CMS BREAK INTO THE MIDLAND BANK

In the world of finance, technology is playing a much more important part than many people realise. Take foreign exchange dealers, their job is being increasingly assisted by communications, information and computer systems all of which enable them to buy and sell money faster and more efficiently than before. Money, like other commodities, is bought and sold in the worlds main trading centres; Tokyo, Hong Kong, the Middle East, London and New York – fast communication is important. Information to a dealer in London about trading in Tokyo or Hong Kong will indicate any underlying trends or market movements which assist the dealer in trading and the service of his customers.

As world trade continues to grow businesses need to buy, sell and deposit foreign currency both now and in the future in order to reduce foreign exchange risks. Information about many world currencies and the rapid changes that occur need to be relayed as quickly as possible to all concerned so that immediate decisions can be taken.

The Rates Display system which was designed for Midland Bank plc, Group Treasury provides fast audio and visual communications between dealers while at the same time incorporating computational processing of data. The system comprises 130 CMS computer units, each containing a 6502 low cost controller, a high resolution colour graphics card and a special communications card. Each unit is connected via an 8 pair telephone type cable which forms a high speed data ring with many unique features. No central equipment is required as all units are masters with the ability to receive and transmit autonomously. The speed of transmission can be up to 10M baud although for practical purposes 38K baud will be adequate. If data needs to change, say the UK pound moved up one point or pip (£0.0001), this would be transmitted by the dealer simply by pressing two keys; this change in data base is simultaneously transmitted to all other units (regardless of number) and updates each unit's data base. The new data will then be displayed if the page selected contains the data or a derivative of it. Any change of data is timed stamped and colour changes are used to indicate the last change on that page.

The CMS system contains some 40 currencies and can display 1000 pages; it provides for many calculations to take place automatically. The data is battery backed in case of power failure and for storage overnight weekends and holidays.

CONTENTS

WHY CHOOSE CMS?

Because we put you, the customer, first, choosing CMS eliminates many of the difficulties that can arise when buying electronic equipment. Our products are well designed. They are assembled at our factory using the latest manufacturing techniques and are thoroughly soak tested before despatch. They are supported by a comprehensive set of manuals which contain clear concise instructions on how to use each product and example programs where applicable. We are justifiably proud of the high standard of our after-sales back-up. We can guarantee all our customers easy access to our competant team of applications engineers who are available to offer instant advice and clarification whenever necessary.

SO REMEMBER, WE GUARANTEE

- ■ Reliable high performance products
- ■ Concise and extensive documentation
- ■ Access to an informed team of engineers
- ■ Top rate after sales technical support
- ■ Fast efficient delivery – all CMS products ex stock
- ■ Competent friendly service

AND A GROWING NUMBER OF SATISFIED CUSTOMERS

Marconi
Medical Research Council
Memory Devices
Electricity Research Council
Beechams Pharmaceuticals
Ministry of Defence
Midland Bank
R.A.F.
Lucas Electrical
Prestel
STC
British Telecom
Rolls Royce
British Leyland
Stock Exchange
Redifusion Robotics
Reuters
BBC
Wilkinson Sword
Royal Signals
ABC News
Universities
Schools/Colleges
Hospitals
Research Establishments
Philips
Racal Decca
British Antarctic Survey
Plessey
U.S. Navy
Pilkington Brothers
G.E.C.

PUT YOUR NAME ON THE MAP!
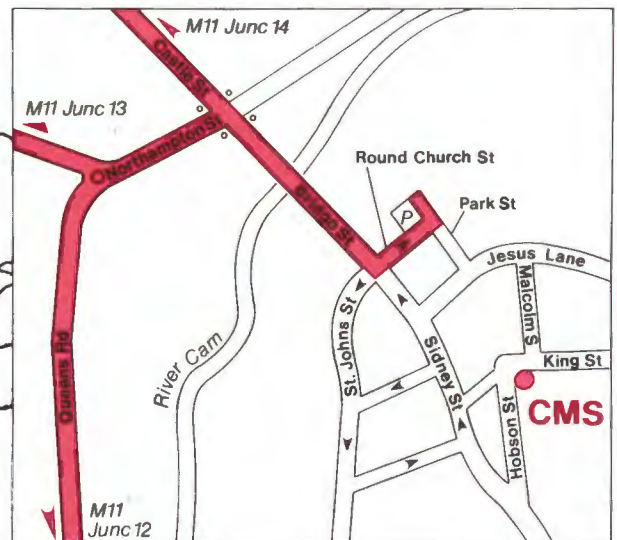
THE FACTORY

The champagne corks were popping a few weeks ago as CMS celebrated in style – the official opening of its new 10,000 sq. ft. factory. We see the factory as significant for three reasons.

Firstly – it is an obvious extension to our original objective, which was to create, by careful design a range of Eurocards flexible and versatile enough to ensure their suitability for a wide range of applications. The factory will guarantee that our Eurocards are built to the same high standard as they are designed.

Secondly – it gives us the ability to maintain stock levels which are adequate to satisfy the ever inceasing demand for our products. The factory has been equipped with the very latest in production and test facilities. Much of the production is automated and we have designed some unique test equipment for fast fault diagnosis and reliability testing.

And thirdly – the purchase of the factory is a firm investment for the future and that is a crucial factor for you as well as for us because it gives you that definite assurance that this high-tech company is here to stay!


CUSTOM MADE

Think of CMS eurocards as a type of high tech Lego and you will have no difficulty in grasping just how versatile they are.

Although the range has been designed for its flexibility we realise that there will always be some customers needing something slightly different. To satisfy this demand CMS offer a highly attractive customising service. There are various ways in which this can work. For instance, we have several customers who have started out using two or three CMS cards in their equipment, as their volume has increased we have taken another look at their requirements to see if efficiency and performance could be improved. The answer is invariably yes and we have successfully combined functions contained on two or more cards onto a single board. Similarly, for those customers using existing products in sufficient numbers, we are prepared to remove any facilities not required.

Alternatively you may want a customised product from the word go.
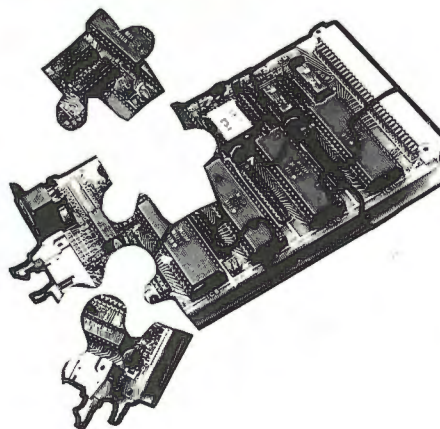
Just let us know what the system has to do and we will do the rest. Our design team will work along side your engineers to assess feasibility, decide on a specification, design the PCB, and write the software. We can then offer you all the benefits of our recently equipped factory to produce high quality, low cost eurocards quickly, efficiently and conveniently.

CMS Soft was formed in Cambridge in January 1985, to provide total software support for the ever growing needs of the parent company and its customers.

The company is headed by four partners, each of whom is an expert in his own field. Alf Haills, the company chairman has many years of experience in the development, test and insulation of network processor systems, particularly using 6502. John Trew, a communications engineer together with Alf is responsible for the currency dealing system installed in the Midland Bank in London. John also doubles as financial manager of the company keepng one eye firmly on the budgets of the next-mentioned members of the partnership. Phil Taylor is a name that many will already familiar with, having several processor system designs to his credit. Phil generally acts as information officer, assessing customers needs and matching these with both hardware and software solutions. Joe Brown, who wrote this monologue, is naturally the brightest and most talented of all the CMS directors. This, coupled with his unique role of modesty, lead to his appointment as chief software engineer. Joe has some 18 years experience in electronics, the latter part concerned with micro electronics and software engineering, particularly in the field of interactive language development. He is responsible for the production and test of operating systems, custom bespoke control software, and the support of the parent companies software needs and that of their customers in general.

CMS Soft also employ the services of several expert consultants, enabling the company to satisfy the needs of any customer, large or small, where system control, service languages etc. are required.

The company has the unique "MULTI-BASIC" to its credit, discussed elsewhere and we believe that this will be adopted as the ipso-facto standard for control of 6502 systems for the foreseeable future. Work is already underway on a similar product for the new generation 68000 system card created by CMS, this will give the end user a choice of hardware, software solutions, unmatched by any other company. Other products produced by the company are FORTH compilers for both the 6809 and 6502 systems and also for the BBC Micro.

The company offers friendly informed advice on a whole range of topics, and if you feel we could be of service to you, why not give us a ring?

6502 PUT YOURSELF IN CONTROL...

DEVELOPMENT SYSTEM

The CMS 6502 development system provides an uncomplicated, low cost solution for industrial users wanting to program in BBC BASIC. Based on the BBC micro and the CMS 6502 Industrial Controller card, it incorporates MULTI-BASIC (the Real Time Multi Tasking Extension ROM). Using this system, even those control applications which were difficult or impossible may now be tackled with ease. Full bus expansion is achieved by an industrial racking system providing the interface to a complete range of I/O and video support cards manufactured by CMS. Once the program being developed is running satisfactorily the CMS boards may be disconnected from the BBC micro to run stand alone in the target application.

6502 Development System being used as a FILESERVER in a typical network application.

INDUSTRIAL NETWORK

Included in MULTI-BASIC are keywords which allow the user to implement a complete industrial network.

A network consists of a Supervisor controlling up to 126 remote stations, interconnected by the Industrial Standard RS422 serial interface. Each remote station may be regarded as a stand alone processor system, programmed in BBC Basic or some other high level language, and performing a discreet task or multi tasking.

The MULTI-BASIC network manager software contains extensive error checking to ensure reliable performance in even the noisiest of industrial environments.

19 MULTI-BASIC network keywords are provided, allowing the user to write a basic program which can interrogate, reprogram or simply receive and transmit data to or from any one of the remote stations in the network.

Several supervisor display pages are included in the manager software to enable users to supervise at a glance system status and remote activity.
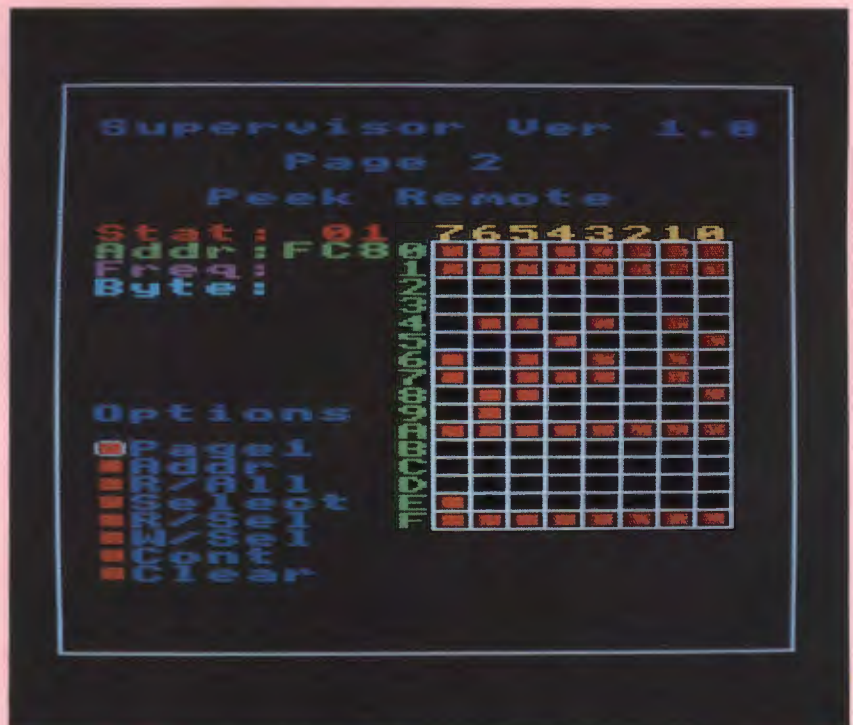
A typical display when examining the memory of a remote station.

...WITH MULTI-TASKING BASIC

INDUSTRIAL CONTROLLER

The CMS Industrial Controller supports all the commands of BBC Basic on a single Eurocard, just 100 mm x 160 mm in size. However sophisticated the function required by the industrial engineer, Input/Output or video, the range of hardware manufactured by CMS provides the answer.

With the addition of MULTI-BASIC, the user not only has a true multi-tasking environment by 54 extra Basic Keywords, making programming for control both simpler and more readable. The commands include SET, UNSET, TOGGLE for VIA (Versatile Interface Adaptor) control. Also included are Timers, Real Time Clock, and comprehensive commands for ADC and DAC hardware. Software to support full colour graphics or the 40/80 column terminal card is available for those requiring a video display in their target system.

By providing good, reliable hardware and an easy software package to drive it, CMS promises that even the most inexperienced of users will have no problems in developing suitable Industrial systems.
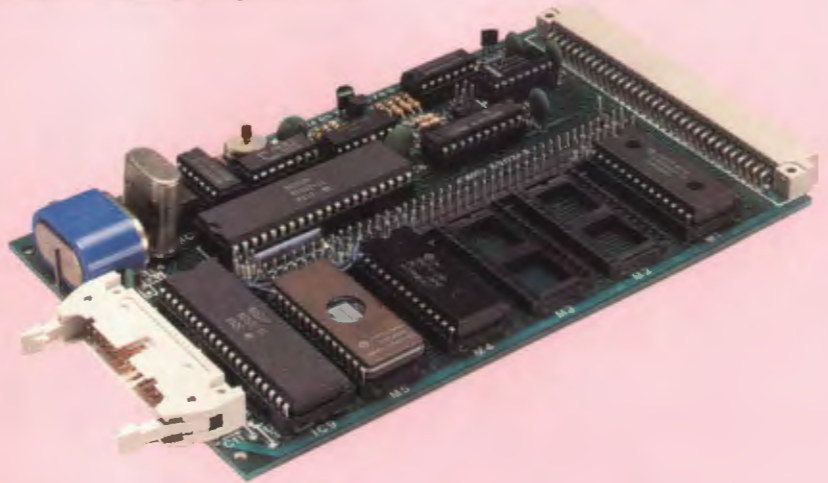
A TYPICAL TARGET SYSTEM

There is a growing need in manufacturing industry for improved process control and better management information systems. To date, such systems have been expensive and not easily justified for small plant operators – even though savings in energy costs, better product control and reduced labour costs can be easily achieved.

The CMS system readily lends itself to this area and at a price easily justified to the smaller plant – kilns, small furnaces, driers, boilers, refrigeration plant management schemes etc. Its rugged construction, excellent input and output facilities, and powerful operating and graphics system, are ideal for the complete control and information tasks on such plants. It can be networked and linked to stand alone, intelligent controllers to give a powerful distributed intelligence system providing maximum integrity and process security.

It has already been engineered into various plant control and "policing" schemes including systems for kilns, spray driers and production plant mimicks. All at a fully engineered cost substantially below existing systems on the market.

CMS ☎ (0223) 324141

MULTI BASIC   . . .THE

SOME BASIC HISTORY

In December '84 Phil Taylor of CMS and Joe Brown were discussing the ever-growing range of products developed by the company. Consequently, it was agreed that an easy-to-use software environment was required, particularly for those using 6502 systems. At that time CMS had a fully fledged Operating System for their 6502 card, capable of running several languages including BBC BASIC. It was thought that could the latter be expanded, it would provide a powerful more user-friendly medium for control purposes. Almost a decade ago, a modified form of BASIC was developed for this purpose called ONLI BASIC. Its terms of reference were however, narrow, and several of the concepts are now out-of-date, even rather naive. It was felt that a far more powerful engine could be developed using the very elegant BBC BASIC as the statement parser/discriminator, with additional control words, functions and procedures. The subject of Multi-tasking was also discussed, and as a result work was started on the program in early January by both Joe Brown and Barry Worrall.

The result of these endeavours is Multi-Basic, and the program far outstrips former expectations, including over 50 new commands to BASIC, being fully Multi-Tasking and supporting event driven 'tasks'. Unlike other so-called real-time BASICS, both background and foreground tasks are fully transparent, there is no need to artificially halt execution of the foreground with statements such as WAIT etc. Full control of the interpretive pathways is maintained by the discriminator in the program.

Using the concept of a 'task', the user may define his program as a foreground task, and several background tasks. Time will be 'stolen' from the foreground task whenever an event has occurred. Such events may be of the timed variety, that is executed at regular intervals, or of a sporadic nature. Both types of event are catered for, as the following examples demonstrate. First let us discuss the timed variety. Consider:

TIME TRIGGERED MULTITASKING

ENABLE . . . EVERY

```
100  TASK time
110      RD_HMS[hrs%;mins%;secs%]
120      P.TAB(10,10);hrs%;mins%;secs%
130  EXIT
```

We can enable the execution of the above at regular 1 second intervals with:

```
140  ENABLE time EVERY 100cs
```

Noting that line 140 need only be executed ONCE to enable 'time'.

A foreground task is simply the 'normal' BASIC program, e.g. a 'dummy' foreground task could be:

```
600  REPEAT
610  UNTIL 0
```

although the user may want to do more than this!

The point of the above is that EVERY 100 centi-second, the time will be read from the system real-time-clock, and output on the VDU, whilst carrying on executing lines 600–610 (or your slightly more useful program!)

Eight such 'tasks' may be current at any one time, and facilities are given to DISABLE or OMIT any or all, so that others may be defined and executed.

It is also possible for a task to DISABLE itself. For example the following task will be executed only once after the time interval specified in its associated ENABLE . . . EVERY statement.

```
50  TASK once
60      PROCboiler_off
70      DISABLE once
80  EXIT
```

The above example is that of a task executed at regular intervals. We move now to irregularly occurring events, and these too, are catered for, in an elegant and economical way with the construct:

EVENT TRIGGERED MULTITASKING

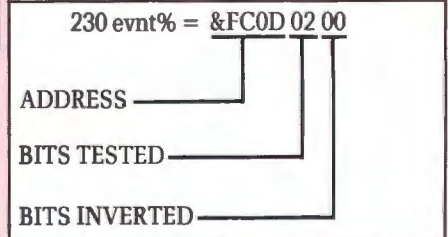### ENABLE . . . . WHENEVER

Consider the following:

```
200  TASK gtkey
210      FETCH[PORTA;&FC00;&FF;key%]
220  EXIT
```

The above is a task which, when executed, will read the contents of PORT A on the CMS 6502 card.

If the VIA is configured for Tube handshake, data arriving on PORT A, will cause a corresponding status bit to be set in the Flag register at &FCOD.

So we specify a variable containing the address and bit we want to test, also if the bit is to be inverted:

```
230 evnt% = &FC0D 02 00
```

ADDRESS ————
BITS TESTED ————
BITS INVERTED ————

and with:

```
240  ENABLE gtkey WHENEVER evnt%
```

we do the impossible!

Without the users program polling or otherwise referring to PORT A again, when data arrives on PORT A, task 'gtkey' will be executed.

As has been mentioned earlier, the system can perform up to 8 tasks concurrently. The user may, however, have as many tasks defined the program as space allows, and using the commands OMIT and ENABLE, inaugurate the execution of any selection of tasks.

Both the example tasks above, after execution, return control to the foreground program. NO other BASIC can be used in this way, and the authors are justifiably proud of their creation.

ULTIMATE IN CONTROL

Briefly the commands used for the concurrency facilities are as follows:

TASK . . . EXIT	Define the operation of a task.
ENABLE . . . EVERY	Enable execution of a quoted task at regular intervals.
ENABLE . . . WHENEVER	enables execution of a quoted task when the event occurs
DISABLE . . .	Disable the task but leave it in the 'current' list.
OMIT . . .	Disable the task and remove it from the 'current' list allowing the addition of another task to the list.

The 'wild-card' '*' may be used with either DISABLE or OMIT to DISABLE ALL current tasks, or OMIT ALL.

VIA CONTROL

These commands are provided for ease of access and control over any number of memory-mapped Versatile Interface Adaptors, and include all the operations commonly associated with these devices.

SETBITS	Set Selected bits of a given VIA Register.
UNSET	Clear selected bits of a given VIA Register.
CONFIGURE	Store the given bit-pattern in a selected VIA Register.
FETCH	Fetch the contents of a specified VIA register ANDed with the given bit-pattern.
TGGLE	Toggle (Exclusive-OR) the contents of a selected VIA Register with the given bit-pattern.
SHFTL	Logically shift left the contents of a selected VIA Register.
SHFTR	Logically shift right the contents of a selected VIA Register.

Examples:

```
TGGLE[PORTB;svia%;%01010101]
CONFIGURE[DDRB;&FC80;%00001111]
SETBITS[PORTA;svia%;bits%]
```

SYSTEM TIMERS

The system timers comprise two 5-byte timers which may be accessed using normal BASIC (TIME function), and also three 4-byte timers which will hold a full integer value. The latter are referred to as Timers 3, 4 and 5, and two functions are provided for accessing these. All timers are incremented once per centi-second under interrupt control.

RD_TIMER	Read the current value of the indicated timer.
SET_TIMER	Write the given value into the specified timer.

Examples:

```
300   value% = −100
310   SET_TIMER[3;value%]
320   RD_TIMER[4;result%]
```

REAL TIME CALENDAR CLOCK

A set of procedures has been given to read or write all the registers in the Real-Time-Clock, making, for example, the display of the Time, Date etc., simple and concise. Also provided are comparison functions to allow program flow control on system time dependency.

DATE_EQ	A function returning True or False depending on whether the given Date is equal to that in the clock.
DATE_GE	A function returning True or False depending on whether the system Date is greater than or equal to, the Date given.
HMS_EQ	Similar to DATE-EQ, but testing the Hours, Minutes and Seconds.
HMS_GE	As DATE-GE, but for testing Hours, Minutes and Seconds.
PERIOD_EQ and PERIOD_GE	As above but testing the week number and day number.
RD_DATE	Read the Day, Month and Year from the Real-Time-Clock.
RD_HMS	Read the Hours, Minutes and Seconds from the clock.
RD_PERIOD	As above but read the week and day numbers. WR_DATE, WR_HMS and WR_PERIOD correspond to the above, but write the given values to the clock registers.

Examples:

```
120   IF HMS_GE[12;30;00] THEN PRINT " Lunch
      Time !"
```

or, if you prefer, a background task:

```
200   TASK dotime
210       RD_HMS[hrs%;mins%;sec%;]
220       PRINT
          TAB(30,1);hrs%;":";mins%;":"secs%;
230   EXIT
300   ENABLE dotime EVERY 100cs
```

The above would print the time in the form: hrs:mins:secs in the top right corner of the VDU every second.

ANALOGUE I/O

The BASIC commands provided and described in this section provide easy access to the systems 16 ADC channels and also to the DAC converters.

INIT_ADC	Initialise the ADC converters ready for use.
IN_ADC	Read a selected ADC channels 12 Bit value.
OUT_DAC	Output a 12 Bit value to the system DAC.

RELAY DRIVERS

Since the CMS System Analogue Card provides sixteen 50V output lines at ½ amp, a command has been provided to access these.

RELAY	Drive the output lines high or low.

NETWORK COMMANDS

The following keywords are provided for use in conjunction with the SuperVisor Operating System, their effect is to interrupt the chosen remote station and perform a discreet operation. After this function has been performed, the remote will continue on as before interruption. Hence it is possible to invigilate the action of a program running in a chosen remote. Space does not permit a full explanation here, so a brief discription follows, of some keywords and their associated actions.

RS_BYTE	Read a byte in a selected remote.
WS_BYTE	Write a byte to a selected remote.
RS_STRING	Read a group of bytes in a selected remote.
WS_STRING	Write a group of bytes to a selected remote.
RS_VEC	Read two bytes in a selected remote.
WS_VEC	Write two bytes to a selected remote.
RS_INT	Read a 4 byte integer value in a selected remote.
WS_INT	Write a 4 byte integer value to a selected remote.
RS_HWM	Read the selected remotes Operating System High Water Mark (OSHWM).
RS_HWM	Read the selected remotes Operating System High Water Mark (OSHWM).
WS_HWM	Write a new OSHWM in the selected remote.
RS_PAGE	Read the value of PAGE in a selecte remote.
WS_PAGE	Write a new PAGE value in the selected remote.
RS_TOP	Read the value of TOP in a selected remote.
WS_TOP	Write a new TOP value to a selected remote.
RS_HIMEM	Read the value of HIMEM in a selected remote.
WS_HIMEM	Write a new HIMEM value in a selected remote.
SYNC	Synchronise a selected remotes Real-time-Clock with that in the SuperVisor.
S_TEST	Test a remote station for service.

A Professional Microproc

We at CMS are now able to offer a choice of 6809 microprocessor development systems. Whether you prefer a complete stand alone system or one based around the BBC micro, we can come up with the goods! Both systems are versatile and adaptable, reliable and efficient – well able to match the requirements of the most demanding user. Running FLEX, a very powerful well supported operating system. The user is given access to a vast range of high level languages and a wealth of supporting software development packages.

The system enables the user to develop software for 6809 and most 8 bit and some 16 bit micros.

For those of you who already have a BBC micro and disc drives, we can provide professional development systems from as little as £500! Our 6809 2nd processor connects to the micro via the tube interface, and can either fit neatly under the micro's lid for software development or plug into the CMS industrial racking system for software and hardware development.

CMS 6809 Development System based on the BBC MICRO

We are proud to launch our complete stand alone microprocessor development system. Specifically designed for the industrial user requiring a fast environment for 6809 development, its modular design allows for expansion as the users demands increase. It is easily configured to run as a target system for those applications requiring disc storage. The system comprises:

– A 6809 industrial controller with 64K DRAM and optional battery back-up.
– The new CMS floppy disc controller, supporting up to three quad density 3.5" or 5.25" disc drives. The drives are capable of accessing over 2MBYTES of disc storage and the 3.5" diskettes are enclosed in a tough plastic covering to ensure adequate protection in even the most hostile of environments.

—The recently introduced 40/80 column Teletext card, with centronics printer port and serial communications to an IBM style keyboard.

Housed in an extremely rugged industrial rack, this system has to be the best value for money on the MDS market today!

CMS 6809 Stand Alone Development System

6809 HARDWARE

We knew we were onto a winner with our 6809 2nd Processor! The first of its kind to be launched, it remains to this day the clear market leader.

Universally acclaimed and used by ever growing numbers in industrial and educational sectors, the 64K RAM based card can be used for both software and hardware development.

In its simplest form, ideal for software applications, the card fixes unobtrusively under the lid of the BBC Micro. For both software and hardware development the 2nd Processor should be plugged in to the CMS Industrial Racking System, thereby allowing direct access to the extensive range of CMS interface cards. The obvious attraction of this system is that it gives the system designer the ability to edit, develop and debug programmes using a RAM based system, before finally transferring it to ROM for use in the target system.
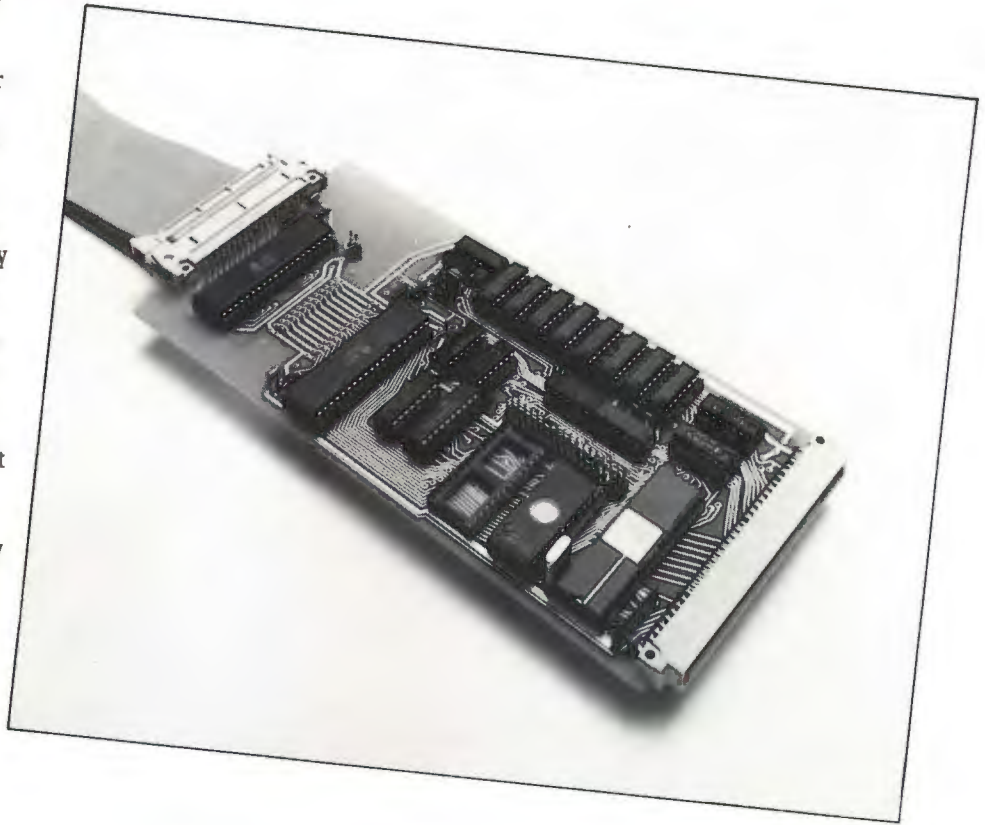
FLEX OPERATING SYSTEM

Originally written in 1977 for systems using the Motorola MC 6800, by Technical Systems Consultants Inc. FLEX was subsequently converted to run on the 6809, since when it has become an international standard. It is one of the most sophisticated and powerful operating systems available today.

For those unfamiliar with FLEX it can be favourably compared with CP/M as far as versatility and performance are concerned but whereas CP/M is aimed primarily at the world of commerce, FLEX really comes into its own in the fields of engineering, microprocessor development and technical education.

FLEX is probably the most popular disc operating system (DOS) for the 6809.

The implementation supplied by CMS is user friendly and comes complete with 6809 Macro-Assembler, line orientated editor and a comprehensive set of utilities. Documentation for the DOS,

assembler, editor and utilities is provided by a well written 200 page user manual.

The FLEX operating system holds an extension utility command set on disc. The great advantage of this is that extra commands may be added easily. The Macro assembler supplied is an excellent programming tool and many colleges are using CMS 6809 systems to demonstrate

```
+++CAT 1

FILES OF DRIVE NUMBER 1

ERRORS.SYS      FLEX.SYS        PRINT.SYS
CAT.CMD         COPY.CMD        DELETE.CMD
P.CMD           LIST.CMD        ASN.CMD
RENAME.CMD      APPEND.CMD      BUILD.CMD
EXEC.CMD        SETUP.CMD       SAVE.CMD
TTYSET.CMD      O.CMD           LINK.CMD
JUMP.CMD        DATE.CMD        PRINT.CMD
PROT.CMD        QCHECK.CMD      VERIFY.CMD
VERSION.CMD     XOUT.CMD        I.CMD
EDIT.CMD        ASMB.CMD        SAVE.LOW
PRINT.TXT       TIME.CMD        STARTUP.TXT
SETUP.TXT       DEMO.CMD        MASK.BIN
UNMASK.BIN      DEM1.TXT        DISCERR.CMD
DISCERR.TXT     SOUND.CMD       RB2.CMD
SYNTH.CMD       DEMO.PL9        SYNTH.PL9
SOUND.PL9       TIME.PL9        BBC.LIB

+++
```

to students assembly and disassembly techniques for different micros.

As the world of microelectronics moves at such a rapid pace, it is becoming increasingly important for engineers to work with a system that does not limit them to one microprocessor. FLEX running on the CMS 6809 processor provides support software for almost every 8 bit and some 16 bit microprocessors. More and more engineers are using FLEX as it supports a large range of high level language compilers and tool kits, capable of utilizing the 6809's advanced architecture, CMS FORTH, PL9, PASCAL, 'C', BCPL and BASIC are all available, many of them producing ROMable code.

Many MDS users are buying the CMS system as a low cost alternative to more expensive proprietary systems.

SOFTWARE

PL9 CONTROL LANGUAGE COMPILER

PL9 is a co-resident editor/compiler/trace debugger for the 6809. It features an easy to use editor; a true compiler producing pure ROMable 6809 machine code, and a trace debugger which allows the user either to single step or break point a PL9 programme a source line at a time.

PL9 is a structured language supporting procedures based on the control structures found in BASIC, PASCAL, PL/M and 'C'. Specifically developed for dedicated control applications in a microprocessor environment, it retains both speed and flexibility whilst making programmes shorter and more readable. It is largely self documenting due to its ability to support variable names and labels of up to 127 characters in length.

Functions not supported directly by the compiler, such as I/O routines, can be easily 'included' in PL9 programmes, allowing the user to generate new keywords to suit his own requirements. (CMS provide I/O library routines free for all their cards.) PL9 makes extensive use of the 'stack' for temporary variable storage which makes all PL9 modules position independent and romable.

Variables may be located in fixed positions when interfacing with hardware or programmes written in other languages.

PL9 recognises three distinct data sizes; byte, (8 bit) integer (16 bit) and real (32 bit) floating point. For those requiring both integer and floating point calculations in their control programmes, PL9 is an absolute necessity. One of the more powerful aspects of PL9 is the direct access to the registers 'A' 'B' 'D' 'X' 'CC', which greatly simplifies linking with external assembly language procedures. To illustrate a typical PL9 programme we list below a simple example to initialise and output an incrementing count to Port B of a VIA (Versatile interface adaptor).

It can be clearly seen that PL9 supports procedures which make the programme structured and very readable.

By using PL9 in an application the engineers' throughput should be 10–20 times that of Assembler. Requiring no runtime package the compiler produces very effective ROMable machine code.

■ SLEUTH DISASSEMBLER
Sophisticated disassembly system. Can be used to generate source code from object code programmes for 6800, 6801, 6803, 6805, 6809, 6502, Z80, 8080, 8085.

Supplied in source form for assembly on users systems. Fully interactive in use.

■ CROSS ASSEMBLERS
CMS provide a complete range of cross assemblers for both Motorola and Intel families of microprocessor. Most 8 bit micros are supported: Z80, 8080, 8085, 8048, 6800/6801, 6301, 6805, 6502, and some 16 bit micros.

■ CMS FORTH
This disc based FORTH compiler comes with 200K of source programmes and examples. One of the best FLEX implementations of FORTH for the 6809 to date.

■ MACE
A complete co-resident editor/assembler for 6809.

■ XMACE
A complete co-resident editor/assembler which runs on 6809 but produces object code for 6800, 6801, 6802, 6803, 6808.

Quick to learn, easy to use.

■ DEBUG
A powerful 6809 assembler debugging tool. The tracer gives the user continual breakpoints and screen display of internal register conditions.

```
CONSTANT VIA=$EE80;              /* VIA Base Address           */

AT VIA BYTE PORT_B,              /* Input / Output Port    B   */
          PORT_A,                /* Input / Output Port    A   */
          PORT_DDRB,             /* Data Direction Register A  */
          PORT_DDRA;             /* Data Direction Register A  */

PROCEDURE INIT_PORT;             /* Make Port B All Bits Output*/
    PORT_DDRB=$FF;
ENDPROC;

PROCEDURE DELAY( INTEGER TIME ); /* A Simple Delay Routine     */
    REPEAT
        TIME=TIME-1;
    UNTIL TIME=0;
ENDPROC;

/*          ------------------                                 */

PROCEDURE MAIN_PROG;             /* Main Program Starts Here   */
    INIT_PORT;                   /* Call Proc to Initalise Port*/
    PORT_B=0;                    /* Clear Port B               */
    REPEAT
        DELAY(500);              /* Delay 500 units            */
        PORT_B=PORT_B+1;         /* Output Incrementing Count  */
    FOREVER;

+++
```

REVIEWERS COMMENTS

❝ We fought in the office as to who was going to review the 6809 Second Processor. ❞   Mike Cook – *Micro User*

❝ CMS provide not only a 6809 with 64K memory, but also my favourite operating system, Flex. This card is elegant and powerful. ❞
Mike James – *Electronics & Computing*

❝ The most exciting of the 8 bit add ons for the BBC Micro is the 6809 system from CMS. ❞
Roger Cullis – *Practical Computing*

❝ The advantage the 6809 processor brings is its ability to run advanced software tools, as well as the Industrial standard operating system, Flex. ❞
Clive Grace – *A&B Computing*

❝ The only disappointing thing about the CMS 6809 software was that I had to return it after the review. ❞
Mike Cooke – *BBC Micro User*

LOW COST LINKS

❝ We don't know how you do it for the price! ❞ is one of the most frequent comments made about the cards on this page. Whereas the old adage 'you pays your money and you takes your choice' is often used to explain shortcomings, in this case it means exactly what it says. For an almost unbelievably small outlay, you can choose from a versatile selection of microcomputer functions and facilities – all the hardware necessary to implement systems ranging in complexity from the sophistication of a bank dealing room, to the simplest form of thermostat control. Specifically designed with the industrial user in mind, our single board computer alone can handle most control tasks. It is powerful, easy to use and is available with a choice of processor 6809 or 6502. It is easily reconfigured, accepts different memory devices and can support a variety of memory maps.

Furthermore, both versions can be expanded to run a wealth of high level languages for most system designers.

Add the versatile interface board and you immediately give the controller its route to the outside world. It skillfully combines three widely used micro functions – high speed serial communications, 80 digital I/O lines and a true centronics printer port. All of which can be used singly or simultaneously to create the perfect package for networking, dedicated machine control and most forms of industrial monitoring.

Add a 13 bit data acquisition board and you have a complete and comprehensive data logging system, with both analogue to digital and digital to analogue conversion providing 13 bit stability, plus 50V digital I/O lines. The card is particularly suited to those control/monitoring tasks such as measurement of temperature, pressure and flow where accuracy is the main consideration. High current drivers are provided to facilitate the control of relays, valves and stepper motors.

Add a 40/80 column colour teletext card and you have at your finger tips a complete stand-alone video terminal. Complete with Serial and Centronics Printer Port.
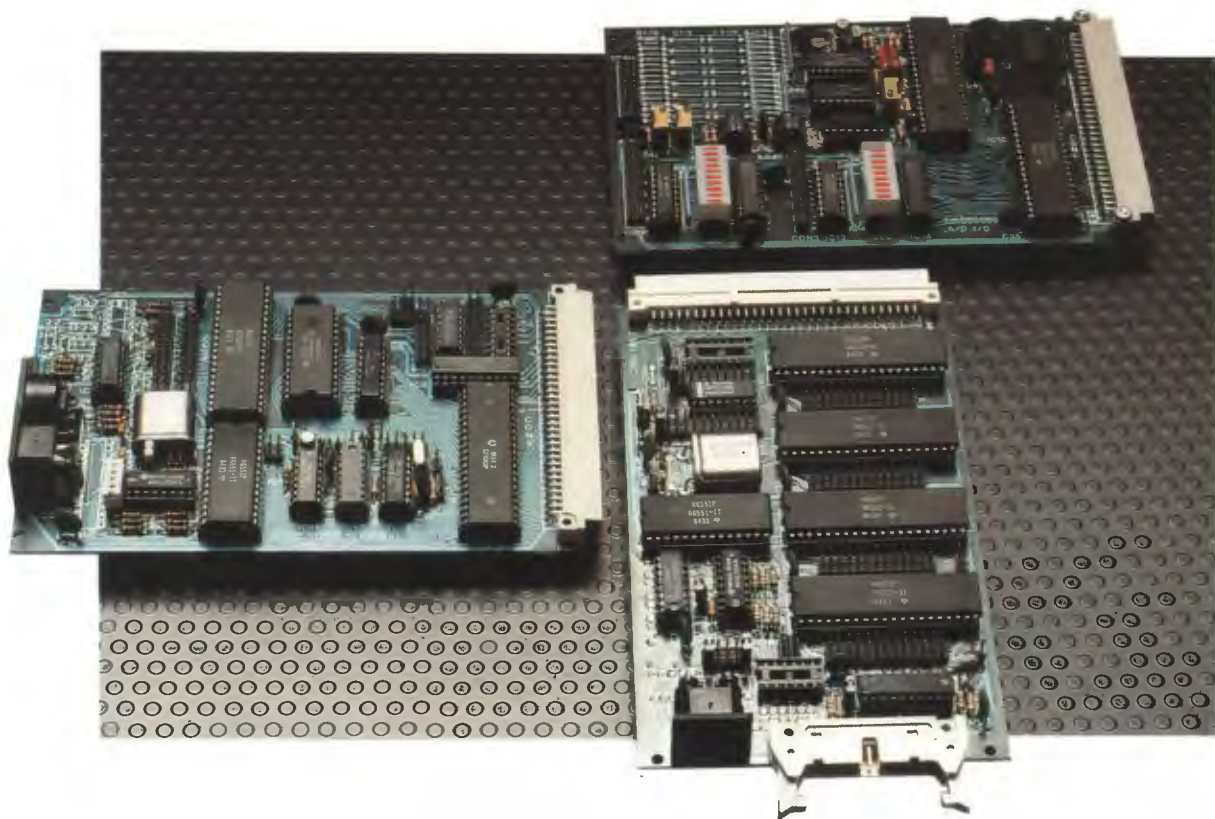
SOFTWARE LINK

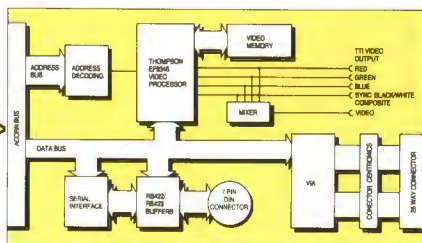|	
6502	BBC BASIC MULTI-BASIC FORTH
6809	PL9, 'C', BCPL PASCAL, FORTH.

6809–6502 INDUSTRIAL CONTROLLER

● Supports upto 128K PROM with 32K RAM
● Real time calendar clock and alarm
● 2 timer counters
● Dynamic memory management
● Battery backed CMOS RAM
● 20 digital I/O lines
● Easy to use
● Low cost
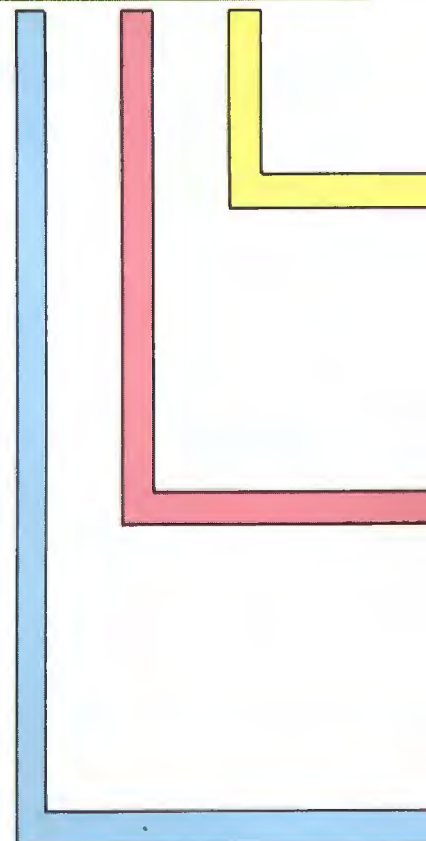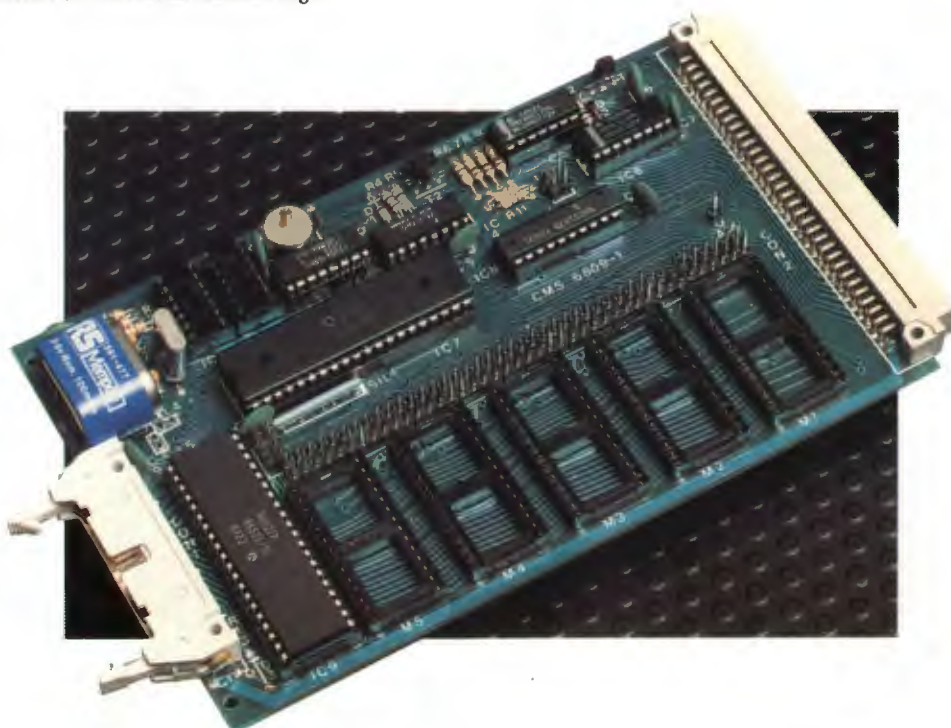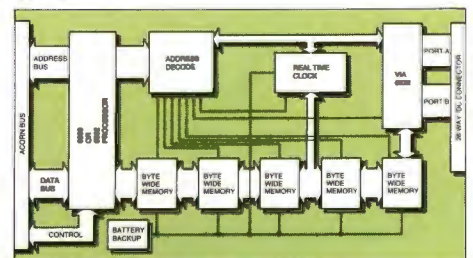
40/80 VIDEO TERMINAL

- Full colour 40 or 80 column
- Enhanced teletext character set
- Hardware scroll capability
- Serial interface RS23/422
- Occupies only 32 bytes memory

- 8k video memory expandable to 16k
- Genlock option available
- Underline, flashing, reverse video
- User definable characters
- Pixel graphics
- VIA Interface
- Centronics Printer Port

ANALOGUE DIGITAL INTERFACE

- 16 High performance 13 bit ADC input channels
- Actually stable to 13 bits
- 12 bit DAC with potentiometer controlled offset and gain
- Capable of unipolar/bipolar operation
- 16 digital output lines can drive 50V each at ½ amp
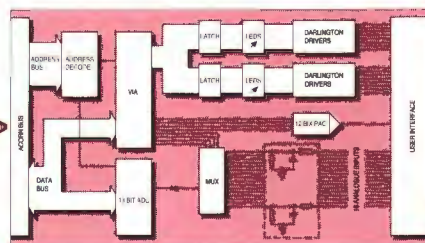
- All output lines have LED Indicators.
- 4 digital input lines upto 100V
- 2 user programmable timer counters
- Ideal for control and teaching

VERSATILE INTERFACE BOARD

- 4 versatile interface adaptors providing 80 independent digital input/output control lines
- Easy interfacing via 26 way IDC connector
- 8 programmable timer counters
- ACIA providing serial Interface at rates between 50 to 19, 200 Baud
- Programmable independent transmit and receive clock capability
- RS422–RS423 interface buffering for high speed communications in noisy environments
- Serial output buffers may be programmed to go tristate for distributed multi process applications
- True centronics printer interface

- Free MULTI-BASIC Software drivers
- Free software drivers written in PL9

- Free MULTI-BASIC Software drivers
- Free PL9 software drivers
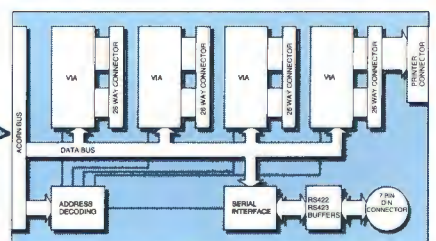
WHAT ARE *YOU* DOING

MAGNETIC FIELD THERAPY
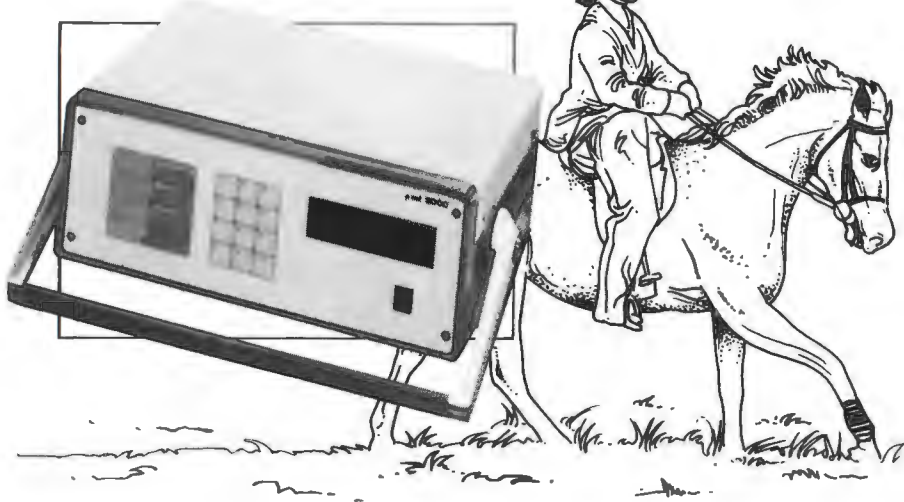
Magnetic field therapy is now being used by the medical and vetinary professions for the treatment of acute and chronic sports injuries, including fractures.

As technology in this field progresses a sophisticated control system is demanded. This is why a CMS 6809 controller is at the heart of this new and exciting medical development.

Magnetopulse Ltd, the designers of this system, chose the controller on its merits, not just it's price. The complete 6809 development package was purchased from CMS and the software written in PL9.

CMS are as proud of their involvement in this project as they are of the products themselves.

BAKERY CONTROL

There is a lot of dough to be made from CMS Systems, and Craven Process Controls should know! Using our Low Cost 6809 controller, high performance graphics card and versatile interface board, they are able to bring seemingly obsolete manually driven bakery control systems right up to date. Taking advantage of the latest technology, Craven Process Control take existing plant equipment and modify it so that it can quickly and accurately weigh and measure the ingredients contained in the 100 different recipes stored within the system memory.
A high resolution graphics display is provided so that the operator can monitor the mixing process at all times.
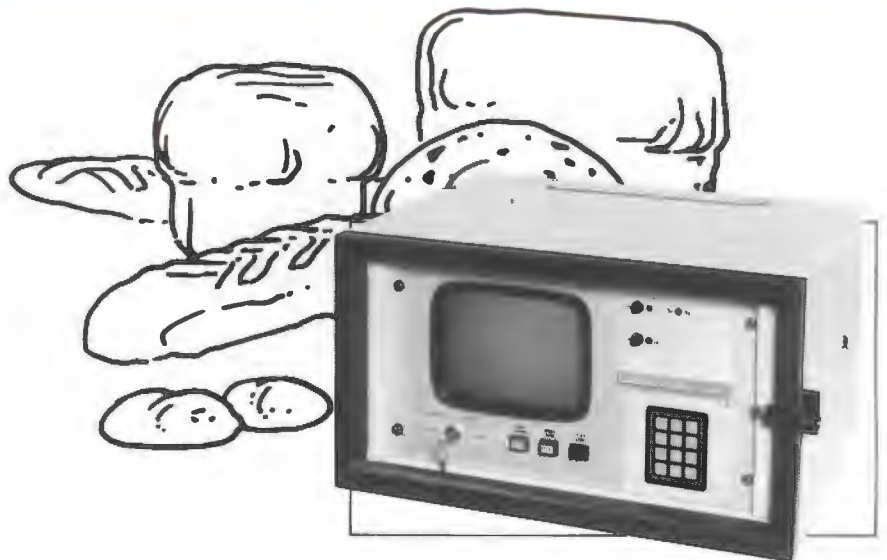

SNOOKER-LITE
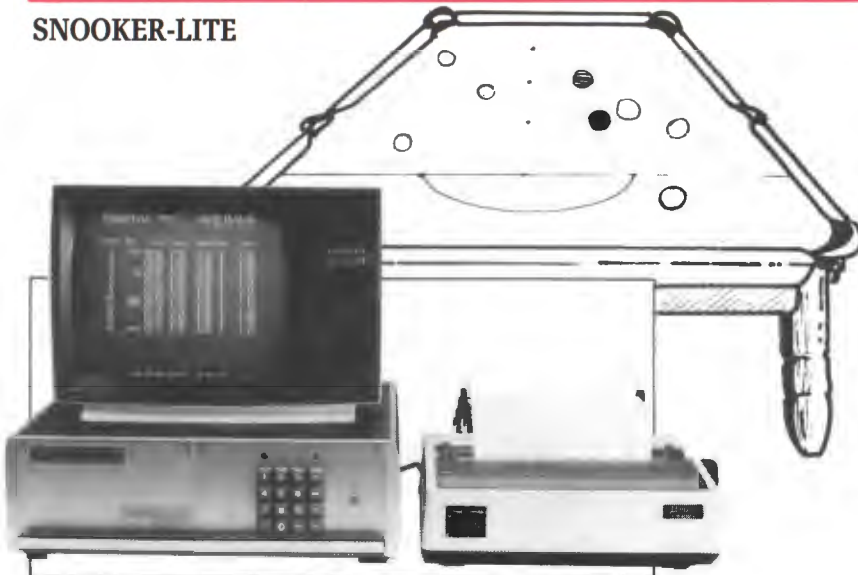
Snooker is fast becoming one of the most popular pastimes around for both player and spectators. For the players, the game is one of skill and ingenuity, very similar infact to that of the programmer writing the software for a control system for snooker tables. 'Snooker Lite' – by Dedicated Micros, monitors the time spent on tables and calculates charges instantly. Again the CMS cards provide all the control timing and calculation in this application. Running 24 hours a day, and with each controller handling up to 64 tables, reliability is vital, which is just why CMS cards were chosen for the job.

Education Update

GETTING TO GRIPS WITH THE OUTSIDE WORLD

The main function of a general education in electronics is to provide students with the broadest knowledge of the subject while at the same time keeping to the tightest of budgets. The CMS route well satisfies these demands.

Some of our first systems were successfully put through their paces in micro labs so we have no hesitation in recommending their suitability for colleges, universities and research establishments. The advantages of the CMS approach are obvious. Our development systems 6502 – 6809 are based around the BBC Micro. As many colleges already have these machines, the simple addition of one of our 2nd Processors can provide a complete and professional development system for less than £500! The equipment is rugged and durable, built to the highest industrial standards and well able to cope with the treatment meted out by inexperienced students during "hands on" sessions. The systems are easy to use and are well documented. They give educational users access to the wide range of high level software packages. Cross assemblers are readily available, giving the student the ability to develop software for different microprocessors.
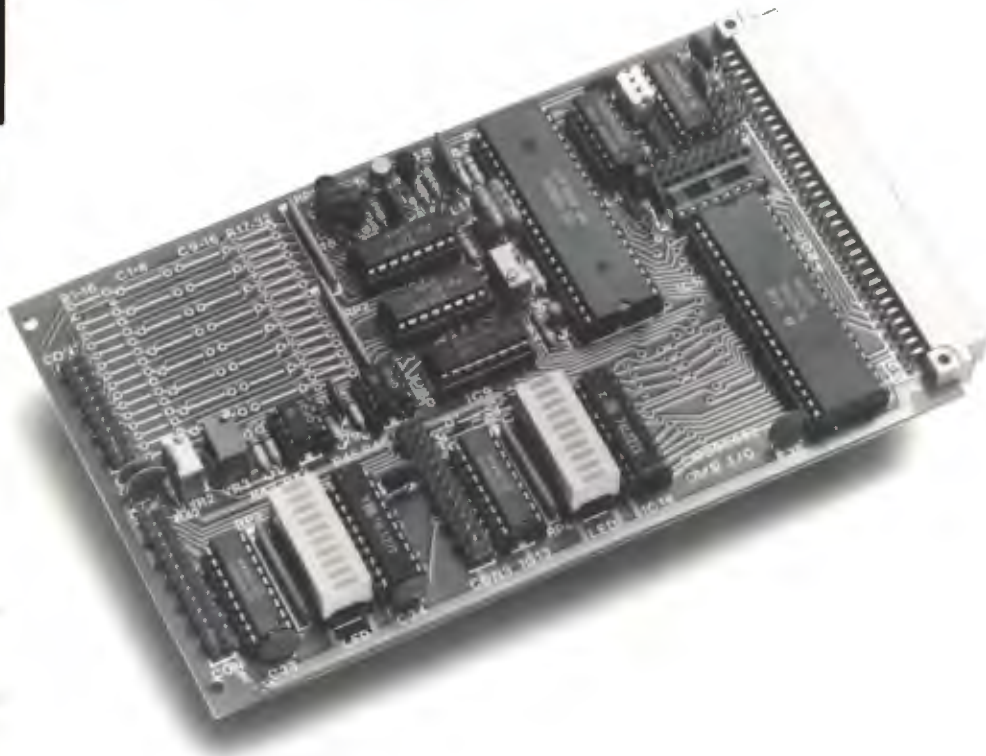
Featured above is our new analogue and digital interface card. This card is particularly suited to the university or college user, where precise measurement and control is often required. With 16 independent channels of analogue input; voltage, current, temperature or pressure may be accurately measured. Buffered analogue output is also provided, while 16 high current digital output lines, each with LED indication of status allow relays, stepper motors etc to be driven. Complete software support for this product is available for all users, with MULTI-BASIC and PL9.

IEEE INTERFACE

The CMS IEEE interface is certain to prove invaluable to those users involved in scientific or experimental applications. Adhering to the IEEE 1978 specification, the card enables CMS systems to interface to the extensive range of scientific and technical equipment conforming to that bus. The controller will act as a talker/listener controller as required.

It is suitable for linking up to 14 separate IEEE compatable devices such as DVMS, frequency counters etc. Software drivers are available for both 6809 and 6502.
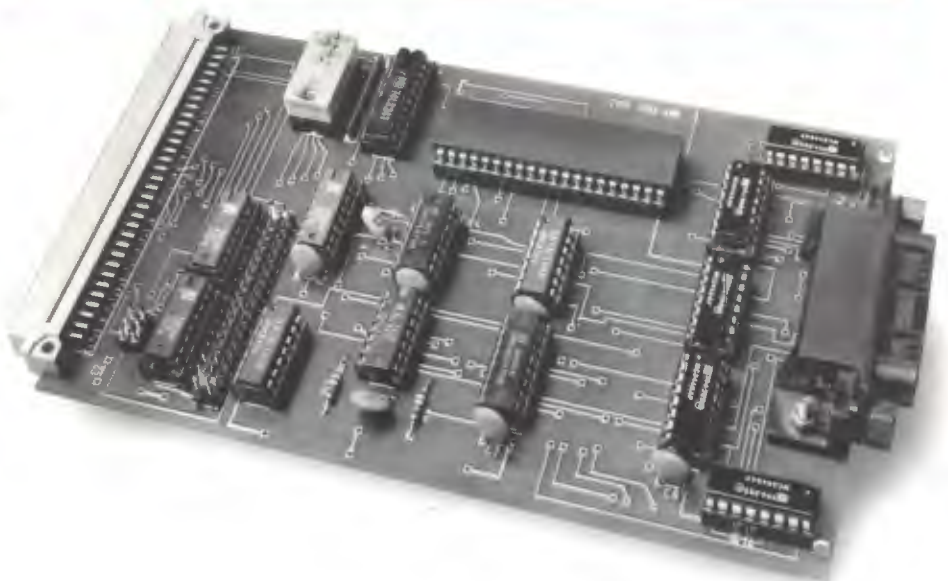
CMS GRAPHICS

IF WE CAN'T SUPPLY THE GRAPHICS YOU NEED WE WANT TO KNOW WHY!

Although we say it ourselves, our design team really proved their expertise with the high performance graphics card. They actually managed to combine onto a single standard eurocard, all the advanced features previously only available on multiple board configurations.

Based on the Thompson EF9366 Graphics Processor chip, its ability to display mixed text of different sizes, colours and graphics, make it especially suitable for process control applications. The high resolution colour display comprises four colour planes, three planes of primary colours, red, green and blue (RGB) and one inverse or intensity plane offering a flashing facility. The black and white mode supports 16 levels of grey. Each colour plane is 512 pixels wide by 256 pixels high. The chip is capable of a very fast drawing speed–in excess of 1.4 million pixels per second.

An internal ROM is used to derive a full set of ASCII characters and the high density text mode supports up to 32 rows of 85 characters in any combination. Character, size and orientation are fully user programmable and the unique hardware zoom facility allows characters to be scaled independently in X and Y up to 16 times.

. . . OR JUST SOME TEXT

The CMS full-colour Teletext Terminal will be welcomed by everyone despairing of ever finding a video card that works as efficiently in 40 column as it does in 80 column. Ideal for use as a remote terminal it is capable of running both BBC BASIC or 6809 Software. There is a optional Genlock capability which enables the user to superimpose computer information on to video pictures.

NEXT ISSUE

- MULTI-BASIC for the BBC Micro

- 1 MHZ BUS expansion card

- The CMS FDC explained in detail

- Inside a College Micro Lab

- The CMS 68000 system

- TMS 320-Digital Signal Processing

FEEDBACK

Let us know what interesting things you are doing with CMS products and we'll give you a mention in a future issue of INPUT.
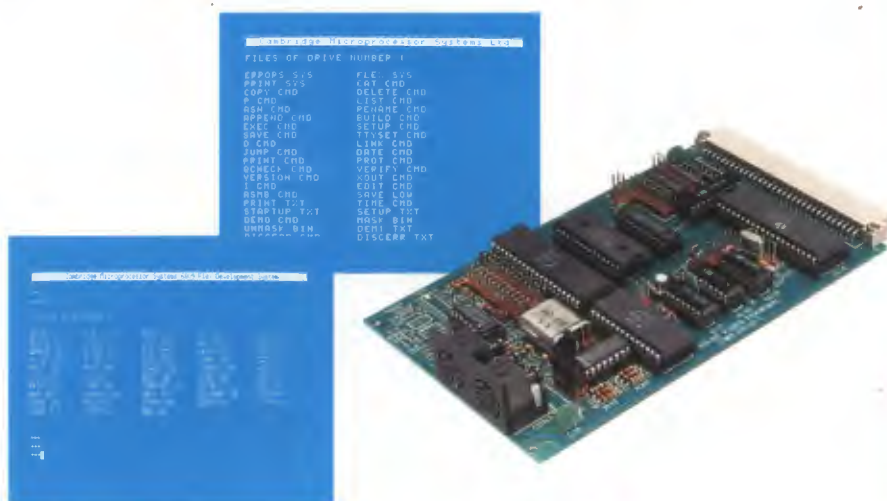
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Cambridge CB1 1NL
Telephone 0223 324141**