ACORN COMPUTER SYSTEMS

Acorn Computers Ltd is an independent designer and manufacturer of microcomputer systems based in Cambridge, England. The company have developed a modular computer system based on the Eurocard printed circuit board (100 x 160mm). From these internationally sized boards a wide range of computer systems may be built up. The Eurocards can be mounted very simply in a 19" card frame which, in turn, can be housed in a stylish metal case.

The hardware is designed to the highest standards using the latest LSI integrated circuits where appropriate. Two part DIN and Insulation Displacement Connectors are used throughout the systems giving very reliable interconnections. The systems are ideally suited for use in the office or laboratory and sealed enclosures can be supplied for industrial environments.

In common with many mini and main frame computers the Acorn systems contain resident Operating System programs which handle input, output, and storage on disk or cassette. Supported by the OS, a range of languages may be run including Acorn's own version of BASIC. Also available is software for driving peripheral devices e.g. Printers, Teletypes and Modems. Using the Operating System programs can be loaded and executed automatically when the computer is switched on allowing them to be used by personnel not familiar with computer technology. Applications like this include business systems, text editing, word processing and Prestel terminals.

Acorn systems have proved to be particularly popular in laboratory and process control applications where the flexibility of both hardware and software has been utilised in data acquisition and real time operation. For many of these applications Acorn has produced Eurocards and software to the client's own specification. Automatic Test Equipment has also been constructed using Acorn computers.

Both hardware and software are being continuously developed at Cambridge, a recognised centre for British computer technology, where the academic environment complement's Acorn's expanding commercial and marketing capability.

Assembled and tested equipment is guaranteed for a full six months if used correctly. The component parts of kits are also guaranteed for six months and a fast service facility for assembled kits is available at Cambridge. In general, repairs are carried out within two weeks by a qualified service team.
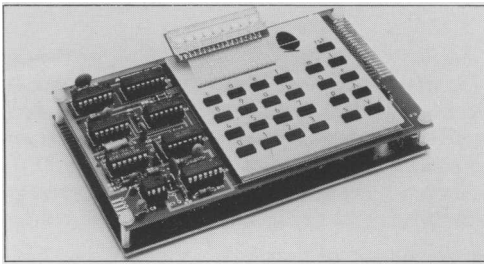
One of Acorn's Most successful products is the Atom, a personal computer available in kit and built form. Although simple to operate and available in minimal configuration it is fully expandable with the wide range of Acorn cards available. One of these can fit directly within the Atom casing. A wide range of purpose built software is available. Acorn also manufacture the BBC mircrocomputer and are one of the two companies whose products are approved by the Department of Industry and the Department of Education and Science.

Recent developments at Acorn have been in the area of computer inter-communication. Two products, the Acorn Econet, which allows up to 255 Acorn computers to communicate with each other and to share facilities such as disks and printers, and the Cambridge Ring, which provides a high speed, low error rate communication path between computers, are world leaders.

Contents

System 1

The 6502 processor Eurocard (100 x 160mm) has crystal control, 1 K byte of RAM and 512 bytes PROM containing a system monitor. A second Eurocard is mounted above it using pillars and the two are connected by ribbon cable. This second card is fibreglass, through hole hard nickel plated with solder resist and component identification. The nickel is used as the PCB is an integral part of a click action 25 key hexadecimal keyboard. An eight-digit seven-segment LED display is used for operator interface. The board also contains a CUTS Tape interface, the design of which includes a dual op-amp input and zero crossing detector for high reliability of data transfer.

The system monitor contained in two fusible link PROM's (74S571) is very easy to use and provides the following facilities using one of the 8154 devices as a keyboard interface and display driver:

Reset initialises the computer after switch on. **Memory alter and examine,** the address and data content at any location may be examined and/or rewritten after this command, and the monitor will recall the address used with this.

Go, starts execution of program from desired address.

Break point insert/remove, allows setting and cancellation of break-point anywhere in memory at which time all internal registers can be displayed or a user service routine can be executed.

**Restore,** allows continuation in original environment of program after break.

Save to tape, transfers memory contents between given locations on to tape.

Load from tape loads data into locations specified by the first two bytes on tape. Display indicates data transfer during loading and reverts to reset on successful completion.

The monitor provides of number of useful sub-routines which can be inserted in user programs and includes a character font for seven segment representation of the complete ASCII character set.

The System 1 is provided with a Users Manual which includes an introduction to binary numbers, descriptions of the 6502 internal architecture and Acorn hardware, a listing and explanation of the instruction set and monitor program and a step by step introduction to machine code programming complemented by 16 original applications programs.

The System 1 serves as a low cost development system for the microcontroller, a self-contained computer for the home enthusiast and by virtue of its modular concept, the basis for a full scale computer with VDU, floppy disk storage etc., it also represents the simplest intelligent controller on the Econet.
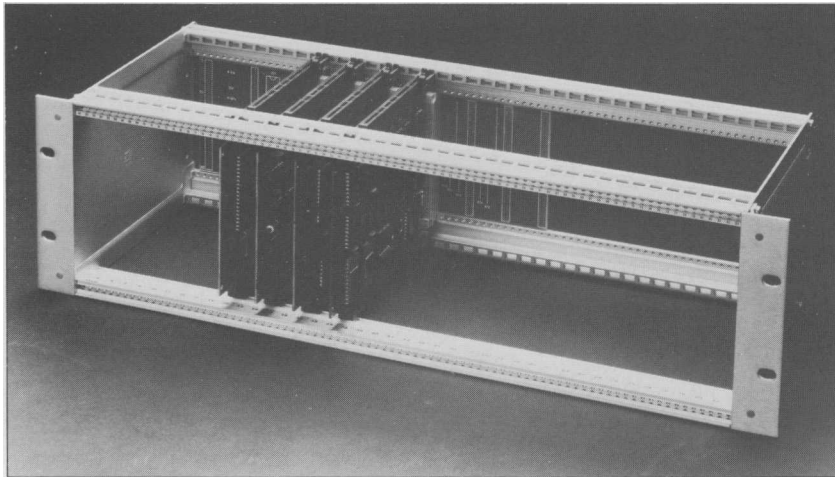
System 2

The System 2 has many applications in the area where audio cassette based storage is required. It also provides a basis for the addition of more Eurocards.

The System 2 contained within a 19" card frame consists of the following Eurocards:

6502 CPU

Fitted with the usual components together with a crystal, 1K of RAM and one I/O chip, this board interfaces to a parallel ASCII keyboard and carries a 2K byte COS ROM.

VDU Interface

This board drives a TV monitor in monochrome or colour giving Teletext characters or graphics. The Operating System program sets up and controls the screen format and scrolling.

Memory Board

Carrying 4K bytes of RAM (a further 4K may be added) this board provides the system memory. Also supplied is the BASIC ROM which is mounted on this board. A second ROM containing a floating point package and scientific functions may be added.

Cassette Interface

Using this board programs and data may be stored on an audio cassette recorder.

The four boards are connected in the card frame using an 8-slot backplane with two-part Eurocard DIN connectors and the system is easily expanded with other boards from the Acorn range.

The System 2 provides a cost effective computing system with the addition of a parallel ASCII keyboard, a TV monitor and a 5v at 3A power supply.

Further optional refinements are the addition of front panels with professional connectors and a 19" case for the card frame.

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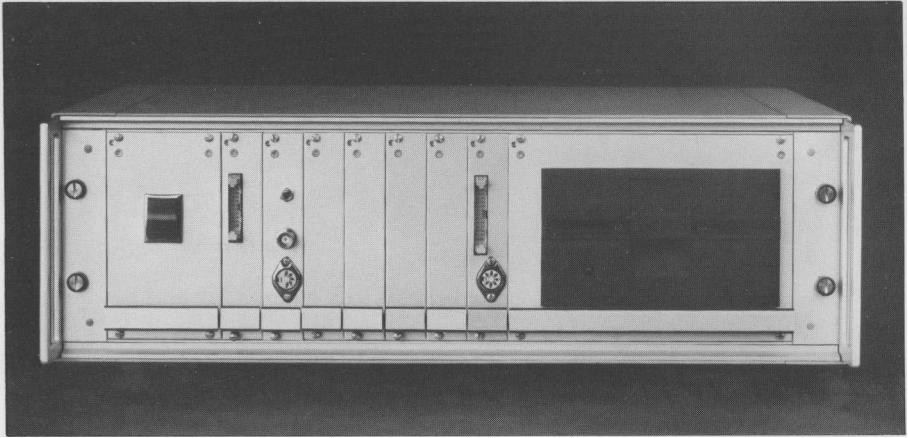
System 3

The System 3 in its basic form is a system driving a single disk. The hardware consists of a card frame, backplane with 4 sockets, 6502 CPU, VDU interface, 8K RAM, floppy disk module, DOS and resident 4K BASIC.

The mini-floppy disk drive is mounted in a $5^{1}/_{4}$" module together with its controller card and provides approximately 100K bytes of storage. A DOS ROM on the CPU card controls the drive and handles files and input/output devices i.e. the parallel ASCII keyboard and memory mapped VDU. Supplied with each system is a utilities disk with a formatting program for soft sectored disks. Acorn software e.g. BASIC, LISP, an Assembler and other compilers and interpreters may be loaded from disk or contained in ROM.

All the Acorn Eurocards are compatible with this configuration, allowing enormous variations on a modular basis. The illustration above shows the addition of a further 3 RAM cards (giving 32K bytes of memory in total) and a Versatile Interface Board all contained in a stylish casing.
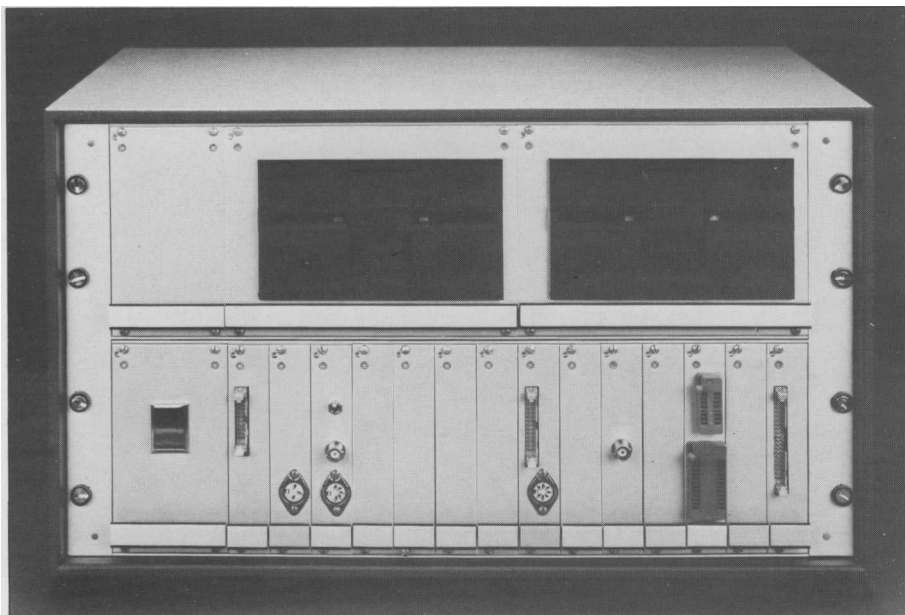
System 4

The System 4 is housed in a double height rack with facilities for up to 14 Eurocards. The basic system has as standard two floppy disk drives, power supplies, card frame buffered backplane, 6502 CPU, VDU interface, 16K RAM and disk controller. A DOS controls both disk drives, and a disk with utilities programs including disk copy is supplied with each system.

The system illustrated has the additional audio cassette interface, 32K bytes of RAM and serial and parallel interfaces via the Versatile Interface Board. Also shown are an Analogue to Digital converter, a PROM blower for 16 pin fusible link and 24 pin UV erasable devices and an In Circuit Emulator used in the development of other microcomputer systems.

The System 4 is not available as a kit.

System 5

The System 5 is housed in a 4U, 19" card frame with seven Eurocard slots. There is provision for one or two mini-floppy disk drives allowing systems with from 100 to 800K bytes of disk memory to be supplied depending upon the type of drive used. Also used in the system is a switch mode power supply Eurocard giving 5 and 12v supplies, larger systems with two disks drives will have two of these supplied.

The system will have the 6502 CPU, the disk controller and the 32K DRAM Eurocard fitted as standard with either 80 X 25 character VDU or the 40 X 25 Teletext VDU Interface card. The remaining three card-slots can be used for memory extension. An additional 16K DRAM card gives a contiguous 48K of memory and two further 32K DRAM cards may provide a total of three 32K user pages. Alternatively these card slots can be filled with any of the interface cards; the system illustrated above has a Versatile Interface card, an Econet Interface card and 48K bytes of DRAM.

The System 5 will support any of Acorns range of languages as detailed in the software section of this brochure.

An Acorn ASCII keyboard and a monochrome or colour monitor are all that is required to bring the System 5 into operation.

System 5 is only available fully assembled and tested after customers specification of the cards to be fitted. 2 MHz 6502 versions of System 5 will be available soon.

Prestel Terminal

Acorn Computer systems contain a Teletext/Prestel standard VDU which can drive both colour and monochrome monitors. The System 3 above connects via a serial interface port to an integral Modem and functions as a Prestel terminal. Data may be received from Prestel and stored on the mini-floppy disk for subsequent processing and display. Files may be created on the system using the Prestel screen editor and disk storage. When correct, Information Providers may transmit these files to the Prestel computer using the bulk update facility.

The Prestel software contains powerful editing commands, user number storage and auto telephone dialling. It is mainly written in BASIC and can be modified to meet specific user requirements.

Printers, Teletypes and further VDUs may also be connected to Acorn computers which support one or two mini-floppy disk drives. When not connected to the Prestel computer the system provides powerful computing facilities including a wide selection of languages and peripheral devices.
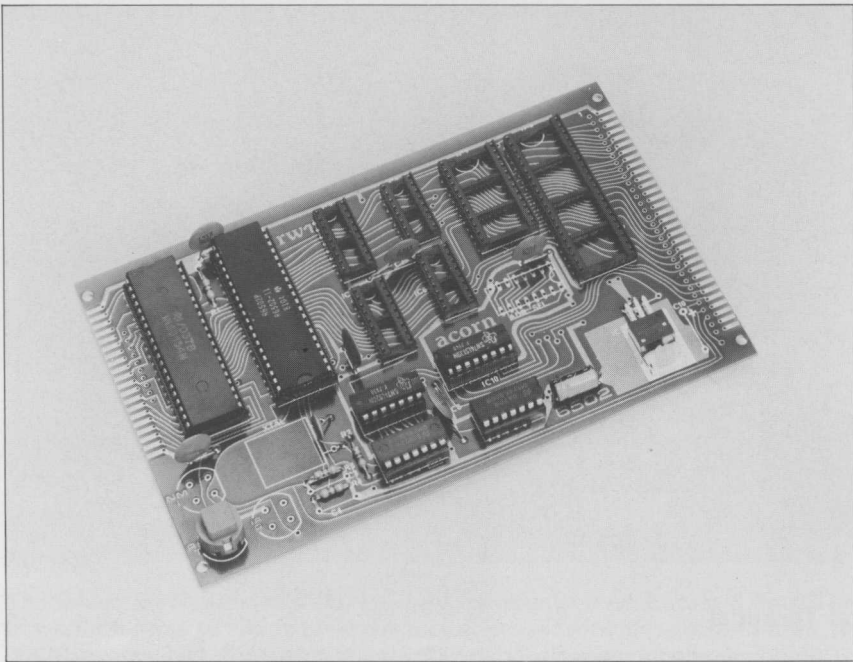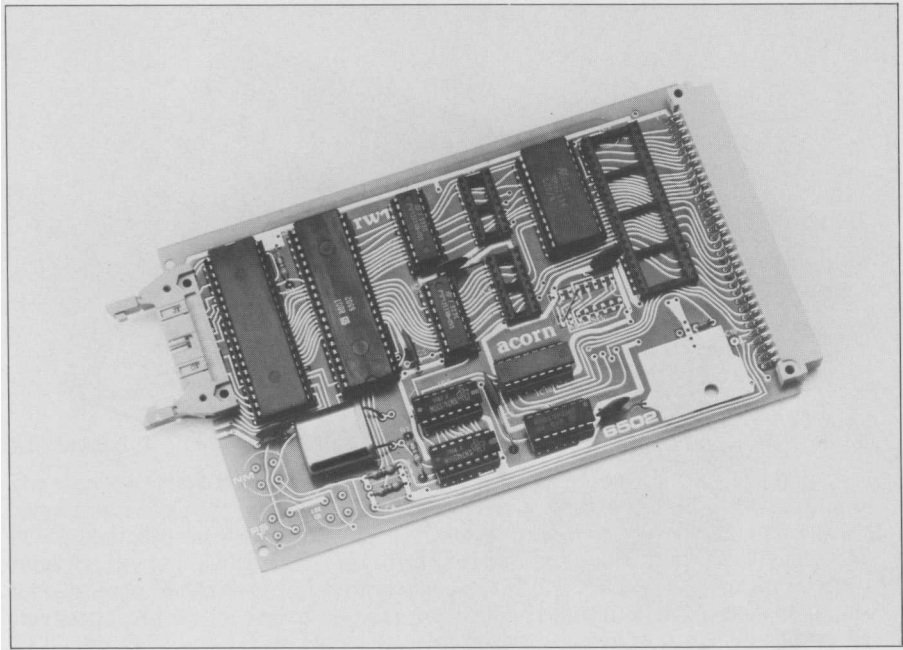
Microcontroller

This Acorn single board microcontroller was designed for low cost industrial applications and is based on the 6502 processor. It is a Eurocard (100 x 160mm) made of a high quality glass fibre laminate with through hole plating solder resist and component identification. The standard controller is provided with 6502, 128 bytes of RAM, 16 lines of I/O, capacitor controlled clock and address decoding and logic. This board also has provision for up to $4^1/2$ bytes of ROM (32 + 2 of 74S571), $1^1/4$K bytes of RAM (2114) and 32 lines of I/O (2 x 8154), a crystal controlled clock is also optional. The processor used employs pipelining giving fast execution times (4 µS for load accumulator, 6 µs for jump to sub-routine and 2µs for internal register operations). It is noted for its wide range of powerful addressing modes and harmonious instruction set.

The I/0 device used is the INS8154 whose sixteen lines are single bit addressable, can be individually configured and are TTL compatible. A handshake mode is provided facilitating asynchronous data transfer at high speed, and direct interface to peripherals. A wide variety of memory — I/O configurations can be selected by wire links in the address select socket on board.

The standard Eurocard edge connector carries the address and data bus, eight control lines, sixteen I/O lines, the single DC supply rail and 5v regulated output from the onboard regulator. The opposite end of the card has 16 I/O lines, two control lines and 5v output.

This board with the crystal controlled clock becomes the 6502 CPU in the Acorn Systems 1, 2, 3, and 4.

6502 CPU

The 6502 CPU is designed for use in the Acorn Systems 2,3, and 4 and it plugs on to the standard Acorn 8 or 14 slot backplanes. The 6502 microprocessor is run from a 1 MHz crystal controlled clock and for TTL devices provides address decoding. On the card is 1K byte of static RAM in 2114's and an 8154 I/O device provides 16 I/O lines, 8 of which connect to a ASCII keyboard via a 20-way ribbon cable connector. Other lines on the 8154 can connect to the cassette interface via the back plane.

A second 8145 can be fitted giving 16 other I/O lines on the 64-way connector and a ROM can also be added to carry the systems OS software (alternatively this can be on a static RAM card).
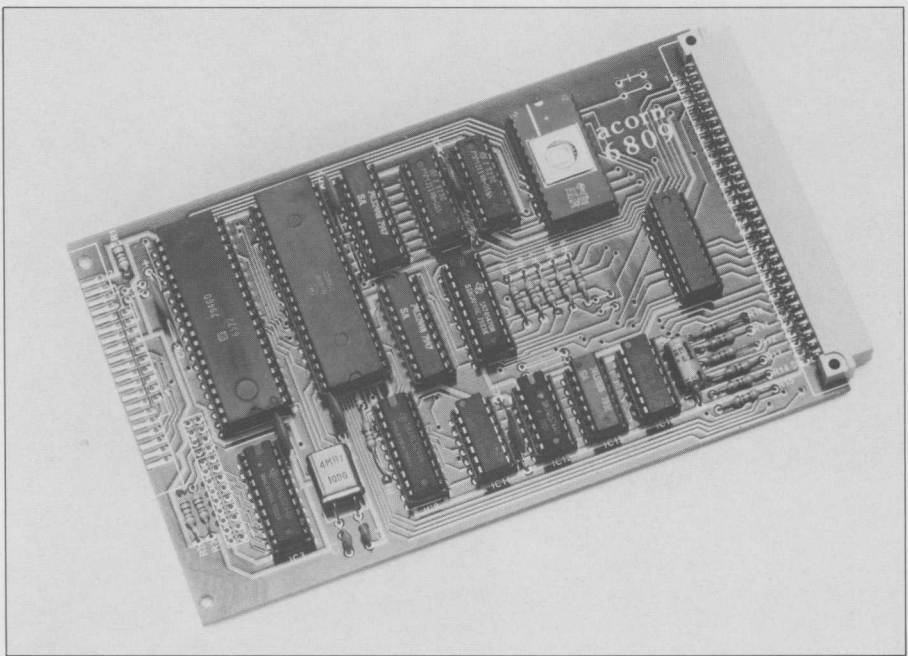
6809 CPU

This Eurocard (100 x 160mm) is a plug-in replacement for the 6502 CPU card to upgrade systems to use the advanced facilities of Motorola's 6809 8-bit processor. This microprocessor is generally considered to be the programmer's processor and is ideally suited to run high level languages such as Pascal. The Acorn 6809 is provided with an operating system in 2K which handles the Acorn VDU, ASCII encoded keyboard and printer; it is readily expanded and very user friendly.

The hardware provides for direct plug-in connection to Anadex type printers and encoded keyboards and all 6809 signals are taken off the board via the Acorn bus 64 way edge connector. The address and data lines are buffered and 1K of user RAM is provided.

Hardware

DIN standard indirect edge connector
20-way and 26-way I DC connectors for keyboard and printer
MC 6809 microprocessor
2K ROM (Initially 2716) 4K and 8K compatible
1K RAM (2 x 2114)
BIPOLAR PROM for address decoding
6522 — two ten bit parallel I/0 port for keyboard and printer
Random logic devices

Bus buffers

The Acorn 6809 is provided with a User's Manual which describes how to use the Monitor's commands, and includes programming examples.
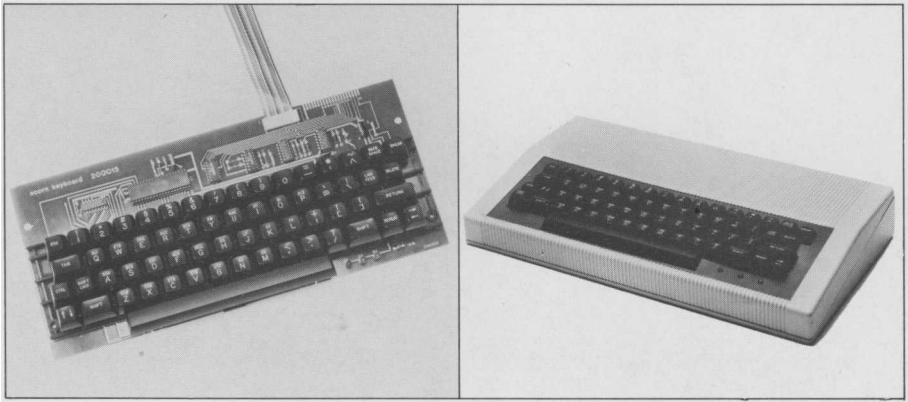
Keyboard

The Acorn keyboard uses a high quality 62 key mechanism for professional computer input applications. The key mechanism is mounted on a 355 x 150mm PCB which also carries circuitry to scan and encode the keys producing the ASCII code for any key which is pressed. The keyboard encoder circuit has a 2 key rollover feature enabling fast typing speeds. ASCII is a 7-bit code for up to 128 characters and the keyboard outputs this code in parallel on seven signal lines at TTL level (TTL logic 0, +5v logic 1). Also output is a strobe signal which may be selected to be positive or negative going to indicate that a key is being pressed. A single +5v supply at 80A is required to run the keyboard. All connections to the keyboard are normally via a 20 way flat ribbon cable which connects straight to Acorn computer systems.

On the keyboard are some special function keys. Two of them connect straight to the output connector on individual signal lines giving a logic 0 when pressed. One may be used to reset the computer (break) and the other can connect to an input port on the computer for examination by the users own software. Two other keys, control and shift, change the character set produced by the keyboard encoder circuit to give ASCII control characters and upper/lower case selection. There is a shift lock key and another key locks the keyboard into a TTY Caps mode (TeleType Capitals) where the shift key works as usual for numbers and symbols but only capital alphabetic characters are produced. This is useful when programming in languages like BASIC where lower case alphabetic characters are illegal. The output signal lines always carry the code for the last key to be pressed even if the key has been released and a repeat key causes the strobe to start pulsing giving repeated codes for the same key to the computer. An auto repeat feature starts the repeat circuitry automatically if the key is held down for more than one second. Three LEDs on the circuit board indicate TTY Caps mode, shift mode and power on.

The keyboard can be supplied in a stylish injection moulded plastic case if required. The keyboard is only available assembled and tested.
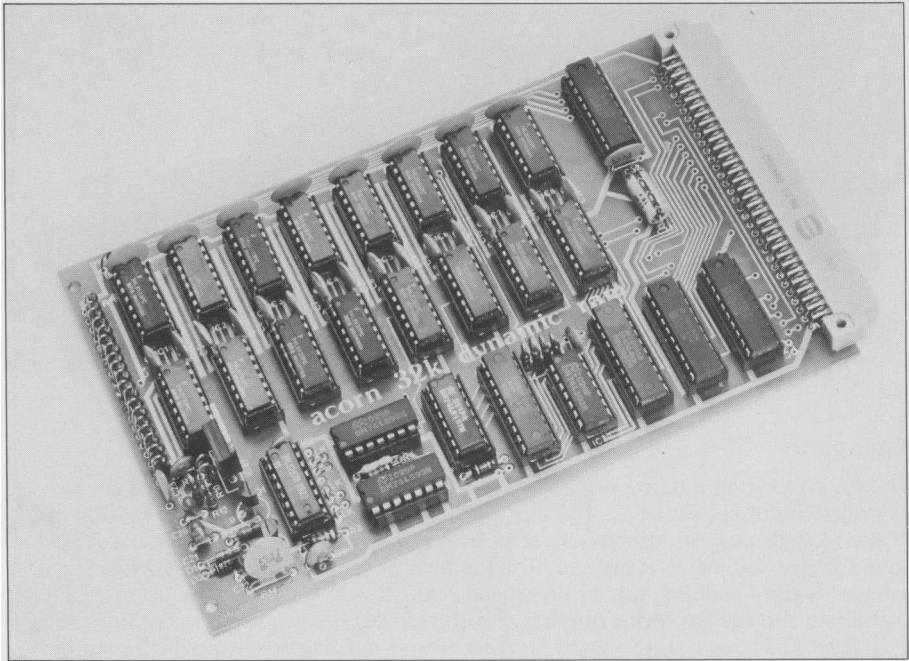
32-K Dynamic RAM

This Eurocard provides 32768 bytes of Random Access Memory for a computer system. All of the circuitry is on a 100 X 160mm Eurocard which connects to the standard Acorn computer bus, and it is intended for 6502 or 6809 systems.

The 16 dynamic RAM devices are organised as two banks of 16384 by 8 bits. Timing is generated on the card in synchronism with the 1 MHz CPU clock and the hardware transparent-refresh circuitry allows random access of the RAM in any clock cycle.

The RAM is organised into four sections (or two in the 16K-byte option), each of which is 8192 bytes (two blocks) long. These four sections can each be linked to begin at address 0,2000,4000,6000,8000, C000, and E000 (hex). In the Acorn systems 2,3, and 4 the card will usually be used to provide 8K-bytes of program space at C000 to DFFF, and 24K-bytes of text space at 2000 to 7FFF (hex). A second 16K-byte card can then be used to fill the remaining space from 8000 to BFFF (hex) if required. The dynamic RAM cards can be freely mixed with static RAM cards and they can be paged if required.
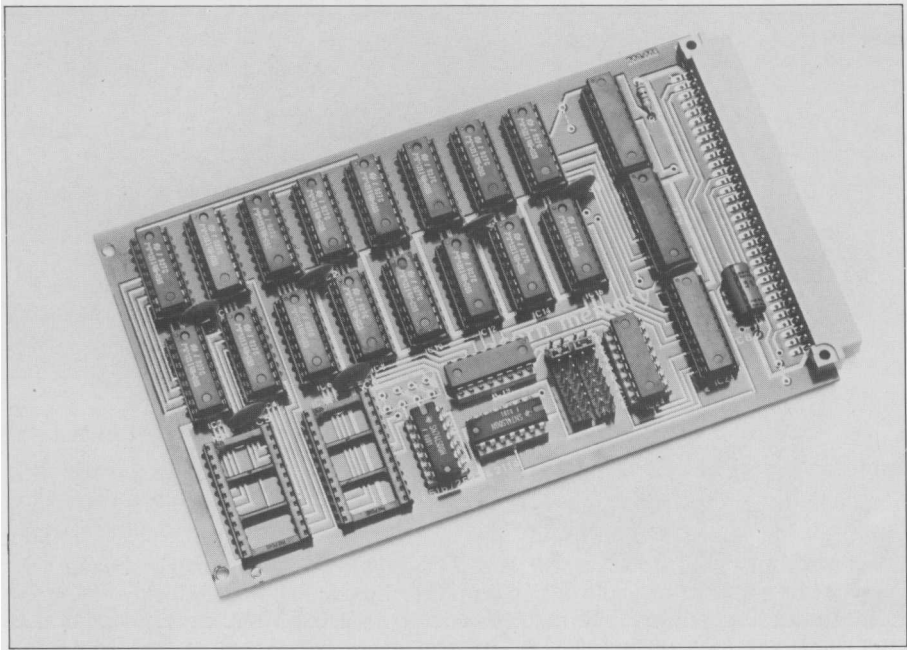
8K Static Memory

A Eurocard (measuring 100 x 160mm) of high quality fibre glass through hole plated PCB with solder resist and component identification. It has provision for 8K of RAM (2114) and 8K of EPROM (2532).

This card is available with memory options populated in 1K steps in the case of RAM and large variety of ROM or EPROM. This card is fully buffered for use with any system but has the advantage that the inputs of all cards except that being accessed are tri-stated and present no load to the bus. The Eurocard connector carries the bus and address selection by wire links on the card and allows RAM and ROM to be placed independently in any 8K block of memory. The memory card is a natural first step in expansion of the System 1 and provides storage and working memory for programs in the Acorn systems.
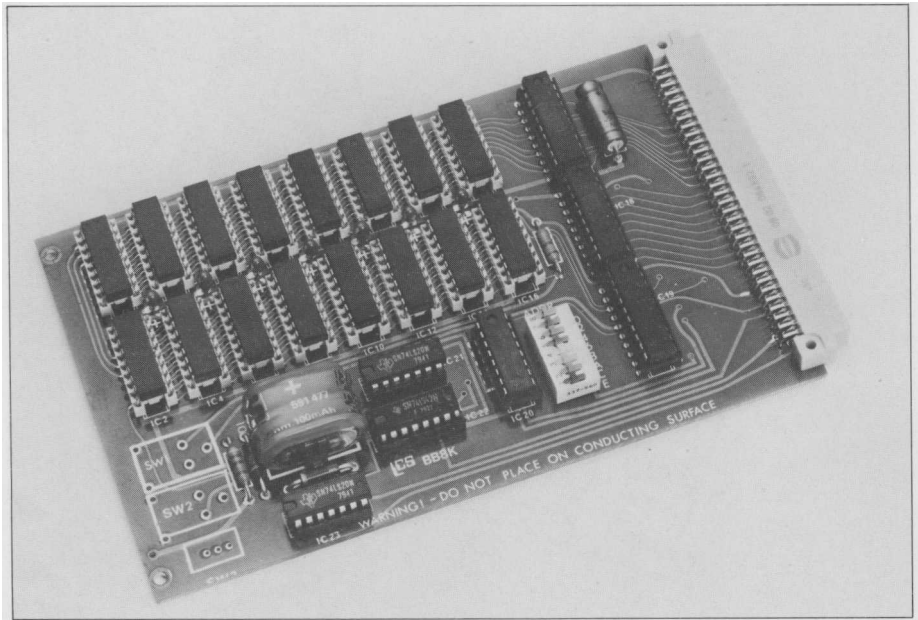
CMOS RAM

The CMOS RAM card gives 8K bytes of non-volatile RAM which can be used to store data that is retained when the system is switched off. The card is a 100mm x 160mm Eurocard and connects to the standard Acorn bus using a 64 way connector. A +5v supply is all that is required.

On the card are 16 CMOS RAM ICs which provide a contiguous two blocks of memory, address decoding links allow these two blocks to be memory mapped from any even block boundary. e.g. 0000, 2000, 4000 (hex). Address and data bus buffers then interface the memory ICs to the Acorn bus. A 3.6v battery provides the minimal current requirement of the RAMs so that they hold their data when the +5v goes down. This battery is charged up from the +5v supply when it is on. Data retention will be at least 60 days. As soon as the +5v begins to go down the bus buffer chips are disabled stopping invalid data from being stored in the RAMs by a dying CPU. There is also provision for an external power fail signal which can be driven from a mains failure detector off the card. Finally there is provision for a write protect switch and a card isolate switch which puts the card into power down mode prior to unplugging it from the Acorn system. Using this the card can be used to transfer data between systems.
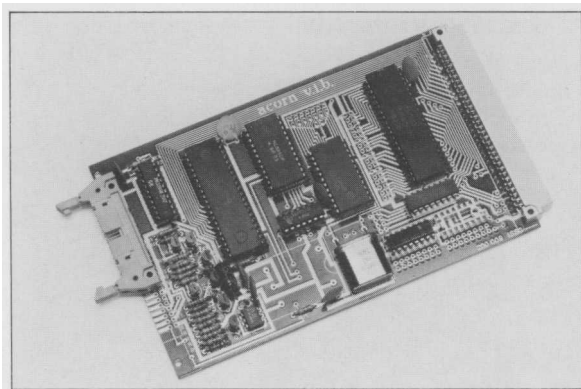
Versatile Interface

This board connects to the standard Acorn bus and provides interfaces via the three integrated circuits listed below:

6522

This device has two, ten bit parallel, TTL level I/O ports (i.e. 8 individually programmable data bits plus 2 control bits each) and a pair of interval timers for providing real time interrupts. One port connects to side B of the bus, the other going via a high current buffer to the front of the board where a 26 way connector may be fitted. This connector is pin compatible with the Centronics, Anadex and other printers.

INS 8255

This device provides three ports of TTL level parallel I/O via a 34 way connector. Two of these ports are 8 bits wide and may each be programmed to be either all input or all output whilst the third port which is also 8 bits wide, has its direction programmed in two groups of 4 bits.

MC6850

This device provides serial interfacing together with an MC14411 bit rate generator IC and a 1.8432 MHz crystal which enable standard baud rates in the range 75 to 9600 baud to be selected. Edge connectors on the front of the board provide a 20mA Teletype connection and a RS232C connection. The 20mA serial input is via an optical isolator giving ground isolation between interconnected Acorn systems. The RS232C interface requires a ± 12 volt supply which may either be connected via the front edge connector or can be provided by an on-board 5v to ± 12V converter module. The serial data is also available at TTL levels and the control lines "Clear to Send" and "Request to Send" are available at RS232C or TTL.

As supplied the board is memory mapped at page OC (i.e. in block zero) and the buffered 6522 port provides connection for the system printer as required by both COS and DOS. Program examples of inputting and outputting serial data will be supplied so that users can write software to use these as peripheral terminals.

With the addition on board of a 74LS138 the board can be mapped in any block allowing many boards to be used as experimental interfaces or for provision of extra printers etc.
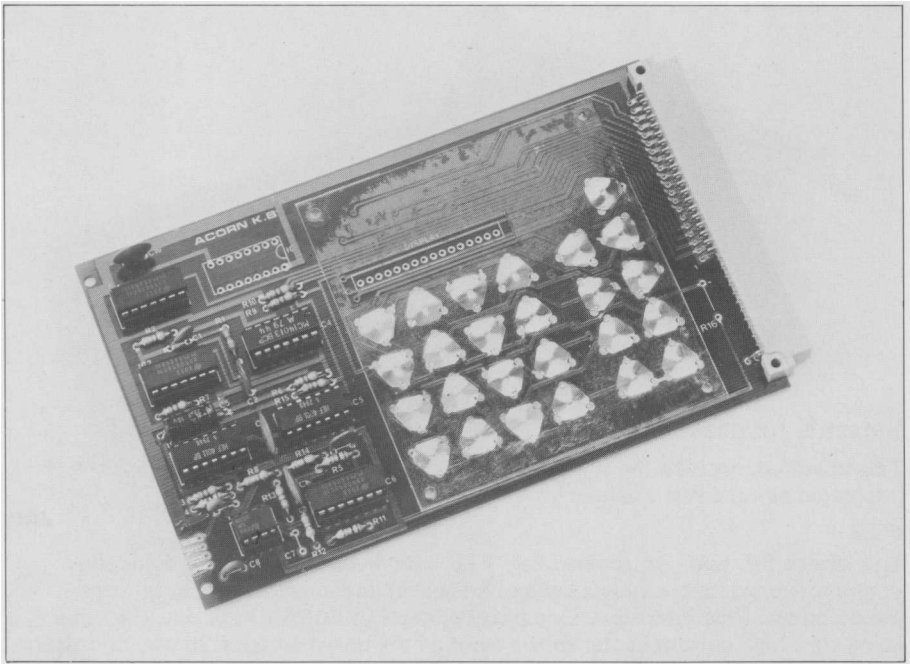
Cassette Interface Card

The upper Eurocard of the System 1 is available without the keypad and display
when it performs as a Cassette Interface card in System 2. It may also be added
to Systems 3, 4 and 5 if desired. The Computer Users Tape Standard (CUTS)
frequency modulates data on to a standard audio cassette recorder with a two
tone system in which 2.4KHz represents a logic 1 and 1.2KHz a logic 0.
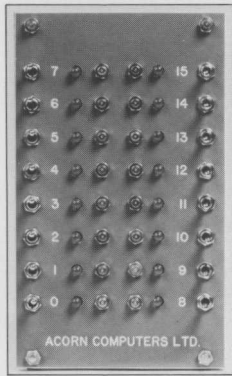
Laboratory Interface

The Laboratory Interface provides 16 optically isolated connections each of which may function as input or output to the computer system. The opto-isolators and a INS 8254 integrated circuit are amongst the components carried on a standard Eurocard (100 x 160mm) which plugs on to the Acorn computer bus. A remote circuit board with 16 power drivers and LED indicators may be connected by up to 25 metres of 40 way flat ribbon cable to the Eurocard.

The remote circuit board has 16 connections each of which is set to input or output using a switch. In its output mode each connection can drive loads drawing current at up to 3 amperes each from the remote supply voltage which may be
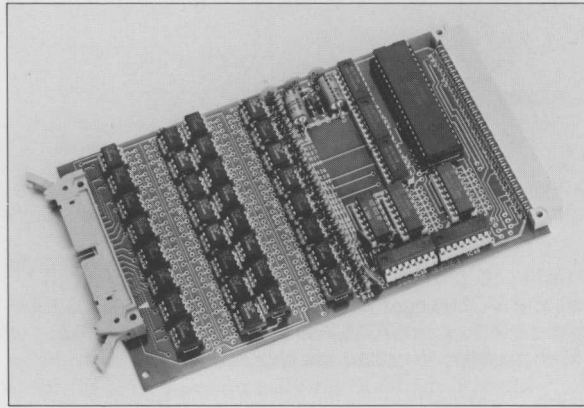

in the range 6 to 48v. A catching diode on each output allows inductive loads to be used. In input mode each connection is driven by contact closures to the remote supply common. An LED indicates the state of each connection in input or output mode.

The remote supply voltage is optically isolated from the Acorn system on the interface Eurocard giving the computer immunity to electrical noise generated by the load switching. Noise produced by other equipment at the remote station is also isolated and ground loop problems encountered in the laboratory environment are eliminated. The remote supply can be different to the computer 0 volt line by as much as 48v peak.

Acorn's ON LI BASIC may be used to configure the 16 input/output ports of the INS 8254 such that they match the modes set by the 16 switches at the remote station. Inputs are then read and outputs are then driven by the program. The program may be synchronised to real time using interrupts which are generated by circuitry on the interface Eurocard with a periodic time of 10 milli-seconds.
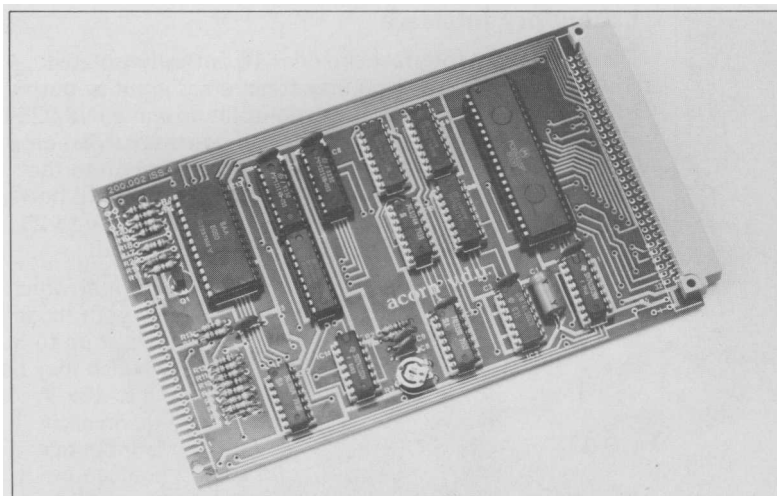
Teletext VDU Interface

The Visual Display Unit Controller Board connects to the Standard Acorn bus and contains a memory mapped character storage RAM which is transparently written to read from by the CPU.

A MC8845 programmable controller IC proves all the synchronisation signals to drive a 625 line 50 fields per second VDU, together with refresh addresses for the character RAM. Characters are then fed to an SAA5050 character generator IC which produces the necessary dot patterns to create the characters to refresh the VDU.

The SAA5050 produces Teletext standard characters and has Red, Green and Blue drive outputs giving coloured characters or graphics.

The RGB, and sync outputs may be used to drive a colour encoder and modulator for a UHF TV; also provided is a 1v/75 ohm composite sync and video output which can directly drive a monochrome monitor on which the different colours will appear as different scales of grey.

Also provided are listings for programs which set up the MC6845, display 25 instructions in hex on the VDU. (With double or treble byte instructions on a single line) and allow the drawing of graphics or characters on the VDU. These programs may be loaded and run using the System 1 Monitor. Acorn systems 2, 3, 4 and 5 are usually supplied with operating system software which controls the 6845 and outputs characters onto this VDU.

The VDU controller PCB can be supplied in kit form with a full set of IC sockets. It is easily assembled using a small soldering iron. The board operates from a single +5v supply from which it draws not more than 500 mA.
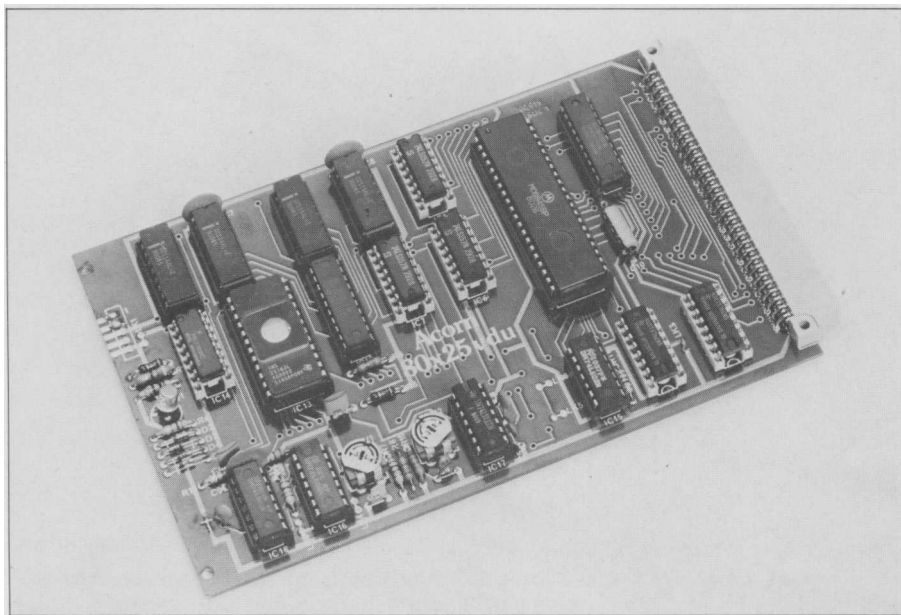
80 x 25 VDU Interface

The 80 x 25 character VDU interface is designed for use in professional applications to drive a video monitor. The VDU interface is a 100 x 160mm Eurocard which connects via a 64 way plug and socket to the standard Acorn computer bus. It produces a 1 volt composite signal which drives the 75 ohm input on a monitor.

The screen is mapped to a 2K byte area of memory which usually resides at locations 1000 to 17FF (hex). An MC6845 programmable controller IC provides the addresses for the screen memory, and the horizontal and vertical sync signals. Accesses to the screen memory is transparent with either a 1 MHz or a 2MHz CPU clock.

A character-generator ROM contains the full ASCII character set, and also produces recognisable symbols on the screen for many of the control codes. If required special character sets may be obtained by fitting a user-programmed 2716 EPROM. A 12-MHz dot clock is used to serialise the data from the character-generator ROM and this is then fed to a video amplifier which provides a composite-video output from the card. The high 12-MHz data rate used to produce 80 characters on a line may be unsuitable for UHF modulator applications, and in order to view the 80 x 25 screen a monitor diagonal of 10 inches or more will normally be required.

Software to drive the 80 x 25 VDU is contained within special versions of the System 3,4 and 5 Operating System ROMs, and the 80 x 25 versions must be specified when ordering a system.
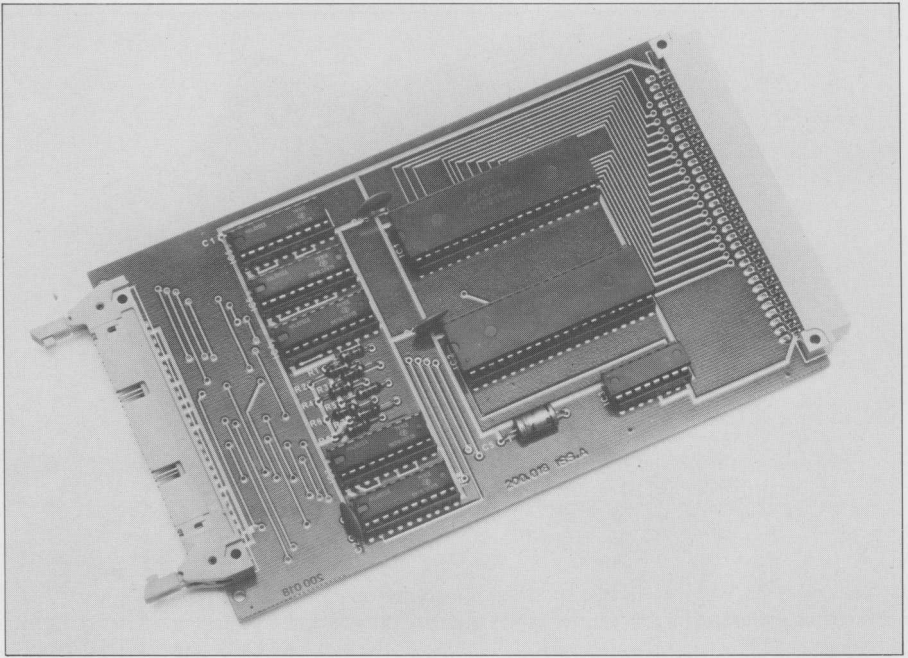
Daisy-Wheel Printer Interface

This is a 100 x 160mm Eurocard which plugs into the standard Acorn bus and interfaces to daisy-wheel printers via a ribbon cable.

Designed initially for the Ricoh RP1600 the card contains two 16 bit 1/0 devices which are memory mapped into the Acorn system. Line drivers and receivers connect via a 50 way ribbon cable header to the printer. The Eurocard is intended to plug on to 6502/6809 Acorn systems via its 64 way DIN connector but operation with any micro-computer system should be possible including those with asynchronous busses e.g. 8080/Z80 based machines.

Acorn offer a software package for use with the card which allows micro-spacing of the daisy-wheel for text justification. Full printer handshaking and error condition sensing is provided.
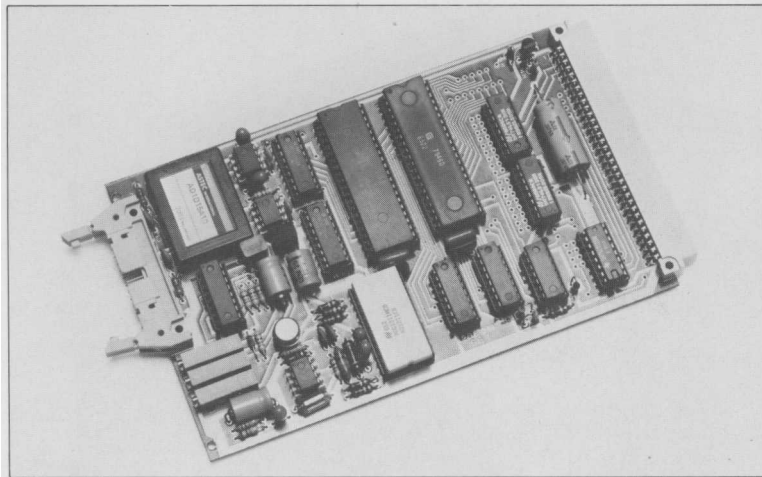
Analogue Interface

The analogue interface card offers the Acorn system user laboratory standard facilities for the examination and control of analogue signals. It is a 100mm x 160mm Eurocard and connects to the standard Acorn bus using a 64 way indirect connector. The following devices are used:

DAC1222 (2 off)	12 bit Digital to Analogue converters, fully buffered with BI — F ET OP AMPS, giving output voltages in the range — 5.12v to +5.11v a resolution of 2.5mv.
ADC1210	12 bit Analogue to Digital converter, with eight channel analogue multiplexer and sample and hold circuit. Input voltage range —5.12v to +5.11v, resolution 2.5mv.
LH 0071	Precision voltage reference (10.24v) removing any need for range adjustment or calibration on the ADC or the DAC's.
6522	Versatile Interface Adaptor. Controls the ADC enabling software programmable conversion rate using internal timers and full interrupt control of the analogue system.

The board also has single bit digital input and output signals, enabling a storage oscilloscope or X — Y recorder to be driven directly by the analogue outputs, using the digital output for the z axis (beam on/off or pen down/up) and the input for interrupt control.

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ADC conversion rates	12 bit up to 10,000 conversion/sec
	8/10 bit up to 25,000 conversion/sec
Connections	8 analogue inputs) —5.12v.
	2 analogue outputs) to +5.11v
	Digital input) TTL
	Digital input/output) level
	10.24V reference output

All interleaved with reference ground lines.
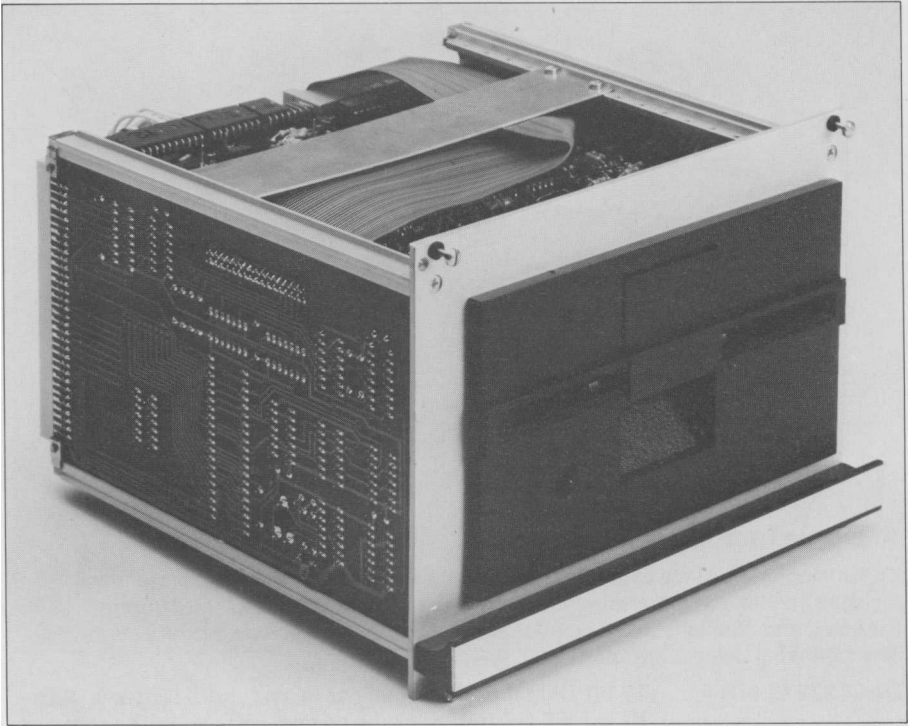
Disk Module

This module fits a standard $5^1/4$" mini-floppy drive into the Acorn Eurocard rack system. In single height racks the disk controller card can be fitted in the side of the module whilst in a double height rack one card supports two drives.

With the addition of this module and the Disk Operating System (DOS) Rom a System 2 can be upgraded to a System 3 or 4.
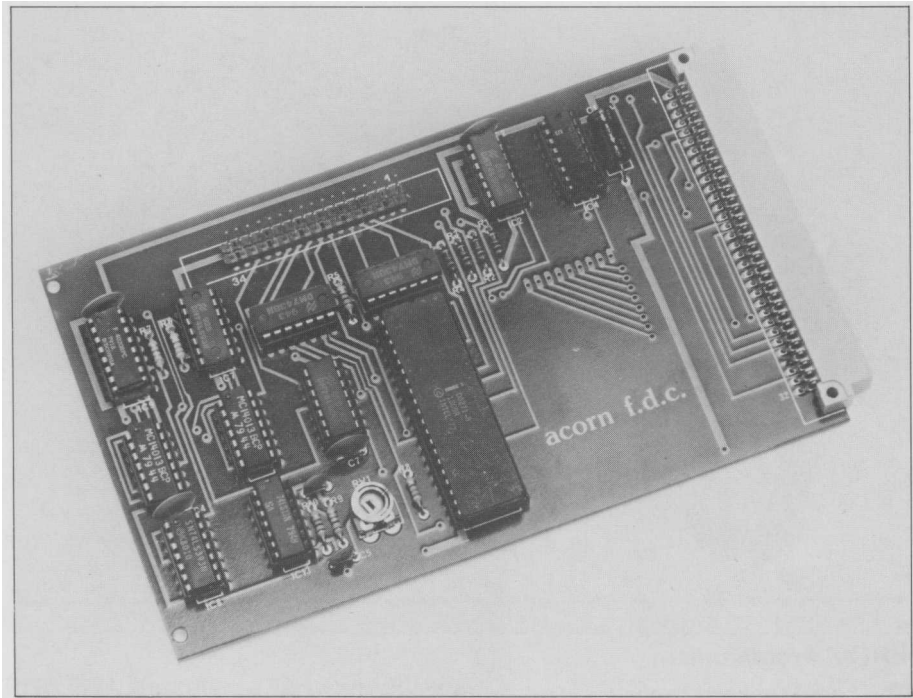
Disk Controller

This Eurocard (100 x 160mm) connects to the standard Acorn bus and provides an interface to one or two disk drives. It is capable of controlling four drive surfaces on two double-sided drives. Single or double track density drives may be used.

The advanced 8271 controller integrated circuit is used to relieve the CPU of many tasks associated with disk control. The IBM 3740 soft sectored format, (or its derivative for mini-floppies) is used.

The Acorn Disk Operating System (DOS) ROM provides comprehensive commands for controlling the drives.

A 34 way flat ribbon cable connects to the drives after the Shugart interface standard.
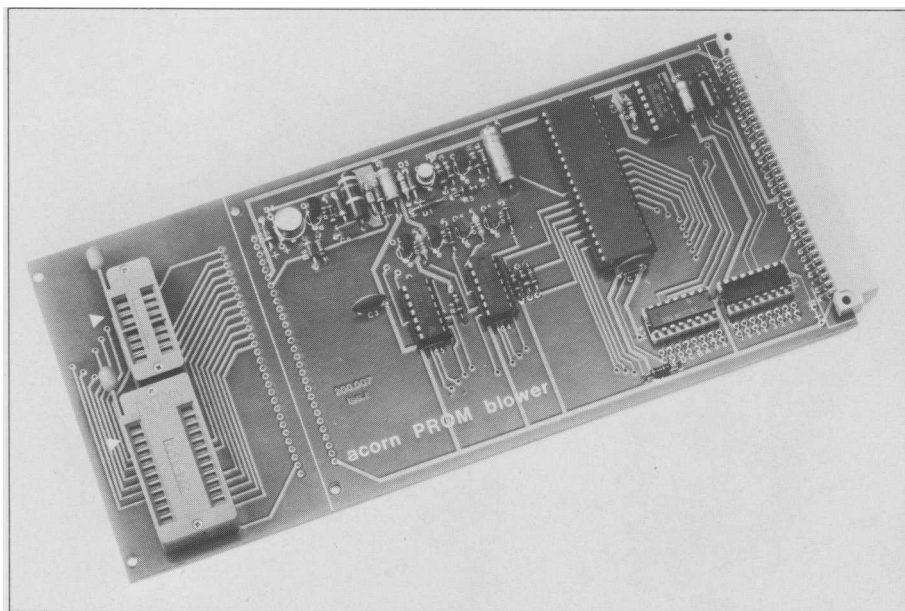
PROM Programmer

This board connects to the standard Acorn bus and may be used to program bipolar PROM's of the 74S571 type and PROM's types 2758, 2516, 2716 and 2532. i.e. 5v only 1K, 2K and 4K byte devices.

Supplied with the board is a technical manual which includes an assembly listing of a $1^1/_2$K byte program allowing device type selection, copying of a ROM's contents into RAM, verification of a ROM's contents against RAM and the blowing of a ROM to match the RAM's contents. A cyclic redundancy check is performed on ROM's giving a signature identifying different ROM data. The program requires that an Acorn Operating System of the system 2, 3 or 4 type is present.

The programming board is longer than the usual Acorn Eurocard so that the two Low Insertion Force ROM sockets are accessible from the front of the system. If desired this extra piece of board can be removed and connections to sockets on a remote panel can be made.

A +12v supply is required for 745571 devices and a +26v supply is required for the EPROMS.
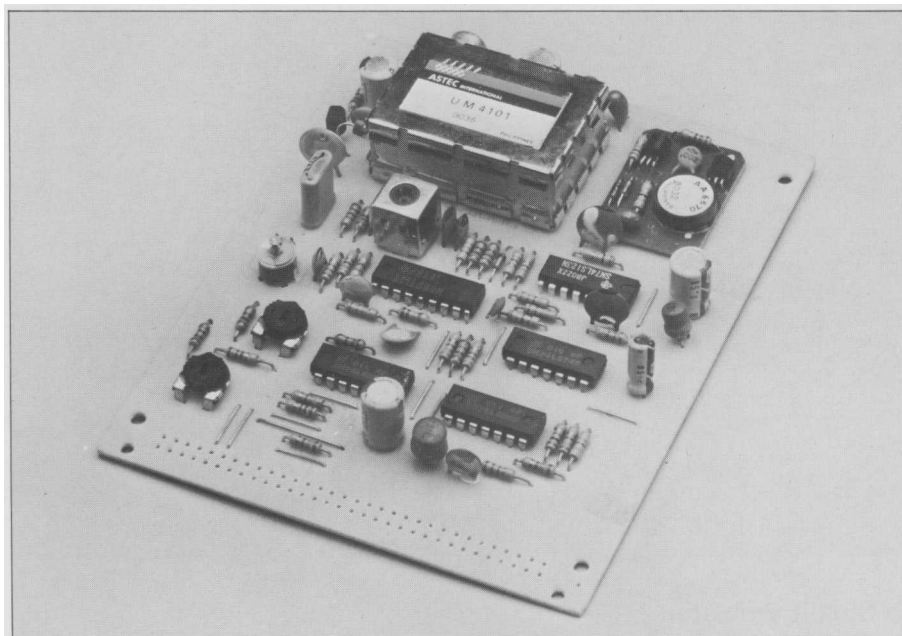
RGB PAL encoder — UHF modulator

This card is complementary to the normal eurocard range, but also intended for general OEM use by the industry. It is an RGB-input PAL colour encoder with intercarrier sound, and was designed by Acorn for manufacture by Astec International. It is of particular interest to the Viewdata/Prestel industry for displaying high-quality colour graphics on a standard domestic television.

It accepts Red, Green, Blue and synchronisation signals and converts them to a composite PAL colour video signal; this is modulated onto a UHF carrier to produce an output on channel 36 suitable for feeding the aerial socket of a television. The board will also drive a monochrome TV to give a black and white picture, with the intermediate colours appearing as different levels of grey. The circuit includes a sound input, and the sound sub-carrier oscillator may be tuned to either 5Y2MHz or 6.0MHz. Separate presets are provided for accurate setting of the spot frequencies for the colour and sound sub-carriers, should this be needed. The card operates from a single 5 volt supply, and is designed to fit a standard eurocard rack.

The RGB PAL Encoder/UHF Modulator forms an ideal interface between the Acorn Teletext/Prestel VDU and a colour TV. Connection to the Acorn Teletext/ Prestel VDU is by an 8-way ribbon cable, which carries power as well as the signal lines. Note that Acorn provide a separate UHF PAL colour board for the Atom, and the two boards are not interchangable.
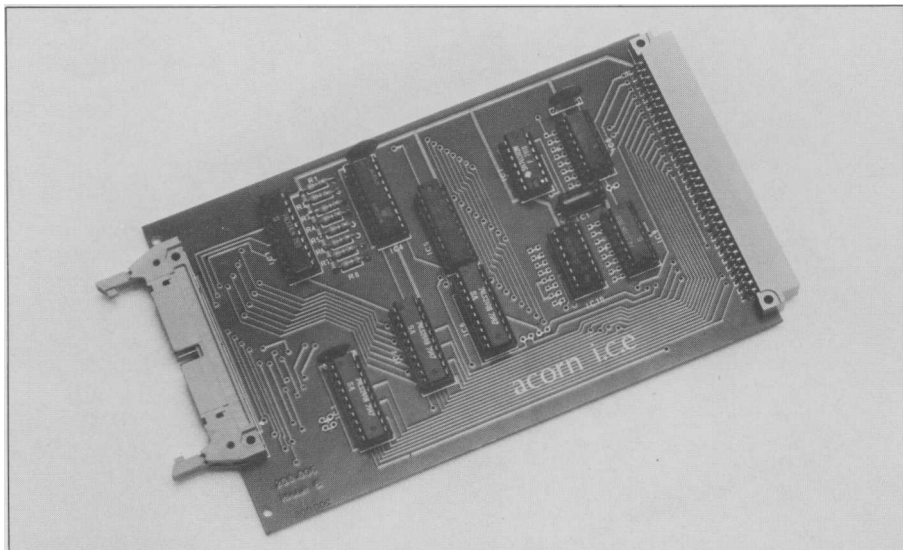
In Circuit Emulator

The In Circuit Emulator (ICE) allows an Acorn system to connect to a second micro-processor target system by way of its 6502 processor socket. Once established this connection may be used to test hardware and to evaluate software in the target system. The ICE will be most useful in the development of new 6502 based products and in the test and repair of existing equipment.

The ICE hardware is carried on a single Eurocard (100 x 160mm) which connects to the standard Acorn system bus. A 40 way flat ribbon cable plugs on to the front of this card and provides connection to the 40 way dual-in-line plug for the target processor socket. In operation the ICE re-locates any two blocks in the target system to appear as blocks A and B in the host system. The selection of the two blocks is achieved by writing to the ICE control register which is a latch on the ICE card. After setting the control register any read or write operations by the host system into its blocks A or B are sent down the ICE cable into the target system. In this way the target system hardware may be accessed for testing with the same bus timing as would appear from its own processor. As the block selection is under software control programs for testing the target hardware can dynamically relocate the ICE allowing the whole of the target memory map to be tested.

When developing software in the host system for eventual use in the target system it will be necessary to define the machine addresses as those in blocks A or B. After proving the program these addresses must be changed to their real values before blowing the program into Read Only Memory and fitting it and the 6502 to the target system.

Also on the ICE card is a single byte register which may be read by the host system. The bits in this register indicate the state of various pins around the 6502 socket in the target system including the +5 volt rail and the 1 MHz clock.
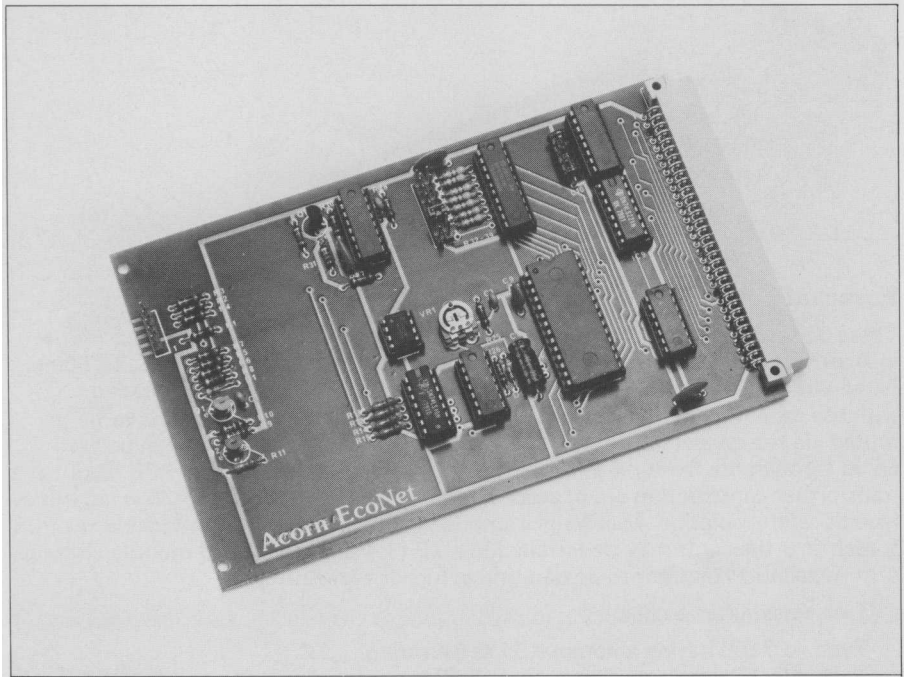
Econet Interface

The Econet Eurocard is the System version of the Econet interface card that fits into the Atom computer. It plugs into the backplane and carries the ROM with the low level Econet software to allow the host system to be linked to other Acorn products. See Econet leaflet for full details.
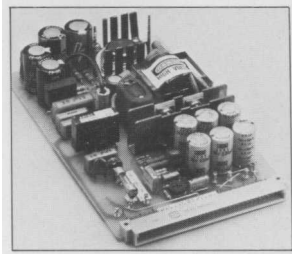
Eurocard Power Supplies

These 30-Watt switch-mode power supplies have been specially developed for use in Acorn Eurocard rack systems. They are supplied as Eurocards, 100 x 160mm, fitted with DIN 41612 connectors. Use of 32, 64 or 96 way plugs loaded with the minimum number of pins enables both the inputs and outputs to be routed via the connector if required. Alternatively, the mains input can be hard wired through the front panel to termination pads on the PCB. The PCB layout and transformer construction are in accordance with IEC 380 and IEC 435 standards as regards safety isolation. Maximum component projection above and below the PCB is such that the cards may be installed in a 7E (1.4") dimensioned module although such installation requires some derating at higher temperatures.

Two versions are available:-
Type AC7150 having a nominal 5v at 6A rating.
Type AC7151 having:- Output 1. 5v/3A
                                   Output 2. 12v/1.2A

The AC7150 has two independent secondary circuits each rated at 15 watts power capability. A preset potentiometer enables one of these secondaries to be set up to any voltage between 4.5v and 7.5v. The other secondary tracks the first. Since both secondaries are floating they may be connected in series, parallel or isolating modes. Thus, the AC7150 is capable of producing a variety of outputs. Examples are:-

Parallel connection:-   5v/6A
                                 or 7.5v/4A

Series connection:-   9v/3A
                               or 12v/2.5A
                               or 15v/2A
                               or 6-0, 6v at 2.5A each side.

In the AC7151 the 12v output is obtained by "stacking" a 7v secondary on top of the basic 5v secondary.

Both the AC7150 and AC7151 have the ability to operate from 115v or 230v nominal input line voltages, the appropriate range being selected by means of a link on the PCB.

These power supplies have the inherent ability to withstand output short circuits of less than 50 milliohm for an infinite time duration under worst case line input (265v) .

The AC150/1 have been designed to have a MTBF of 30k hours under full load and nominal line input conditions with an ambient temperature of 25°C.

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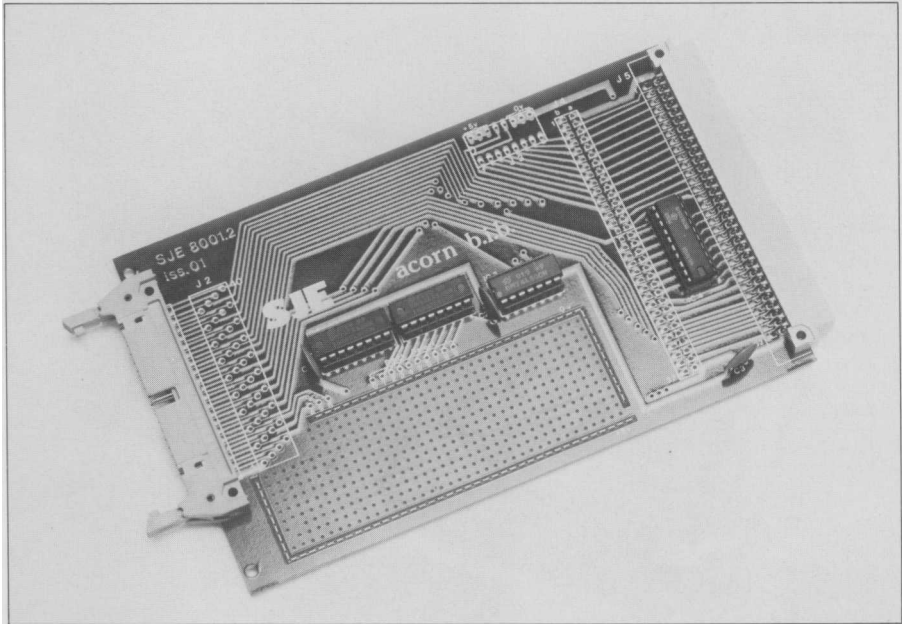
Bus Interface

The Bus Interface Board (BIB) is a 100 x 160mm Eurocard which pluqs onto the standard Acorn computer bus. Using it a card frame and back-plane carrying Acorn cards can be interfaced to other machines, for instance AIM 65, KIM etc., giving users of these machines access to the wide range of control and interface circuits manufactured by Acorn. A 40-way flat ribbon cable connects to the front of the BIB and on to the rear of the AIM 65, this cable carries the data, address and control lines from the AIM and thus allows the 6502 processor on the AIM to control the Acorn cards in the rack. Logic circuitry on the BIB allows memory blocks in the Acorn card frame to be located into the AIM 65 address map.

The BIB is available in two configurations. The minimum configuration provides an interconnection system so the AIM 65 can be connected to the Acorn back-plane and memory blocks on the back-plane connect directly into the AIM 65 address map. In the maximum configuration data bus buffering is also provided together with block select circuitry so that the Acorn cards on the back-plane can be located into different blocks in the AIM 65 address map. Buffering for the sixteen address lines is already present on the Acorn back-plane.

Also on the BIB is an area of pads on a 0.1 inch matrix on which additional circuitry can be constructed by the user.
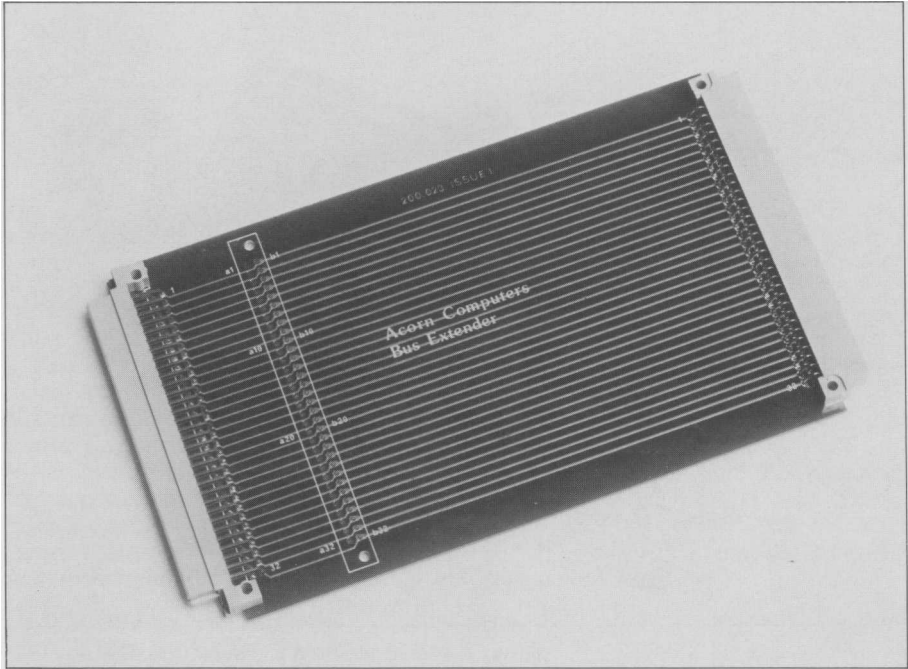
Bus Extender

The Acorn bus extender is a Eurocard (100 x 160mm) which plugs into any 64 way backplane socket. This brings the 64 connections to the front of the Eurocard rack where a second socket can be fitted to it. Any other Eurocard can then be plugged into the extender leaving the Eurocard clear of the casing giving easy access, and allowing the Eurocard to be serviced or developed while operating in the system. Suitable for use in any DIN 41612 two row 64 way connector system.
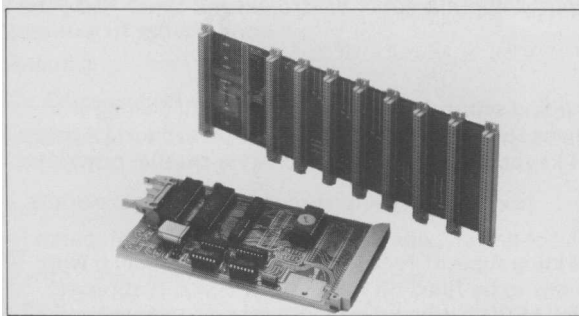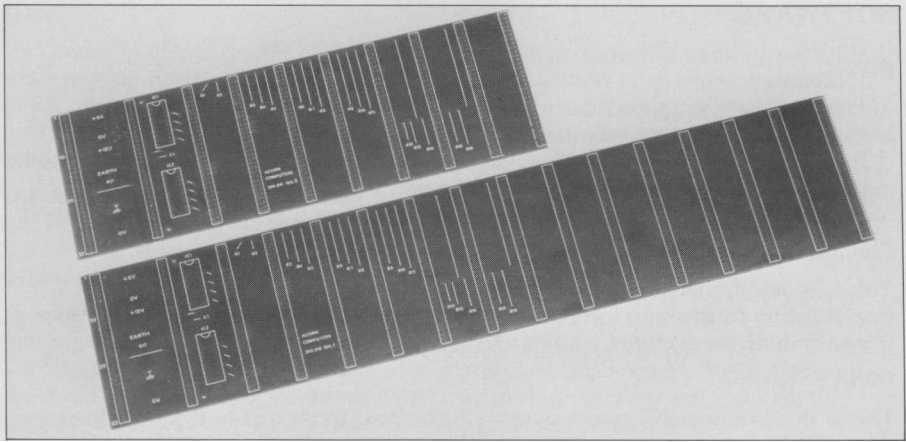
Backplanes

Acorn have two backplanes to interconnect their range of Eurocards with DIN 41612 Connectors. An 8 location backplane is in System 2 and 3 and a 14 location backplane for System 4.

The backplanes are single sided PCB's with provision for 64 way sockets. Side A (the standard Acorn bus) is connected by copper tracks along the length of the PCB and side B is connected by wire wrapping to configure a system for interrupts, cassette interfaces etc.

Both the backplanes have locations for two buffers on the processor address lines and power-supply connectors if required. The backplanes are suitable for 6502 or 6809 based systems.

SOFTWARE

BASIC

This is a 4K byte program which interprets the popular BASIC programming language. Acorn's interpreter uses 32 bit integers to provide a numeric range of ± 2,000,000,000, and has additional instructions specifically aimed for manipulating real machine addresses. The interpreter requires an Acorn Operating System for handling keyboard and VDU and can typically process 500 statements per second.

Floating Point Extension

This is an additional 4K byte program which adds 9 digit floating point manipulation to the repertoire of the integer BASIC interpreter. Also included are scientific function and plot routines for the VDU.

ONLI Extension

This is an additional 2K byte program which adds statements to BASIC allowing the control of experiments in real time. Designed to operate with laboratory interface the state of each output or input is easily controlled and timed using the 10 mS clock interrupt.

Cassette Operating System

This is a 2K byte program providing support for other programs by dealing with peripherals and allowing programs to be filed on cassette tape. It supports Acorn's teletext VDU, a parallel ASCII keyboard and a Centronics style parallel printer via a VIB.

Disk Operating System

This is a 4K byte program providing support for other programs by dealing with peripherals and allowing programs to be filled on mini-floppy disks. It supports Acorn's teletext VDU, a parallel ASCII keyboard and a Centronics style parallel printer via a VIB. The mini-floppy is Acorn's single density single-sided drive with controller, giving the user 100K bytes of file space. A second mini-floppy drive can be added.

ADE

This is a 4K byte program for assembling machine code programs. It comprises 3 distinct parts:

1) a full symbolic 2 pass assembler

2) a symbolic disassembler

3) a text file editor

The ADE requires an Acorn Operating System for handling keyboard and VDU.

LISP

This is a 6K byte interpreter plus an initialised workspace for this famous list processing language. The interpreter requires an Acorn Operating System for handling keyboard and VDU.

Screen Editor

This is a 21/2K byte program for creating and editing plain text with an integral justifier which is available in a micro-space version for Daisy Wheel printers.

Pascal

The Acorn implementation of Pascal is designed to provide a fast and powerful alternative to Basic on all our systems. Pascal is a modern programming language which allows and encourages the use of structured programming methods which in turn allow programs to be developed and in particular maintained much more efficiently than is possible with older languages.

The Acorn Pascal system includes, in addition to the compiler, an *editor* which also acts as the user interface to the other programs in the system, *an interpreter* for the compiler generated intermediate code, and an *in-line assembler* for programming critical or "close-to-the-machine" routines.

The compilers in current systems are restricted to a subset of standard Pascal so that the whole system can be resident in memory for fastest program development, but the subset includes all the most used features of the language, the main items sacrificed being the most advanced data structures. Extensions are included to provide full access to graphics and operating system facilities.

Versions of the system are available for both disk and ROM.

Summary of specification Compiler

The Pascal subset supported includes:

— integer (16 bit), character, boolean, and floating point (40 bit) data types

— all the executable statements of standard Pascal

— procedures and functions with parameters and local variables

— arithmetic, logical and relational operators

— library functions and procedures

— arrays and text files

— in-line mnemonic assembler

— built-in graphics and interface to the operating system

Editor

Commands include:

— forward and backward search

— delete, insert and modify lines

— save and load text and object code

— compile text and execute object code

Software is also available from Acorn for interfacing the following devices:
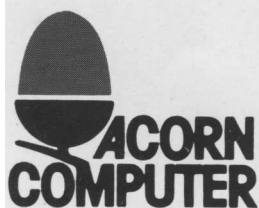
1   Serial terminals e.g. 20mA Teletypes and RS232C devices
2   Modems and in particular the GPO Prestel system
3   PROM programmer for fusible link and UV erasable devices.
4   Daisy Wheel printers i.e. RP1600

Glossary of Terms

ADE	Assembler, Disassembler, Editor
ASCII	American Standard Code for Information Exchange
BASIC	Beginners All purpose Symbolic Instruction Code
CMOS	Complimentary Metal Oxide Semi-conductor
COS	Cassette Operating System
CPU	Central Processor Unit
CRT	Cathode Ray Tube
CUTS	Computer Users Tape Standard
DOS	Disk Operating System
DRAM	Dynamic Random Access Memory
EPROM	Erasable Programmable Read Only Memory
IC	Integrated Circuit
ICE	In Circuit Emulator
I DC	Insulation Displacer & Connector
I/O	Input/Output
LED	Light Emitting Diode
LISP	List Processing
ONLI	On Line experimental control
PCB	Printed Circuit Board
PROM	Programmable Read Only Memory
RAM	Random Access Memory
RGB	Red Green Blue
ROM	Read Only Memory
TTL	Transistor Transistor Logic
UHF	Ultra High Frequency
UV	Ultra-violet
VDU	Visual Display Unit
VIB	Versatile Interface Board
AP	Microprocessor

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