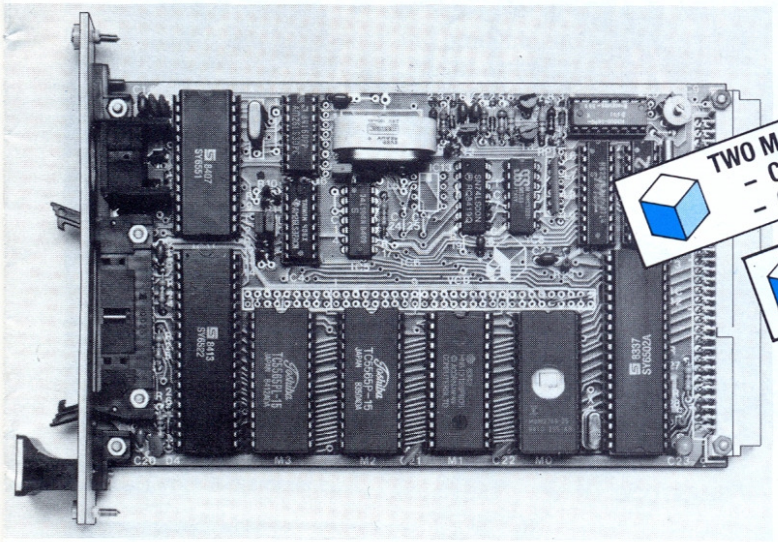
CONTROL UPDATE

News of the CUBE range of industrial control products sent to customers of Control Universal Ltd

No.1

EuroBEEB in Full Bloom



TWO MAJOR NEW SOFTWARE PRODUCTS
- CUBE Control BASIC
- CUBE Control NET

DISK FILING SYSTEM READY
ISSUE 7 BOARD RELEASED

CUBE Control BASIC Control NET

Control Universal's most important ever software products, CUBE Control BASIC and CUBE Control NET, are announced simultaneously for delivery by January on orders taken now. Both these products will be included in the fully populated EuroBEEB at no extra charge.

Control BASIC

CUBE Control BASIC has the centre spread of this first issue of "Control Update", and is a critically important product to the Engineer using industrial micro computers because for the first time he can control the real world with BASIC statements as simple as "TURNON 25" and "IN#31" (for reading an input). Control BASIC allows the user to control inputs and outputs, both digital and analog, and act on the basis of time, date and counts as easily as defining the problem in conversational English. Control BASIC is effectively an extension to BBC BASIC, for which all commands remain fully available, intermixed with Control BASIC, for handling text, arithmetic and graphics.

Control NET

From January 1985, EuroCUBEs and EuroBEEBs will be delivered with software embedded in the operating system which allows up to 30 CUBEs on a control system communication network, using a CUBE or a BBC Computer as a master. (Operating system MOSB.3). No additional hardware is required; the CUBEs communicate through the serial port already fitted on each card.

Full story page 4.

EuroBEEB Disk Filing System

Control Universal have signed a contract with Microware under which the new CUBE Doublestore Floppy Disk Controller will use exactly the same software as that supplied with the highly successful Microware Double Density Filing System for use with the BBC Microcomputer.

This allows the EuroBEEB to load and save to disk directly on the CUBE bus, with no BBC Microcomputer present, in a format compatible with standard BBC disks. Machine code, data and BASIC programs can all be saved in the same way.

Doublestore will also eventually replace CU-STOR, as the disk controller board for 6809 systems. Shipments of CUBE Doublestore for use with EuroBEEB will commence January 1985.

Full story page 11

New Issue Boards

EuroBEEB is now a completely separate product, rather than just a EuroCUBE-65 with BBC BASIC on board. Of several changes, the most important is a built-in easy way to change the socket configuration from CMOS RAM to EPROM, performed when installing a finished product for permanent duty, where the program being in battery-backed CMOS RAM would be inappropriate. Full details of the other changes are on page 8.

Control Universal to move soon?

The growth of the company has already led to Engineering being on the other side of Newnham Road from the main factory, in a building referred to as "The Cottage". To get there means a treacherous trip across Cambridge's busy ring road – worse if it's raining!

However, even with the cottage, the conditions are too crowded, and negotiations are in hand for a much larger modern factory on the other side of Cambridge city centre.

MICRO-FLOPPIES NOW!
3½" drives available now, see page 11.

6809 EuroCUBE gets its clock

Issue 5 of 6809 EuroCUBE has the long-awaited real-time calendar clock – product is available now.

Apologies to those who have been kept waiting; for £35 we will exchange earlier boards for issue 5.

New products galore...

"ADCU" – Analog and Digital Capture Unit

The ADCU, with built-in computer, analog and digital ports, and special data capture software can take up to 32,000 readings at up to 10 kHz.

It can be controlled from any computer with a serial port; the package includes graphics display software for the BBC.

See page 5

CUBE Hi-Res Unit

The CUBE Hi-Res Unit provides a high-resolution graphics terminal package for use with any computer, through its serial link.

See page 7

CY-DRAM – Sideways RAM card

Used in the ADCU to increase the data collection capacity by extending the RAM memory "sideways". Each card provides four blocks of 16kB of RAM memory, and up to 16 cards can be used in any system. (The practical limit is actually determined by the number of backplane slots).

See page 8

NEW WATCHDOG – System Healthy Monitor

The New Watchdog is a much improved concept with red/green LEDs for health indication, bleeper for failure warning, interception through a choice of NMI, IRQ or RESET, and a completely spare standard 16 channel user port.

See page 9.

CU-KEY 99 – a very superior keyboard

This product was previewed in the Summer 84 catalogue as CU-KEY-81 (The final number represents the number of keys). Now fully designed, deliveries should commence in January 1985.

See page 10

"Jobber Interface" replaces "Rackline"

The "Jobber Interface" provides on one card:-

- interface for CU-KEY-25
- interface for 24 column rack-mounted printer
- interface for 24 column x two row liquid crystal display unit

See page 8

Control Universal Limited, Andersons Court, Newnham Road,
Cambridge CB3 9EZ. Telephone: (0223) 358757. Telex: 995801 GLOTX-G.

What a lot we suddenly are!

Getting the right organisation to serve customers properly takes a good number of people, and after twelve months of vigorous recruiting, we now have that number of good people – 42 to be precise. Each Department has a strong, professional manager to head it, supported by a loyal and enthusiastic team. The numbers in brackets refer to the picture key.

Derek Sapsworth **(1)**
Test Manager

Geoff Sore **(2)**
Regional Sales Engineer – SE

Isaac Schalom **(3)**
Regional Sales Engineer – NW

Simon Hamilton-Roberts **(4)**
Systems Assembler

Richard Baker **(5)**
Sales Manager

Peter Collins **(6)**
Systems Assembler

Barry Moate **(7)**
Production Manager

Darren Coates **(8)**
Leading Hand – systems

Mark Sheldon **(9)**
Draughtsman

Jon Dane **(10)**
Managing Director

Simon Howlett **(11)**
Trainee Assembler

Peter King **(12)**
Test Engineer

Dave Hunt **(13)**
Technical Director

Peter Watson **(14)**
Deputy Sales Manager

Dennis Murphy **(15)**
Internal Sales Engineer

Mike Humphreys-Davies **(16)**
Financial Manager

Dave Jarvis **(17)**
Purchasing Manager

Alasdair Philips **(18)**
Senior Engineer

Arthur Mason **(19)**
Assembly Foreman

Russell MacDonnell **(20)**
Test Engineer

Doug Nelson **(21)**
Storeman

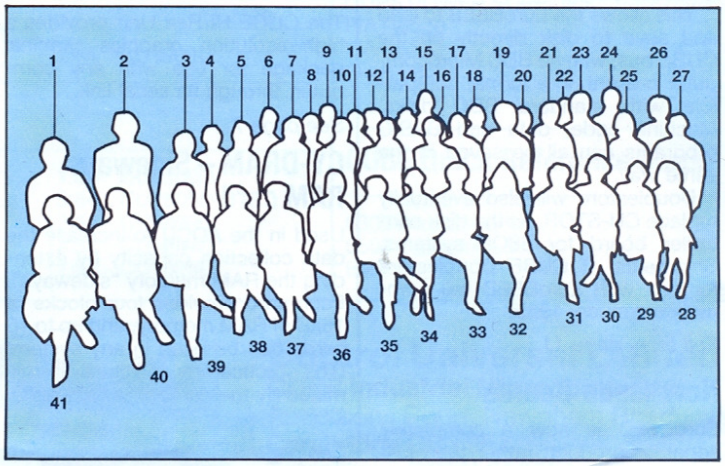
Simon Roberts **(22)**
Internal Sales Engineer

Mark Hassell **(23)**
Regional Sales Engineer – Midlands

Mark Cullen **(24)**
Junior Engineer

Graham Smith **(25)**
Junior Test Engineer

Keith Hodson **(26)**
Senior Engineer



Philip Mann **(27)**
Publications Co-ordinator

Sandy Payne **(28)**
Purchasing Assistant

Nicola Blake **(29)**
Despatch Clerk

Lyn Hume **(30)**
Accounts Supervisor

Rosemary Toull **(31)**
Despatch Supervisor

Pat Summers **(32)**
Sales Clerk

Sam Summers **(33)**
Sales Office Junior

Louise Wright **(34)**
Receptionist

Jean Yates **(35)**
Pcb Assembler

Sue Sebborn **(36)**
Personnel and
Administration Manager

Ruth O'Dell **(37)**
Accounts Clerk

Caron Igoe **(38)**
Leading hand – Pcb

Rachel Blackwell **(39)**
Pcb Assembler

Janine Lettau **(40)**
Publicity Controller

Lesley Monshall **(41)**
Technician

Eric Lyon (not pictured)
Credit Controller

**Control Universal Limited, Andersons Court, Newnham Road,
Cambridge CB3 9EZ. Telephone: (0223) 358757. Telex: 995801 GLOTX-G.**

Technical Support at your fingertips...

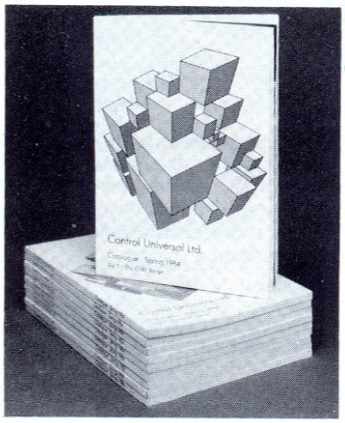
on your desk...on the phone... on your doorstep...with the product.

A technical product like the CUBE range needs good support in order for the user to feel confident in specifying it for his application. This ideal is achieved by providing:-

- **good sales explanations of the products and their applicability**
- **competent sales staff at the end of a phone to expand the detail with reference to a user's particular need**
- **regional staff, qualified engineers, ready and willing to visit your premises to help sort out an application, and provide on-going support**
- **clear, extensive technical documentation, providing all the detailed engineering information required to employ the equipment**

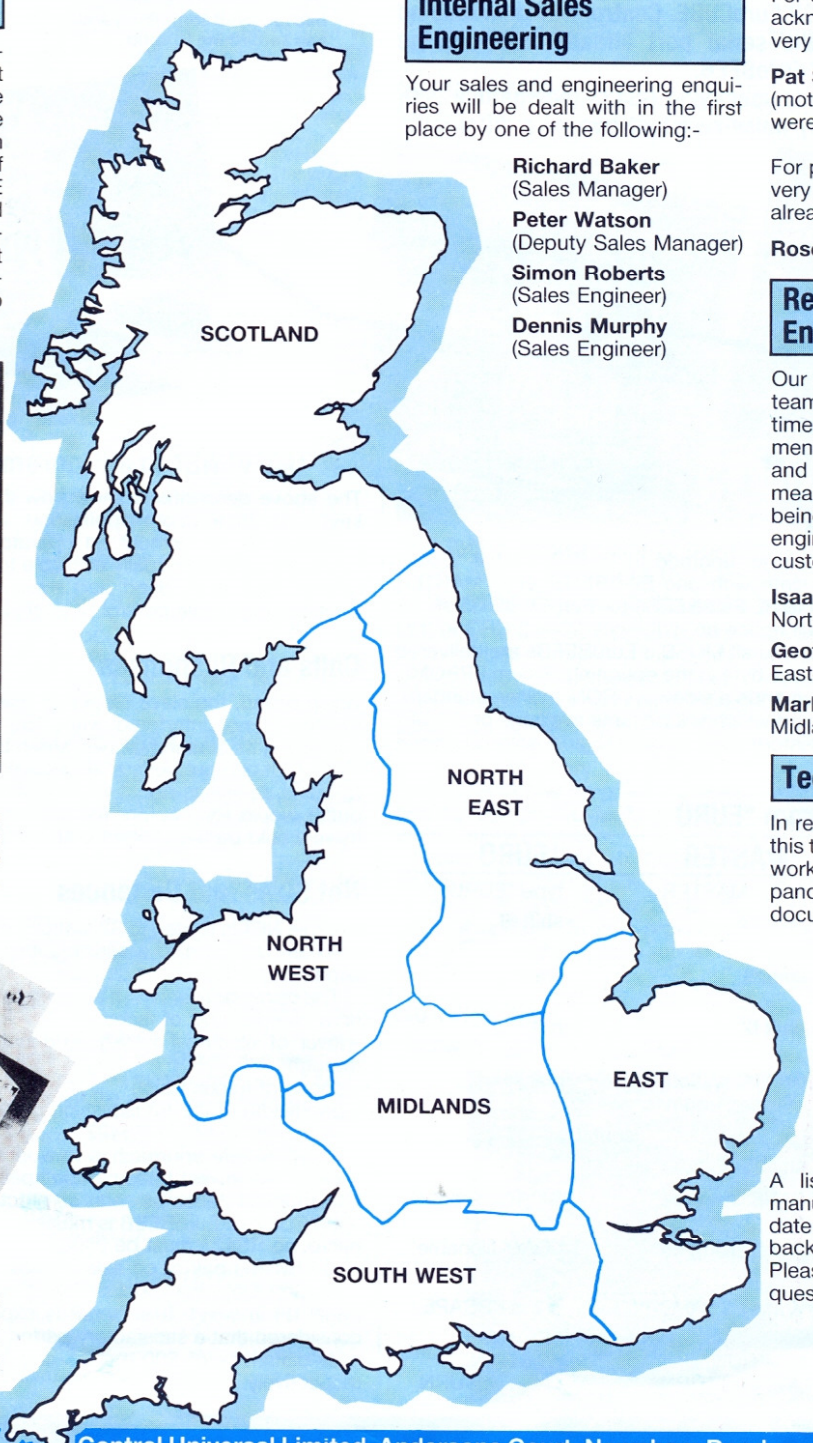
Sales Information

The catalogue is published approximately twice a year. The current issue is Summer 1984, and will be replaced in the new year. It is in the form of an A5 sized book, with more than two hundred pages of detailed information on the CUBE range, BBC Microcomputers and accessories, video monitors, printers, disk drives, etc. If you don't have a copy, please use the enclosed pre-paid order card to indicate your requirements.



If you already have the catalogue, one of the best ways of extending your information is by reading the technical manual for the product.

These are available without charge – a list of the publications is shown on the back cover of this newsletter. The order card can be used for these also.



Internal Sales Engineering

Your sales and engineering enquiries will be dealt with in the first place by one of the following:-

Richard Baker
(Sales Manager)

Peter Watson
(Deputy Sales Manager)

Simon Roberts
(Sales Engineer)

Dennis Murphy
(Sales Engineer)

For catalogue requests, queries on acknowledgements, price and delivery enquiries ask for:-

Pat Summers or **Sam Summers**
(mother and daughter, in case you were wondering)

For progress enquiries, or any delivery query relating to an order already placed, please ask for:

Rosemary Toull or **Nicola Blake**

Regional Sales Engineering

Our regional sales engineering team is completely new, and at the time of going to press our recruitment exercise was not complete, and is continuing actively. In the meantime, the vacant areas are being looked after by the internal engineers, who are willing to visit customers as required.

Isaac Schalom
North-West

Geoff Sore
Eastern England

Mark Hassell
Midlands

Technical Manuals

In recognition of the importance of this task, we now have three people working full time on creating, expanding and updating technical documentation, namely:-

Janine Lettau
– Publicity Controller

Philip Mann
– Publications Co-ordinator

Keith Hodson
– Engineer

A list of the currently available manuals, and their most recent date of re-issue, is given on the back cover of this newsletter. Please use the order card to request any that you need.

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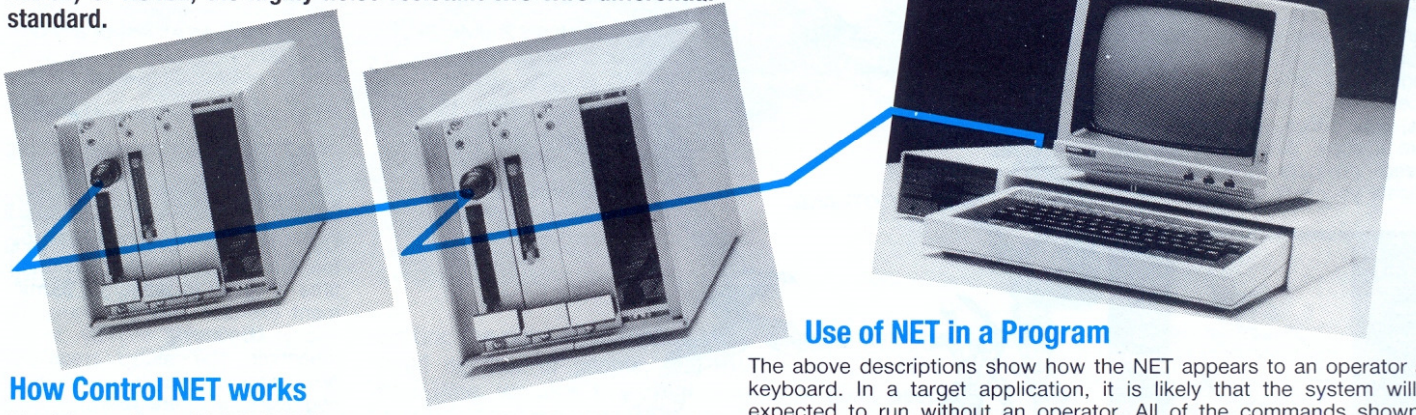
CUBEs Communicate on Control NET – to a BBC Micro or to a Master CUBE

CUBE Control NET is the answer to one of the most frequently voiced problems in the industrial control world – "how can low-cost computers perform local processing duties and at the same time remain in full communication with a master control computer?".

The Control NET software is embedded in version 3 of the operating system of the 6502 EuroCUBE. Control NET demands no extra hardware; it uses the serial port already fitted to the standard EuroCUBE-65 and EuroBEEB.

The user has the choice of specifying RS423 (compatible with RS232) or RS422, the highly noise-resistant two-wire differential standard.



How Control NET works

The Master Control NET ROM is an upgrade to *EURO, in that *EURO allowed the BBC to communicate with one EuroBEEB, and *MASTER allows communication with up to 32 EuroBEEBs (or EuroCUBE-65's).

With one station, the user will notice no difference from *EURO in that station 0 is active on switch on, and all MOSB.3 EuroBEEBs are delivered as station 0. (This is defined by one byte in the operating system EPROM).

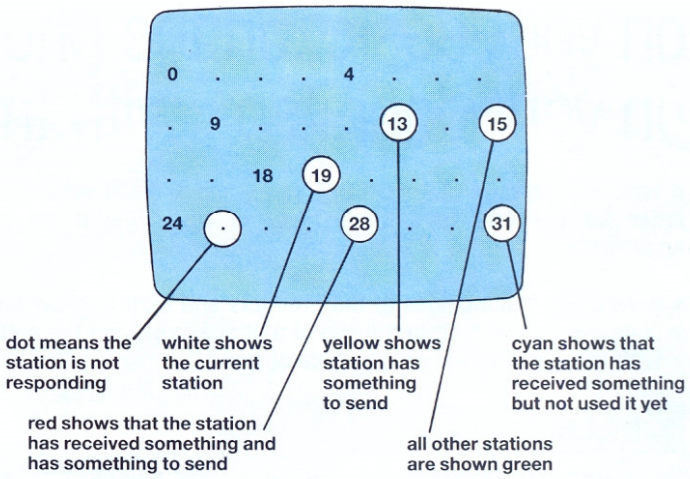
The NET Master Software demands a sideways ROM facility, standard, of course, on the BBC Micro, and which will become available on CUBE/EuroBEEB with CUBE Doublestore (see page 11) and with CU-MEM Selecta.

How *MASTER differs from *EURO

Action	*MASTER	*EURO
Enable communication	type *MASTER	type *EURO
Send hardware reset to every station	shift f9	shift f9
Send software reset to current station	shift f8	n/a
Display station status (see below)	shift f2	n/a
Change current station	shift f1, station number, return	n/a
Return to BBC	shift f0	
Call BBC * command	shift f0	
Save station memory to master's disk	SAVE"filename"	SAVE"filename"
Load into station memory from master's disk	LOAD"filename"	LOAD"filename"
Stop program on current station	press ESCAPE	press ESCAPE
Start program on current station	type RUN, press RETURN	type RUN, press RETURN

Display station status

Shift f2 brings up a display like this:–



Use of NET in a Program

The above descriptions show how the NET appears to an operator at a keyboard. In a target application, it is likely that the system will be expected to run without an operator. All of the commands shown as keyboard calls are equally available to a program. Further development of Control NET is in hand and there will be more software tools made available for simple control of multiple slaves from a master.

Calls and Responses

When polled, the slave responds using interrupts; the task it is currently running is not interfered with. The response is to send back a byte containing its station number, and bits six and seven set if there is data in the output or input buffers respectively. This information allows the master to make decisions about its next move; normally anything in the output buffer would read before the master's next network action, and nothing more would be transmitted until the slave had cleared its input buffer.

Net Sizes and Distances

A single NET is limited to 32 stations plus the master. This makes for easier software, and is also a sensible limit from the point of view of the drive capability of the output devices.

The distance over which serial data may be reliably transmitted depends on a complex mix of factors:–

– level of electrical background noise in the environment transmitted through
– speed of transmission
– bandwidth of the transmission cable
– choice of RS423 or RS422

The only safe approach is to work within the following limitations:–

– select the lowest transmission speed acceptable in the application
– keep the distance as short as practicable
– if a CUBE or EuroBEEB is master, use RS422. (not available on the BBC micro, so RS423 must be used)
– use twisted pair or co-axial cables.

Control Universal publish two manuals on Serial Transmissions (see page 12) in which this theme is expanded upon. As a guide, it can be considered that a satisfactory performance will be achieved at 9600 baud over distances of 600 metres and 1200 metres for RS423 and RS422 respectively.

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ADCU – even better than first announced!

CUBE ADCU – Analog and Digital Capture Unit – has commenced shipments in a mature configuration which exceeds even the exacting standards specified by the marketing department.

Independent Processor

Originally conceived as an extension to the BBC micro, using Beebex, the ADCU now contains the full specification EuroBEEB, with BBC BASIC and real-time clock. This means, of course, that the ADCU can work with any computer having a serial port through which to communicate. It will even work with a simple terminal.

Control BASIC

The whole concept and importance of Control BASIC is explained in detail in the centre spread of this newsletter, but the ADCU is the first product actually to be shipped with Control BASIC command words available. Thus, the ADCU can do more than just capture data, it can control the entire situation, using Control BASIC words such as TURNON, DELAY, and DAC#, which outputs a value through the analog outputs, if fitted.

High Speed Reading

The mass RAM storage is of particular point if the readings are to be taken at high speed; at slow speeds the results might just as well be stored directly onto disk.

When originally announced, the reading speed was specified at 7kHz, but software improvements have raised that to 10kHz, still using the same reliable 1MHz processor. (Note that the "sprint" speed of 10kHz is only possible using a single channel. With 2 or more channels the speed is limited to 1kHz).

Background task

If the read speed is specified at less than 1kHz (ie. read interval exceeding 1024uS) then the sampling becomes a background task, allowing dual tasking.

Thus, if SAMPLE is typed as a direct command, the prompt returns immediately, even though the whole sampling process may take several minutes or even hours.

Likewise, if included in a BASIC program, the SAMPLE command is executed, and the program passes on to the next command, even though it may be some time until the SAMPLE is completed. Obviously, the closer to 1kHz the SAMPLE has been asked to operate, and the more channels that are to be read, the slower the rest of the BASIC program will be executed.

EuroBEEB – powerfully convenient

The ADCU can be thought of as just a white box which takes lots of high speed analog readings and regurgitates them on demand down a serial line to whatever computer happens to be listening.

But, because it includes EuroBEEB, a fully featured microprocessor unit with BBC BASIC on board, it can be so much more. Already, the Control BASIC allows it to control the test whose results it is measuring. In addition, it is worth noting that ADCU's with MOSB.3 (from Jan 85) will be fully prepared for linking onto a network. Using Control NET, up to 32 ADCUs can exist on the same network, all responding to commands from a BBC micro or a Master CUBE/EuroBEEB with disks.

CY-DRAM mass RAM storage

Each ADCU comes with a CY-DRAM, (see also page 8) which consists of a 64kB dynamic RAM card divided into four 16kB sections, which are arranged "side-by-side" allowing all of the memory to be used for data collection.

Further memory extension is possible using the spare slot in the mini-rack. Another CY-DRAM can be plugged in here, extending the memory by 64kB, allowing 65,536 readings altogether. (Note that the read speed is at a maximum of 1kHz when the system is extended beyond the first CY-DRAM).

If even more memory than this is desired, a larger rack is needed. The largest standard rack has sixteen slots, of which EuroBEEB and CUBAN-12 (the analog interface) take two slots. The maximum memory space is therefore 896kB, ie allowing 458,752 16-bit readings.

CUBAN-12 high performance analog interface

The ADCU's third card is the CUBAN-12, a high performance analog interface which provides:–

eight 12-bit analog inputs
seven digital i/o channels
plus:– provision on board for four 12-bit analog outputs

Mini-rack

The ADCU is delivered fitted to the CUBE Mini-rack, which is a four-slot standard Eurocard rack with built-in power supply.

Extensions to ADCU

The ADCU is the first product to be shipped with Control BASIC, and its operating system is a special, being effectively MOSB.3 (see page 9, Machine Operating Systems) but without Control NET.

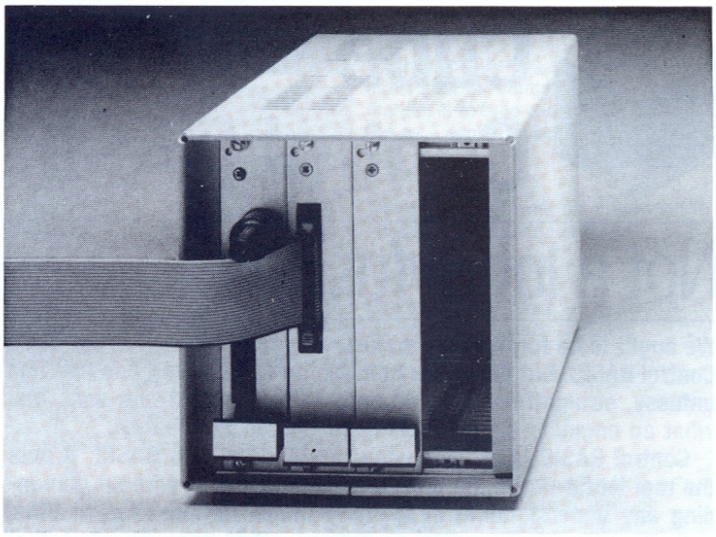
From January 1985, shipments will be the full version of MOSB.3, and the following extensions will all then simply require a change to the appropriate operating system EPROM.

disks (any MOS version 3)

Now that there will soon be a disk available for the EuroBEEB, (see page 11) this naturally means that it will be available for the ADCU. Data collection can then be performed either at high speed into the RAM for transfer to disk after the event, or if the interval between events is sufficiently great, each reading can be transferred immediately to disk. (NB. use of disks is a main task, not a background task, as described above).

hi-res video (MOSC.3)

This is an especially good idea, as it can add colour graphical display to the ADCU, to present the data in useful form, either as it happens, or in the case of a high speed situation, as soon as it has happened.



teletext video (MOST.3)

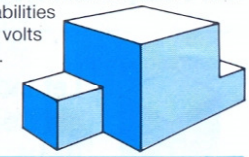
A simple, low cost colour display interface, useful for presenting textual and numerical information to the user.

keyboard (any MOS version 3)

A choice of three keyboards is available – see page 10.

Heavy duty outputs (any MOS version 3)

There are a range of opto-isolated industrial input/output units. See the catalogue for details of INDIO, POWER-50, READ-24/50 and the Delegate Industrial Interface. These offer AC and DC switching capabilities up to 250 volts at 3 amps.



CU-MEM Mark 5 supports 8kB CMOS RAM (5565)

The latest version of the CU-MEM eight socket memory carrier board allows the use of the 8kB CMOS RAM, type 5565, providing up to 64kB of non-volatile battery-backed RAM on one card.

CU-MEM is the most popular card in the CUBE range – more than 2000 have been delivered to date.

In the past, most customers have used 2kB CMOS RAMs on CU-MEM, with back-up provided by the on-board battery. The 5565 8kB CMOS RAM has dropped in price and its use on CU-MEM has become highly attractive.

Using 5565 RAM on CU-MEM also permits 32kB of CMOS RAM on bank A, plus up to 32kB of EPROM on bank B, thus providing the entire memory map on one card.

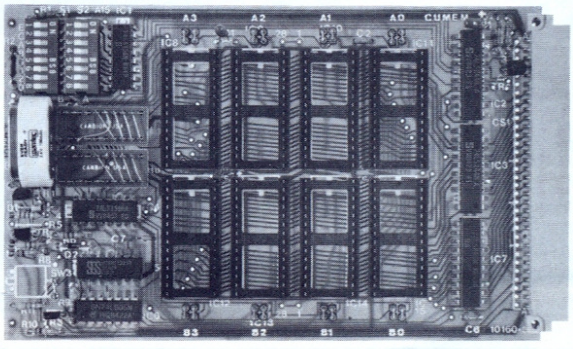
No price rise

CU-MEM mark 5 is the same price as the mark 4, ie £89 for one off. The 5565 is available from Control Universal at the reduced price of £39 for one, with discounts depending on quantity, on a sliding scale up to 32%.

Special Offer on 16kB CMOS Mk IV

Until stocks (about 250 at the time of printing) of the Mark IV CU-MEM are exhausted, this version is offered with 16kB CMOS RAM at the special price of £115, compared to the previous price of £153.

This product is ideal for use with EuroBEEB, as it increases the non-volatile RAM from 16kB to 32kB.



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Cube Control BASIC

Not a lot of fuss...!

We ought to be forgiven for making a song and dance about CUBE Control BASIC. But the whole point about Control BASIC is that it is unfussy, straightforward, and easy to understand and use. Just what an engineer would specifiy...if he had the chance.

Control BASIC is an extension to standard BBC BASIC. It puts the real world under the control of the engineer, without demanding any understanding of memory maps, initialisation of VIAs, end of conversion signals or any of other esoteric stuff that computer buffs go in for.

You want to turn on channel 4? Type TURNON 4. Read a 12 bit analog value into a variable called PRESSURE? Type PRESSURE = ADVAL 6. Start MOTOR6 if SWITCH8 is on? Type IF IN # SWITCH6 TURNON MOTOR 8.

That's easy – that's CUBE Control BASIC.

Let Industry get Control of itself

CUBE Control BASIC is the brainchild of Dave Hunt, Control Universal's Technical Director, and is the outcome of two strongly held beliefs.

1. Industry has so far taken up nothing like the opportunities for using microcomputers in control, and ought to be encouraged.

2. As long as the Control Engineer, or Plant Engineer has to choose between the inadequacies of ladder diagrams for arithmetic and graphics, and the obscurity of BASIC for handling inputs and outputs, not much progress will be made.

Looks familiar

There are now something like half a million BBC Microcomputers in use. Many of them are in industry where the senior engineers have been using them for laboratory purposes, but an even larger number are in education, where nearly every newly qualified engineer now coming into industry has had experience on a BBC.

Add to this reservoir of experience the other versions of BASIC on all the computers now in use, and it is clear that the choice of BBC BASIC as a programming medium will be highly popular with most engineers.

But will it cope with the job? As standard BASIC, switching on an output by typing "?&6800 = ?&6800 AND &CB" must seem obscure to all but the most devoted machine code enthusiast. However, until Control BASIC, this was the form demanded by BBC BASIC. "TURNON PUMP65" seems a triumph of practical thinking.

Matching the hardware

Making the software that simple would show up the hardware rather quickly if it were not up to the same standards of convenience. The CUBE range offers a wide range of analog and digital inputs and outputs, both light and heavy duty. Both EuroCUBE processor cards have a real time clock on board which can be read just using the words CLOCK and DATE. (TIME is used for interval timing).

CUBIO
64 channel TTL level digital i/o

CUBAN-8
16 x 8-bit analog i/p
1 x 8-bit analog o/p
16 x TTL digital i/o

CUBAN-12
8 x 12-bit analog i/p
4 x 12-bit analog o/p
7 x TTL digital i/o

INDIO (opto-isolated)
16 channels on an industrial base. Mix/match from:-
3 amp o/p up to 6Ovdc
3 amp o/p to 110vac
3 amp o/p to 240vac
input 5vdc nominal
input 24vdc nominal
input 50vdc nominal
input 110vac nominal
input 240vac nominal

(Only the issue 2 version of INDIO is suitable for use with Control BASIC. Deliveries commence Jan 85)

LABORATORY/ INDUSTRIAL INTERFACE
16 channels total software selectable as dc inputs or 2 amp 24vdc outputs. Convenient connection fascia. All opto-isolated.

READ-24/READ-50
16-channel opto-isolated. 24 or 50 vdc input.

POWER-50
16 channel opto-isolated output; will switch 2amp up to 50v

SERIO
Four channel serial interface, each with independent baud rate and parallel port (8 bit).

Naming the real world

One of the great advantages of BBC BASIC, with its long variable names, is that meaningful labels can be given to functions, values, text messages and so on. Now Control BASIC adds the ability to name inputs and outputs in the real world, with a consequent enormous improvement in readability and clarity.

This should mean that fewer programming mistakes will be made during development, and that any other engineer can take over the maintenance of the program with very little effort.

In the example below, for instance, inputs, outputs and truth statements all have helpful names.

Not a high price...

There is no charge for Control BASIC supplied with new issue EuroBEEBs.

Please refer to page 9, under the heading "Machine Operating System 3 – what you need to know". There you will see that the EuroBEEB operating system has been divided into two 8kB areas, the first of which, containing Control NET and Control BASIC, is supplied in all cases without extra charge.

UPGRADES:– Customers with versions 1 and 2 of the operating system (MOSB.1 and MOSB.2) may upgrade by returning their old EPROM and requesting one of the version 3 options on page 9. The charge for the upgrade is £40, plus £10 if the EPROM has to be upgraded from 8kB to 16kB, or £10 for the supply of a new 8kB EPROM, £20 for the supply of a new 16kB EPROM.

```
10  REM This program fills a reaction vessel at 5.30am
20  TOOHIGH = 90:TOOLOW=30:  REM note use of words for limits
30  BASE = &D000:        REM Sets output base address
40  OUTCH 0,1:           REM Defines channels 0 and 1 as outputs
50  INCH 8:              REM Defines channels 8 as an input
60  HEATER = 0:          REM heater as output 0
70  PUMP = 1:            REM pump as output 1
80  LEVEL = 8:           REM level switch as input 8
90  TEMPSENS = 0:        REM temperature as analog input 0
100 REPEAT:UNTIL CLOCK#$ = "05:30:00"
110    REPEAT
120      IF IN#LEVEL TURNOFF PUMP ELSE TURNON PUMP
130      TANKTEMP=ADVAL TEMPSENS/100
140      IF TANKTEMP<TOOLOW TURNON HEATER
150      IF TANKTEMP>TOOHIGH TURNOFF HEATER
160   UNTIL IN#LEVEL AND TANKTEMP>90 OR (CLOCK#$ = "06 00 00")
170 IF CLOCK#$="06 00 00" PRINT "TIMEOUT FAILURE":TURNOFF
    PUMP:TURNOFF HEATER
```

CONTROL UPDATE

This is Control BASIC

ADVAL
Reads a value from an analog input.

BASE
Defines the lower end of a group of TTL input/output devices (VIAs)

DAC#
Writes a value to an analog output.

DELAY
Interval timer, programmed in centi-seconds.

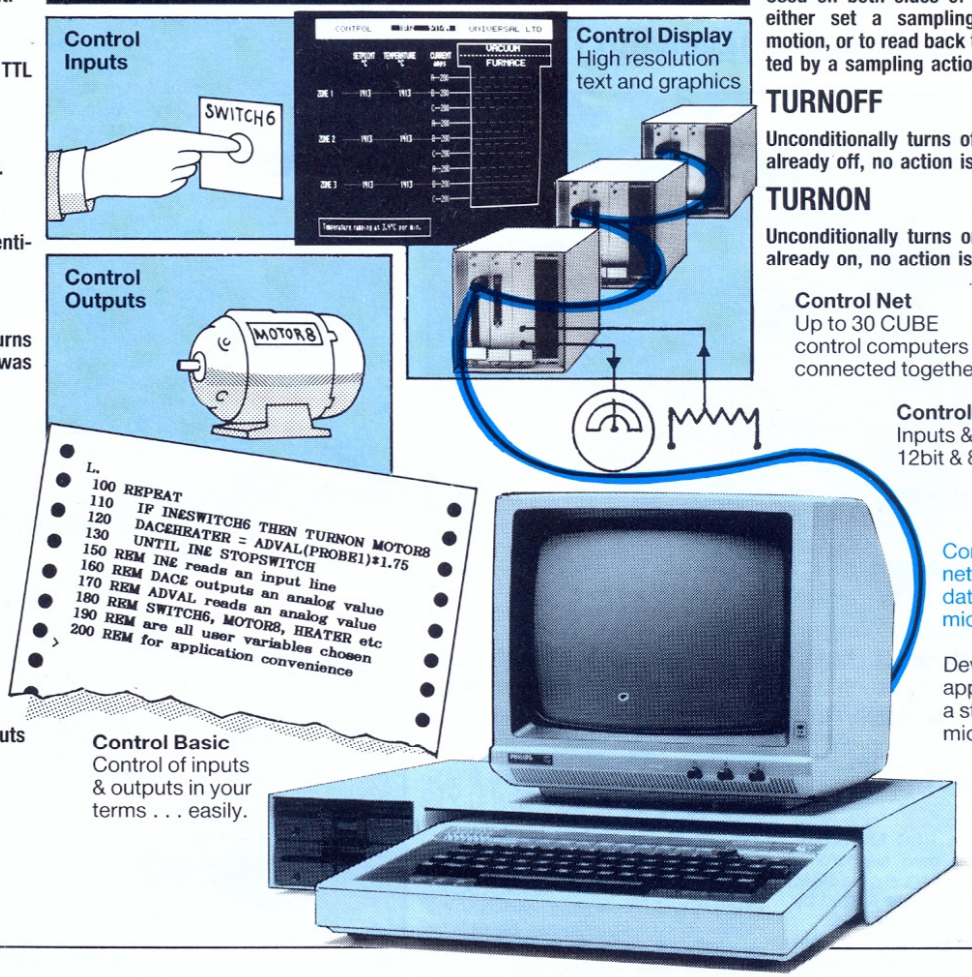
FLIP
Inverts the state of an output – ie turns it on if it was off, turns it off if it was on.

IN#
Reads the state of an input

INCH
Defines i/o channels as being inputs

OUT#
Writes a 0 or 1 to an output, thus turning it on or off.

OUTCH
Defines i/o channels as being outputs



SAMPLE #
Used on both sides of an equation to either set a sampling sequence in motion, or to read back the data collected by a sampling action.

TURNOFF
Unconditionally turns off a channel. If already off, no action is taken.

TURNON
Unconditionally turns on a channel. If already on, no action is taken.

Control Net
Up to 30 CUBE control computers connected together

Control Analog
Inputs & outputs 12bit & 8bit

Control the network, collect data on the BBC microcomputer

Develop the application on a standard BBC microcomputer

CUBE HI-RES UNIT

High resolution colour graphics on any computer – including programmable logic controllers

For those computer users who have a system already, but need high resolution colour graphics, here is a low cost solution. CUBE HI-RES provides 8 colours at a resolution of 512 x 256 pixels, together with fully programmable text.

For £767 (£625 for monochrome version) the CUBE HI-RES provides a completely independent unit with its own microprocessor (Euro-BEEB) and separate graphics display processor.

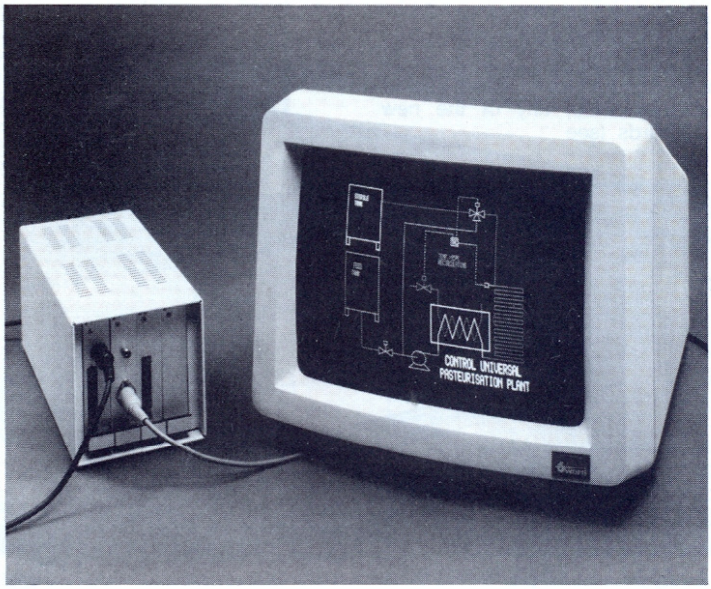
Graphics

The resolution is 512 x 256 pixels, and all the BBC-style commands for graphics colour, move draw and plot are supported. (Not FILL). The resolution and facilities are closely similar to MODE 0 on the BBC, but where the BBC is monochrome, the HI-RES is full colour.

In addition special commands allow specification of full, dotted, dashed or dot-dashed line drawing.

Text

There is a full ascii set of characters, and they may be written as 85 columns by 32 rows, or the width and height of each character can be independently expanded. In addition, an italic mode may be used, and the text can be defined to read vertically instead of horizontally. All background and foreground colours are supported.



Memory and speed

Of course, being on the serial port of the host computer means that none of the memory of the host computer is used. The HI-RES processor card has the CUBE operating system and 8kB of RAM, the CU-GRAPH graphics processor card has 48kB of RAM for screen display.

The system is supplied ready to use at 9600 baud, but lower speeds can be selected by making links on the processor card.

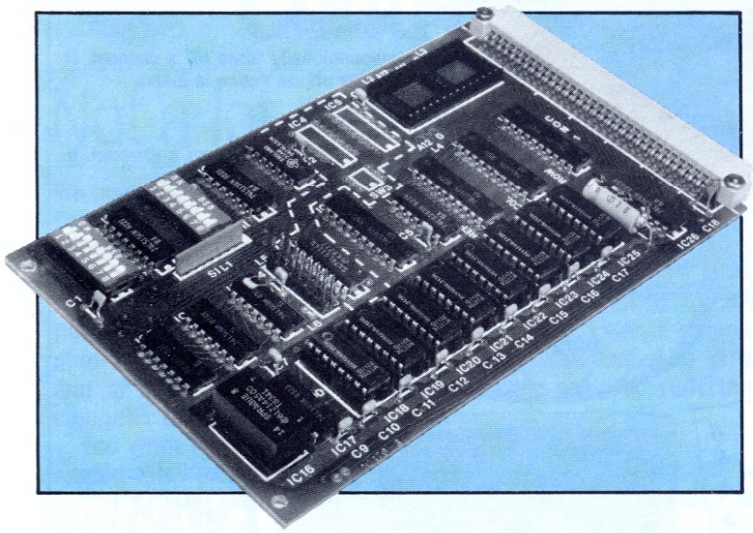
HI-RES on Programmable Logic Controllers

If there's one sort of device that really needs the CUBE HI-RES, it's probably the programmable controller. These usually only have facilities for controlling inputs and outputs, and if any graphics display unit is available, it tends to be frighteningly expensive. For example, the Texas 5TI/550TI range can be used with a video programming unit that provides a colour display, but costs about four times as much as the CUBE HI-RES. We have successfully connected a 550TI to a CUBE system – details on request.

Control Universal Limited, Andersons Court, Newnham Road, Cambridge CB3 9EZ. Telephone: (0223) 358757. Telex: 995801 GLOTX-G.

CY-DRAM

The Megabyte Concept



"CY-DRAM" is a 64kB memory card arranged with four pageable "sideways RAM" areas. This allows a processor with limited addressing capability, such as the 6502 and 6809, to have large areas of RAM available, in particular for high speed data collection.

The Concept

Similar to the excellent "side-ways ROM" feature of the BBC Microcomputer the CY-DRAM card supports a method of getting more accessible RAM memory into a memory map limited by the eight-bit processor to only 64kB.

Theoretically, up to 16 CY-DRAM cards can be used at once, so providing an additional 1MByte of RAM, but with only sixteen slots in the largest CUBE rack, a maximum of 15 cards plus the processor can be used, to give 983kB of extra RAM.

How it Works

The user defines an area of memory by setting the memory enable switches on the card. Then, simply writing to a latch causes the processor's attention to switch from one physical 16kB block of memory to another, both of which appear in the same position in the memory map.

Use with BBC BASIC

When using BBC BASIC on the EuroBEEB, there is really only one useful memory allocation, which is $4000 to $7FFF. BASIC programs can be put into the sideways RAM area, but great care has to be exercised that references from the unpaged area of RAM are compatible, no matter which paged area has been selected. Much more popular is CY-DRAM'S use with data collection or data storage, which can of course be controlled from a BBC BASIC program.

Mass Data Storage

This is what CY-DRAM is good at. It takes only one machine code instruction to switch from one paged area to another; the rest of the access is at full processor speed – much faster than a disk can manage. For example, the ADCU (Analog & Digital Capture Unit described on page 5) uses CY-DRAM to allow the capture of 32,000 sixteen-bit values in 3.2 seconds. Naturally, more cards can then be added to allow up 458,752 readings to be taken (using EuroBEEB, CUBAN-12 and 14 CY-DRAM cards in a 16 slot rack).

Choice of Processors

On the 6502 processor without BASIC, or at any time on the 6809 processor, the sideways memory area can be defined as any four blocks of 4kB, on 4kB boundaries (ie each memory enable switch defines the first digit of the four digit hexadecimal address of the block selected).

Issues 5 & 7 EuroCUBEs

EuroBEEB

Issue 5 introduced EuroBEEB as a completely distinct product, rather than as a 6502 EuroCUBE with BBC BASIC on board, in that the EuroBEEB is delivered with all sockets permanently configured as follows:–

M3 8kB CMOS RAM
M2 8kB CMOS RAM or
M1 16kB BBC BASIC
M0 16kB operating system EPROM

At issue 7, in order to make the change between CMOS RAM and EPROM really easy, memory socket M2 has been fitted with an 18 pin socket, into which the user plugs one of two headers supplied with the board. It is then a moment's work to change the EuroBEEB from the development configuration with CMOS RAM to the operating version with EPROM.

Real time clocks

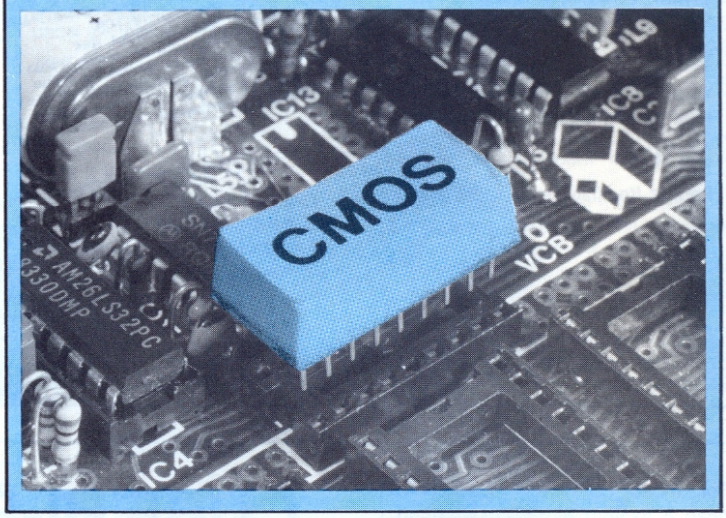
Real time clocks have been fitted both to the 6809 and 6502 EuroCUBEs from issue 5.

Hard RESET Pins

All issue 7 EuroCUBEs have a pair of pins to which the user can add a reset button, perhaps conveniently mounted on the front panel.

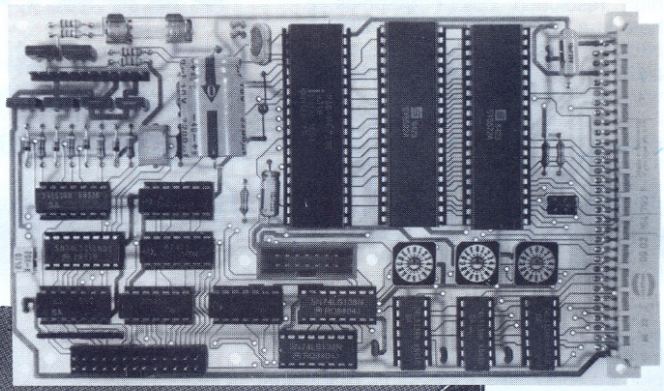
16kB MOS socket

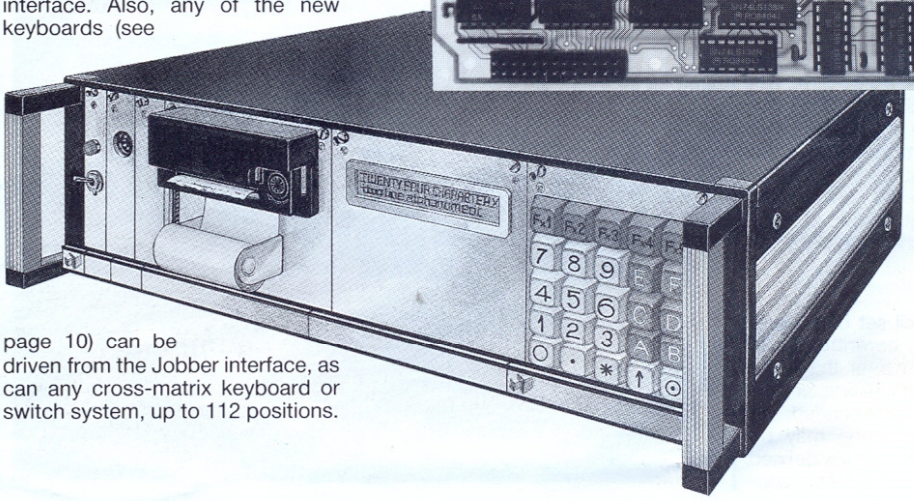
Socket M0, which contains the operating system EPROM, is now configured for a 16kB device, so that both 8kB and 16kB EPROMs can be used without making any board changes.



JOBBER interface connects keyboard, liquid crystal display and rack printer

The popular combination of liquid crystal display, rack-mounting narrow printer and 25-way keyboard, as embodied in the JOBBER industrial computer, are now all driven from one Eurocard, called Jobber interface. Also, any of the new keyboards (see page 10) can be driven from the Jobber interface, as can any cross-matrix keyboard or switch system, up to 112 positions.

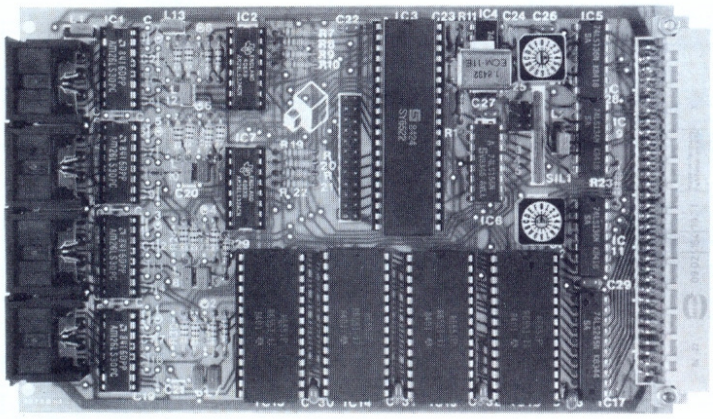




Mark II SERIO –

a completely new design

- now uses 6551 ACIA as the active device (same as on EuroCUBEs)
- interrupts fully implemented
- On-board 6522 VIA provides handshaking, two timers and an 8-bit digital port



Meeting the CUBE standard

SERIO Mark I was a bought-in design, beneficial in that it provided an instant solution to the demand by customers for a serial interface card. However, it was based on the Western Digital chip, and when the Syntertek 6551 was selected as the standard serial port chip for EuroCUBEs it was a logical decision to bring the serial interface card into line.

Issue 2 therefore was a completely new design which employed the superior 6551 chip, and which therefore has broadly similar software to that on the EuroCUBE serial port, a clear advantage to the user.

The eight bit digital port has the same pin-out as that on the new CU-KEY-99 series (see page 10), ie it is a 20 way ribbon cable connector bringing out port B of the VIA, plus control lines CB1, CB2, plus 5v and ground. The BBC user port meets the same specification.

WATCHDOG – Meaner, and with sharper teeth

Watchdog is the CUBE "system healthy" card, which causes emergency action to be taken should the computer fail to provide the stream of pulses to the card to say "I am still working normally".

Watchdog has been completely redesigned, taking special note of comments from customers on what they are looking for. The new version has red/green LEDs for visual status indication, a bleeper for warning of a time-out, and a choice of actions to be taken in the event of a time-out.

What is Watchdog?

The best way of automatically checking that a computer is working normally is to program it to send periodic pulses to a pure hardware device that will generate an alarm if a pulse is not received when expected.

Watchdog can be set to expect a pulse at intervals from 1mS to 68 seconds, and if the pulse is not received within the expected time, the following actions take place:–

1. Green LED goes out, Red LED comes on and flashes.
2. The bleeper sounds an intermittent signal – bleep, bleep, bleep....
3. A short pulse is provided to one of the following, as set by the user:–
   - NMI
   - IRQ
   - RESET
4. The relay, which is held closed while all is well, drops out. This could cause a mains contactor to open, if required.

Features

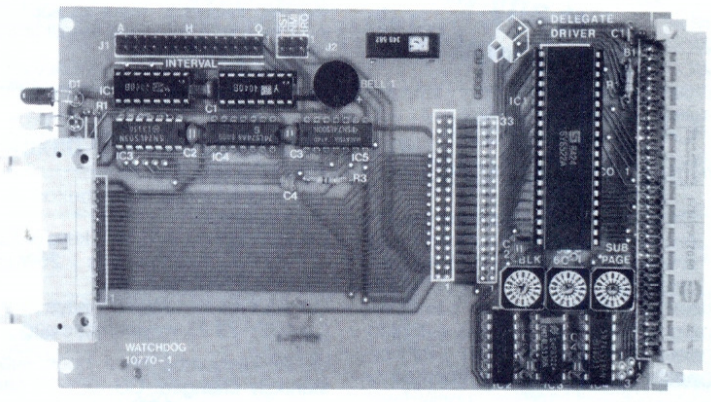
*** programmable time-out period**
A link is set on the board using a push-on jumper which allows the period to be set from 1mS to 68 seconds in 16 steps.

*** LED status indication**
A green LED is illuminated as long as a time-out has not occurred. The red LED comes on and flashes once a time out has occurred.

*** Bleeper**
Intermittent bleeping occurs once time-out has occurred.

*** user-available VIA**
A standard CUBE i/o port (Delegate pin-out) is fitted; all i/o lines are available, except control line CB1.

*** relay**
The relay fitted can take mains voltage, at up to 0.5 amp or 10 watt (whichever is less), and is brought out to the outside world on separate heavy duty connectors.



Machine Operating System 3 – what you need to know

From January 1985, all EuroCUBE-65s and EuroBEEBs will be shipped with version 3 of the machine operating system, which replaces MOSB.2

MOSB.3 will include Control NET and Control BASIC in an 8kB EPROM, but no machine code monitor or peripheral drivers.

Alternative versions of a 16kB operating system EPROM are offered, as below, to accommodate the monitor or various peripheral drivers.

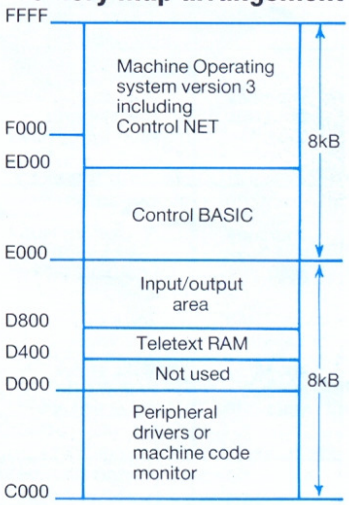
version	used for	size	extras[1]
MOSB.3	minimal systems[2]	8kB	A
MOSC.3	CU-GRAPH	16kB	B
MOSJ.3	Jobber	16kB	B
MOSM.3	Monitor[3]	16kB	A
MOST.3	Teletext	16kB	B

1 extras: type A has Control BASIC and Control NET built in; type B also has the keyboard driver for CU-KEY 99 series.

2 minimal systems: Obviously, without a video driver, EuroBEEB with MOSB.3 only cannot be a stand-alone system. With this version it is intended that the development be done via serial link from a BBC Computer. Once the program is developed, there need be no video or other computer, and the system will auto-start using the power-up-and-run turnkey facility.

3 monitor: The machine code monitor is available to systems with other than MOSM.3 only as a sideways ROM, called "SIDEMON" which can be mounted on CUBE Doublestore or CU-MEM Selecta.

Memory Map arrangement



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Local Exhibitions: Bringing the CUBE to you

Control Universal are naturally proud of the range, and all the new and interesting products described in this newsletter. We have a permanent demonstration room in our Cambridge factory, which will be considerably expanded when we move, probably in January.

However, in case it is not convenient for you to visit Cambridge, we take pleasure in inviting you for a coffee, demonstration and conversation in one of the local venues listed below.

Early indications are that the travelling show is a successful idea, and we are likely to continue it next year. More details in newsletter no 2.

All exhibitions are from 10am to 4pm, and will be signposted in the foyer of the hotel.

Date	Eastern England East London	Western England West London	Midlands	North West	North East	Scotland
Exhibitor	Geoff Sore	Richard Baker	Mark Hassell	Isaac Schalom	Jon Dane	Jon Dane
Thursday 1st Nov 1984	Moat House Hotel London Road BRENTWOOD Essex	Post House Hotel Herbert Walker Avenue SOUTHAMPTON	OXFORD Europa Lodge Wolvecote Roundabout	Crest Hotel NEWCASTLE UNDER LYNE		
Thursday 8th Nov 1984	Post House Hotel London Road Wrotham Heath SEVENOAKS	Bull Hotel Oxford Road GERRARDS CROSS	Pennine Hotel Mackline St DERBY	Alma Lodge Hotel 149 Buxton Road STOCKPORT	Hallan Towers Hotel, Broomhill Sheffield	
Thursday 15th Nov 1984	Post House Hotel Ipswich Rd NORWICH	Courtlands Hotel 19, The Drive BRIGHTON	Swan Hotel The Embankment BEDFORD	Victoria Hotel Bridge Street BRADFORD		
Thursday 22nd Nov 1984	Post House Hotel Bell Common High Rd EPPING	White Hart Hotel St Johns St SALISBURY	Centre Hotel Humberstone Rd LEICESTER	Crest Hotel The Ring Way PRESTON	Post House Hotel Emerson District 5 WASHINGTON	
Thursday 29th Nov 1984	Gt Eastern Hotel Liverpool St LONDON EC2	Post House Hotel GATWICK	Post House Hotel Chapel Lane Great Barr BIRMINGHAM	Post House Hotel Palatine Road Northenden MANCHESTER		
Thursday 6th Dec 1984	Noke Hotel Watford Rd ST ALBANS	Post House Hotel Marlborough Rd SWINDON	Shakespeare Hotel Chapel St STRATFORD	Tillington Hall Eccleshall Road STAFFORD		Albany Hotel Bothwell Street Glasgow Wednesday 5th Dec 1984
Thursday 13th Dec 1984	Post House Hotel London Road IPSWICH	Post House Hotel Pentwyn Rd CARDIFF	Albany Hotel St James St NOTTINGHAM	Victoria Hotel Bridge Street BRADFORD		

Of course, we'll visit you at any time you wish.

Now that we have a field sales engineering team, we can call at your office on request. Please ring the sales office at Cambridge, and we will be delighted to arrange an appointment. Equally, we shall be pleased to make an appointment for you to come and see all of our products at Cambridge.

CU-KEY-99: bigger and better in every way

This product represents the top of a completely new range of keyboards, in which the connection to the processor card uses only eight bits. This releases the other eight bits of the digital port to be available as a standard BBC-type user port. The connector for this port are mounted on the keyboard interface supplied with each keyboard.

Product range:-

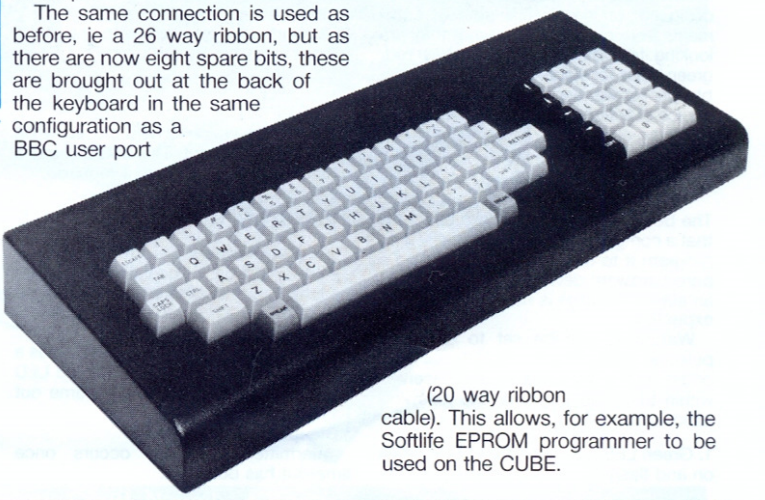
CU-KEY-99 64 QWERTY keys + 10 function keys + 25-way numeric pad

CU-KEY-64 64 QWERTY keys

CU-KEY-25 25-way numeric pad

CUBE keyboards have been substantially changed. CU-KEY-53 and the old version of CU-KEY-25 required the processor to continually poll the keyboard. In the new version a key depression generates an interrupt.

The same connection is used as before, ie a 26 way ribbon, but as there are now eight spare bits, these are brought out at the back of the keyboard in the same configuration as a BBC user port (20 way ribbon cable). This allows, for example, the Softlife EPROM programmer to be used on the CUBE.



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NEW AND DIFFERENT...

Codes, prices and ordering information on the new products described in this newsletter, and amended prices of other products.

Good news! Boxed disk drives have come down in price, so has the 8kB CMOS RAM chip (5565).

Code	Description	Price £	ready to ship

EuroBEEB

CUBE Control BASIC and CUBE Control NET are included in version 3 of the EuroBEEB/EuroCUBE 65 operating system, standard from Jan 85. (see page 9, Machine Operating System). The following are the new versions of EuroBEEB, with the new options on operating systems.

CUE6508B	EuroBEEB, 8kB RAM, MOSB.3	275.00	Jan 85
CUE6516B	EuroBEEB, 16kB RAM, MOSB.3	314.00	Jan 85
CUE6508C	EuroBEEB, 8kB RAM, MOSC.3	289.00	Jan 85
CUE6516C	EuroBEEB, 16kB RAM, MOSC.3	329.00	Jan 85
CUE6508J	EuroBEEB, 8kB RAM, MOSJ.3	289.00	Jan 85
CUE6516J	EuroBEEB, 16kB RAM, MOSJ.3	329.00	Jan 85
CUE6508M	EuroBEEB, 8kB RAM, MOSM.3	289.00	Jan 85
CUE6516M	EuroBEEB, 16kB RAM, MOSM.3	329.00	Jan 85
CUE6508T	EuroBEEB, 8kB RAM, MOST.3	289.00	Jan 85
CUE6516T	EuroBEEB, 16kB RAM, MOST.3	329.00	Jan 85

Disks

CUE2OOO	CUBE Doublestore with DFS	184.00	Jan 85
CUU2028	CUBE rack mounting disk pack with Doublestore, DFS and two eighty track double sided 3½" drives	995.00	Jan 85
CUU2018	CUBE rack mounting disk pack with Doublestore, DFS and one eighty track double sided 3½" drive	655.00	Jan 85
CUU2024	CUBE rack mounting disk pack with Doublestore, DFS and two forty track single sided 3½" drives	875.00	Jan 85
CUU2014	CUBE rack mounting disk pack with Doublestore, DFS and one forty track single sided 3½" drive	575.00	Jan 85

NB. For use with CU–STOR and 6809 systems, the 3½" drive units above are available NOW, at the same price as shown.

Peripherals and Systems

CUU1291	CUBE ADCU (Analog and Digital Capture Unit)	895.00	NOW
CUU6570	CUBE HI–RES Unit (monochrome)	625.00	NOW
CUU6570C	CUBE HI–RES Unit (colour)	767.00	NOW
CUE6416	CY–DRAM sideways RAM card	195.00	NOW
CUE1800	WATCHDOG system healthy card	90.00	Dec 84
CUE4900	JOBBER Interface for driving Viewline LCD, Rackprint and CU–KEY–25	125.00	NOW
CUE4950	JOBBER interface without printer driver chip	95.00	NOW
CUE7104	SERIO (issue 2) 4–channel serial interface with user port	175.00	NOW
CUE7102	SERIO (issue 2) 2–channel serial interface with user port	155.00	NOW
CUE0505	CUMEM Mark 5 (supports CMOS RAM type 5565	89.00	NOW
CMI5565	CMOS RAM type 5565 (£10 price reduction)	39.00	NOW
BBABZ15	BBC BASIC II ROM	65.00	NOW

Keyboards

CUU9999	CU–KEY–99 full size encoded keyboard in enclosure	135.00	Jan 85
CUU9964	CU–KEY–64 encoded QWERTY keyboard in enclosure	95.00	Jan 85
CUE9925	CU–KEY–25 new version of 25 way keyboard without interface, enclosure or front panel	25.00	Jan 85
CUU9925	CU–KEY–25 as above on front panel	45.00	Jan 85
CUE9900	Keyboard interface for CU–KEY 99 series keyboards	29.00	Jan 85

Disks on the EuroBEEB

– disk filing system – "Doublestore" FDC – 3½" disk drives now

Disk filing system

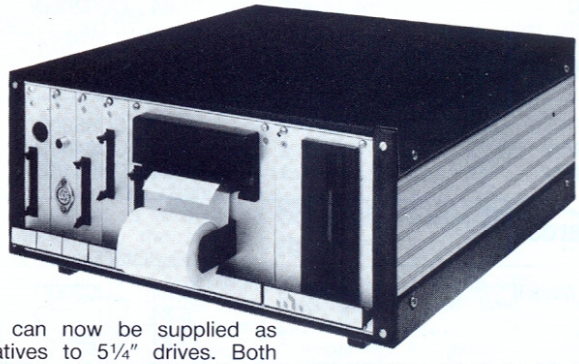
Using the software of the Microware DDFS, the EuroBEEB with operating system version 3 will be able to support a full specification disk filing system, both in BASIC and in machine code, for programs and for random files.

It is specified at single density for 1MHz operation, and uses the CUBE Doublestore as the disk controller on the standard CUBE bus.

CUBE Doublestore

The DDFS ROM is carried on the Doublestore board, in the first of its four sideways ROM sockets. The others can be used for any other sideways ROM which obeys the BBC operating system rules. (eg. SIDEMON, the CUBE machine code monitor)

"Micro floppies" 3½" disk drives



These can now be supplied as alternatives to 5¼" drives. Both micro floppy drives and media are still rather more expensive than the larger format, but the gap may be expected to lessen as the popularity and the competition increase, and they already offer several advantages:-

– smaller: One micro floppy uses only 3" of rack space, two use 5", compared with 7" for one or two 5¼" drives - more robust media: the case of the micro floppy is rigid plastic rather than flexible card, and the dust gate closes automatically on removal from the drive.

– polarised: the door cannot be closed if the disk is inserted in any but the correct orientation.

– fail safe write protect: a sliding tab is OPENED to prevent write action. If removed entirely, it is permanently protected.

The drives selected by Control Universal are completely compatible with 5¼" drives in that they are 40 or 80 track, respond to the same disk filing system, and use the same pin-out on the controller card. This means that your existing system can be changed; it requires only a different cable from the controller to the drive.

Flex Software

FLX0250	MACE 6809 assembler used to include XMACE. Now XMACE is a separate product and is reduced from £65.	38.00	NOW
FLX0250X	XMACE 68XX range cross assembler	49.00	NOW
FLX0350	TSC 6809 debug package	75.00	NOW
FLX0420	TSC extended BASIC	100.00	NOW
FLX0421	Pre–compiler for TSC BASIC	50.00	NOW

Boxed disk drives for BBC Micro

All boxed drives are available now.

Code	total capacity kB	drives	sides	tracks	power supply	price £
CUU3111	100	1	1	40	NO	120.00
CUU3116	100	1	1	40	YES	160.00
CUU3112	200	2	1	40	YES	285.00
CUU3141	400	1	2	80	NO	190.00
CUU3146	400	1	2	80	YES	209.00
CUU3142	800	2	2	80	YES	415.00

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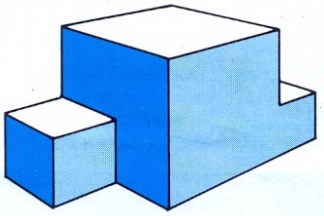
CONTROL UPDATE

ARE YOU FULLY INFORMED?

The quality and the quantity of CUBE Technical documentation is rising rapidly. Should you wish to have a later issue of the manual for a product you already have, or if you would like to use the manual as a means of evaluating the suitability of a unit for your application, just fill in the enclosed order card with your requirements. There is no charge.

Title	Manual Issue no.	Date	Order number code
CPU Cards			
EuroCUBE-09/7	1	9.84	CU0900D
CU-NINE	2	1.84	CU2900D
6809 data sheet	1	10.83	CU0901D
EuroCUBE-65/5	1	9.84	CU6500D
EuroBEEB	2	7.84	CU6599D
CUBE MONITOR Peripheral Driver	1	10.84	CU6501D
EuroCUBE-65 & 09 Issue 2	1	1.84	CU6507D
Modifications to Issue 2 Euro-CUBE	1	1.84	CU6506D
CUBIT	2	1.84	CU0600D
CUMOT	2	1.84	CU0200D
Memory Cards			
CU-MEM	3	9.84	CU0500D
CU-DRAM	2	1.84	CU6400D
CY-DRAM	1	6.84	CU6416D
I/O Cards			
SERIO Mark II	3	10.84	CU0300D
INDIO	2	6.84	CU1300D
CUBIO	2	10.84	CU8000D
Video Cards			
CUGRAPH – Manual	1	1.84	CU1000D
– circuit diags	1	1.84	CU1004D
– Peripheral Driver	1	9.84	CU1001D
CUBE HI-RES graphics chip data sheet EF8336	1	10.83	CU1002D
GRAPHICS CHIP app'ns note	1	10.83	CU1003D
TELETEXT – Manual	2	10.84	CU4000D
– circuit diagram	2	10.84	CU4001D
– character generator SAA5050	1	10.83	CU4004D
A/D Cards			
CUBAN-8	2	8.84	CU0800D
– "Wireless World" Reprints	1	10.83	CU0801D
CUBAN-12	3	9.84	CU1200D
– AD574A 12-bit ADC data sheet	1	10.83	CU1202D
Floppy Disk Controllers			
CU-STOR	1	1.84	CU1900D
Keyboards			
CUKEY-53	1	1.84	CU5300D
CUKEY-25 (old-type)	1	8.84	CU2500D
CUKEY-99	1	12.84	CU9999D
CUKEY-64	1	12.84	CU9964D
CUKEY-25 (new type)	1	12.84	CU9925D

Title	Manual Issue no.	Date	Order number code
Systems			
CUBEFLEX 6809 DEVELOPMENT SYSTEM (MOSF.2)	1	10.84	CU0901D
CUBE BeebFLEX	4	9.84	CU2901D
ADCU	3	10.84	CU1201D
Flex			
FLEX Explained	1	7.84	CU0902D
FLEX Range of Software	1	7.84	CU0903D
FLEX Notes	1	9.84	CU0904D
PL/9 Overview	2	10.84	CU0905D
PASCAL versus 'C'	1	9.84	CU0906D
Jobber			
RACKLINE	1	1.84	CU4900D
EuroBEEB JOBBER	1	6.84	CU6502D
VIEWLINE	1	10.83	CU4801D
Miscellaneous			
BACKPLANES	3	6.84	CU1400D
BEEBEX	1	1.84	CU2700D
*I/O	2	2.84	BS1630D
BBC BASIC – An Overview	1	1.84	BB0001D
SIDEWISE	1	10.83	BB1000D
CU-PROM for BBC and CUBE	1	10.83	CU2800D
CUBE-ICE	2	6.84	CU2600D
CU-PRINT -R & -P	1	1.84	CU0700D
ROMULATOR	3	10.84	CU2300D
SUPERTRAX	2	6.84	BB4080D
Clock MEM3000	1	10.83	CU6502D
Serial Transmissions (1) – RS-423/422	1	10.83	CU6503D
Serial Transmissions (2) – RS-423/422	1	10.83	CU6504D
SCREEN EDITOR	1	1.84	CU6509D
DELEGATE 'POWER'	2	8.84	CU3600D
DELEGATE 'READ'	2	8.84	CU3700D
SWITCH-MODE POWER SUPPLIES	1	1.84	CU21OOD
CUPS POWER SUPPLIES	1	1.84	CU1500D
PIA R6520	1	10.83	CU6520D
VIA R6522	1	10.83	CU6522D
ACIA R6551	1	10.83	CU6551D
CUBE Quick Reference Cards			
6809 Instruction set	1	5.83	CU6809R
6502 Instruction set	1	5.83	CU6502R
BASIC	1	5.83	CU6502B



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