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Memory and Data Storage Devices



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Memory Devices

Memory devices are electronic devices that store information for immediate use in electronic hardware. Memory devices utilize **digital logic** to perform their operations.

Examples:

- EEPROM
- RAM
- Flash Memory



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Building Blocks of Memory

Memory devices are often constructed with logic gates and simple memory circuits such as latches and flip-flops.

Types of Logic Gates:

- AND, OR, NOT, NAND, NOR

Types of Latches

- SR NOR, SR NAND, SR AND-OR

Types of Flip-Flops

- D Flip-Flop, T Flip-Flop, JK Flip-Flop



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Memory Types

There are two main types of memory devices:
volatile and non-volatile

Volatile Memory is memory that requires power to maintain stored information (Ex. RAM)

By contrast, **Non-Volatile Memory** is computer memory that stores information even after power has been cycled. (Ex. Flash memory)



ROM

- **Read-Only Memory (ROM)** is a type of non-volatile memory used to store programs and data
- Traditional ROM cannot be changed after it has been written
- EEPROM and EPROM are types of ROM that can be changed after the initial programming. The write time for such devices is often relatively slow
- EEPROMs have a finite amount of times it be erased and rewritten
- Often used to store software or data that is rarely changed (ex. firmware, lookup tables)



Flash Memory

- Flash memory is a type of non-volatile computer memory that can be erased and reprogrammed
- Flash memory is a type of EEPROM with larger memory block sizes
 - This means it also has a limited number of times it can be erased and rewritten
- Flash memory is often used for large solid-state digital storage
- Solid-state hard drives are often made using flash memory



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RAM

- **Random Access Memory (RAM)** is a type of volatile computer memory where memory cells can be accessed in any order
- Since programs do not need to look up addresses for memory, RAM is significantly faster than other memory devices
- RAM is often used for programs or software that are actively being used



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Magnetic Hard Disk Drive

- **Hard disk drives** are non-volatile memory devices used for storing large amount of data
- Data is stored in individual blocks of memory that can be stored or retrieved in any order
- Data is saved by magnetizing ferromagnetic material on a disk using a magnetic lever. The encoding allows for data to be stored even when power is lost
- Primarily used as secondary storage devices for computers.



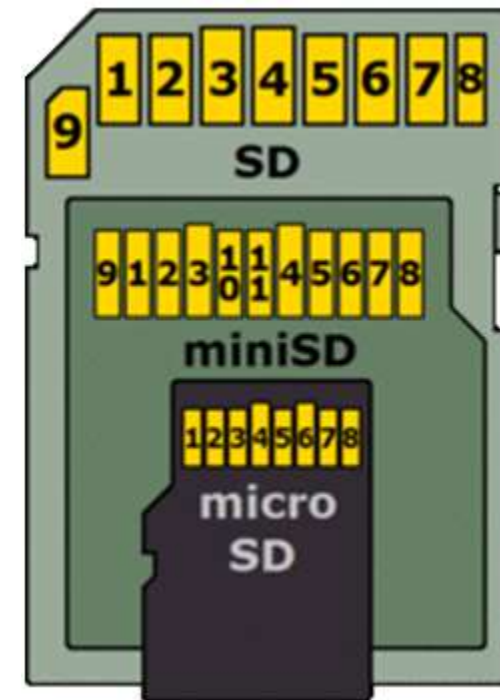
SD Cards

- Secure Digital (SD) cards are a type of non-volatile memory devices used for portable devices
- SD cards utilize flash memory to store large quantities of data in a small physical size
- SD Cards are available in multiple storages size ranging from 512 MB to 1 TB
- SD cards are frequently used in cameras, personal computers, and embedded systems



SD Cards Physical Details

- SD cards are available in three physical sizes: standard, miniSD, and microSD
- Standard: 32 mm x 24 mm x 2.1 mm
- Mini: 32 x 20 mm x 1.4 mm
- Micro: 15 mm x 11mm x 1.0 mm
- The pinout for each size varies





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SD Cards File Systems

Most SD cards are formatted to contain a single file system. The capacity of the SD card is limited by the partition size. It is possible to change the partition size by reformatting the card.

- By default, most SD cards under 2GB have FAT16 partitioning. FAT16 allows for up to 2GB of storage
- FAT32 partitioning allows for up to 4GB of storage
- exFAT (FAT 64) partitioning allows for up to 2 TB of storage, but is often limited by the amount of memory on the card itself