6809 A USEFUL NUMBER

Vincent Fojut looks at two new second processors, aimed at industry and considerably cheaper than comparable alternatives, based on the 6809 micro

ALTHOUGH second processors based on the 6502 and Z80 have received much attention lately, a third 8-bit family of add-on processors, based on the 6809 micro, have recently become available. This review compares two competing 6809 systems for the BBC micro, and considers how they differ from the alternatives.

The two systems are the Cube BeebFlex from Control Universal, and the simply-titled 6809 second processor from Cambridge Microprocessor Systems (CMS). Both offer a surprisingly similar complement of facilities and software support. The major immediate differences are in the packaging of each system.

CMS have squeezed all their hardware onto a single board which is slightly longer than a standard Eurocard. This fits neatly under the lid of the BBC micro's casing, and connects via a short cable directly to the Tube interface. Alternatively, using a longer cable, the card can be mounted in a standard Eurocard rack, and linked to additional boards via its Acorn bus-compatible 64-way indirect connector.

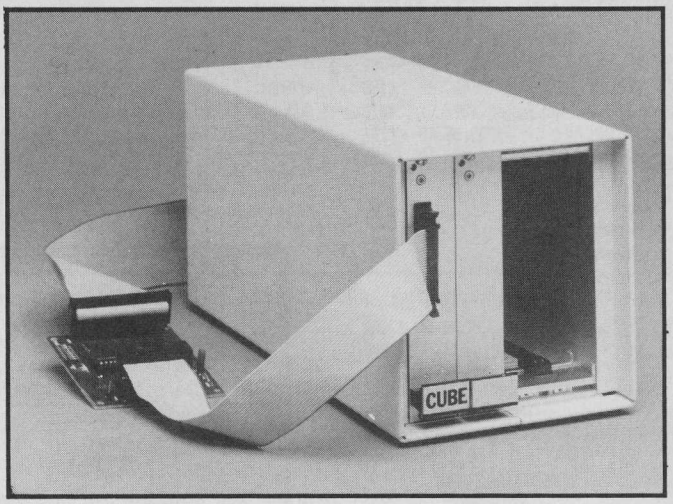
The board is populated with a 6809 central processing unit (CPU) running at 1MHz, a full 64k of RAM, a 4k monitor EPROM (plus space for another 32k of memory) and a couple of 6522 interface chips which act as a link to the Tube. Though not as efficient as a custom-designed Tube ULA (uncommitted logic array) chip, the speed of throughput using the 6522 versatile interface adaptors (VIA) is still acceptable.

Power is taken from the Beeb, so you must run your discs from another source if they're not fitted with their own supplies. Also, if your BBC micro already has expansion boards of one sort or another, you may have to mount the second processor externally. However, if your desktop is already cluttered, installing the board internally is a great space-saver and the end result is quite unobtrusive.

Control Universal have adopted an altogether more substantial approach to their packaging. Three separate circuit boards make up the system:

- A 6809 CPU card which houses the processor, 4k monitor EPROM, scratch-pad RAM and a single VIA
- A 64k dynamic RAM card
- A small Tube interface card, holding a second VIA.

The first two boards are standard Eurocards, and are housed in a metal four-slot mini-rack with an integral power-supply, finished in beige to match the Beeb. Two remaining slots are therefore available for future expansion.



The Cube BeebFlex is made up of three circuit boards

The Cube BeebFlex uses the same dual VIA approach to connect the system to the BBC micro's Tube interface. Since only one VIA can fit onto the CPU card, another small card is needed to hold the second VIA chip. This can be installed within the Beeb (secured to the underside of its lid), or left to flounder untidily on your desktop.

With the aid of appropriate software, both 6809 systems give the BBC micro user access to the range of software written under Flex, the standard disc operating system for the 6800/6809 family.

The CMS system was supplied for review with a BBC disc holding two important programs. The first allows discs to be formatted to standard Flex requirements and run on BBC hardware. The second program, together with the monitor EPROM on the 6809 card, provides the necessary link software for inter-processor communication. Executing the program automatically transfers control to the 6809 monitor – a "CMS >" prompt denoting all is well. With the Control Universal set-up, this linking and formatting software is supplied on a sideways ROM, for permanent installation in the Beeb. Obviously, this latter option is slightly more convenient, providing you have the space for yet another ROM. Typing *FLEX enters the 6809 monitor.

The monitor software is virtually identical on both systems. The range of commands offered is shown in tables 1 and 2 overleaf.

Overall, the Control Universal monitor has a rather unfinished feel to it. For example, I tried dumping the last page of memory (&FF00 – &FFFF) to the screen. Once the end of memory was reached, the dump 'wrapped-around' to low memory (0000 onwards), and would continue to dump *ad infinitum.* Control Universal claims that an improved version of the monitor, which rectifies these oversights, may soon be available. The range of commands is also limited – a command to change register values during the program de-

bugging process would not go amiss.

Flex is probably the most popular disc operating system (DOS) for the 6809. It has established a reputation for elegance, sophistication and user-friendliness. The implementation supplied with both products comes complete with a 6809 macro-assembler and a line-orientated text editor. Documentation for the DOS, assembler and editor is provided in a comprehensive 200-page manual.

The Flex DOS assumes the system on which it is running has at least two disc drives. It has been configured to use the Beeb's disc interface via calls to routines within the Beeb's DFS ROM. I was disappointed by the speed of many disc operations. Creating a Flex system disc (one from which the DOS can be loaded) took approximately six minutes, using a Beeb fitted with Acorn's DFS. It is interesting to note that CMS recommend the Watford DFS as being twice as fast as Acorn's DFS 0.90, but I was, unfortunately, unable to check this. Similarly, those lucky enough to have the new Acorn DNFS should also find disc operations much faster (see George Hill's comments on page 104 of *Acorn User*, September 1984).

With either system monitor in control, Flex is copied into RAM by means of the 'U' command. This initialises the Flex disc operating system. Unlike the range of DFS software for the Beeb, which is all ROM-based, Flex holds virtually all its commands on disc in the 'Utility Command Set' (UCS). One great advantage of this arrangement is that further commands can be appended to the UCS with ease, by adding suitable command files to the system disc. This in no way encroaches on free memory, since the extra commands stay on disc, and are only loaded when required. (To complicate matters, CMS have recently announced that a 16k EPROM is to be made available, holding linking software, formatter and Flex in firmware – eliminating the need to load Flex from disc on startup.)

Memory requirements can be seen from the system memory map (figure 1). An uninterrupted 48k of RAM is normally available to the user, but once a language interpreter/compiler is loaded into this area, the amount of free memory is reduced.

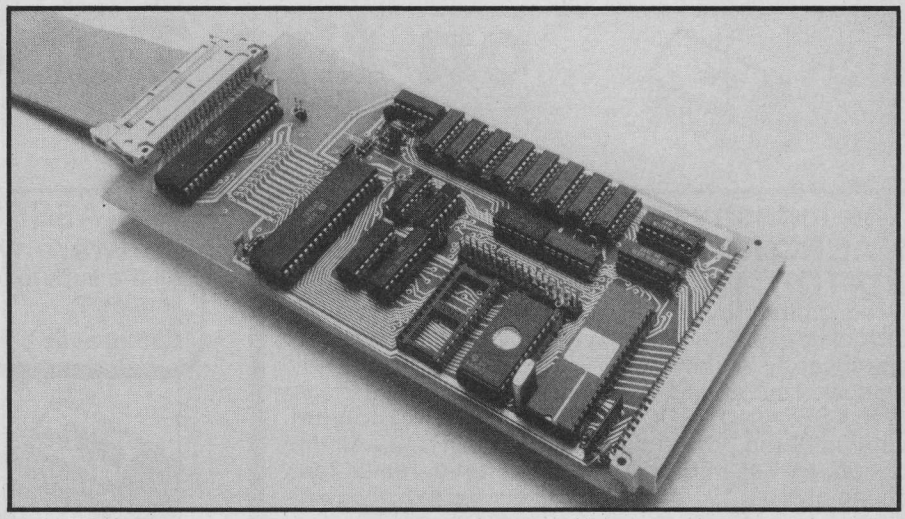
Undeniably, the range of software available under Flex is not as extensive as that for CP/M, especially in the area of commercial business applications. However, there is still a wide variety of sophisticated programs and languages accessible to the Flex user.

Both companies are aiming the board predominantly towards the professional engineering market, as a low-cost development system for dedicated applications. CMS offer the 6809 card in a compatible single-board controller (SBC) format, for use in final application hardware. The SBC can also accept low-power CMOS RAM, and has facilities for battery backup. Similarly, the two main boards in Control Universal's BeebFlex are standard Eurocards from the extensive range manufactured by the company, which are mostly available in anything from fully-assembled form, right down to bare boards. Therefore, using either 6809 system, applications can be developed with the BBC micro/second processor combination, then transferred to identical dedicated hardware.

Software development is by no means limited to the 6809. A wide range of cross-assemblers and disassemblers are available for most popular 8-bit CPUs (including the 6800, Z80/8080 and 6502 families), and even bigger beasts like the 16-bit 68000 are catered for. Users of the 6502 are particularly well-blessed – in addition to the above tools, a 6502 machine simulator is available, to allow testing/debugging of 6502 code, using the 6809. There is even a package to perform 6502 to 6809 machine-code translation.

The 6809 is generally considered to be the most elegant and powerful of all 8-bit CPUs. To solve a given software problem, the 6809 typically takes fewer instructions, less memory, and is appreciably faster than other 8-bit processors, when running at comparable clock rates. However, since the 6809 in each system runs at 1MHz, as opposed to the 3MHz 65C02 and 6MHz Z80B in Acorn's second processors, the 6809 add-ons do not stand out in terms of speed. Faster versions of the 6809 are available, and it's rather a shame that neither company opted for 2MHz operation – then we might really have appreciated the impressive speed performance the 6809 is capable of.

Nonetheless, the processor is cer-



The CMS 6809 second processor squeezes all the hardware onto a single board

Command	Meaning
U	Boot a Flex system disc
K	Fill memory area with specified byte
C	Perform cyclic redundancy check
M	Memory examine/modify
G	Execute program at specified address
N	Execute program at (current program counter + 1)
Q	Test memory area
D	Dump memory to screen/ printer
L	Load 6809 memory from 6502
S	Save 6809 memory to 6502
O	Branch offset calculator
F	Flex warm start

Table 1. CMS 6809 monitor commands

FLEX 0.1
C <adr1> <adr2> CRC check
D <adr1> <adr2> Dump memory
F FLEX warm start
G <adr> Go to Hex address
I Initialise Monitor
K <adr1> <adr2> <data> Fill memory
L <adr1> <adr2> <FROM> Load 6502 RAM
M <adr> Memory examine
O <adr1> <adr2> Offset calculation
Q <adr1> <adr2> Test memory
R Registers
S <adr1> <adr2> <TO> Xfer to 6502 RAM
U Up load FLEX

Table 2. CubeFlex 6809 monitor commands

tainly no slowcoach, even at 1MHz, and irrespective of speed, the sophistication of its instruction set cannot be ignored. With a copious set of registers, a wealth of true 16-bit operations and an extensive range of addressing modes, even assembly language programming on the 6809 seems rather high-level!

The 6809's advanced architecture has also allowed the efficient implementation of many popular high-level languages. The software development engineer will find a great variety of languages running under the Flex/6809 combination, offering an environment to suit most applications. There are the old stalwarts of computing such as Basic, Cobol and Fortran, and also more modern, structured languages such as Pascal, Forth, C, BCPL and PL/9. This last is a true machine-code compiler, written specifically for the 6809, which offers the ease of high-level programming without sacrificing the speed and hardware-intimacy of assembler. Furthermore, many of the languages running on the 6809, such as PL/9 and certain versions of Pascal, allow programs to be transferred to ROM/EPROM for use in dedicated applications or stand-alone systems.

The 6809 macro-assembler provided with the Flex package is an excellent programming tool. A measure of its versatility is that the cross-assemblers available under Flex, for other CPUs, are actually implemented as 'macro sets' for use on the very same assembler. This saves having to buy a completely new assembler for each different processor you want to program.

The other major program provided with the Flex system, the Text Editor, is a reasonable, but old-fashioned, line-orientated package. It lacks some of the convenience of a full-screen editor, but it is perfectly adequate for creating assembler program source files etc.

The VAT-inclusive price of a 6809-based second processor system with cable, link/formatter software and Flex, comes to around £400 for the CMS version, and about £490 for the cased and powered Cube BeebFlex. This clearly makes either 6809 option more expensive than other extensions based on the 6502 and Z80. However, though there is obviously some overlap, each system addresses distinct sectors: the Z80 add-on for business, the 6502 variant for sophisticated home/educational use, and the 6809 version for industrial/technical development.

Which of the two 6809 second processors is better? The CMS system is compact, relatively low-cost, and if you don't plan further expansion, this would seem to be a sensible choice. If you do want to expand, or don't have the space and surplus power for another add-on, Control Universal's package is rugged, self-powered, and has two spare expansion slots.

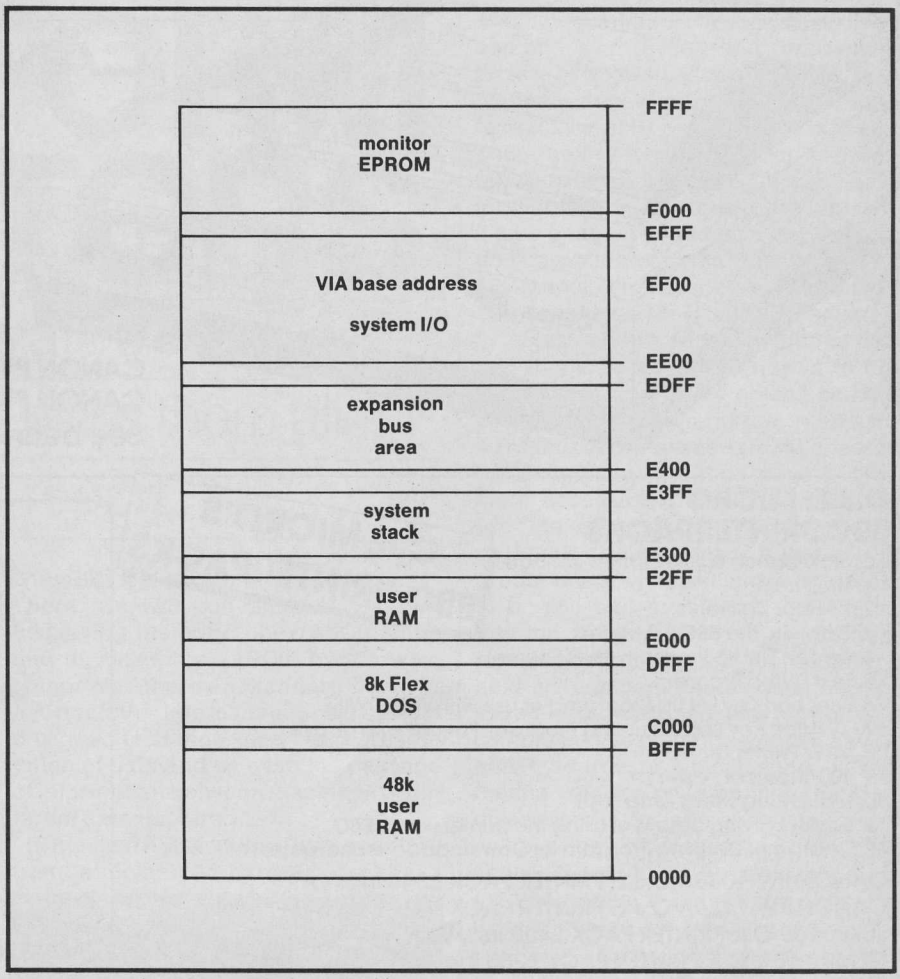


Figure 1. 6809/Flex system memory map

If you envisage really extensive expansion, it's worth remembering that either system can be housed in a much larger rack. Since both use Acorn bus-compatible connectors, cards from either company (and others) could be mixed on the same system. Control Universal's range of Eurocards is very wide, offering high-resolution colour graphics, disc controllers, analogue and digital I/O, EPROM programmers, etc. CMS are rapidly developing a similar range of expansion cards.

One of the languages you cannot run on the 6809 add-on is BBC Basic, which is available in forms suitable for both the 6502 and Z80 second processors. However, the advantages far outweigh this shortcoming. What the 6809 systems offer is an 8-bit processor which is second to none in terms of programming elegance, a sophisticated and user-friendly disc operating system, and a wide range of powerful programming languages and development tools.

Undoubtedly, for those with the appropriate Beeb hardware, either product offers a 6809/Flex system at considerably less cost than comparative alternatives. I can see both configurations proving very popular with industry, higher education, and even a few well-to-do hobbyists.

SUPPLIERS

Cambridge Microprocessor Systems
44a Hobson Street,
Cambridge CB1 1NL.
Tel: (0223) 324141.
6809 second processor card £249.00
Small connecting cable (6in) £10.00
BBC to 6809 link/formatting software £10.00
Unconfigured Flex, with assembler, editor and manual £85.00

Control Universal
Andersons Court, Newnham Road,
Cambridge CB3 9EZ.
Tel: (0223) 358757.
Cube BeebFlex, with case, psu and link/formatting sideways ROM £359.00
Flex, with assembler, editor and manual £65.00

All prices exclude VAT