## CONTROL CHARACTER

Control characters are ASCII codes that are used to indicate to the computer that a specific operation must be carried out. These codes fall outside the range used for normal text, numbers and punctuation, and are often not printable. Many control characters are universally recognised — ASCII 13 is always used to indicate a Carriage Return — while others are used for different purposes on different machines. The Oric and Atmos computers, for example, use control characters for double-height printing, for disabling the screen and for changing the displayed colours. Word processing packages use control characters for formatting text output by sending instructions to the printer.

## COURSEWARE

You may be getting a little wary of the seemingly endless series of 'ware' words. The terms *hardware* and *software* are by now universally recognised; *firmware* denotes system software that is held in ROM; *courseware* is used in educational circles in connection with computer aided instruction (see page 235). It refers to the range of educational software that is available for a particular machine. A microcomputer's courseware may consist of a selection of independent programs from different sources that cover separate topics and that have nothing in common. The term is also applied to programs from the same source that use the same command structure but cover different subjects in the curriculum. Sometimes the word is used to refer to a single program, with demonstration and questions held in separate data files.

## CP/M

Like Hoover, Biro or Thermos, CP/M is a proprietary product name that has found its way into common usage as a generic term and is often used as a description of a business computer. CP/M is, in fact, an operating system that was written by Gary Kildall of Digital Research for 8080- and Z80-based machines. CP/M stands for Control Program/Monitor (or Control Program for Microprocessors), and was the first operating system to be adopted by a large number of computer manufacturers, enabling software writers to develop programs that would run on many different machines.

Its wide acceptance was due to the fact that it was the first in the field, and in many respects CP/M is a far from ideal system, containing several hang-overs from the crude microcomputer system for which it was written. CP/M file-editing, for example, is based on a facility for editing reels of punched paper tape. Numerous versions of CP/M have been released. These include Concurrent CP/M, which allows several different programs to be run simultaneously, and Personal CP/M, which is stored in ROM instead of on disk.

## CPU

The CPU, or *central processing unit*, is the part of the computer that does all the important work. All computers, irrespective of size, have a CPU. The CPU on a microcomputer, however, is contained in a single silicon chip, otherwise known as a microprocessor.

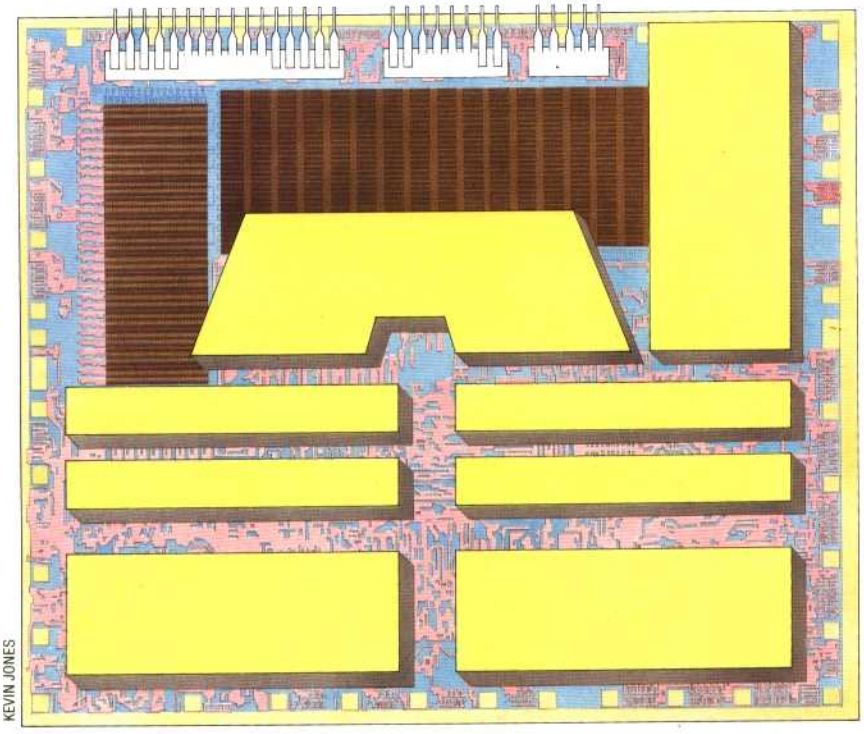
The task of the CPU is to receive program instructions in machine code and carry them out. These instructions may be used to move numbers around in memory or to perform simple arithmetic. All instructions and numbers are in the binary number system.

Each CPU is made up of many thousands of components, although some CPUs are more complex than others. One measure of the complexity of a CPU is the size of numbers that it can handle, measured in binary digits (bits). Many calculators use four-bit CPUs, home micros generally use eight-bit CPUs, some business micros use 16-bit CPUs, and mini and mainframe computers often use 32 or 64-bit CPUs.

Some microprocessor CPUs combine more functions on one chip than others. Many have built-in clocks to produce the vital timing signals, others need a separate clock chip. A number of CPUs include small amounts of memory, while others have all their main memory outside the CPU. The CPU handles all the real computing work, but needs external components before it can be used.

The CPU sends and receives data and control signals over three sets of signal lines, known as buses. These are the data, control and address buses. These buses, plus a few other connections (such as power), enter and leave microprocessor CPUs through the short 'legs' that emerge from the package. The CPU chip itself is encased in this plastic or ceramic package and measures only 5mm (1/5th of an inch) in diameter.

**CPU**
A typical micro CPU showing pin connectors for the buses. The other shapes represent the ALU, registers, program counter, stack pointer, and control block



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