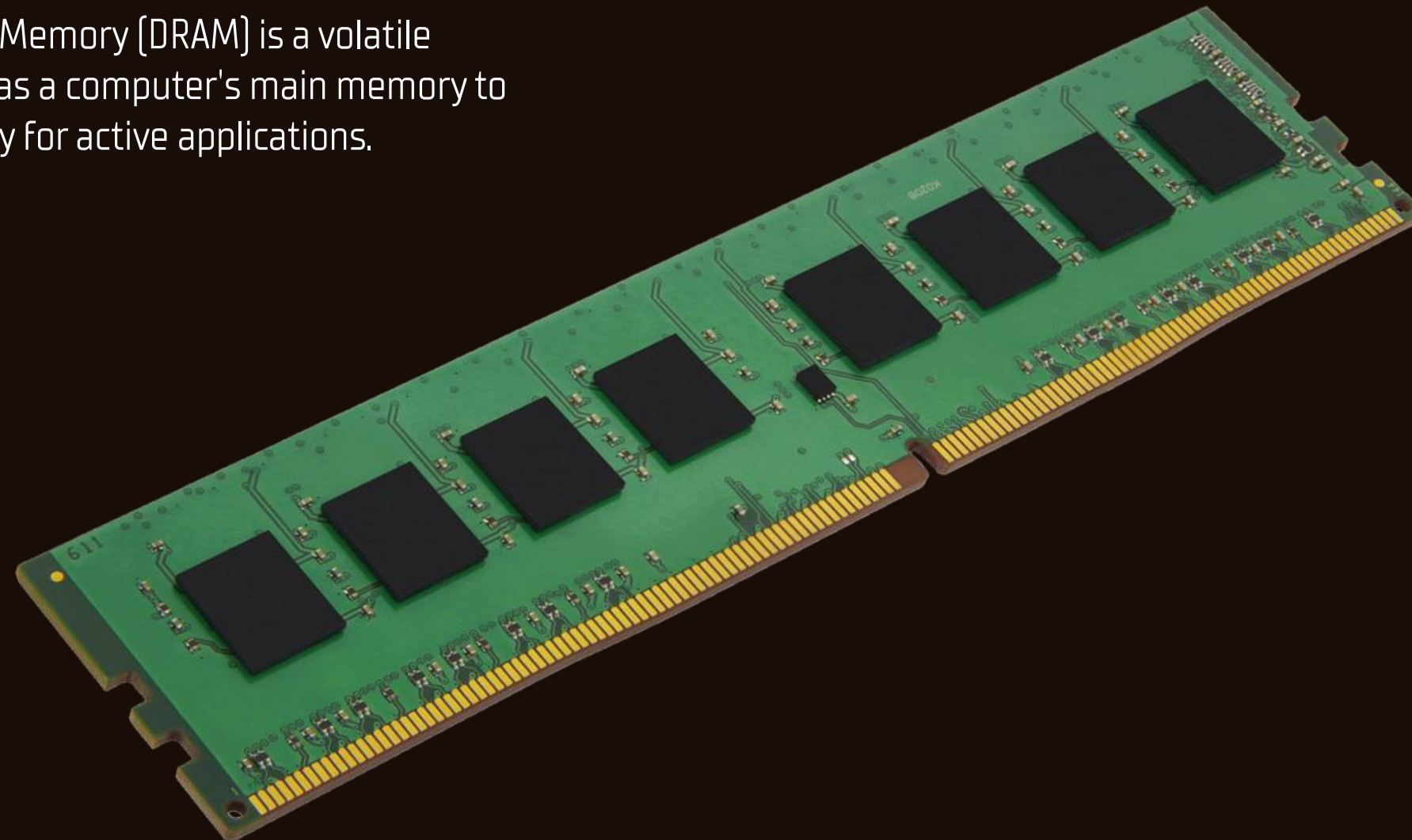
Access time: How long before you get your food

Hertz: How many orders they complete per second

Nanoseconds: Tiny time delays while preparing food

RAM (RANDOM ACCESS MEMORY)

Dynamic Random Access Memory (DRAM) is a volatile semiconductor memory used as a computer's main memory to store data temporarily for active applications.



RAM (RANDOM ACCESS MEMORY)

Standard DRAM Speeds [in Hz]

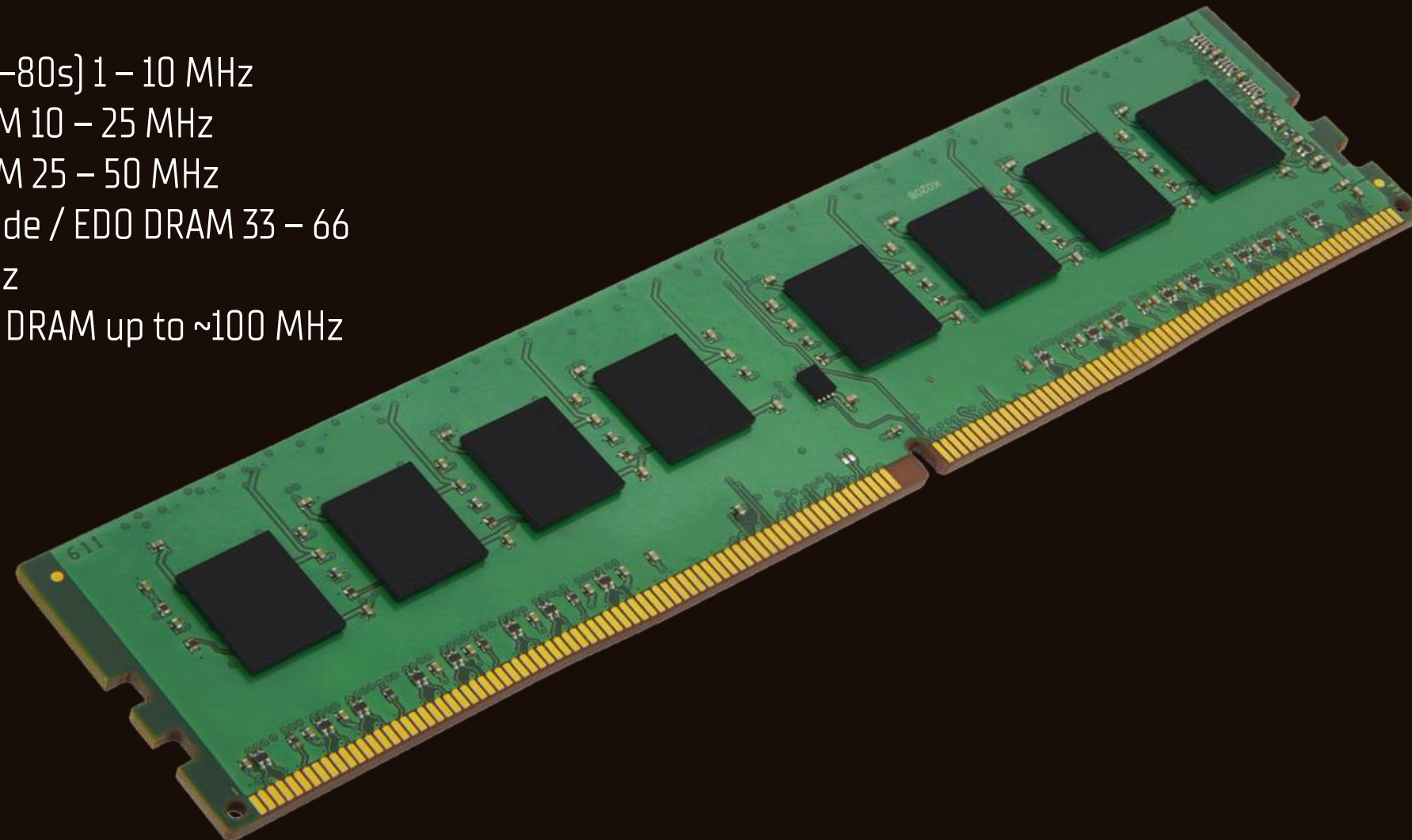
Early DRAM (1970s–80s) 1 – 10 MHz

Late 1980s DRAM 10 – 25 MHz

Early 1990s DRAM 25 – 50 MHz

Late 1990s Fast Page Mode / EDO DRAM 33 – 66
MHz

High-end asynchronous DRAM up to ~100 MHz



RAM [RANDOM ACCESS MEMORY]

2. SRAM [Static RAM]

- Faster than DRAM
 - Does not need refreshing
 - More expensive
- Used for cache memory



RAM (RANDOM ACCESS MEMORY)

Standard SRAM Speeds (in Hertz)

Early SRAM (1970s–80s) 1 – 10 MHz

1980s–early 1990s SRAM 10 – 50 MHz

Mid–late 1990s SRAM 50 – 200 MHz

High-performance asynchronous SRAM 200 – 500 MHz

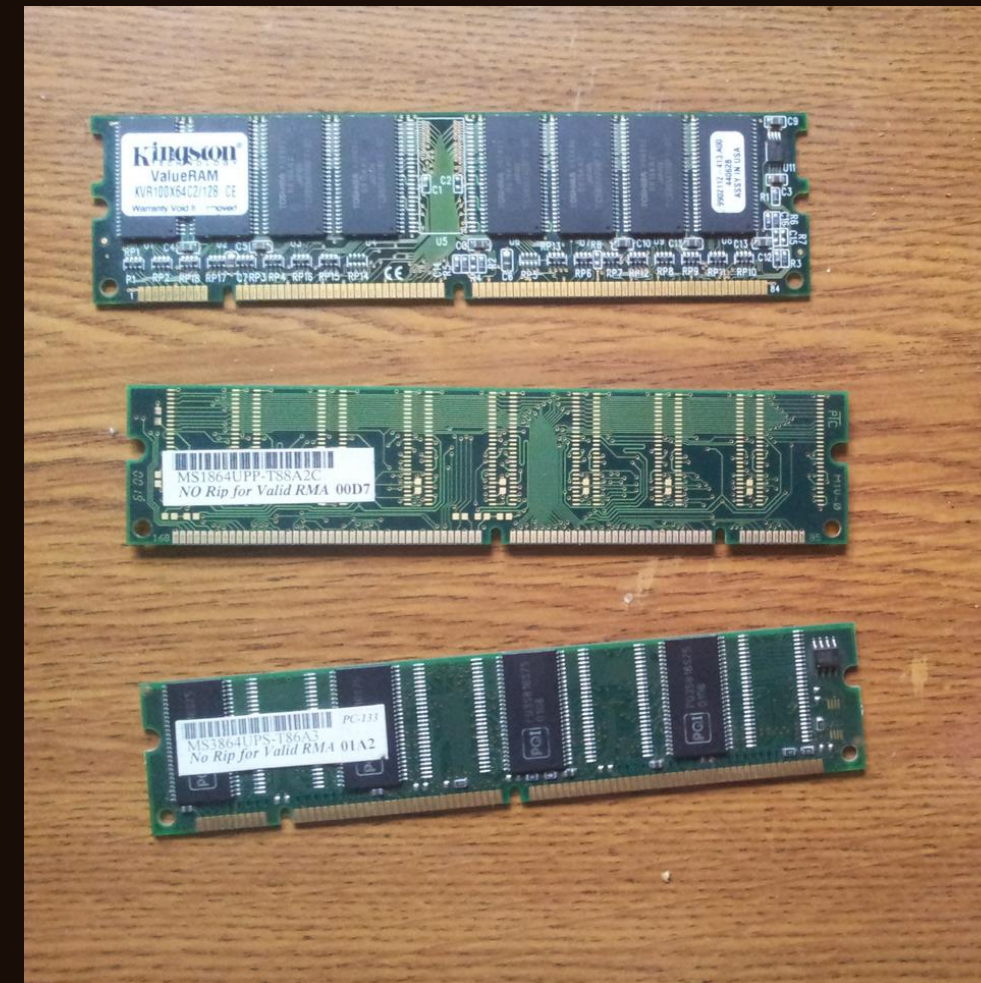
Modern synchronous SRAM (but still “standard”, not DDR) 500 MHz – 1+ GHz



RAM (RANDOM ACCESS MEMORY)

3. SDRAM (Synchronous DRAM)

- Works in sync with system clock
 - Faster than DRAM
 - Used in older systems



RAM (RANDOM ACCESS MEMORY)

Standard SDRAM Speeds (in Hertz)

Early SDRAM (PC66) 66 MHz

PC100 SDRAM 100 MHz

PC133 SDRAM 133 MHz

High-end SDRAM 150 – 200 MHz



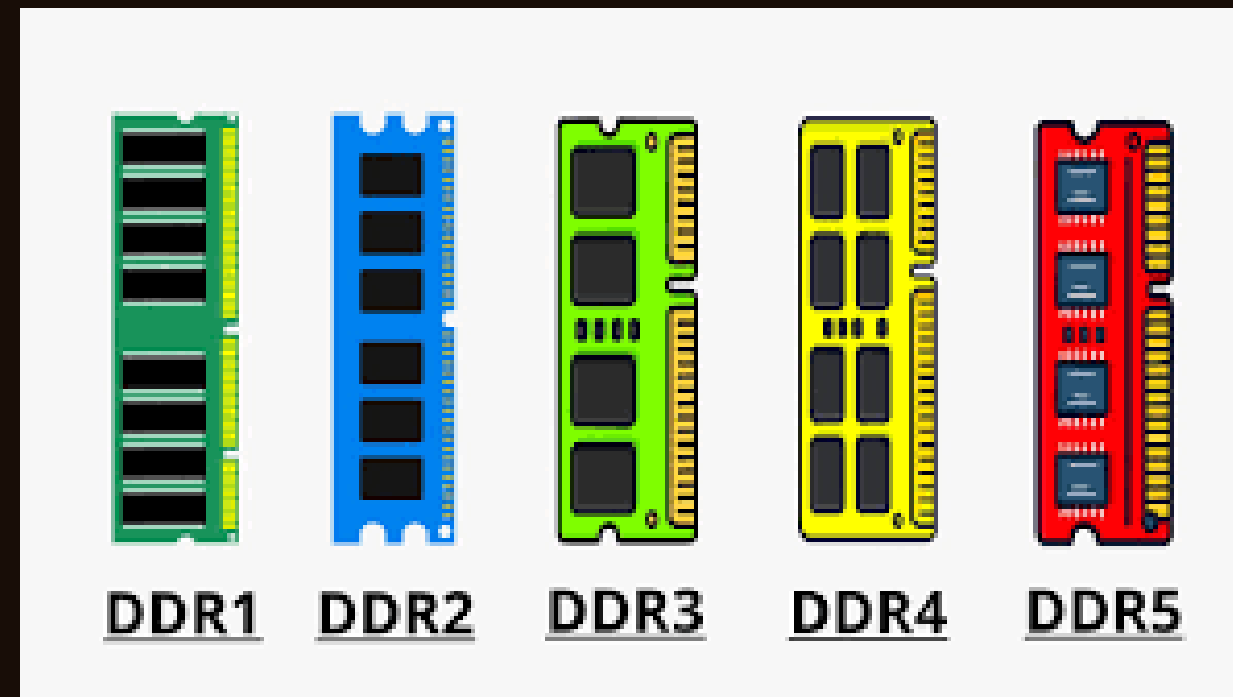
RAM [RANDOM ACCESS MEMORY]

4. DDR RAM (Double Data Rate RAM)

- Transfers data twice per clock cycle
- Most widely used RAM type

Common versions:

- DDR (2000) 200 – 400 MHz
- DDR2 (2003) 400 – 1066 MHz
- DDR3 (2007) 800 – 2133 MHz
- DDR4 (2014) 1600 – 3200 MHz
- DDR5 (2020) 4800 – 8400+ MHz



RAM (RANDOM ACCESS MEMORY)

5. LPDDR (Low-Power DDR)

- Uses less power
- Found in smartphones and laptops



RAM (RANDOM ACCESS MEMORY)

Common LPDDR Speeds by Generation

LPDDR3 Older smartphones, tablets, low-end ultrabooks 1600–2133 MT/s

LPDDR4 Mid-range to high-end phones, ultrabooks 3200–4266 MT/s

LPDDR4X Modern smartphones, tablets, efficient ultrabooks 3733–4266 MT/s

LPDDR5 Flagship phones, gaming phones, high-end laptops 6400 MT/s

Note: LPDDR5X (cutting-edge devices, high-speed mobile) 8533–10667 MT/s

MT/s (mega-transfers per second) = effective memory speed. The actual clock frequency is roughly half of MT/s because LPDDR is double data rate.

Quick Notes

Most current smartphones use LPDDR4X or LPDDR5.

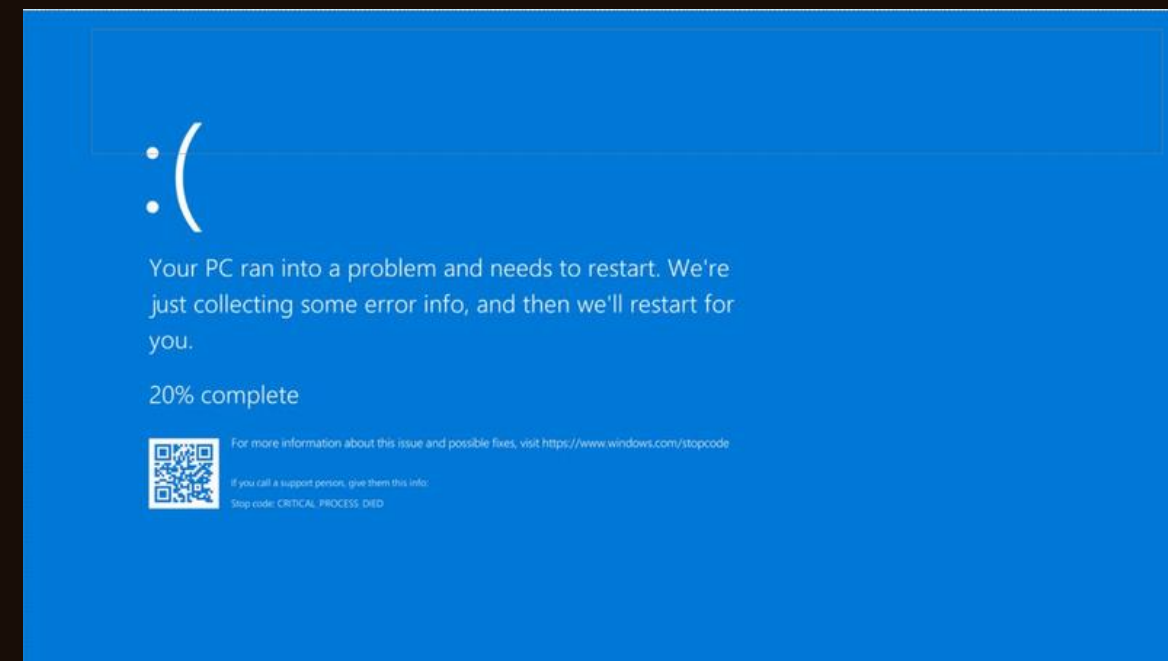
Older phones (2015–2019) mainly used LPDDR3 or LPDDR4.

LPDDR5X is very new and found in flagship devices [2023+].

RAM (RANDOM ACCESS MEMORY)

Common RAM Issues

- PC does not boot
- Frequent freezing or crashes
- Blue Screen of Death (BSOD)
- System very slow
- RAM troubleshooting
- Reseat RAM modules properly
 - Clean RAM slots (dust)
- Try one RAM stick at a time
- Use correct RAM type and speed
- Replace faulty RAM



ROM (READ-ONLY MEMORY)

Definition

- Non-volatile memory
- Stores permanent data
- Data is not lost when power is

Function of ROM

- Stores firmware (BIOS/UEFI)
- Helps start the computer (booting)
- Controls basic hardware operations
- Loads instructions before RAM is

used UEFI stands for:

Unified Extensible Firmware Interface

It is the modern system firmware that helps a computer start and load the operating system.

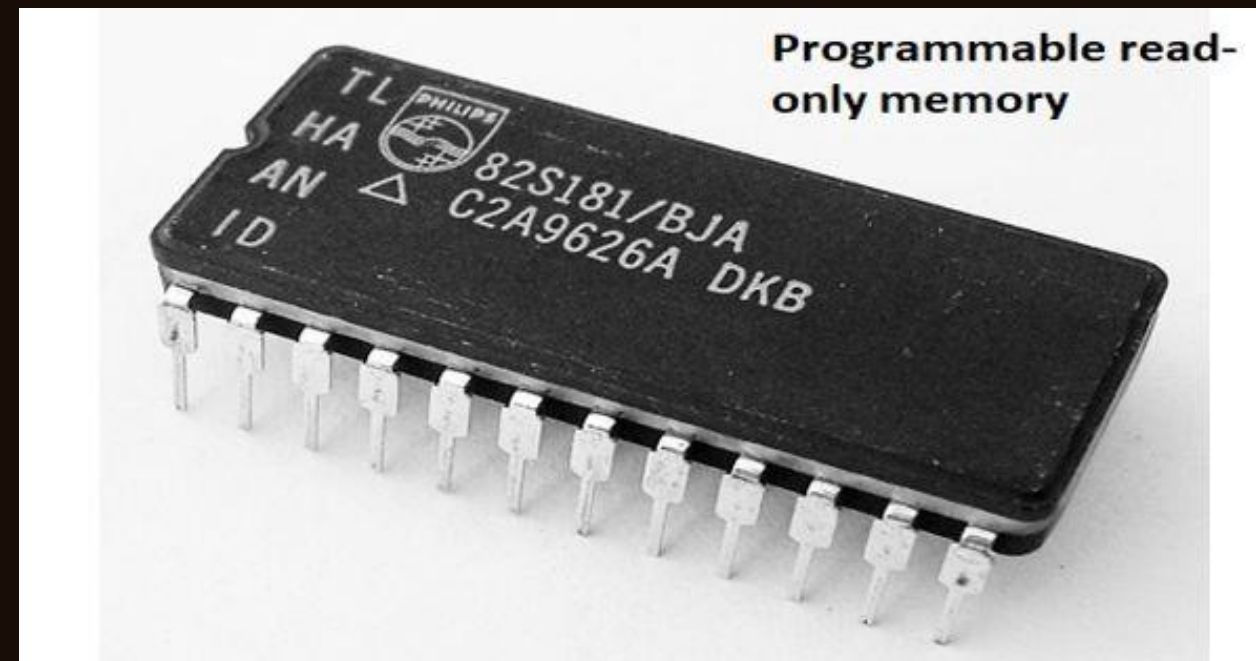


ROM (READ-ONLY MEMORY)

Other types of ROM

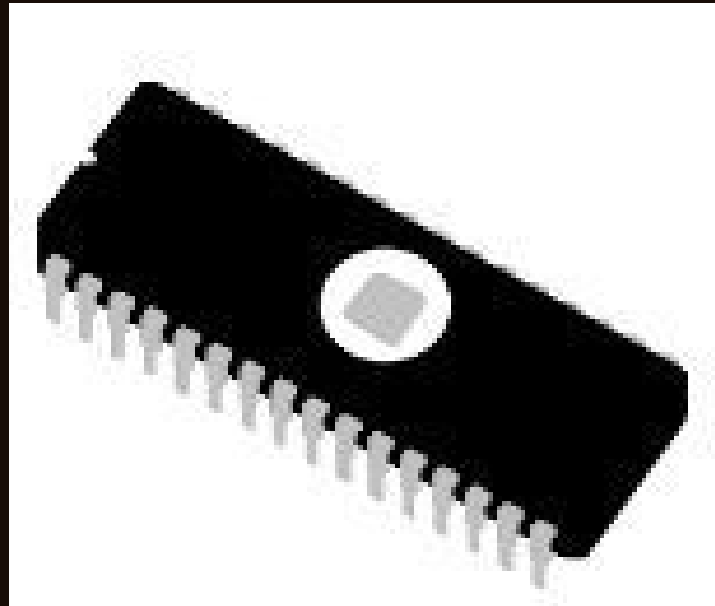
1. **PROM (programmable read only memory)** – a blank chip which can be programmed only once using a special device called a programmer. Once it's programmed its contents cannot be modified or erased.
2. **EPROM (erasable programmable read only memory)** – can be programmed multiple times. Its contents can be erased by using UV (ultraviolet) light. Exposure to the UV light will erase all contents.
3. **EEPROM (electrically erasable programmable read-only memory)** – similar to EPROM but its contents can be electrically erased and re-written without having to remove it from the computer.
4. **Flash Memory** – a modern type of EEPROM, it can be erased and re-written to electrically. It is much faster than EEPROM. It is ideal for electronic devices such as mobile phones and digital cameras.

PROGRAMMABLE READ-ONLY MEMORY (PROM)



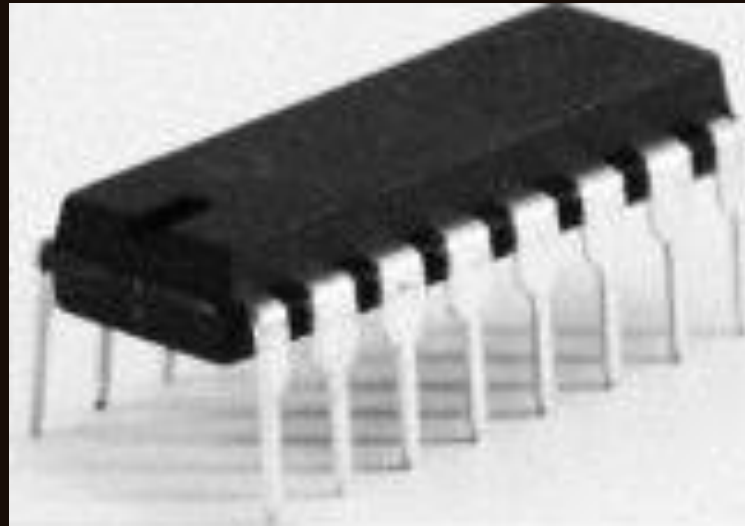
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EPROM (ERASABLE PROGRAMMABLE READ-ONLY MEMORY)



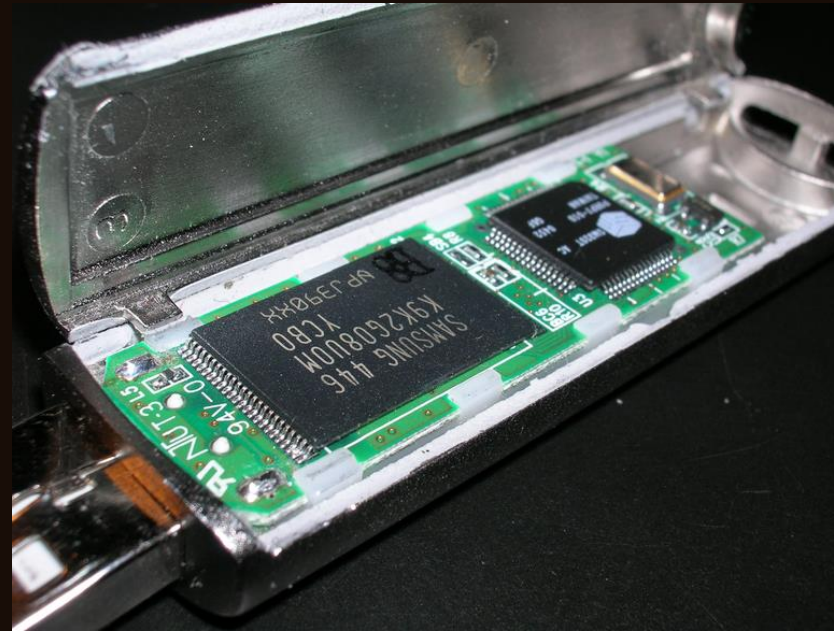
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ROM (READ-ONLY MEMORY)



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FLASH MEMORY ROM



4. **Flash Memory** – a modern type of EEPROM, it can be erased and re-written to electrically. It is much faster than EEPROM. It is ideal for electronic devices such as mobile phones and digital cameras.

ROM (READ-ONLY MEMORY)

Common Issues

- Corrupted firmware
 - Outdated BIOS
- Booting problems
- ROM chip damage (rare)

Troubleshooting ROM Issues

- Update or reflash BIOS/firmware
 - Reset BIOS/CMOS settings
- Ensure stable power supply
- Check error messages or beep codes
- Replace motherboard (if needed)

CMOS stands for

Complementary Metal-Oxide Semiconductor

It refers to the technology used to store small but important system settings in a computer. CMOS stores settings, and you access or change them through BIOS/UEFI.

GPU (GRAPHICS PROCESSING



Description

GPU processes and renders images, videos, and graphics.

Function

- Handles display output to monitor
- Improves graphics performance
- Essential for gaming, design, and video editing

GPU (GRAPHICS PROCESSING UNIT)

Common GPU Issues &

Troubleshooting

- No Screen Display – Check cables, restart PC, reseal graphics card
- Graphics Card Not Found – Restart PC, update drivers, check BIOS
- Freezing or Crashing – Update drivers, close heavy apps, restart
- Overheating – Clean dust, improve airflow, let fans run properly
- Weird Lines or Flickering – Restart, update drivers, lower settings
- Slow Performance – Use high-performance mode, close background apps
 - Fans Not Working – Check temperature, adjust fan settings
 - PC Suddenly Shuts Down – Check power supply and cables
 - Screen Tearing – Turn on VSync or sync settings
 - High-Pitched Noise – Limit frame rate, enable VSync

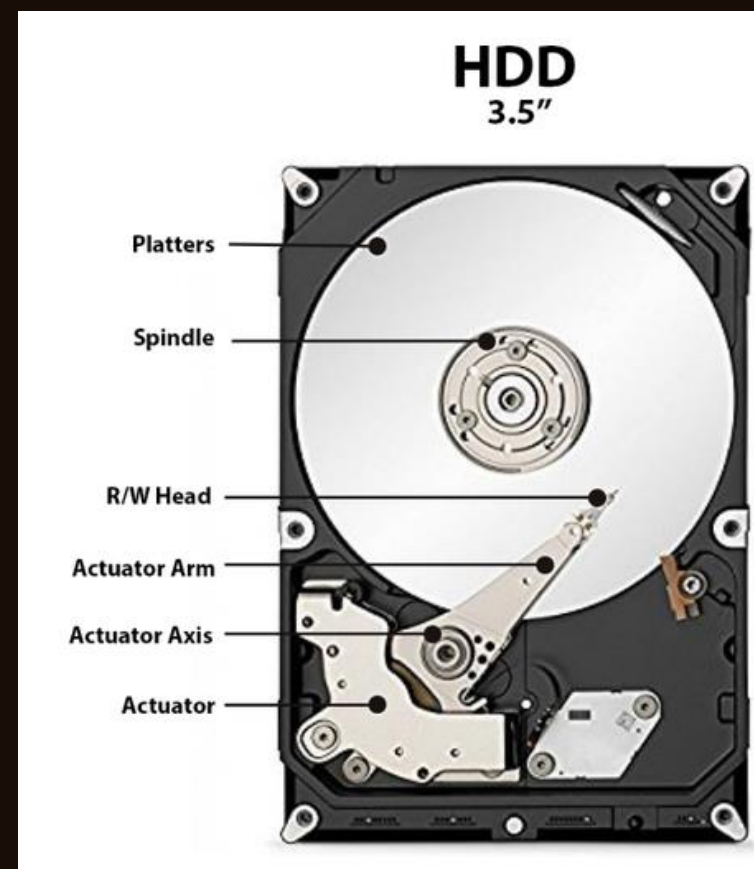
VSync (Virtual Synchronization)

- Makes screen movement smoother
- Prevents screen tearing during videos or animations
- Helps with smooth scrolling (web, documents)
- Useful for presentations and video playback
 - May slightly reduce performance

HARD DISK DRIVE

[HDD]

- Traditional storage device that uses spinning magnetic disks (platters) to store data.
 - Data is read and written by a moving read/write head.
 - Common form factor for desktops: 3.5-inch, sometimes 2.5-inch



HARD DISK DRIVE

Common [HDD]

Issues

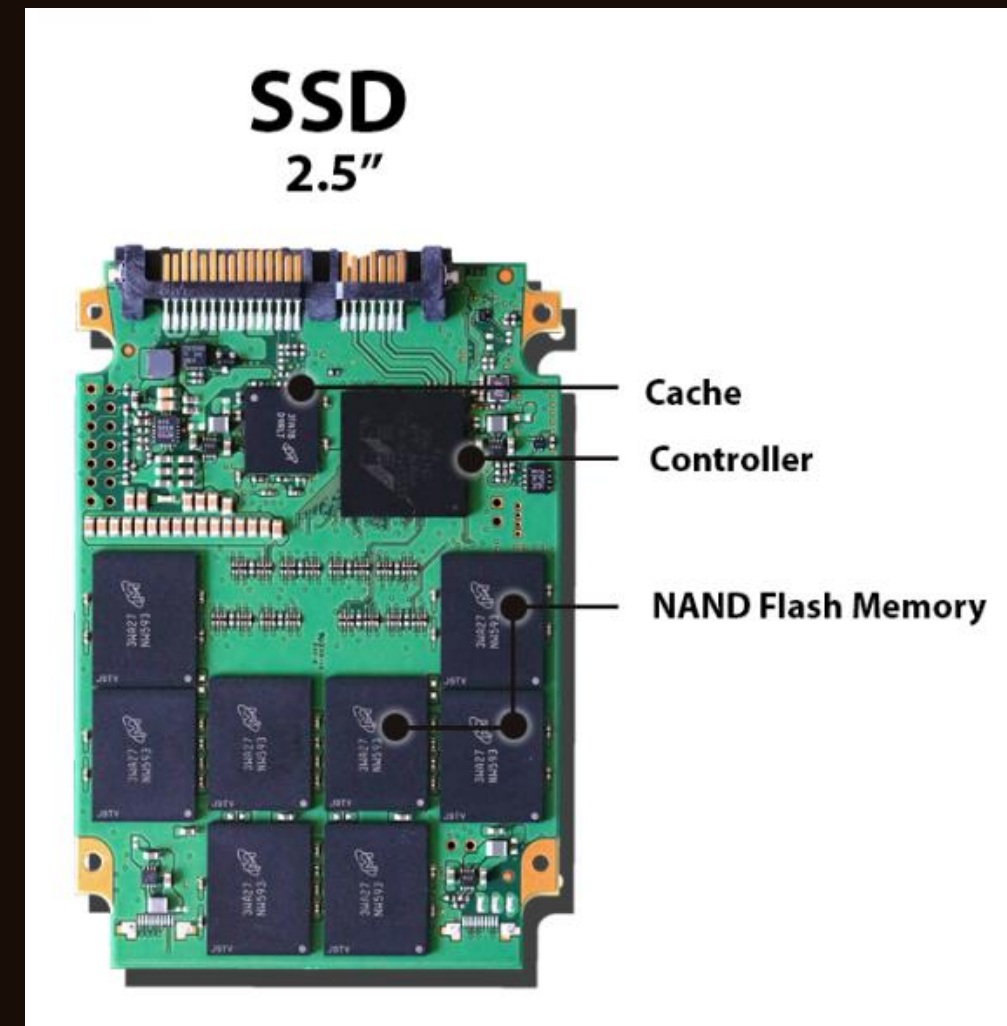
- Slow performance: Especially when fragmented or old.
- Bad sectors: Physical damage on the disk surface.
- Clicking noises: Could indicate mechanical failure ("click of death").
 - Failure to boot: OS may not load if HDD is corrupted.
- Data corruption: Can occur due to power loss or bad sectors.

Troubleshooting

- Check connections: Ensure SATA cable and power connector are secure.
- Run disk checks: Use tools like chkdsk on Windows to scan for bad sectors.
- Defragment the drive: Speeds up file access (only for HDDs, not SSDs).
 - Backup data immediately: If you hear unusual noises or errors.
 - Replace if failing: Mechanical failure cannot usually be repaired.

SOLID STATE DRIVE (SSD)

- Data storage device using flash memory
- No moving parts → fast & silent
- Stores OS, applications, and files
- Improves boot time and system speed



SOLID STATE DRIVE

Issues:

- Not detected
- Slow performance
- Storage fills quickly

Fixes:

Check cables & BIOS
Enable TRIM / update
firmware
Keep free storage space
Back up data regularly

The TRIM command is an operating system feature for SSDs that improves performance and extends lifespan by informing the drive which data blocks are no longer in use.

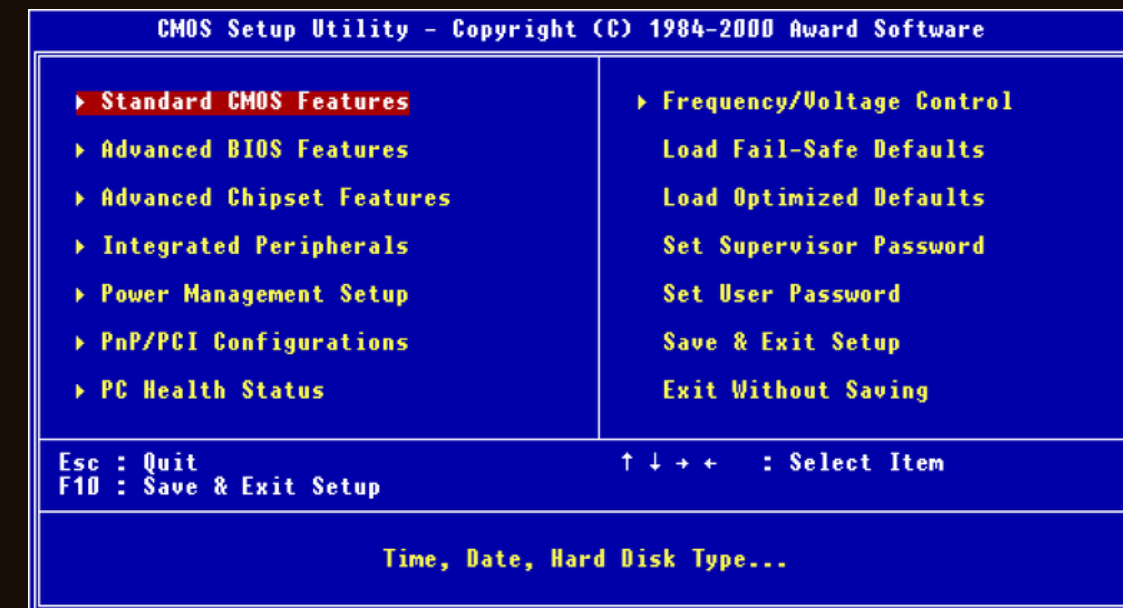
BIOS (Basic Input Output System)

- Basic system settings that start the computer
- Controls how hardware like the graphics card works

- Used to fix detection or startup problems
 - Accessed when the PC first turns on

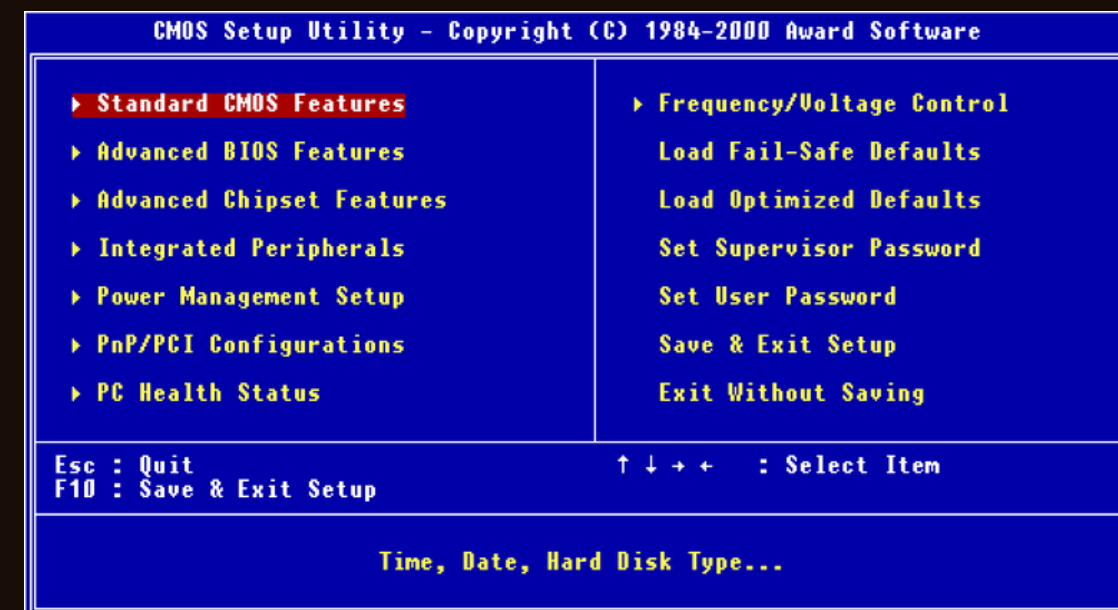
How to Open (Activate) BIOS

- Turn off the computer
 - Turn it back on
- Immediately press Delete or F2 on the keyboard
 - Keep pressing until the BIOS screen appears
- Other common keys: F10, F12, Esc (depends on the computer)



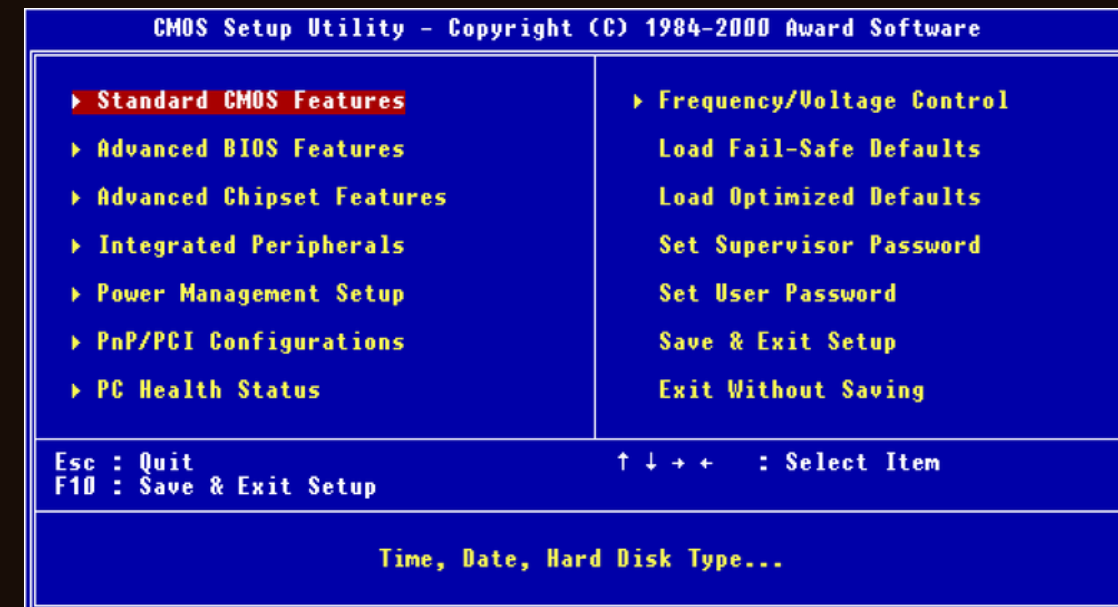
Main Functions of BIOS

- Boots the system
- Loads the operating system
- Performs hardware checks
- Runs POST (Power-On Self-Test)
 - Manages system settings
- Boot order, date & time, hardware options
 - Controls basic input/output
- Enables communication between hardware and OS



Typical Issues BIOS Troubleshoots

- Boot errors
 - No boot device found
 - Computer won't start
- Hardware detection problems
- RAM, hard drive, keyboard not recognized
- POST error beeps/messages
- Indicates faulty CPU, RAM, or GPU
- Incorrect system configuration
 - Wrong date/time
- Disabled hardware components
 - Outdated firmware
- Compatibility or stability issues



DESKTOP COOLING DEVICES

1. Air Cooling (Fans & Heat Sinks)

- Most common type of cooling for desktops
- Includes CPU fans, case fans, and heat sinks
- Heat sinks are metal blocks (usually aluminum or copper) that absorb heat from components



DESKTOP COOLING DEVICES

1. Air Cooling (Fans & Heat Sinks)

Function

- Pulls hot air away from CPU/GPU
- Pushes cool air into the case
- Maintains safe operating temperature



DESKTOP COOLING DEVICES

1. Air Cooling (Fans & Heat Sinks)

Common Issues:

- Dust buildup → reduces airflow
 - Fan failure → overheating
- Loose or improperly seated heat sink

Troubleshooting:

- Clean fans and heat sinks regularly
 - Replace faulty fans
- Reapply thermal paste on CPU if overheating

DESKTOP COOLING DEVICES

2. Liquid Cooling (Water Cooling)

Description:

- Uses water or coolant to transfer heat away from CPU/GPU
- Includes pump, radiator, tubing, and water block



DESKTOP COOLING DEVICES

2. Liquid Cooling (Water Cooling)

Function:

- More efficient heat transfer than air cooling
- Keeps high-performance systems cooler and quieter



DESKTOP COOLING DEVICES

2. Liquid Cooling (Water Cooling)

Common Issues:

- Leaks in tubing or connections
- Pump failure → overheating
- Algae or corrosion in the loop

Troubleshooting:

- Check for leaks and tighten fittings
 - Replace faulty pump
- Flush system and refill coolant

DESKTOP COOLING DEVICES

3. Hybrid Cooling (Air + Liquid)

Description:

- Combines air and liquid cooling for better performance
- Often used in high-end gaming PCs



DESKTOP COOLING DEVICES

3. Hybrid Cooling (Air + Liquid)

Function:

- Uses liquid to cool CPU/GPU and fans to remove heat from radiator
- Reduces noise while keeping components cool



DESKTOP COOLING DEVICES

3. Hybrid Cooling (Air + Liquid)

Common Issues:

- Complexity → more points of failure
 - Fan or pump failure
 - Dust buildup

Troubleshooting:

- Maintain both fans and liquid loop
 - Replace failing components
- Monitor temperatures using software

DESKTOP COOLING DEVICES

4. Passive Cooling

Description:

- Uses heat sinks without fans or pumps
- Relies on natural air convection



DESKTOP COOLING DEVICES

4. Passive Cooling

Function:

- Silent cooling for low-power devices (e.g., mini-PCs, some laptops)



DESKTOP COOLING DEVICES

4. Passive Cooling

Common Issues:

- Limited cooling capacity → overheating if load is high
- Dust accumulation reduces effectiveness

Troubleshooting:

- Keep device in ventilated area
- Clean heat sinks regularly

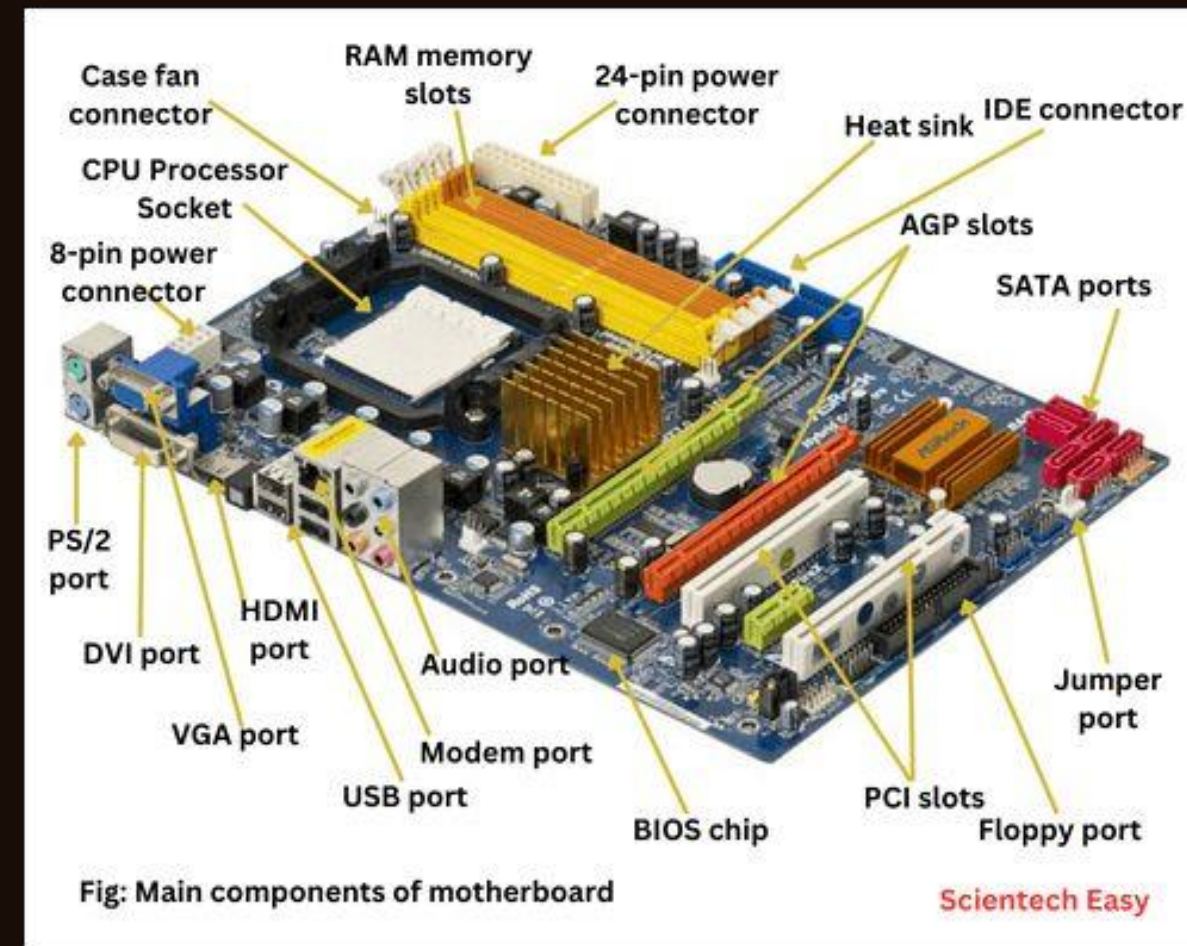
MOTHERBOARD

Definition

- The main circuit board of a computer
- Connects and allows communication between all components (CPU, RAM, storage, peripherals)

Functions

- Houses CPU, RAM, and expansion cards
- Provides power and data pathways (buses)
- Connects storage, input/output devices, and peripherals
- Manages communication between hardware components



MOTHERBOARD

Common Issues

- No power / failure to boot
- Overheating due to poor airflow
- Loose or damaged connections
- Short circuits or component failure

Troubleshooting

- Check power connections and power supply
- Inspect for visible damage or burnt components
 - Reset CMOS/BIOS settings
- Replace faulty components or the motherboard

CPU (CENTRAL PROCESSING UNIT)

Definition

- Known as the “brain” of the computer
- Executes instructions from programs and operating system

Functions

- Processes data and instructions
- Performs calculations and logical operations
- Coordinates communication between all hardware components
- Controls software execution and system performance



CPU (CENTRAL PROCESSING UNIT)

Common Issues

- Overheating → thermal shutdown
- System crashes or slow performance
- Improper installation → bent pins, poor contact
- Compatibility issues with motherboard or RAM

Troubleshooting

- Ensure proper cooling (CPU fan or liquid cooler)
- Reapply thermal paste if overheating
- Check CPU seating and motherboard socket
- Update BIOS/UEFI for compatibility

STANDARD FLOW OF HARDWARE TROUBLESHOOTING A DESKTOP PC

Step 1: Identify the Problem

Observe symptoms:

PC won't turn on

Beep codes during startup

Overheating, no display, random
shutdowns

Ask: When did it start? Any recent changes?

Step 2: Check Power Supply and Connections

Verify power cord and wall outlet

Check PSU switch and voltage settings

Inspect motherboard power connectors and
cables

STANDARD FLOW OF HARDWARE TROUBLESHOOTING A DESKTOP PC

Step 3: Perform Visual Inspection

- Look for physical damage: burnt components, bulging capacitors
- Ensure RAM, CPU, GPU, and expansion cards are seated properly
 - Check cooling devices and fans

Step 4: Isolate Components

- Remove non-essential hardware (extra drives, USB devices, peripherals)
 - Test each component individually if possible:
 - RAM → test one stick at a time
 - GPU → test in another system or swap
 - Hard drive → connect to another PC

STANDARD FLOW OF HARDWARE TROUBLESHOOTING A DESKTOP PC

Step 5: Test and Replace Faulty Components

- Replace suspected defective parts with known working ones
- Test PSU, motherboard, RAM, CPU, GPU as needed

Step 6: Verify System Functionality

- Boot PC after each change to check if issue is resolved
- Ensure stable operation and all hardware recognized

Step 7: Document Findings

Record faulty components and solutions
Helps with future troubleshooting