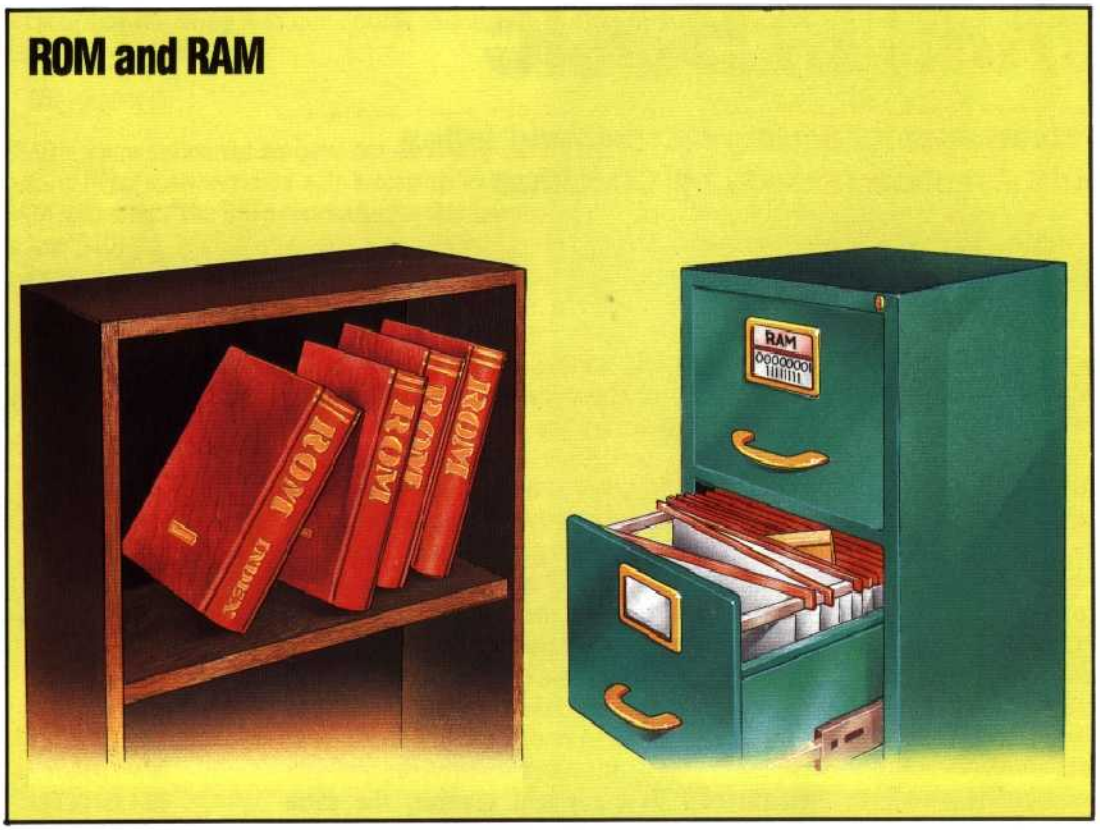
ROM and RAM



Long-Term Memory
The ROM (Read Only Memory) is analagous to a book in that it is a place where information is stored permanently. You cannot change or remove the data any more than you can alter the words on a printed page

Short-Term Memory
The RAM (Random Access Memory) is more like a filing system than a book, since the information can be changed and the data is not permanent — the RAM is wiped clean when the computer is turned off

temporarily, while the computer is working, and results and other data can also be 'written' there temporarily. RAM memory is generally more complex internally than ROM because every bit in every byte of RAM must be capable of being changed if it is 'written to'. A fairly typical RAM chip is the Intel 2114. Each 2114 RAM chip holds 4,096 bits of memory, and these are organised as 1024 'nibbles' (half bytes) of four bits. This means that each location address will output four bits of data. Two of these chips will therefore be needed to produce a whole Kbyte of data. Each 2114 chip has just 18 pins, two of which are used for the ground and power supply. Four are used for the input/output data lines. One is used for the chip select signal (the signal that tells the chip when it is required or 'selected') and one is used to tell the chip, once it has been selected, if it is being written to or read from. The remaining ten pins are used for the address bus. Ten address lines can uniquely identify 2^{10} locations, or 1,024. If a computer were supplied with 64 Kbytes of RAM, and if Intel 2114 chips were used, a total of 128 RAM chips would be required as two chips are needed for every whole byte. These days it is more usual to use higher density RAM chips that pack more memory into the same space. Using more modern RAM chips, such as the 4164, it is possible to get 64 Kbytes of RAM with just eight chips.

RAM and ROM chips are becoming cheaper and more compact year by year and it is now possible to get 128 Kbits on a single chip. Progress in packing even higher densities into single chips is slowing down, however. The circuitry on the silicon is becoming so minute that the optical techniques used to 'etch' the circuits are barely up to the job. The 'high density' memory chips of the future are likely to be manufactured using electron beam or X-ray etching methods.

Broadly, there are two types of RAM memory in use, known as static and dynamic RAM. There are advantages and disadvantages to both types, but dynamic RAM is now used more commonly than static. Both types lose the memory contents as soon as the power supply is switched off, but dynamic memory needs to have the contents 'refreshed' every few milliseconds. Every bit in memory needs to be refreshed or rewritten without slowing down the CPU's ability to access data here. This means that special and very critical timing circuitry has to be designed, making the circuit designer's job more difficult.

Dynamic memory offers two distinct advantages over static memory. Dynamic memory requires only one transistor per bit, compared with the three transistors normally required for each bit in static memory. This allows more memory to be packed into smaller chips. Most dynamic RAM chips have only 16 pins. The other advantage of dynamic RAMs is that they use less power than their static counterparts. They therefore generate less heat and need smaller, cheaper power supplies.

The advantage of static RAM lies in the simplicity of circuit design. Once the contents of memory have been written, they stay in memory without needing to be refreshed. Each one-bit memory cell requires three transistors, so it is difficult to achieve the high densities that dynamic RAM allows. Static RAM also consumes more power and the extra heat generated complicates the computer's cooling system and may require the use of a cooling fan, making the design a lot more expensive.