Safely Stored

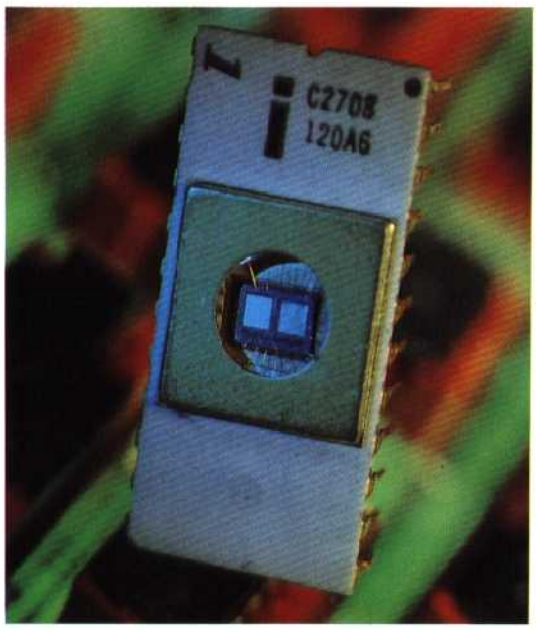
The computer can store thousands of bytes of information in its memory and remember where each one is stored

One way of describing computer memory is in terms of long-term and short-term storage. The long-term type does not lose the information stored and can retain it for long periods even when the power is switched off. Magnetic tape and floppy disks come in this category.

Computers also need fast short-term memory for the temporary storage of programs and results.

Another way of looking at computer memory is to think of it as being either internal or external memory. The internal memory is located inside the computer and is usually fully 'electronic' while external memory is peripheral to or outside the computer. External memory is usually partly mechanical, involving mechanisms such as cassette decks, floppy disk drives or even paper tape punches and readers.

The internal electronic memory is usually called the main memory, while the external memory is referred to as secondary memory or backup memory. These days, internal memory comes in two main varieties – RAM and ROM.



EPROM
The problem with ordinary ROMs is that the memory contents are 'built in' at the manufacturing stage and cannot be changed. EPROMs (Erasable Programmable Read Only Memory) are considerably more flexible. Once programmed, they can be reprogrammed by first erasing the contents and then 'writing' in a new program. EPROMs incorporate a 'window' of silica that allows ultra violet rays to pass through to the interior, causing the capacitors that store the bits in the EPROM to discharge. In the absence of ultra violet light, the capacitors retain their charge indefinitely and the memory contents are retained

Both RAM and ROM are completely electronic devices fabricated in the form of silicon chips and packaged in rectangular plastic cases with sets of parallel tin or silver plated leads. There are further similarities in the way they are selected and 'addressed' by the computer's CPU, but we shall come to that shortly.

The chief functional difference is that ROM memory chips are used to store programs in a permanent form. The pattern of ones and zeros in each memory location is fixed and set at the time of manufacture and cannot be subsequently changed. ROMs are the 'reference libraries' of the computer world. The computer can refer to the contents of the ROM, but is not able to 'write' anything there.

ROM stands for Read Only Memory, read being the term used to describe what the computer does when it 'accesses' or retrieves information from memory. ROMs come in a number of slightly different types, some of which can have the internal program specially removed or erased and can then be re-programmed. A reasonably typical ROM, however, is the 2364 from Intel. This chip is described as being a 65,536 bit ROM, organised as 8 Kbytes of 8 bits. What this means is that the 64 Kbits are grouped together into 8-bit bytes and each 'addressable' location accesses or reads one whole byte. In mathematics $1K = 2^{10}$ (two to the power of ten) or 1,024 so $64K = 64 \times 1{,}024$ or 65,536.

The computer therefore has to be able to select any one of 8,192 (8K) address locations. A close look at the specifications for the 2364 chip reveals that it has 28 pins with one reserved for the +5 volt power supply and one for the ground (earth) connection. This leaves a total of 26 pins. Each byte contains eight bits, so when a byte is read from the chip, the eight bits in that byte have to be conveyed by wires from the chip to the CPU. Consequently, there are eight wires to convey the bits in the byte being read to the CPU. These wires are called the 'data bus'. Eight of the pins on the chip are dedicated to this, one for each bit in the byte.

This leaves 18 pins. One pin is not needed and is not connected. It is retained because it is easier to manufacture chips with an even number of pins. Four pins are used for 'selecting' the chip in various ways. These are the 'output enable' pin, the 'chip enable' pin and the two 'chip select' pins. These pins take signals from the computer to enable the chip to know when it is required.

The remaining 13 pins are the 'address' pins. Each pin is connected to an 'address bus' wire and these carry the address of the byte required, coded in binary form. Thirteen binary digits can give 2^{13} or 8,192 unique combinations of one and zero, so the 13 address lines are just enough to select uniquely each and every of the 8,192 bytes stored in the ROM.

RAMs are the blackboards of the computer world. Programs and data can be stored in them