COA

Chapter 05: | The Read-Only Memory (ROM)

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AGENDA

- ROM Family
- Mask ROM
- read-mostly memory
  - useful for applications in which read operations are far more frequent than write operations

ROM

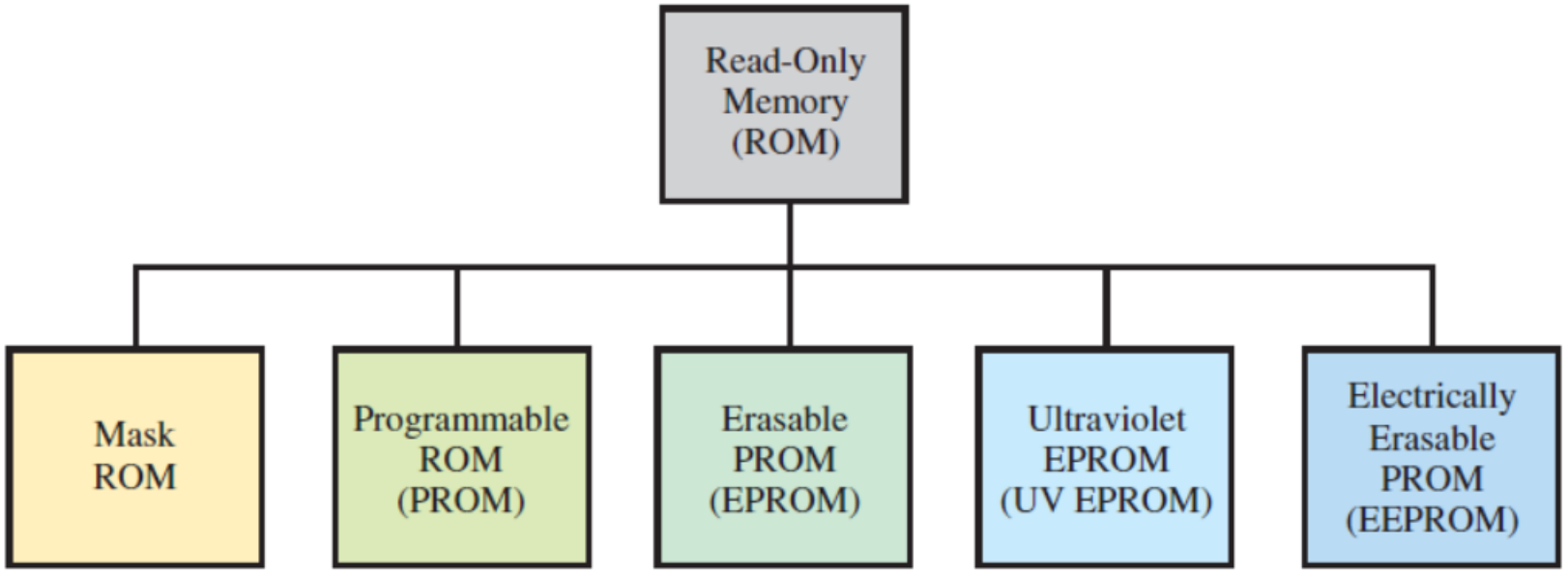
- A ROM contains **permanently** or **semi permanently** stored data
  - cannot be changed **at all** or
  - cannot be changed **without specialized equipment**.
- A ROM stores data that are used **repeatedly** in system applications, such as **tables**, **conversions**, or **programmed instructions** for system **initialization** and operation.
- ROMs **retain stored data –** nonvolatile memories

ROM

InfoNote

ROM is used in a computer to store the BIOS (Basic Input/Output System). These are programs that are used to perform fundamental supervisory and support functions for the computer. For example, BIOS programs stored in the ROM control certain video monitor functions, provide for disk formatting, scan the keyboard for inputs, and control certain printer functions.

ROM Family



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Programmable ROM (PROM)

- PROM is a user programmable memory
  - User can burn information into
  - the **writing** process is performed **electrically** and may be performed by a **supplier** or **customer** at a time later than the original chip fabrication
- For every bit of the PROM, there exists a **fuse**.
- PROM is programmed by **blowing the fuses**
- If the information burned into PROM is wrong, that PROM must be discarded
  - OTP (One-Time Programming)
- **Programming** ROM, also called **burning ROM**, requires special equipment called **ROM burner** or **ROM programmer**

Programmable ROM (PROM)

- A **PROM** uses some type of **fusing process** to store bits, in which a memory link is **burned open** or **left intact** to represent a **0 or a 1**.
- The fusing process is **irreversible**; once a PROM is programmed, it cannot be changed

Programmable ROM (PROM)

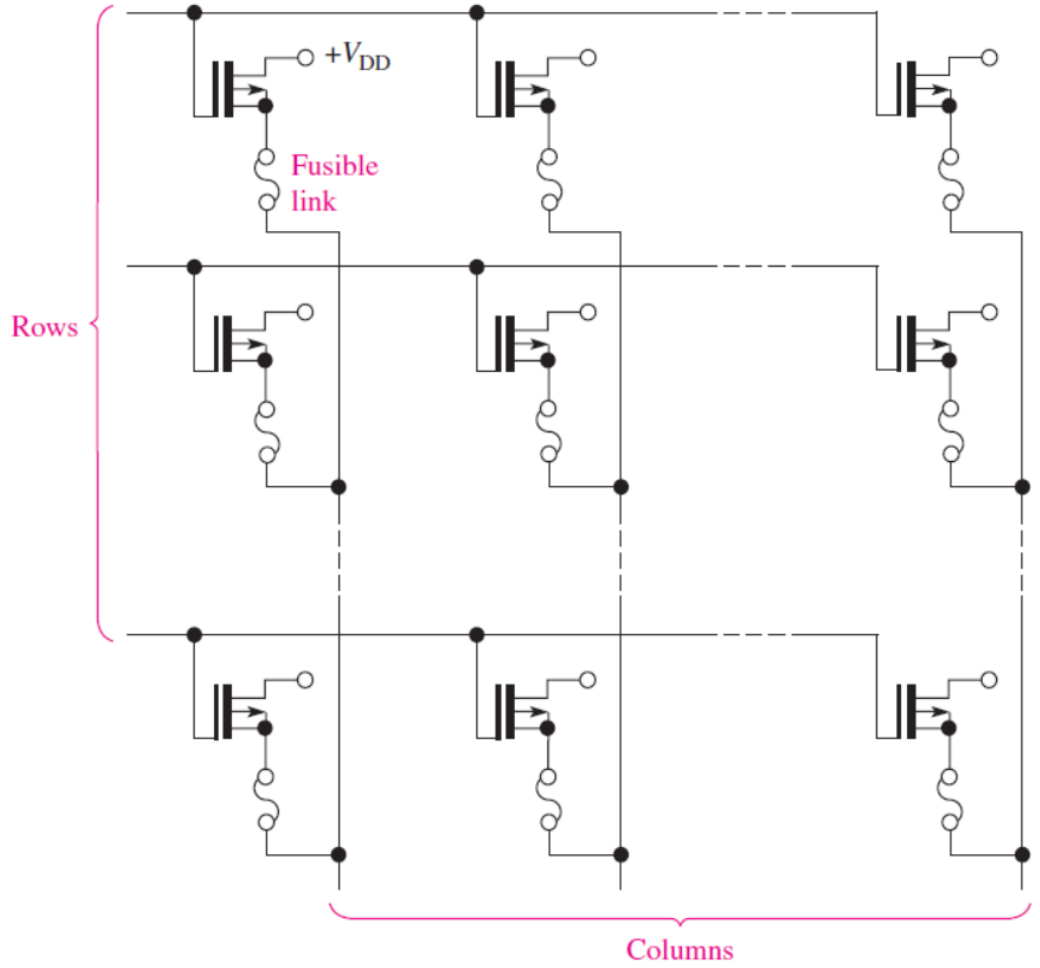


FIGURE 11–30 MOS PROM array with fusible links. (All drains are commonly connected to V_{DD}.)

Erasable programmable ROM (EPROM)

- **Allow making changes** in the contents of PROM **after** it is burned
- In EPROM, one can **program** the memory chip and **erase** it **thousands** of times – this is especially necessary during **development** of the prototype of a microprocessor-based project
- A widely-used EPROM is called **UV-EPROM**
  - Erasing its content can take up to 20 minutes
  - Can not be **erased** and **programmed** on the **system board**

Electrically Erasable Programmable ROM

- EEPROM = E^2PROM
- Method of **erasure** is **electrical** and therefore **instant**
- One can select **which byte** to be erased
- The main advantage of EEPROM is that one can **program and erase** its contents while it is **still** in the system board
- **Cost per bit** for EEPROM is much **higher** for UV-EPROM

Flash memory

- Since the early 1990s, **flash memory** has become a **popular** user-programmable chip – Access time in range of $100\ ns$
- The **erasure** of the **entire** contents (may be block) takes **less than a second** – or one might say in a **flash**
- Flash memory has **no byte erasure option**
- **Programmed while on system board**
  - **Used to program BIOS ROM**
- The program/erase cycle is **100,000 for flash** and **EEPROM**, **1000** for UV-EPROM, and **infinite** for **RAM and disks**

Mask ROM

- The contents are programmed by the **IC manufacturer** – it is **not a user-programmable** ROM
  - referred to simply as a **ROM**
- Since the process is costly, mask ROM is used when the needed volume is **high**, and it is absolutely certain that the **contents will not change**
- It is common practice to use **UV-EPROM of flash** for the **development** phase of a project, and use **mask ROM** after the code/data have been **finalized**

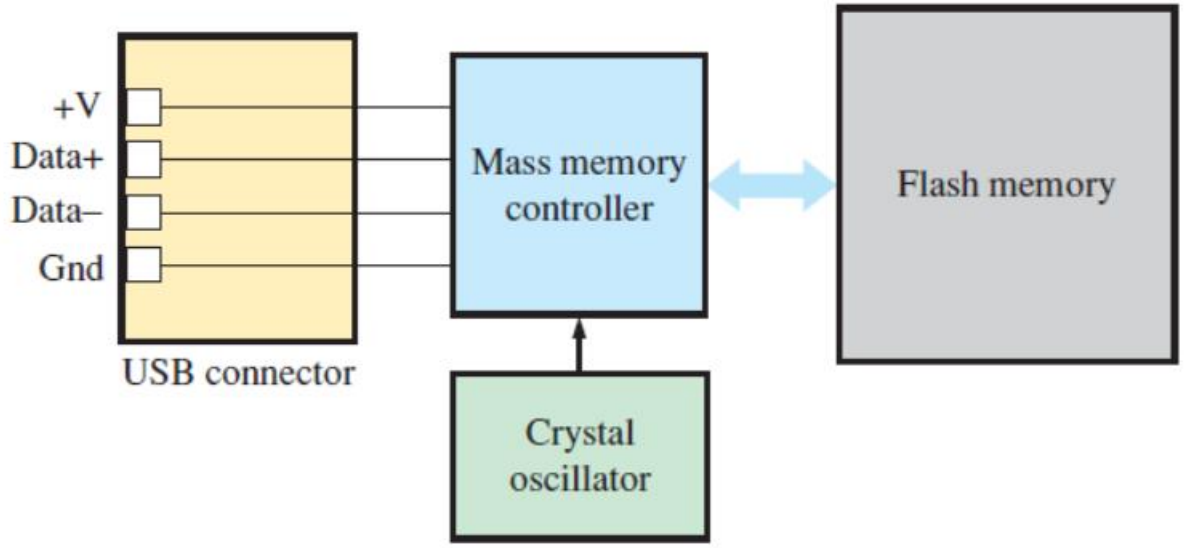
In Brief

Memory Type	Category	Erasure	Write Mechanism	Volatility
Random-access memory (RAM)	Read-write memory	Electrically, byte-level	Electrically	Volatile
Read-only memory (ROM)	Read-only memory	Not possible	Masks	Nonvolatile
Programmable ROM (PROM)			Electrically	
Erasable PROM (EPROM)	Read-mostly memory	UV light, chip-level		
Electrically Erasable PROM (EEPROM)		Electrically, byte-level		
Flash memory		Electrically, block-level		

USB Flash Drive

- A **USB flash drive** consists of a **flash memory** connected to a standard USB connector housed in a small case about the size of a cigarette lighter

(a) Typical USB flash drive



(b) Basic block diagram