Types of ROM | PROM, EPROM, EEPROM, Flash EPROM & Mask ROM

What is ROM?

ROM stands for **Read-only Memory**. It is a type of memory that does not lose its contents when the power is turned off. For this reason, ROM is also called **non-volatile memory**.

Because ROMs are deployed in such a wide variety of applications, there are different types of ROMs suited to different applications across the industry.

Different Types of ROM

Although all ROM basically serves the same purpose, there are a few different types commonly in use today.

Understanding the different types of ROMs will also help you understand how they're used for different applications, and which type may apply to your application.

The different types of ROM used in the industry are:
1. **PROM (Programmable ROM)**
2. **EPROM (Erasable Programmable ROM)**
3. **EEPROM (electrically erasable programmable ROM)**
4. **Flash EPROM**
5. **Mask ROM**
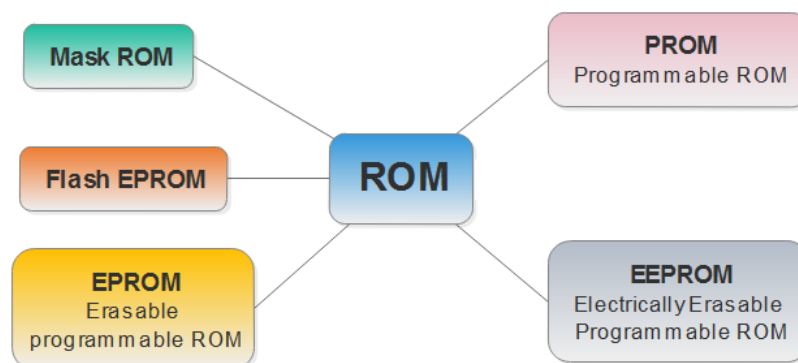
Types of ROM

1. PROM (programmable ROM) and OTP

PROM refers to the kind of ROM that the user can burn information into. In other words, PROM is a **user-programmable memory**.


Bipolar PROM IC

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 since its internal fuses are blown permanently. For this reason, PROM is also referred to as OTP (**One Time Programmable**).

Programming ROM also called burning ROM, requires special equipment called a ROM burner or ROM programmer.

2. EPROM (erasable programmable ROM) and UV-EPROM

EPROM was invented to **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 the development of the prototype of a **microprocessor-based project**.
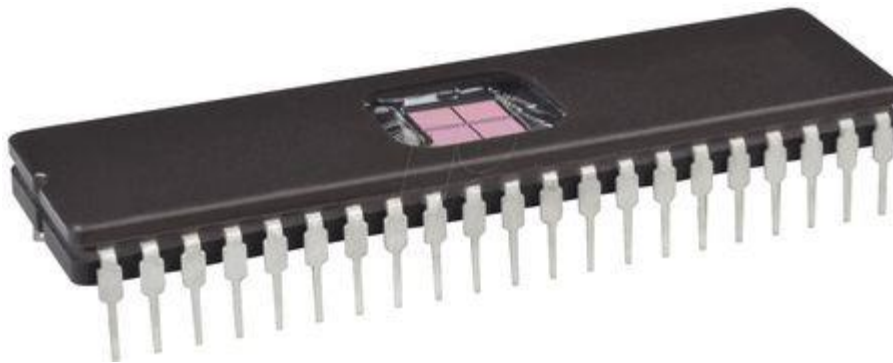
CMOS UV-EPROM IC

A widely used EPROM is called **UV-EPROM**, where UV stands for ultraviolet. The only problem with UV-EPROM is that erasing its contents can take up to 20 minutes.

All UV-EPROM chips have a window through which the programmer can shine ultraviolet (UV) radiation to erase the chip's contents. For this reason, EPROM is also referred to as **UV-erasable EPROM** or simply UV-EPROM.

Programming a UV-EPROM

To program a UV-EPROM chip, the following steps must be taken:

1. Its contents must be erased. To erase a chip, remove it from its socket on the system board and place it in EPROM erasure equipment to expose it to UV radiation for 5-20 minutes.

2. Program the chip. To program a UV-EPROM chip, place it in the ROM burner (programmer). To burn code or data into EPROM, the ROM burner uses 12.5 volts or higher, depending on the EPROM type. This voltage is referred to as Vpp in the UV-EPROM datasheet.

3. Place the chip back into its socket on the system board.

As can be seen from the above steps, not only is there an EPROM programmer (burner), but there is also separate EPROM erasure equipment.

The main problem, and indeed the major disadvantage of UV-EPROM, is that it cannot be erased and programmed while it is in the system board. To provide a solution to this problem, EEPROM was invented.

3. EEPROM (electrically erasable programmable ROM)

EEPROM has several advantages over EPROM, such as the fact that its method of erasure is electrical and therefore instant as opposed to the 20-minute erasure time required for UV-EPROM.
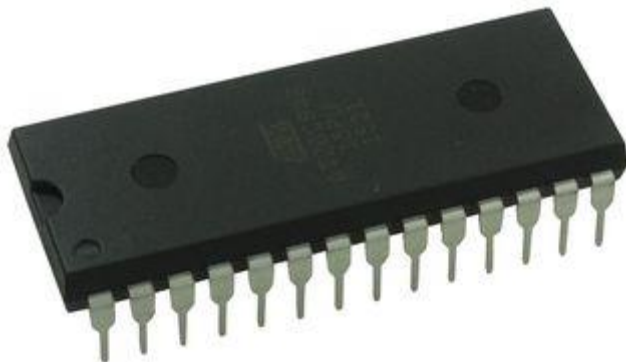
ATMEL Parallel EEPROM

In addition, in EEPROM one **can select which byte to be erased**, in contrast to UV-EPROM, in which the entire contents of ROM are erased.

However, the main advantage of EEPROM is that one can program and erase its contents while it is still in the system board. It does not require the physical removal of the memory chip from its socket. In other words, unlike UV-EPROM, EEPROM does not require an external erasure and programming device.

To utilize EEPROM fully, the designer must incorporate the circuitry to program the EEPROM into the system board. In general, the cost per bit for EEPROM is much higher than for UV-EPROM.

4. Flash Memory EPROM

Since the early 1990s, Flash EPROM has become a popular user-programmable memory chip. and for good reasons.

1. First, the erasure of the entire contents takes less than a second, or one might say in a flash, hence its name, Flash memory.

2. In addition, the erasure method is electrical, and for this reason, it is sometimes referred to as Flash EEPROM. To avoid confusion, it is commonly called Flash memory.
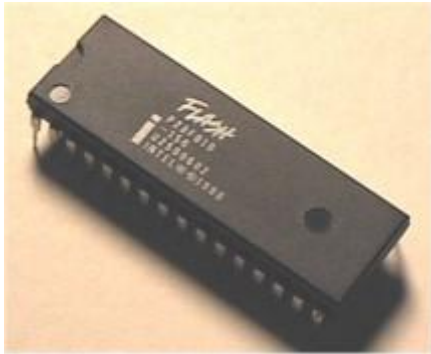
Flash memory EPROM

The major difference between EEPROM and Flash memory is that when Flash memory's contents are erased, the entire device is erased, in contrast to EEPROM, where one can erase the desired byte.

Although in many Flash memories recently made available the contents are divided into blocks and the erasure can be done block by block, unlike EEPROM, Flash memory has no byte erasure option.

Because Flash memory can be programmed while it is in its socket on the system board, it is widely used to upgrade the BIOS ROM of the PC. Some designers believe that Flash memory will replace the hard disk as a mass storage medium.

This would increase the performance of the computer tremendously since Flash memory is semiconductor memory with access time in the range of 100ns compared with disk access time in the range of tens of milliseconds. For this to happen, flash memory's program/erase cycles must become infinite, just like hard disks.

The program/erase cycle refers to the number of times that a chip can be erased and reprogrammed before it becomes unusable. At this time, the program/erase cycle is 100,000 for Flash and EEPROM, 1000 for UV-EPROM, and infinite for RAM and disks.

5. Mask ROM

Mask ROM refers to a type of ROM in which the contents are programmed by the IC manufacturer. In other words, it is not a user-programmable ROM.
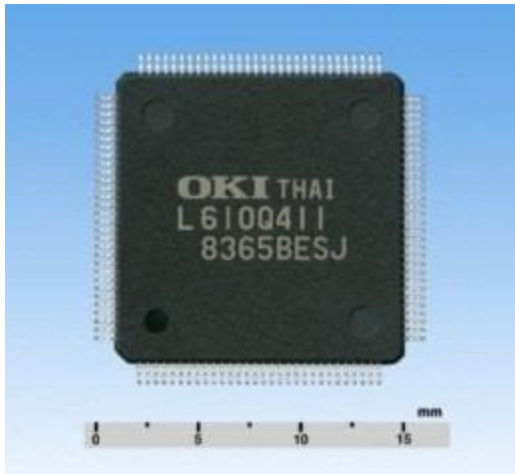
Mask ROM

The term mask is used in IC fabrication. Since the process is costly, mask ROM is used when the needed volume is high (hundreds of thousands) and it is absolutely certain that the contents will not change.

It is common practice to use UV-EPROM or Flash for the development phase of a project, and only after the code/data have been finalized is the mask version of the product ordered.

The main advantage of mask ROM is its cost since it is significantly cheaper than other kinds of ROM, but if an error is found in the data/code, the entire batch must be thrown away. It must be noted that all ROM memories have 8 bits for data pins; therefore, the organization is x8.

SOMETHING IMPORTANT

To put it simply, calling your phone's Internal Storage as ROM is flat-out wrong.

ROM stands for "Read Only Memory" and is memory that resides on your computer mainboard to store vital instruction code that almost never changes — hence "read only." You can't write to it normally, your device only reads data from it and this data is usually instructions (firmware or the like) for your computer. It's not something that is used for the day-to-day computing of the

user, and usually it's only changed through very low-level methods like firmware updates.

This is a completely different thing from storage memory, which a lot of people erroneously use the term for. Storage memory is the actual non-volatile memory of your phone used to keep your day-to-day things like photos, music, and additional apps/programs. Most phones have a core "internal storage" memory along with ways for expansion, usually by microSD cards today.

Some confusion may have arisen from the fact that the core OS of your phone is stored in this internal storage memory but in a special hidden area that cannot be changed normally (the root directory in Android, and whatever its equivalent is called in iOS).

These directories are found in the internal storage of the phone, and are technically Read-Only because you can't edit them without taking special steps that normal users can't do, but that doesn't make your Internal Storage per se into ROM, only this part that houses the vital instructions (OS) to keep your phone running. The rest of your phone's internal storage is obviously writeable, and should not be called ROM.

The ROM type used in almost all phones is Flash memory and especially NAND Flash. You can say it's a type of EEPROM but it has significant differences but mainly the price is much cheaper.

Higher the ROM, higher the internal storage.

Example: 64GB ROM in a phone means around 55GB internal storage is available, where you can:

Store installed apps

Store media

Store any files

If the phone has an SD card, only media and other files can be store in the SD card, may be a few installed apps can also be moved to the SD card.

So, more the ROM, better the freedom. If SD card is also available, then more space for your files.