STATE OF THE ART

Since their appearance in 1982, Motorola's 68000 series of microprocessors, the large-capacity successors to the much acclaimed 6809 eight-bit CPU, have captured a significant part of the market for 16-and 32-bit processors. Selected by Sinclair to power the QL, the 68000 is certain to dominate 16-bit computing.

The 68000 bears a strong resemblance to the MC6800, an earlier Motorola microprocessor that is still widely used, particularly in peripherals such as intelligent controllers. This means that the much more capable 68000 is simple to interface and has the support of a wide variety of ready-made hardware. This includes I/O boards with 6821 PIA (Peripheral Interface Adaptor) chips, VDUs with 6845 CRTCs (Cathode Ray Tube Controllers), clocks using the 6840 programmable timers, and disk controllers.

Another feature of the 68000 makes it attractive to computer designers, and that is the width of the data and address buses. These are completely separate from each other, and each bit has its own pin — unlike the 8086, 8088 and Z8000, on which the pins are multiplexed together: the two buses share a set of pins, signals being interleaved and decoded at their destination.

The processor can therefore run as fast as the rest of the system will permit, and with the newer 50- or 90-nanosecond (10^{-9} seconds) RAM chips this can mean a reduction, or even an elimination, of wait states. The fastest processor in the 68000 series is the 68000L12, many aspects of which can be run at 14 Megahertz.

Sinclair Research has used the 68000's successor , the 68008, in the QL. Internally this is much the same as the others in the series, but to make it more compatible with existing eight-bit systems it has an eight-bit data bus rather than the full-width 16-bit bus. Since it needs fewer pins it comes in an ordinary 40-pin package.

Motorola is soon to produce an even more powerful microprocessor. The 68020 is a 32-bit microprocessor that needs a 96-pin package, the shape and style of which have yet to be finalised. The 68881, a specialised floating point maths processor with eight registers (each 80 bits wide) that will greatly increase the amount of 'real' data that can be handled, is also being planned.

A number of other chips in the 68000 series provide I/O functions similar to those found in earlier chips, but greatly enhanced. From the programmer's point of view, however, the 68000

Winning Series

6502
Developed by MOS Technology, the 6502 microprocessor was to become, with Zilog's Z80, the mainstay of the microcomputer industry. It utilises a 16-bit address bus and an eight-bit data bus. Chief amongst its peculiarities is the organisation of its registers. There is only one accumulator, but the whole of memory page 0 can be used as general-purpose registers

68000
Motorola redesigned and redeveloped the 6800 into the 6809, but not in time to secure a large share of the eight-bit market for itself. This was to prove an advantage, for it led the company to develop the 68000 16/32-bit processor. The 68000 is able to utilise many of the 6502/6800 series support chips, and is built around eight 32-bit data registers and seven 32-bit address registers

Z80
Theoretically more powerful than the MOS 6502, the Zilog Z80 uses similar address and data bus structures but has a considerably strengthened register set — 12 eight-bit general-purpose registers and two 16-bit index registers — and a much larger instruction set. Perhaps its greatest advantage over the 6502 was its ability to support the CP/M Operating System

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has many advantages over most other 16-bit processors, owing to the symmetry of its address and data registers and the rich instruction set.

It isn't perfect, though. First, a distinction is made between the address and data registers, though they are the same size (32 bits) and in most respects are operated upon in the same way by the same instructions. As a result, it is often necessary to move data from an address register to a data register, manipulate it, and then return it to the address register. It would have been easier if Motorola had allowed any register to be used for either data or addresses.

Second, there are redundancies in the instruction set, but as these result from what might be called 'addressing mode cross-over', this isn't critical. This phenomenon arises because the various addressing modes are so different that sometimes one means exactly the same as another, despite having been arrived at by different instructions.

In general, however, the Motorola 68000 series provides large, fast and efficient CPUs that are becoming widely used. In the past year they have been used in Apple's Lisa and Mackintosh, Sinclair's QL, and many multi-user business machines with lower profiles in the market. Providing features that would have cost thousands of pounds only a couple of years ago, and available at a reasonable price, they seem set to become as popular among the next generation of machines as the Z80 and 6502 are today.