Sajjad Jawad Kadhim
IT-Network 3-Stage Evening

سجاد جواد كاظم
جامعة بابل - كلية تكنولوجيا المعلومات

Computer Memory & Storage Devices

Types of memory

There are several types of memory for computers. They are listed below.

ROM

ROM is separated into three categories:

- PROM
- EPROM
- EEPROM

RAM

There are six types of RAM:

- EDO RAM
- SDRAM
- DDR RAM
- DDR2 RAM
- DDR3 RAM
- DDR4 RAM

Storage Devices

ROM

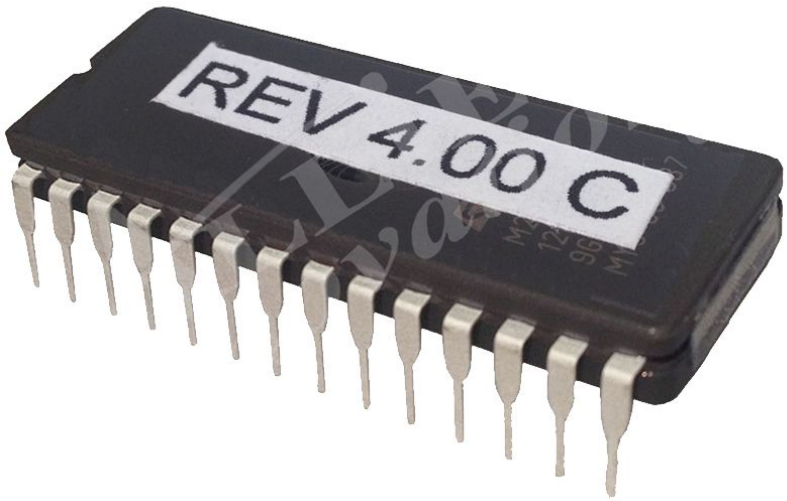
Programmable ROM

PROM or programmable ROM (programmable read-only memory) is a computer memory chip that can be programmed once after it is created. Once the PROM is programmed, the information written is permanent and cannot be erased or deleted. PROM was first developed by Wen Tsing Chow in 1956. An example of a PROM is a computer BIOS in early computers. Today, PROM in computers has been replaced by EEPROM.

A programmable ROM is also referred to as a FPROM (field programmable read-only memory) or OTP (one-time programmable) chip.

When the PROM is created, all bits read as "1." During the programming, any bit needing to be changed to a "0" is etched or burned into the chip using a gang programmer. Below is an example of a gang programmer from Advin that programs multiple ROM chips at one time.

EPROM



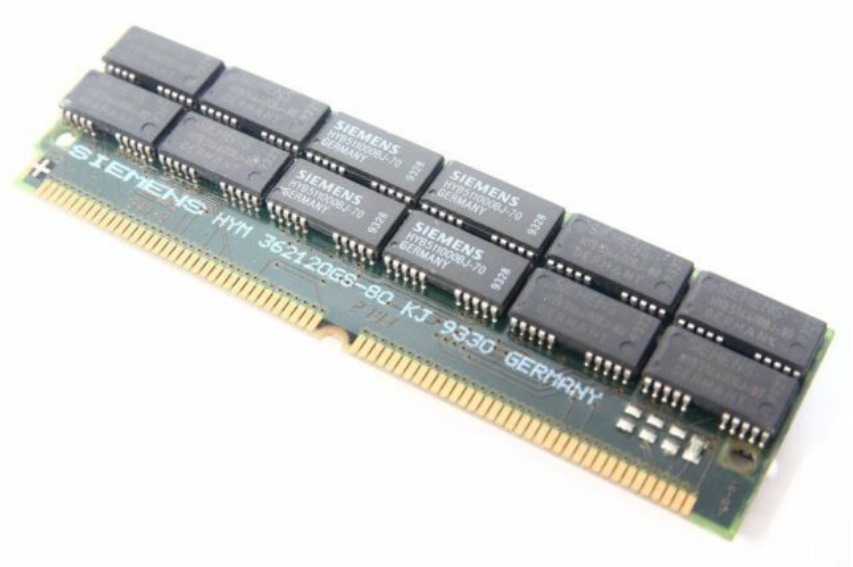
Short for Erasable Programmable Read-Only Memory, EPROM is a non-volatile memory chip that was invented by Dov Frohman in 1971 while at Intel that can only be read. If exposed to ultraviolet light, an EPROM can be reprogrammed if needed, but otherwise does not accept or save any new data. Hardware manufacturers use EPROM when it may be needed that the data contained on the EPROM needs to be changed. An EPROM chip is distinguishable by a small quartz crystal (not glass) circle window that exposes the chip so that it can be reprogrammed. The picture on this page is an example of an Intel 8048 made by NEC and is an example of an EPROM chip.

Today, EPROM chips are not used in computers and have been replaced by EEPROM chips.

EEPROM was a replacement for PROM and EPROM chips and is used for later computer's BIOS that were built after 1994. Having a computer with an EEPROM allows a computer user to update the BIOS in their computer without having to open the computer or remove any chips.

RAM

EDO RAM



Alternatively referred to as hyper page mode memory, EDO is short for Extended Data Out and is a type of memory developed in 1995 by Micron that was first used with Pentium computers. EDO allows a CPU to access memory 10 to 15-percent faster the compatible Fast Page memory by not turning off the data output drivers after the memory has removed the column address. An upgraded variation of EDO memory is BEDO, although it was never widely used.

SDRAM

SDRAM, which is short for Synchronous DRAM, is a type of memory that synchronizes itself with the computer's system clock. Being synchronized allows the memory to run at higher speeds than previous memory types and asynchronous DRAM and also supports up to 133 MHz system bus cycling. Since 1993, this is the prevalent type of memory used in computers around the world. In the picture below is an example of a SDRAM DIMM. The original type, named SDRAM, up to the current type, DDR3, are all derivatives of the SDRAM memory type.

DDR2

Short for double data rate two, DDR2 is the second generation of DDR memory that was released in September 2003. DDR2 is capable of operating at greater speeds than DDR, offers a greater bandwidth potential, operates on less power, and generates less heat. Due to architectural differences, DDR2 memory modules are incompatible with DDR slots.

DDR3

Short for double data rate three, DDR3 is a type of DRAM (dynamic random-access memory) released in June 2007 as the successor to DDR2. DDR3 chips have bus clock speed of 400 MHz up to 1066 MHz, range in size from 1 to 24 GB, and consume nearly 30% less power than their predecessors. DDR3 RAM sticks for a desktop computer have 240 pins. For a laptop computer, DDR3 RAM sticks have 204 pins.

These memory chips can only be installed on a motherboard that supports DDR3 memory and are not backward compatible with DDR2

DDR4

Short for double data rate four, DDR4 is a type of system memory known as SDRAM and was released in September 2014 as the successor to DDR3. DDR4 has bus clock speeds that range from 800 to 1600 MHz and range in storage capacity from 4 to 128 GB per DIMM. DDR4 is also more efficient at 1.2 V when compared to DDR3's 1.5 to 1.65 V range.

Storage device

Alternatively referred to as digital storage, storage, storage media, or storage medium, a storage device is any hardware capable of holding information either temporarily or permanently. an external secondary storage device.

There are two types of storage devices used with computers: a primary storage device, such as RAM, and a secondary storage device, such as a hard drive. Secondary storage can be removable, internal, or external.

Examples of computer storage

Magnetic storage devices

Today, magnetic storage is one of the most common types of storage used with computers. This technology is found mostly on extremely large HDDs or hybrid hard drives.

- **Floppy diskette**
- **Hard drive**
- **Magnetic strip**
- **SuperDisk**

- Tape cassette
- Zip diskette

Optical storage devices

Another common type of storage is optical storage, which uses lasers and lights as its method of reading and writing data.

- Blu-ray disc
- CD-ROM disc
- CD-R and CD-RW disc.
- DVD-R, DVD+R, DVD-RW, and DVD+RW disc.

Flash memory devices

Flash memory has replaced most magnetic and optical media as it becomes cheaper because it is the more efficient and reliable solution.

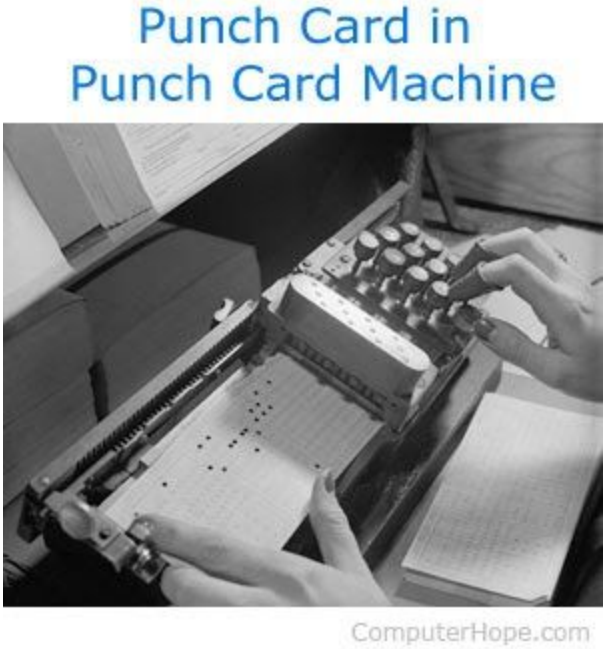
- **USB flash drive, jump drive, or thumb drive.**
- **CF (CompactFlash)**
- **M.2**
- **Memory card**
- **MMC**
- **NVMe**
- **SDHC Card**
- **SmartMedia Card**
- **Sony Memory Stick**
- **SD card**
- **SSD**
- **xD-Picture Card**

Online and cloud

Storing data online and in cloud storage is becoming popular as people need to access their data from more than one device.

- **Cloud storage**
- **Network media**

Paper storage



Early computers had no method of using any of the technologies above for storing information and had to rely on paper. Today, these forms of storage are rarely used or found. In the picture is an example of a woman entering data to a punch card using a punch card machine.

- **OMR**
- **Punch card**